PROJECT:

ASTRID SITE DEVELOPMENT PLAN

2410 SKI TRAIL LANE
CITY OF STEAMBOAT SPRINGS, ROUTT COUNTY, STATE OF COLORADO

FINAL DRAINAGE STUDY

PREPARED BY:

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DRAFT 1ST SUBMITTAL: DECEMBER 22, 2022
DRAFT 2nd SUBMITTAL: MAY 19, 2023
FINAL SUBMITTAL: FEBRUARY 29, 2024

JOB # CO20235

BASELINE
Engineering · Planning · Surveying

CERTIFICATION STATEMENT

I HEREBY AFFIRM THAT THIS DRAINAGE STUDY AND PLAN FOR THE ASTRID SITE DEVELOPMENT PLAN PROJECT 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.

Steven M Batchelder

STEVEN M. BATCHELDER
37112
2/29/24

REGISTERED PROFESSIONAL ENGINEER

STATE OF COLORADO NO.

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, DIMENSION, 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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ATTACHMENTS

ASTRID SITE DEVELOPMENT PLAN

FINAL DRAINAGE STUDY

I INTRODUCTION

A. LOCATION

1. The project area is located at 2410 Ski Trail Lane adjacent to Steamboat Resort. The north limits of the site are adjacent to the ski resort and The Edgemont development. The eastern limits are adjacent to the Bear Claw II and Bear Claw Estates developments which has Lot 11B currently under construction. To the south are the Norwegian Log and Ski Inn Condominiums. Finally on the west are the Ski Trail and Elkhorn at Steamboat Condominiums. The project area is in the northeast quarter of the northwest quarter of Section 27, Township 6 North, Range 84 West of the 6th P.M., City of Steamboat Springs, Routt County, Colorado.

B. DESCRIPTION OF PROPERTY

1. The site is approximately 4.33 acres including the existing right-of-way at the location of the access off of Ski Trail Lane. Total Drainage Area including off-site area is approximately 80 acres. Whereas the proposed project disturbance is roughly 3.5 acres.

2. The site is currently undeveloped and ground cover consists mostly of native grass. There is a lot of relief across the site. The upper end of the site near the Edgemont is at an elevation of 7068 and the lower end of the site near Ski Trail Lane is at 6956 for a difference of 112 feet across the site. Slopes vary from approximately 1% to 50%. A gravel ski/resort access currently cuts through the southwest of the site and there is also a tower for the Steamboat Gondola on the southeast portion of the property.

3. The subject property is zoned as Resort Residential Two, High Density. The directly adjacent properties (except for the resort) are zoned either Resort Residential One or Resort Residential Two.

4. According to the Soil Survey, the project area consists entirely of Routt loam, which is poorly drained and Hydrologic Soil Type C. The offsite flows consist mainly of Hydrologic Soil Type C. See soils map in the appendix for more info.

5. Per FEMA FIRM 08107C0883D with an effective date of 02/04/2005, the project is

entirely outside of the floodway/floodplain of Burgess Creek.

6. There are no irrigation facilities on or adjacent to the property.

7. There are approximately 4,370 square feet of delineated wetlands on the site near the access to the site off of Ski Trail Lane. Of which there will be roughly 2,250 square feet of permanent disturbance of wetlands.

C. PROPOSED DEVELOPMENT DESCRIPTION

1. There are seven multi-family/condo buildings proposed on the property as well as associated drives, sidewalk, sanitary sewer, water, storm sewer, dry utilities, landscaping, and a pool and associated building.

2. This report was prepared in conjunction with the Site Development Plans dated 05/19/2023 by Eric Smith Associates and Baseline Engineering for Steamboat Esquiar LP, and the subsequent Construction Documents prepared by Baseline Engineering dated 02/29/2024.

D. REFERENCED DRAINAGE REPORTS

1. The “City of Steamboat Springs Citywide Stormwater Master Plan” was referenced in the preparation of this report.

2. The “Addendum to Final Drainage Study for Edgemont and Related Access Improvements for Bear Claw II,” by Landmark Consultants, Inc. Dated June 18,2009

3. The “Draft Drainage Study for Edgemont” by Landmark Consultants, Inc. Dated April 9, 2007, Revised July 7, 2007

4. The “Final Drainage Study for Bear Claw II Sub-division” by Landmark Consultants, Inc. Dated June 19, 2018, Revised February 18, 2019

II DRAINAGE CRITERIA AND METHODOLOGY USED

A. DESIGN RAINFALL AND STORM FREQUENCY

1. In accordance with City Drainage Criteria, the major storm is the 100-year recurrence interval storm and the minor storm is the 5-year recurrence interval storm.

2. The values of 0.82 inches and 1.79 inches for the 5-year storm and 100-year storm

respectively were used for the drainage per the City's Drainage Criteria.

B. RUNOFF CALCULATION METHOD

1. The Proposed and Existing basins, including off-site basins are around 80 acres, below the 160 acre maximum for the rational method; therefore the rational method has been used to calculate peak flows for both proposed and existing conditions per section 5.6.2.2 of the City's Engineering Standards.

C. CULVERT, INLET, AND STORM SEWER ANALYSIS

1. Street and Inlet capacities were studied using MHFD-Inlet v5.01, April 2021, by the Mile High Flood District.

2. Hydraflow Storm Sewers Extension for Autodesk Civil 3D, was utilized to create hydraulic models of the storm sewer system.

D. DETENTION DISCHARGE AND STORAGE METHODOLOGY

1. Stormwater detention has been designed using the FAA method as outlined in section 5.11.7.2 in the City's Engineering Standards. The allowable release rates have been determined by using Table 5.11.1 in the City's Engineering Standards which are based on soil groups. The Water Quality Capture Volume was determined from the equation in section 5.12.7.1 of the City's Engineering Standards using a 40-hour drain time.

III EXISTING CONDITIONS (PRE-DEVELOPMENT)

A. ON-SITE DRAINAGE PATTERNS

1. The site is currently undeveloped and covered in native grasses and is roughly 2% impervious. This site is 4.33 acres in size and has roughly 112 feet of fall across the site.

2. There is an existing 24" CMP culvert on the low end of the site near Ski Trail Lane that the entire site and also some off-site basins currently drain to and eventually reaches Burgess Creek approximately 1000 feet to the west of the project. The ultimate outfall location is the Yampa River. This 24" CMP outfall storm is undersized for the existing 100-year flow of 120.6 cfs. This flow has been recalculated with the 2019 NOAA point precipitation values from the updated city

Standards. This flow was previously calculated by Landmark in the "Draft Drainage Study for Edgemont" report the flow was calculated as 106.8 cfs using the old precipitation numbers.

3. There are miscellaneous culverts on the site to convey the off-site flow.

4. There is a gondola tower and associated easement running through the site on the south side of the site that is proposed to remain.

5. Subbasin summary – Refer to the Existing Drainage Basin Map and Runoff Summary table in the appendix for reference.

6. Basin H1
Includes flow from Buildings 2 and 3 of the Ski Inn condos, their adjacent parking lots, sidewalks, and landscape areas. This area flows to the existing 24" CMP outfall pipe

7. Basin H2
Is the main on-site basin and mainly consists of undeveloped land. The existing ski trail acts as the basin barrier and there is a drainage swale adjacent to the trail taking flow to the southeast in a depression and outfalls from a 15" CMP culvert into Basin H1. This basin also includes the 2 lots from the Bear Claw Estates subdivision which is currently under construction. For purposes of this report it will be analyzed as if these lots are undeveloped as they are providing underground detention to reduce flows to predeveloped conditions.

8. Basin H3
Includes the whole Edgemont condo building, pool area, and adjacent drive. This drainage enters the site in two storm sewers and is conveyed down a riprap lined rundown in Basin H2.

9. Basin H4
Contains flow from the Norwegian Log condos, associated parking lot, walks, and landscape areas. This outlets at an 18" CMP culvert that discharges into Basin H1.

10. Basin H5
Includes half of Ski Trail Lane and a small portion of one of the Bear Claw Estates lots. This flow is conveyed though a 15" CMP into Basin H4

B. OFF-SITE DRAINAGE PATTERNS

1. Subbasin Summary – Refer to the Existing Drainage Basin Map and Runoff

Summary table in the appendix for reference.

2. Basin OS1

   This basin in comprised of flow from residential lots and undeveloped land on the ski resort. It is exactly the same basin as H1 as represented in the “Draft Drainage Study for Edgemont” report by Landmark. The area of 58.55 acres, imperviousness of 5%, and Time of concentration of 31.7 minutes were taken from that report. Just the rainfall intensity was updated per the city’s most current standards. This basin in conveyed under Ski Trail Lane via a 24” CMP into basin H5.

3. Basin OS2

   Contains flow from Bear Claw I and II and also upstream from those developments is residential and undeveloped ski resort off-site basins. This basin was copied from the “Addendum to Final Drainage Study for Edgemont and Related Access Improvements for Bear Claw II” study by Landmark. Design Point 18 is at the outlet of the 24” RCP pipe that runs between the two lots on Bear Claw Estates. The area getting to this point is 12.34 acres, imperviousness of 31%, and a time of concentration of 14.4 minutes. Again, the rainfall intensity was updated to use the new values from the city’s standards.

IV PROPOSED CONDITIONS

B. GENERAL

1. The proposed improvements include a large 7 story building with 2 garage floors along the property line adjacent to the ski resort. There are 5 other condo buildings that are 4 stories each and then a pool and associated 2 story building. In addition, there are proposed drives, sidewalk, sanitary sewer, water, storm sewer, dry utilities, and landscaping. The proposed site is approximately 60% impervious and the disturbed area is roughly 3.50 acres of the 4.33 acre site.

C. DRAINAGE PATTERNS & BASINS

1. The proposed drainage patterns will not change significantly from existing drainage conditions and the ultimate outflow locations will remain the same as today. The existing undersized 24” CMP outfall pipe will be replaced by a 36” HDPE pipe which will run throughout the site and convey on-site and off-site flows. The total 100-year historic flow to this pipe is 120.6 cfs and the proposed flow is calculated to be 116.9 cfs with the addition of two detention ponds to help with the increased flow from the increased impervious area. This pipe is directed to Burgess Creek which is approximately 1000 feet to the west of the project. Burgess Creek outfalls into the Yampa River which is the ultimate outfall point for the site.

Refer to the Proposed Drainage Basin Map for reference.

2. Sub Basin Summary – Refer to the Proposed Drainage Basin Map and Runoff Summary table in the appendix for reference.

On-site Basins

3. Basin A1
Is the main pond on the site and all A subbasins drain into this detention pond. The total Major Basin A is 2.58 acres.

4. Basin A2
Contains flow from the access drive and is directed to Pond A directly from a type 13 combination curb inlet.

5. Basin A3
Includes drainage from open space and the adjacent roadway. It is collected in a type 13 combination inlet and ties into the flow from Basin A2 and into Pond A.

6. Basin A4
Collects drainage from Building 2 and the adjacent drive and is collected in another type 13 combination inlet the discharges directly into Pond A.

7. Basin A5
Contains flow from Buildings 3 & 7 and adjacent walks and landscape areas and ties directly in to Pond A.

8. Basin A6
This basin includes flow from behind Buildings 2 & 3 and collects flow from the front of Building 1 in a type 13 combination inlet. It is collected in a storm sewer pipe that goes into a manhole that in turn discharges into Pond A.

9. Basin A7
Exclusively contains flow from the access drive and is collected in a Type 13 combination inlet. This flow is directed towards the manhole from Basin A6 were it combines with that flow and is directed to Pond A.

10. Basin A8
Is entirely comprised of flow from the roof of Building 1 which is collected and routed through the building internally.

11. Basin A0

Includes landscaping area above the retaining wall behind Buildings 1 & 2. This flow is collected in an area inlet and directed to Pond A.

12. Basin B1
Basin B1 includes Pond B and flow from the front of buildings 5 & 6 and the pool. Major Basin B is 0.59 Acres in size.

13. Basin B2
Includes drainage from the back of Buildings 5 & 6 roofs and landscape area behind the buildings.

14. Basin B3
Collects flow from the drive down to the lower garage level of Building 1 at a trench drain at the face of the building.

15. Basin C1
Major Basin C is 0.69 in size and contains undetained flow from the access road to the site. Basin C1 is located at historic design point 1 and is entirely landscaped area and includes Water Quality Pond C.

16. Basin C2
Is exclusively flow from the access drive and is collected in a sag type 13 combination inlet and discharges into Water Quality Pond C.

17. Basin C3
Is comprised of flow from the access drive and the ski trail on the south side of the drive. This flow is collected in a sag type 13 combination inlet and ties into the flow from Basin C2 and discharges into Water Quality Pond C

18. Basin C4
Is upstream of Basin C2 and collects flow from the access drive. It combines with the historic released flow from Pond B and ties into the main storm sewer.

19. Basin C5
Is upstream of Basin C3 and collects flow in a type 13 combination inlet and ties directly into the main storm sewer.

Off-site Basins

20. Basin D1
Basin D1 includes flow from Ski Inn building 2 and associated parking lot which is being improved with these improvements since it currently extends out into the

existing right-of-way. A retaining wall will be constructed to allow for more parking on the southeast edge of the current parking lot. This drainage will be collected in a area inlet and tied into the Basin C3 inlet.

21. <u>Basin D2</u>
Includes flow from Ski Inn condo building 3 and associated parking lot and landscape areas. It extends to the center of Ski Trail Lane. This off-site flow is collected in a flared end section under the realigned ski trail and ties into the main storm sewer.

22. <u>Basin D3</u>
Includes flows from the back of Norwegian Log condo building 2 and landscape areas behind the building. This drains to an existing 18” CMP culvert and then combines with flow from Basin D2.

23. <u>Basin D4</u>
Is comprised of flow from the front of Norwegian Log building 2 and the entire building 1 and their shared parking lot. It also includes from from the center of Ski Trail Lane. This flows to the riprap lined drainageway that was graded to accommodate the offsite flow running through the site.

24. <u>Basin D5</u>
Is the exact same basin as historic Basin H5

25. <u>Basin D6</u>
Includes the currently under construction Bear Claw Estates Sub-division. Both of these lots have proposed underground detention for the buildings and ties into the existing 18” RCP sewer that takes flow from Basin OS2 and runs between the two lots. Therefore, for the purpose of this report it has been treated as an undeveloped parcel of land.

26. <u>Basins H3, OS1, and OS2</u>
Are all unchanged from the historic basins.

D. DETENTION PONDS

1. Pond A is the main detention pond on site and has a capture area of 2.49 acres as well as off-site flow from Basin H3 of 1.9 cfs for the 5-year storm and 5.3 cfs for the 100-year. Pond B has a capture area of 0.68 acres and no bypass flow. Basin C is unable to be detained due to lack of available area and will be free released. However, the discharge will be treated in Water Quality Pond C. According to the

city's standards only 5% of the site may be free released and the release rates from the pond must be reduced accordingly. Basin C is 0.67 acres and 15% of the site. Since there is not adequate real estate for an additional pond and grades make it impossible to use the other ponds, we are proposing to over-size Pond A since it has the off-site flow from Basin H3 and then release the pond at a reduced rate to make up for the free release of Basin C. The release rate from Pond A is also being reduced by the bypass free release flow of the inlets at Basins A2 and A3 of 0.3 cfs for the 5-year storm and 1.9 cfs for the 100-year storm. The ponds were sized using the FAA method as outlined in the city's standards.

2. Pond A

Taking into account over-sizing the pond for the off-stie flow from Basin H3 as discussed above, the required volume for the pond is 1663 cubic feet for the 5-year storm and 5085 cubic feet for the 100-year storm. The water quality capture volume (WQCV) was calculated to be 1683 cubic feet. The pond will have vertical walls all around due to constrained area with a bottom slope of 3% and a depth of 3.5 feet for the 100-year storm. The proposed release rate from the pond was calculated to be 0.9 cfs for the 5-year storm and 1.8 cfs for the 100-year storm taking into account the free release and offsite flows as discussed above. See calculations in the appendix for details. The WQCV will be released through and orifice plate over 40 hours. The outlet structure will be built into the retaining wall and tie into the storm sewer in the access road. The emergency spillway was sized for the 100-year flow of Basins A and H3 of 19.2 cfs. The spillway will be a rectangular weir in the retaining wall 6 feet wide and 1 foot high. The spillway will release directly into the access road. A 10 foot wide maintenance access has been provided at a maximum slope of 10%

3. Pond B

The required volumes for Pond B are 391 cubic feet for the 5-year storm and 1046 cubic feet for the 100-year storm. The WQCV was calculated to be 460 cubic feet. The pond will have a vertical wall on the south side and a minimum bottom slope of 2% and a depth of 2.05 feet for the 100-year storm. The allowable release rate based on the soil type of C is 0.07 cfs for the 5-year storm and 0.37 cfs for the 100-year storm. The WQCV will be released through an orifice plate over 40 hours. The emergency spillway was sized for the 100-year flow of Basins B of 2.8 cfs. The spillway will be a rectangular weir in the retaining wall 1 foot wide and 1 foot high. The spillway will release directly into the access road.

4. Pond C

Pond C is a Water Quality Pond only and will not provide detention as stated above since Pond A is oversized and the flow leaving the site will remain unchanged. The required WQCV is 424 cubic feet. The slopes of the pond are 3:1 and the bottom has a minimum slope of 2%. The depth of the pond is 2 feet and the WQCV will be released through an orifice plate over 40 hours

5. The ponds will be in drainage easements and will be privately maintained by the HOA that will be formed for this development.

E. ON-SITE STORM CONVEYANCE SYSTEM

1. Per the City of Steamboat Springs Engineering Criteria Chapter 4 - Streets, Section 4.2.1.4, the access drive is classified as a local street. Drainage Criteria for a Collector Street have been followed.

2. Per the City of Steamboat Spring Springs Drainage Criteria, Section 5.8.3.2, for Local Streets, Primary Commercial, & Multifamily Access Roads, the Minor Storm drainage system is to be designed so that the flow depth does not excess 6 inches at the gutter flowline. The MHFD Inlet Design sheets reflect a 6” flow depth for the minor storm.

3. Per the City of Steamboat Spring Springs Drainage Criteria, Section 5.8.3.2, for Local Streets, Primary Commercial, & Multifamily Access Roads, the Major Storm drainage system is to be designed so that the major storm depth does not exceed 12 inches at the gutter flowline and velocity shall be less than 8 fps. The proposed buildings will be at least 12” above the adjacent flowline of the gutter. Since they are less than the required 24” due to close proximity to the access drive The MHFD inlet design sheets reflect a maximum of 6” depth during the 100yr storm per the standards. The total street capacity (up to 6” depth) varies from 20 cfs to 24.8 cfs depending on the slope. The max calculated velocity is 8.6 fps for Basin C5 which is just slightly over the max of 8 fps due to the steep slopes on the site.

4. The proposed storm sewer systems are sized to convey the minor storm event (5-year) without surcharging and the major storm event (100-year) without overtopping. The Hydraflow Storm Sewer results in the appendix show that the storm drain system is within these criteria.

5. Inlets were designed using the Mile High Flood District inlet spreadsheet and bypass flow was taken into account for all of the inlets. See the appendix for the results. All of the onsite inlets are either area inlets or Type 13 combination inlets with a curb opening and a grate in the gutter.

6. The on-site storm system will be privately maintained by the property owner/HOA.

F. OFF-SITE STORM CONVEYANCE SYSTEM

1. The offsite flow will be conveyed through a drainage way that has a bottom width of 2 feet and side slopes of 2:1 and is 2 feet deep. The off-site flow of 114 cfs will be 1.4 feet deep in the drainageway at 16.6% and will need to be lined with riprap since it has an erosive velocity of 17.4 fps. This will flow to a CDOT type D inlet which has a capacity of 96 cfs at 2 feet deep in a sump condition. The overflow of 18 cfs will flow down the access road which has a minimum capacity of 20 cfs as discussed above.

V POST CONSTRUCTION STORMWATER MANAGEMENT

A. PERMANENT BEST MANAGEMENT PRACTICES

1. The three on-site water quality/detention ponds will serve as a permanent water quality treatment feature. Refer to section D above and Exhibit B, Storm Water Quality Plan for additional details.

VI CONCLUSIONS

A. GENERAL SUMMARY

Historic drainage patterns and flows will be maintained with the proposed Astrid development. On-site imperviousness is being increased from 2% to 60% so two detention ponds are being proposed with included water quality capture volume to keep the flows slightly less than their current/historic rates and not have an adverse impact on adjacent or downstream properties.

The minor and major storms do not exceed a 6” depth in the gutter.

Pipe hydraulic results show that the 5-yr storm is contained within the pipes with no surcharging. The hydraulic results also that that the 100-yr storm is contained without overtopping.

B. COMPLIANCE WITH CRITERIA & VARIANCE REQUESTS

1. The drainage design complies with the City Drainage Criteria and no variance is requested.

C. NEW STORMWATER SYSTEM REQUIREMENTS

1. The storm water system will need to be maintained periodically and after

significant storm events to ensure the system continues to function as designed. The Astrid HOA will be required to maintain all stormwater conveyance features.

VI REFERENCES

City of Steamboat Springs Drainage Criteria Section 5.0, Effective September 2007, Updated July 2019.

City of Steamboat Springs Engineering Standards, Chapter 4, Streets , September 2007, Updated July

City of Steamboat Springs Citywide Stormwater Master Plan, Short Elliott Hendrickson Inc., March 2013.

Mile High Flood District Drainage Criteria Manual, Vol. 1, 2 and 3, Urban Drainage and Flood Control District, Denver, Colorado, Current Version.

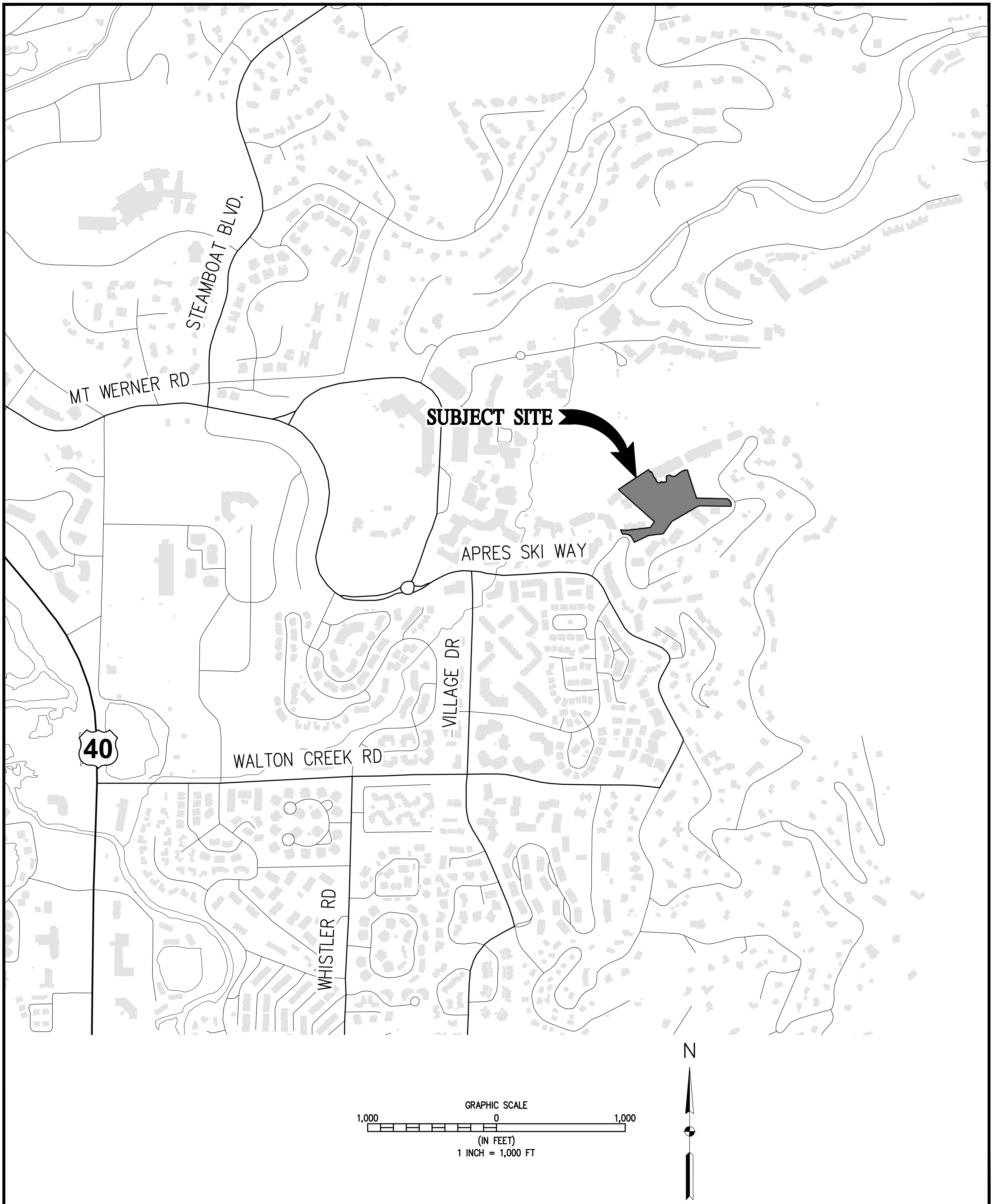
Addendum to Final Drainage Study for Edgemont and Related Access Improvements for Bear Claw II, Landmark Consultants, Inc., June 18,2009

Draft Drainage Study for Edgemont, Landmark Consultants, Inc., April 9, 2007, Revised July 7, 2007

Final Drainage Study for Bear Claw II Sub-division, Landmark Consultants, Inc., June 19, 2018, Revised February 18, 2019

ATTACHMENT 1

VICINITY MAP



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STEAMBOAT ESQUIAR LP

STEAMBOAT SPRINGS

ROUTT COUNTY

ASTRID SITE DEVELOPMENT

2410 SKI TRAIL LANE

VICINITY MAP

DESIGNED BY
SMB

DRAWN BY
SMB

CHECKED BY
SMB

INITIAL SUBMITTAL	12/22/22
DRAWING SIZE	8.5" X 11"
SURVEY FIRM LANDMARK, INC.	SURVEY DATE 06/03/22
JOB NO.	C020235
DRAWING NAME Citywide Vicinity Map.dwg	
SHEET 1 OF 1	

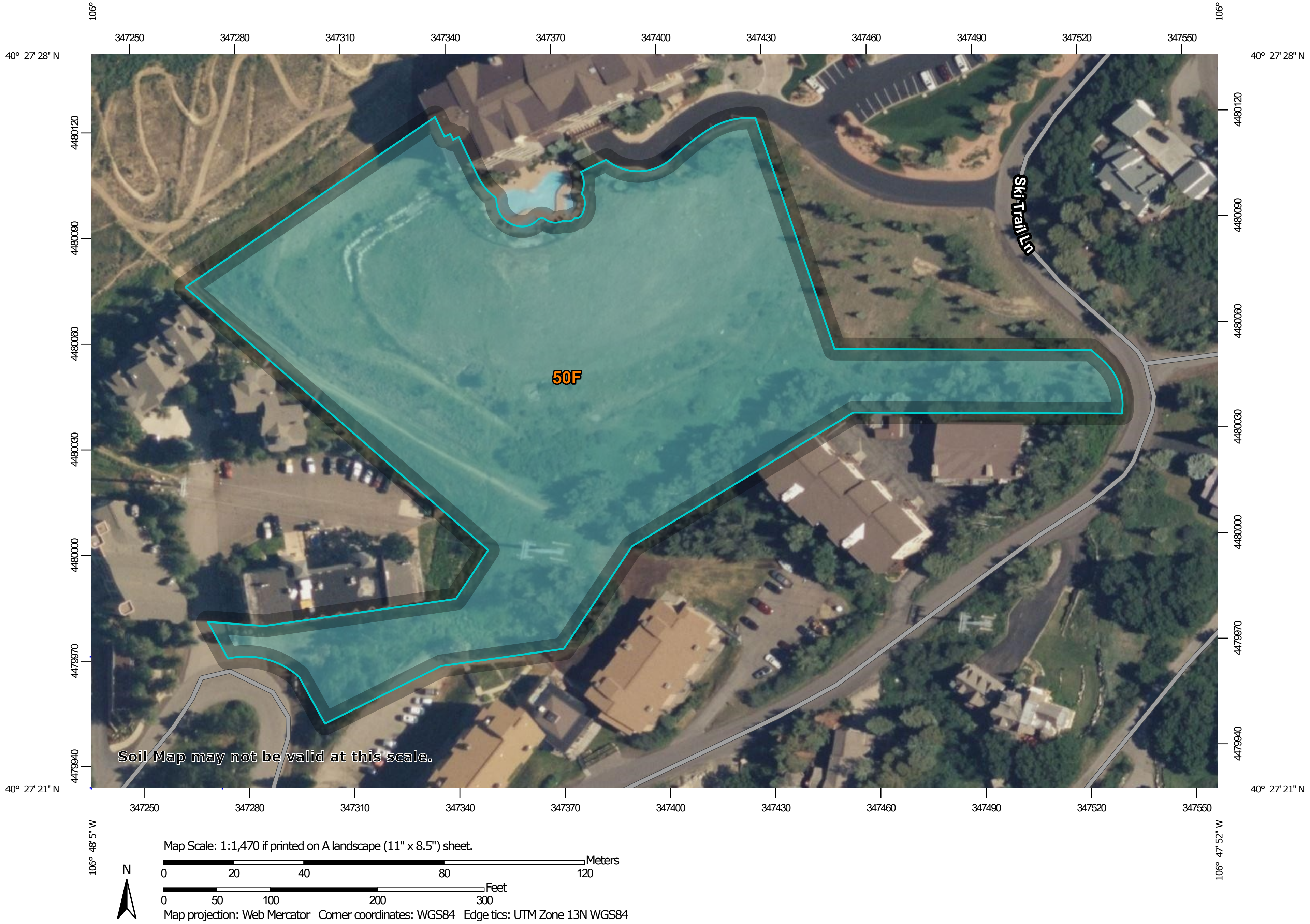
1

O:\C020235 Astrid–Edgemont Ph2\Drawings\Drainage Maps\Citywide Vicinity Map.dwg, 12/20/2022 11:06:49 AM, Steve Batchelder

ATTACHMENT 2

NRCS SOILS MAP & DATA

Hydrologic Soil Group—Routt Area, Colorado, Parts of Rio Blanco and Routt Counties
(20235 Astrid)



Map Scale: 1:1,470 if printed on A landscape (11" x 8.5") sheet.

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 Rating Polygons

- ■ A
- ■ A/D
- ■ B
- ■ B/D
- ■ C
- ■ C/D
- ■ D
- □ Not rated or not available

Soil Rating Lines

- 〰 A
- 〰 A/D
- 〰 B
- 〰 B/D
- 〰 C
- 〰 C/D
- 〰 D
- 〰 Not rated or not available

Soil Rating Points

- ■ A
- ■ A/D
- ■ B
- ■ B/D
- ■ C
- ■ C/D
- ■ D
- □ Not rated or not available

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 12, Sep 7, 2022

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 imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
50F	Routt loam, 25 to 65 percent slopes, very stony	C	4.6	100.0%
Totals for Area of Interest			**4.6**	**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

Tie-break Rule: Higher

ATTACHMENT 3

FEMA Map

National Flood Hazard Layer FIRMette

FEMA

106°48'19"W 40°27'39"N

106°47'42"W 40°27'11"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	🟦	Without Base Flood Elevation (BFE) *Zone A, V, A99* With BFE or Depth *Zone AE, AO, AH, VE, AR*
	▨	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	🟧	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
	▨	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
	▨	Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
	▨	Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN	Area of Minimal Flood Hazard *Zone X*
	▭	Effective LOMRs
	▭	Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES	— — —	Channel, Culvert, or Storm Sewer
	׀׀׀׀׀׀׀	Levee, Dike, or Floodwall
OTHER FEATURES	B 20.2 17.5	Cross Sections with 1% Annual Chance Water Surface Elevation
	8 — — —	Coastal Transect
	513	Base Flood Elevation Line (BFE)
	—	Limit of Study
	—	Jurisdiction Boundary
	— — —	Coastal Transect Baseline
	—	Profile Baseline
	—	Hydrographic Feature
MAP PANELS	☐	Digital Data Available
	☐	No Digital Data Available
	☒	Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 12/6/2022 at 6:53 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

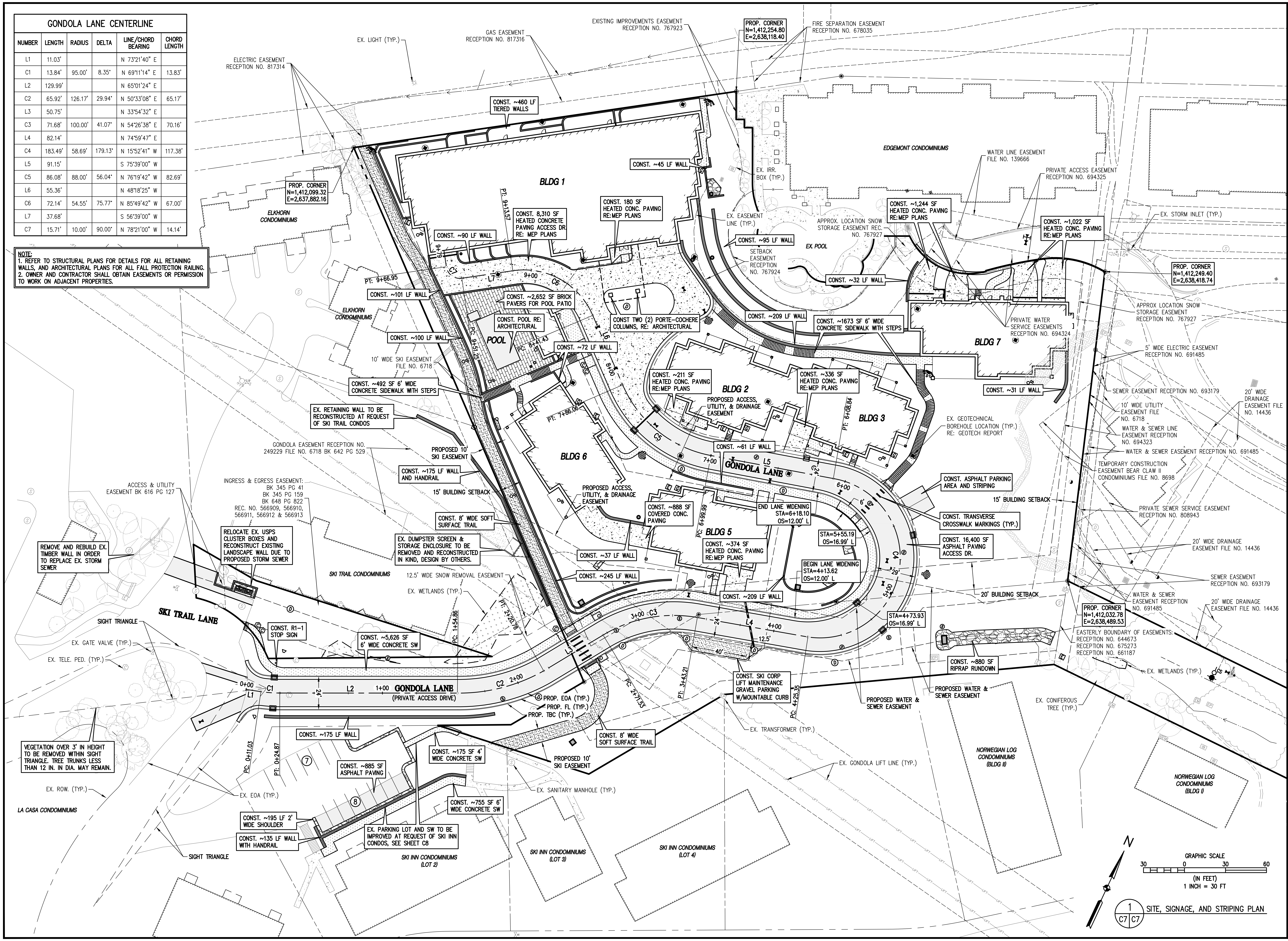
ATTACHMENT 4

SITE PLAN AND STORM SEWER PROFILES

GONDOLA LANE CENTERLINE

NUMBER	LENGTH	RADIUS	DELTA	LINE/CHORD BEARING	CHORD LENGTH
L1	11.03'			N 73°21'40" E	
C1	13.84'	95.00'	8.35°	N 69°11'14" E	13.83'
L2	129.99'			N 65°01'24" E	
C2	65.92'	126.17'	29.94°	N 50°33'08" E	65.17'
L3	50.75'			N 33°54'32" E	
C3	71.68'	100.00'	41.07°	N 54°26'38" E	70.16'
L4	82.14'			N 74°59'47" E	
C4	183.49'	58.69'	179.13°	N 15°52'41" W	117.38'
L5	91.15'			S 75°39'00" W	
C5	86.08'	88.00'	56.04°	N 76°19'42" W	82.69'
L6	55.36'			N 48°18'25" W	
C6	72.14'	54.55'	75.77°	N 85°49'42" W	67.00'
L7	37.68'			S 56°39'00" W	
C7	15.71'	10.00'	90.00°	N 78°21'00" W	14.14'

NOTE:
1. REFER TO STRUCTURAL PLANS FOR DETAILS FOR ALL RETAINING WALLS, AND ARCHITECTURAL PLANS FOR ALL FALL PROTECTION RAILING.
2. OWNER AND CONTRACTOR SHALL OBTAIN EASEMENTS OR PERMISSION TO WORK ON ADJACENT PROPERTIES.



1 C7 C7 SITE, SIGNAGE, AND STRIPING PLAN

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DESIGNED BY	DRAWN BY	CHECKED BY
SMB	TJM	MRB

REVISION DESCRIPTION	PREPARED BY	DATE
INITIAL SUBMITTAL FOR CITY REVIEW	SMB	2/29/24

STEAMBOAT ESQUIAR LP
CITY OF STEAMBOAT SPRINGS
ROUTT COUNTY
THE ASTRID
2410 SKI TRAIL LANE
SITE, SIGNAGE, AND STRIPING PLAN

PREPARED UNDER THE DIRECT SUPERVISION OF
NOT FOR CONSTRUCTION
2-29-24
FOR AND ON BEHALF OF BASELINE CORPORATION

INITIAL SUBMITTAL	2/29/2024
DRAWING SIZE	24" X 36"
SURVEY FIRM LANDMARK, INC	SURVEY DATE 06/03/22
JOB NO.	C020235
DRAWING NAME 20235 SITE PLAN-CD.dwg	
SHEET 7 OF 64	

C7

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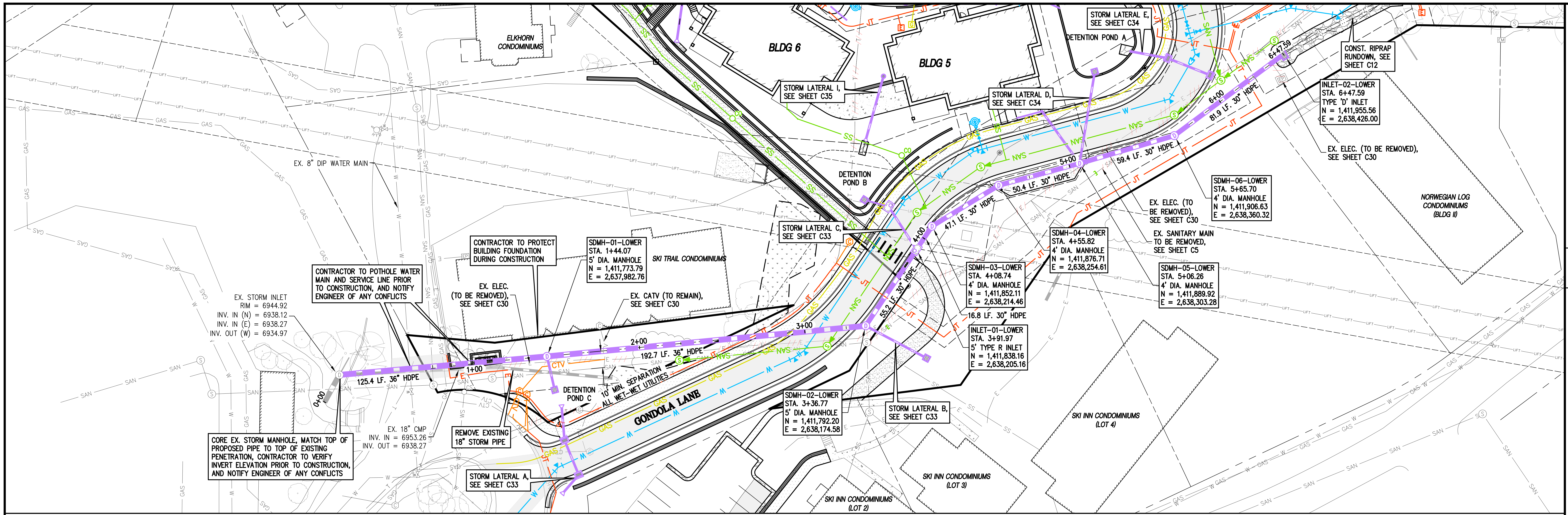

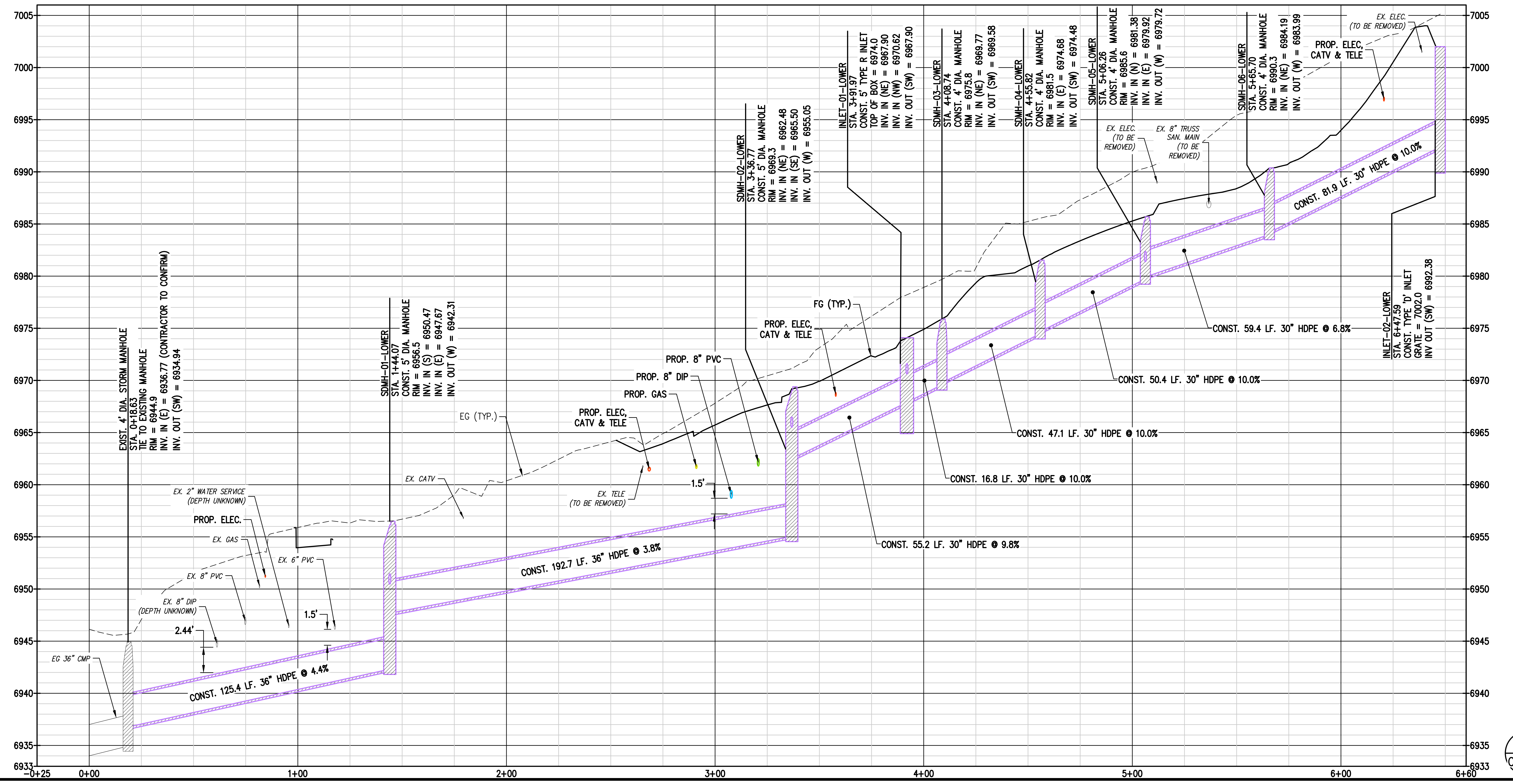

NOTES:
1. ALL INLETS TO HAVE 2' DEEP SUMP.
2. ALL PIPE LENGTHS ARE TO CENTER OF STRUCTURE.
3. ALL TYPE C AND TYPE D INLETS TO HAVE CLOSED MESH GRATE.

N

GRAPHIC SCALE
30 0 30 60
(IN FEET)
HORIZ: 1 INCH = 30 FT
VERT: 1 INCH = 6 FT

1
C31 C31
STORM SEWER MAIN PLAN & PROFILE I

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STEAMBOAT ESQUIAR LP
THE ASTRID
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STORM SEWER MAIN PLAN & PROFILE I
CITY OF STEAMBOAT SPRINGS
ROUTT COUNTY

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SURVEY DATE 06/03/22
JOB NO. CO20235
DRAWING NAME 20235 P&P-STORM MAIN-CD.dwg.dwg
SHEET 31 OF 64

C31

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NOTES:
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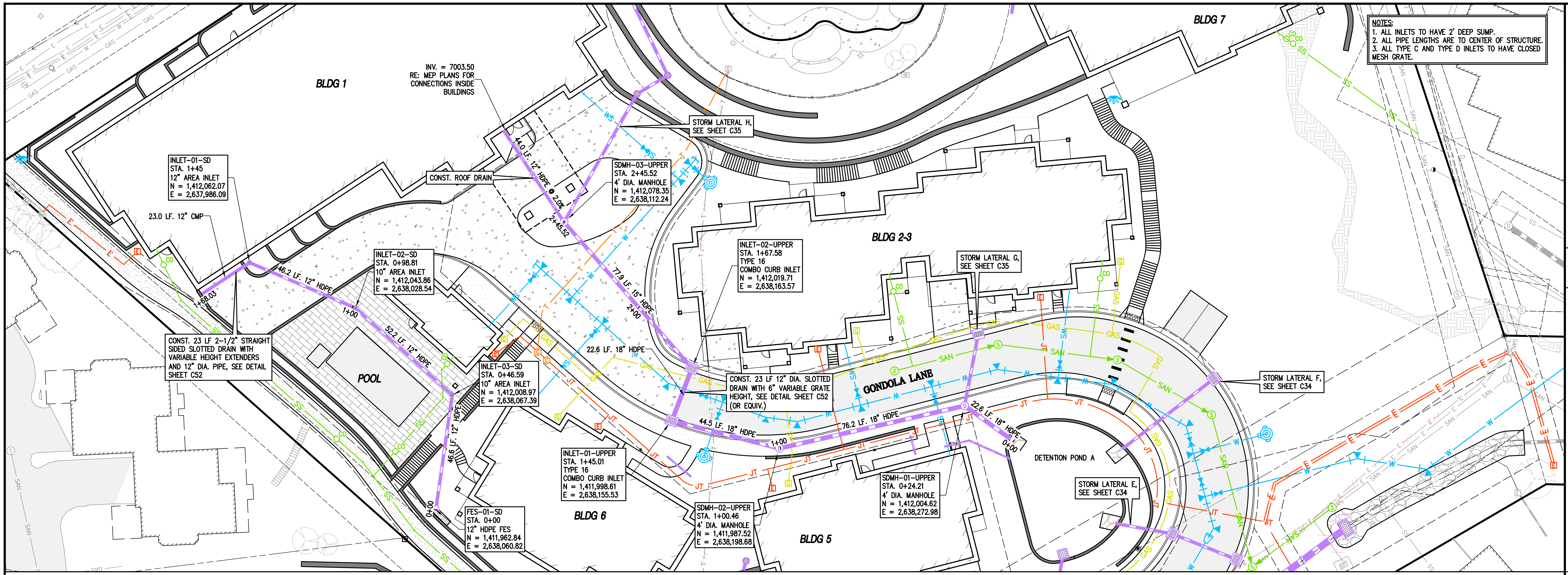
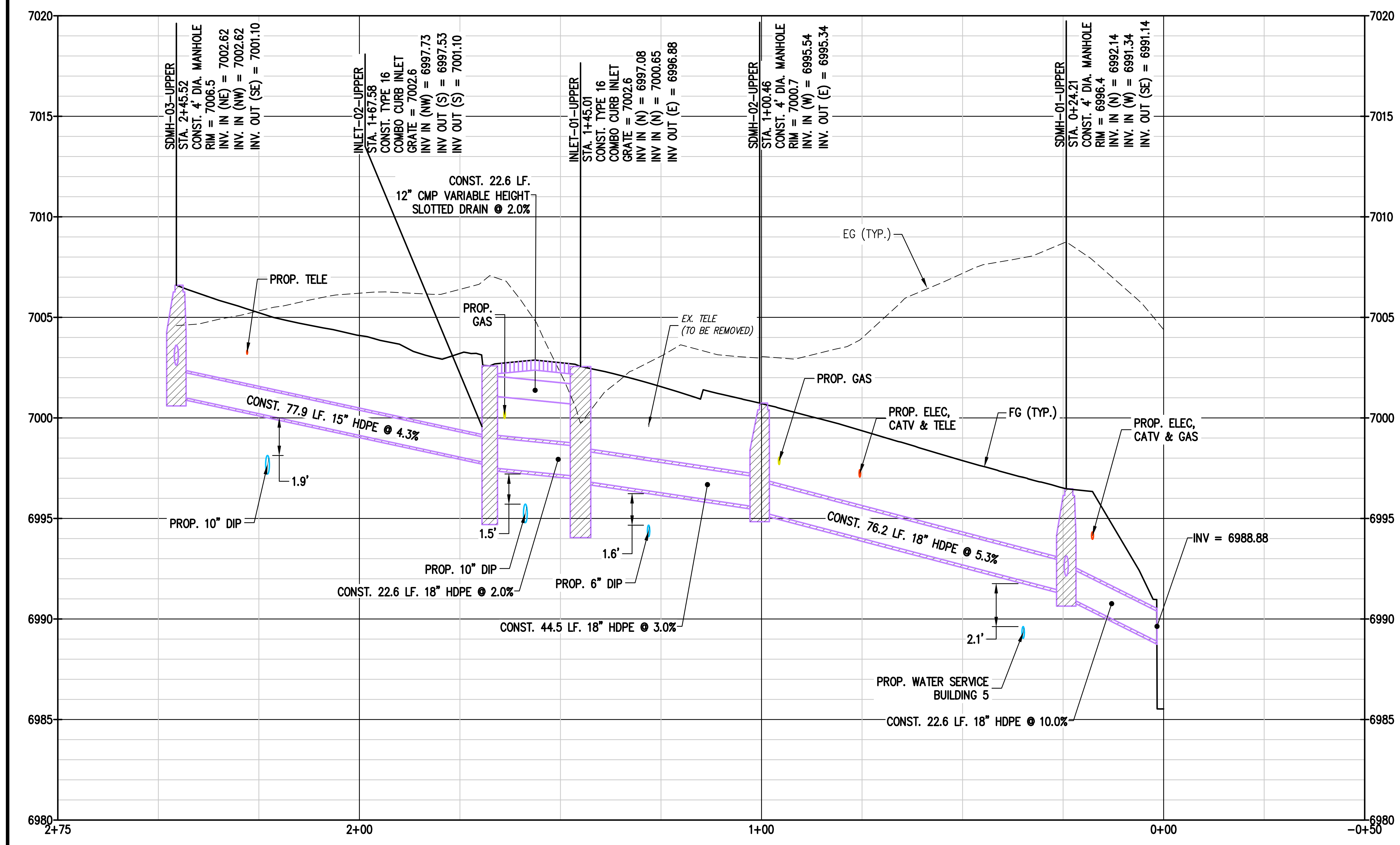
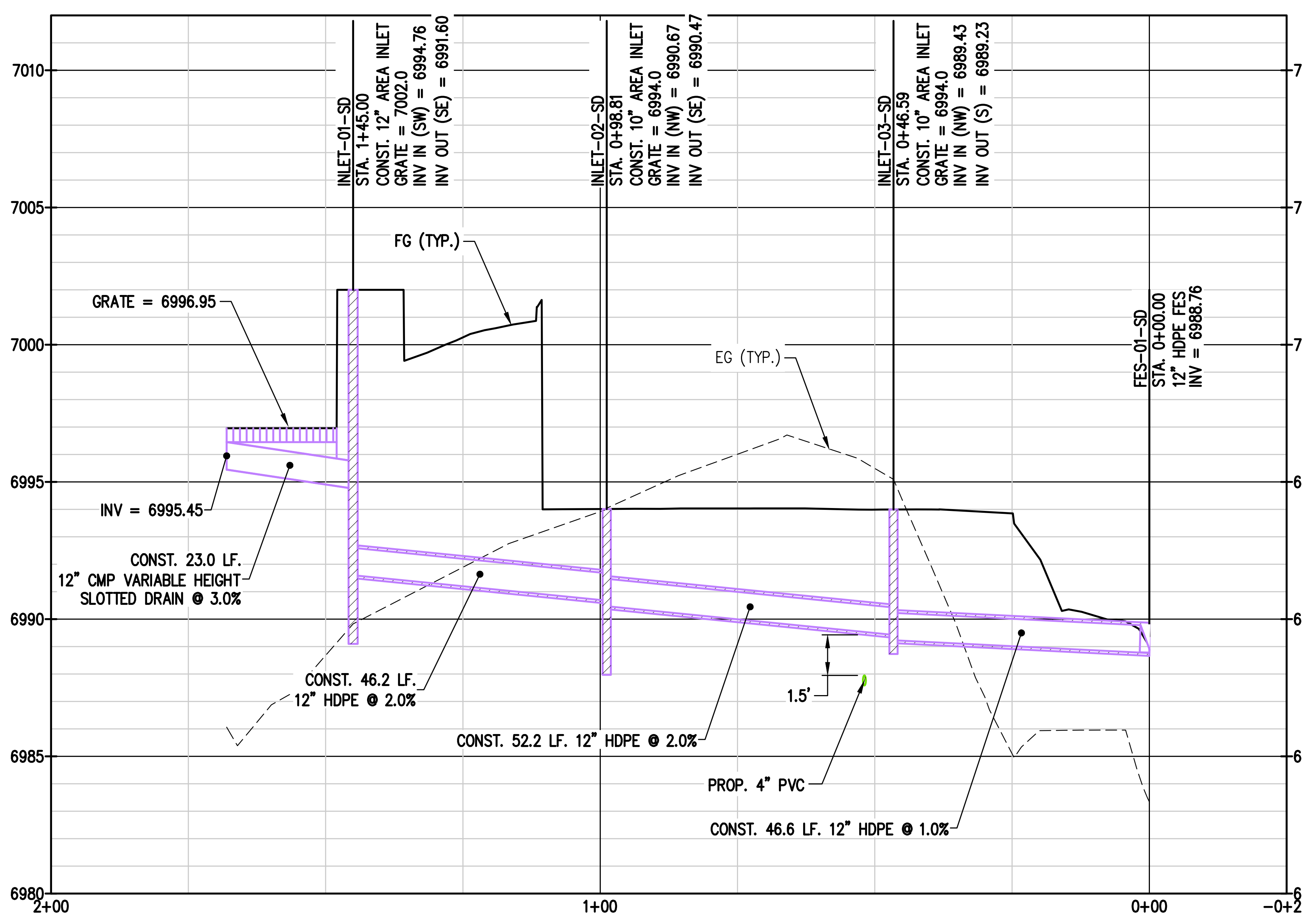
2. ALL PIPE LENGTHS ARE TO CENTER OF STRUCTURE.
3. ALL TYPE C AND TYPE D INLETS TO HAVE CLOSED MESH GRATE.





1 STORM MAIN PROFILE
C32 C32



2 BLDG 1 SLOTTED DRAIN PROFILE
C32 C32

N

GRAPHIC SCALE
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(IN FEET)
HORIZ: 1 INCH = 20 FT
VERT: 1 INCH = 4 FT

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STEAMBOAT ESQUIAR LP

CITY OF STEAMBOAT SPRINGS
ROUTT COUNTY

THE ASTRID
2410 SKI TRAIL LANE
STORM SEWER MAIN PLAN & PROFILE II

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SURVEY DATE 06/03/22
JOB NO. C020235
DRAWING NAME 20235 P&P-STORM MAIN-CD.dwg.dwg
SHEET 32 OF 64
C32

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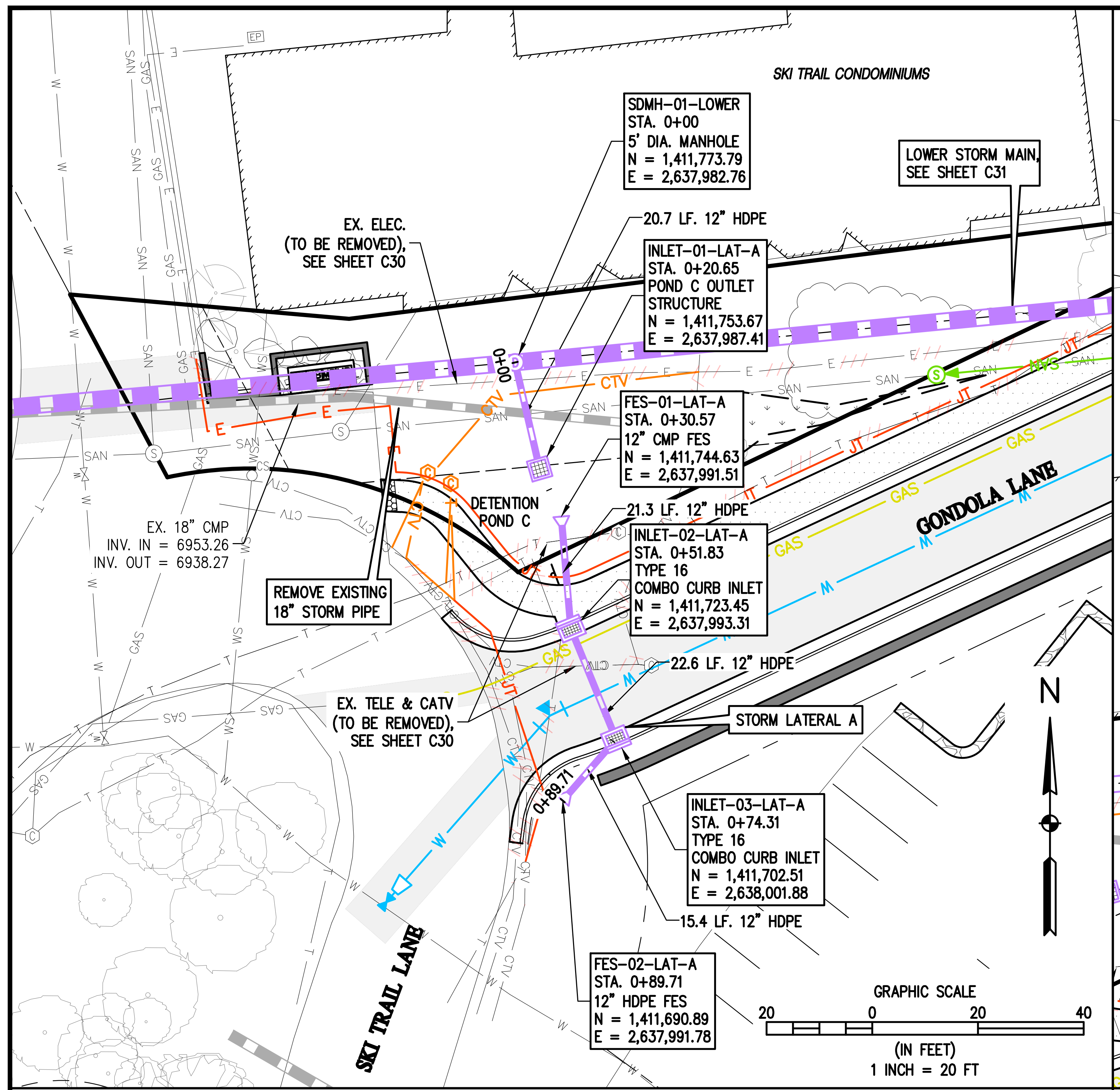

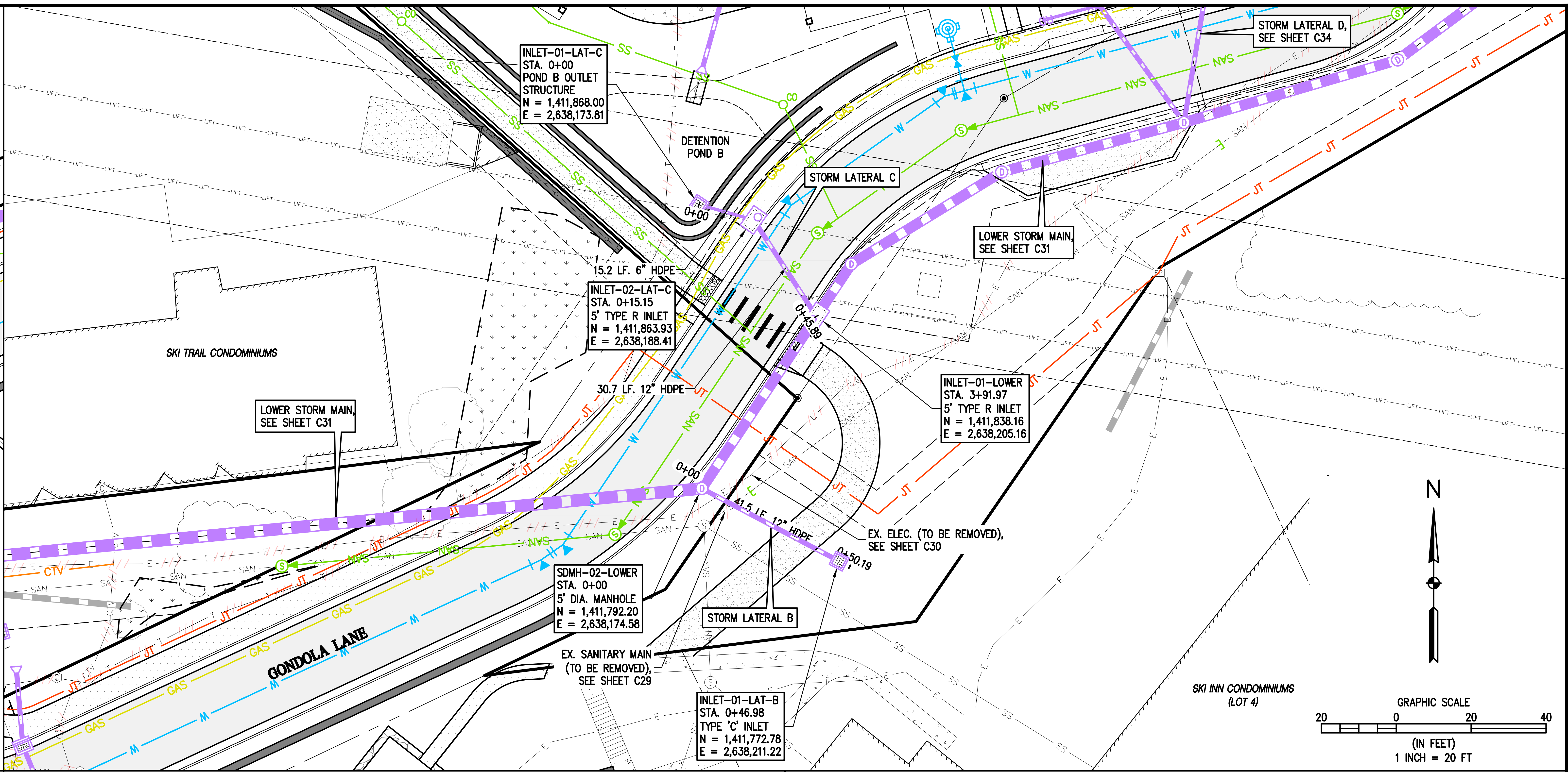

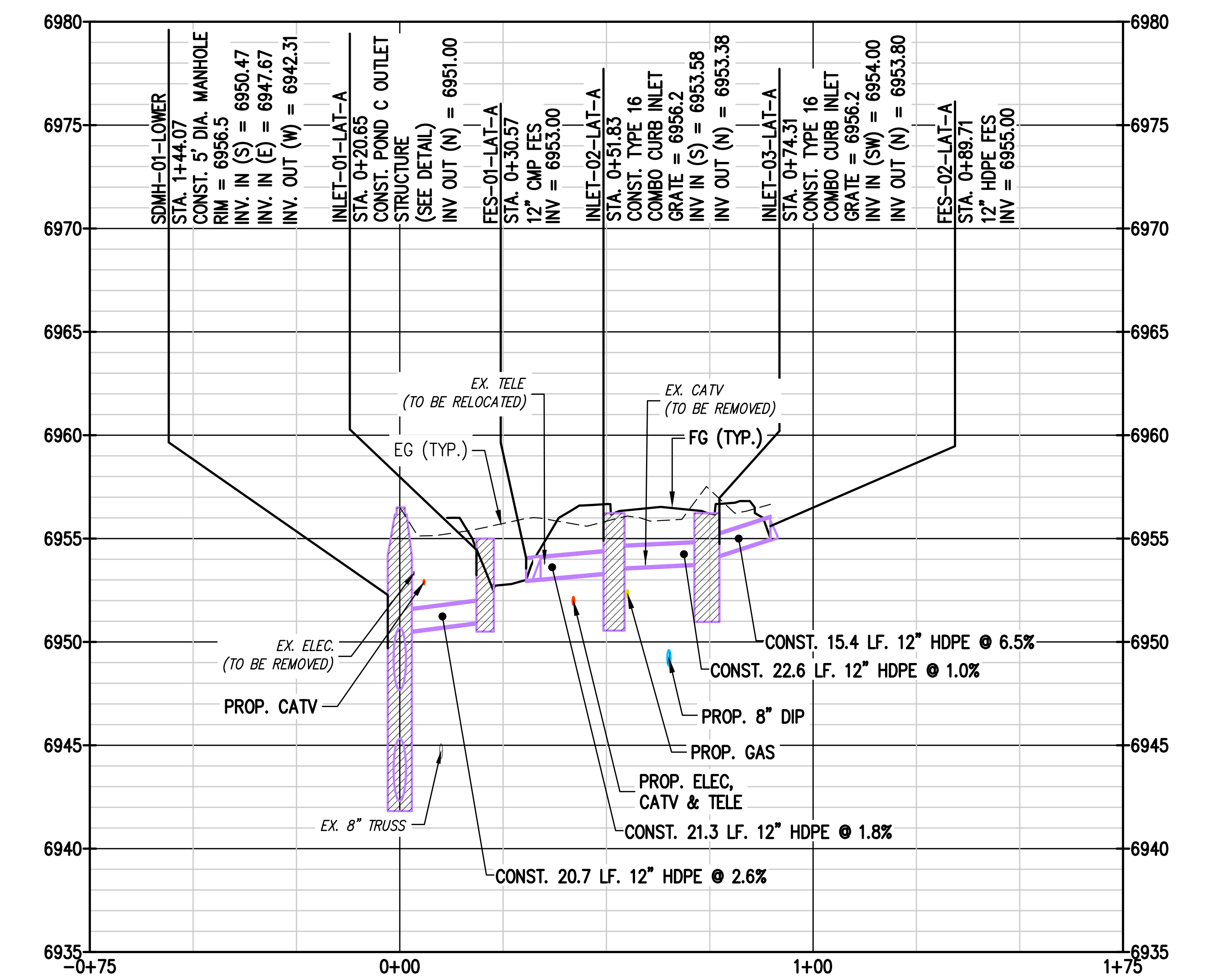

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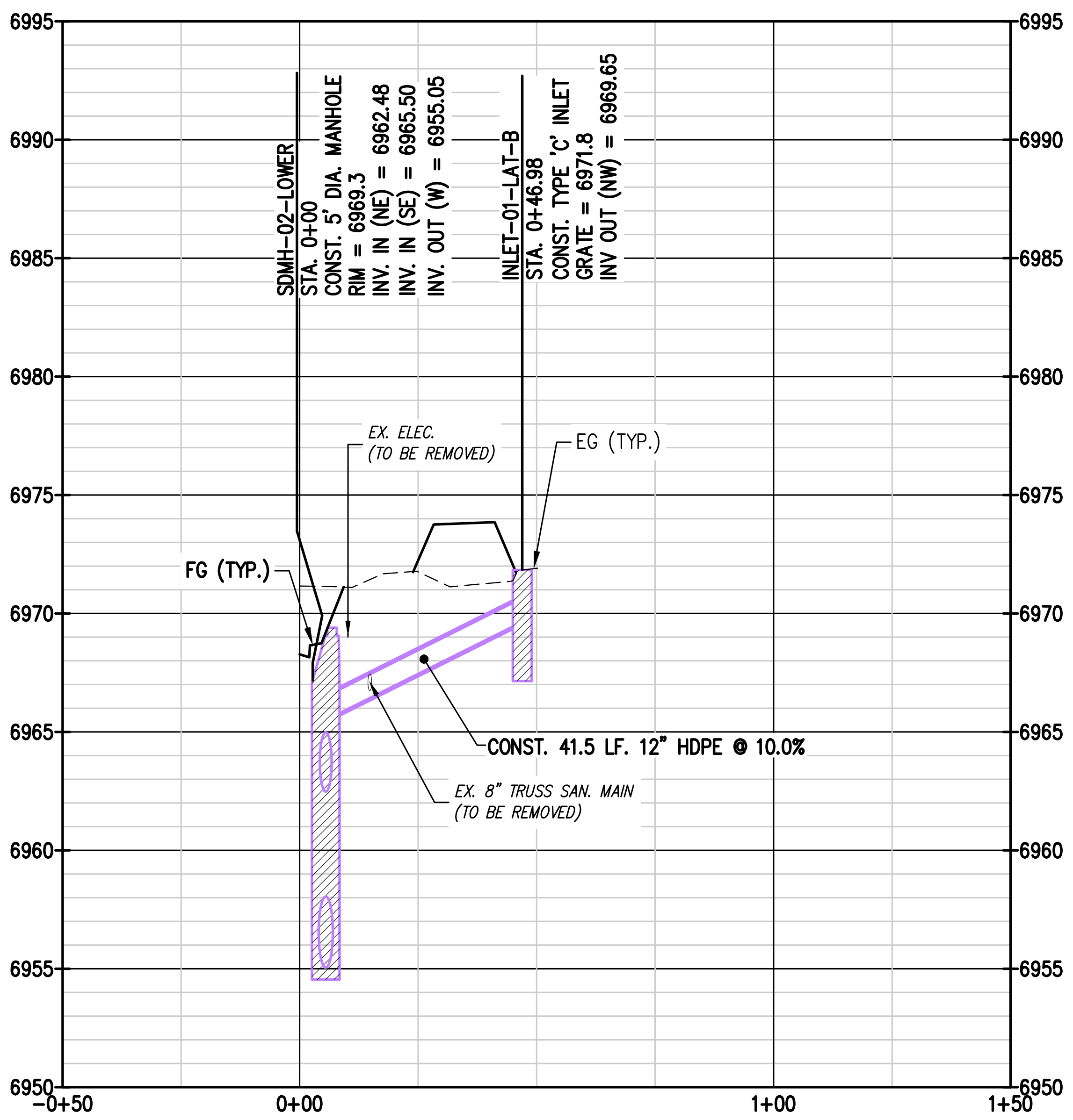
(IN FEET)
HORIZ: 1 INCH = 30 FT
VERT: 1 INCH = 6 FT

1 C33 C33 STORM LATERAL 'A'

AREA INLETS TO BE NYLOPLAST INLET WITH CAST IRON GRATE



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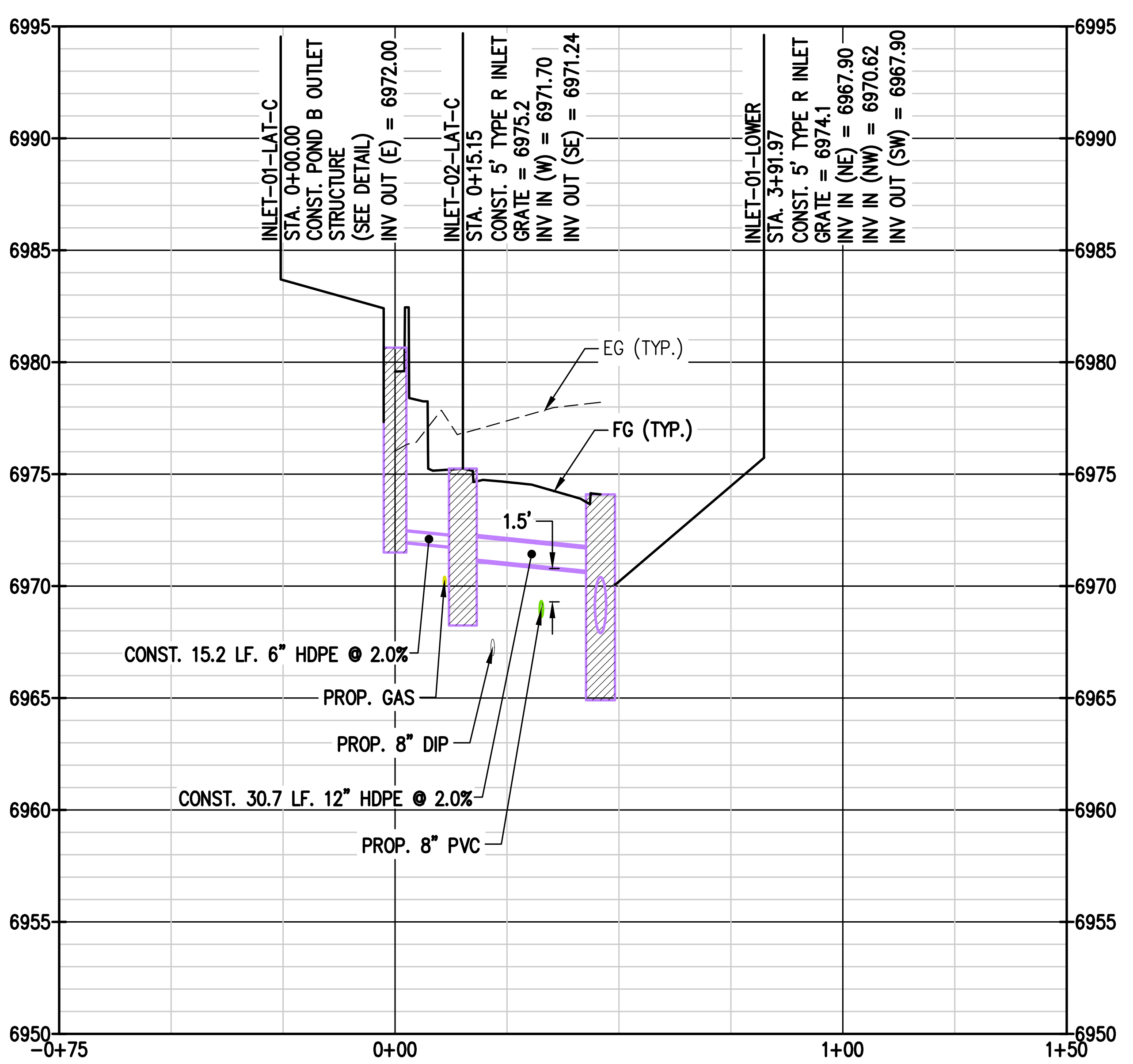
(IN FEET)
HORIZ: 1 INCH = 30 FT
VERT: 1 INCH = 6 FT

2 C33 C33 STORM LATERAL 'B'



GRAPHIC SCALE
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(IN FEET)
HORIZ: 1 INCH = 30 FT
VERT: 1 INCH = 6 FT

3 C33 C33 STORM LATERAL 'C'

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STEAMBOAT ESQUIAR LP

CITY OF STEAMBOAT SPRINGS
ROUTT COUNTY

THE ASTRID
2410 SKI TRAIL LANE
STORM SEWER PLAN & PROFILE – LATERALS A & B & C

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2-29-24
FOR AND ON BEHALF OF BASELINE CORPORATION

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JOB NO.	CO20235
DRAWING NAME	20235 P&P-STORM LATERALS-CD.dwg
SHEET 33 OF 64	

C33

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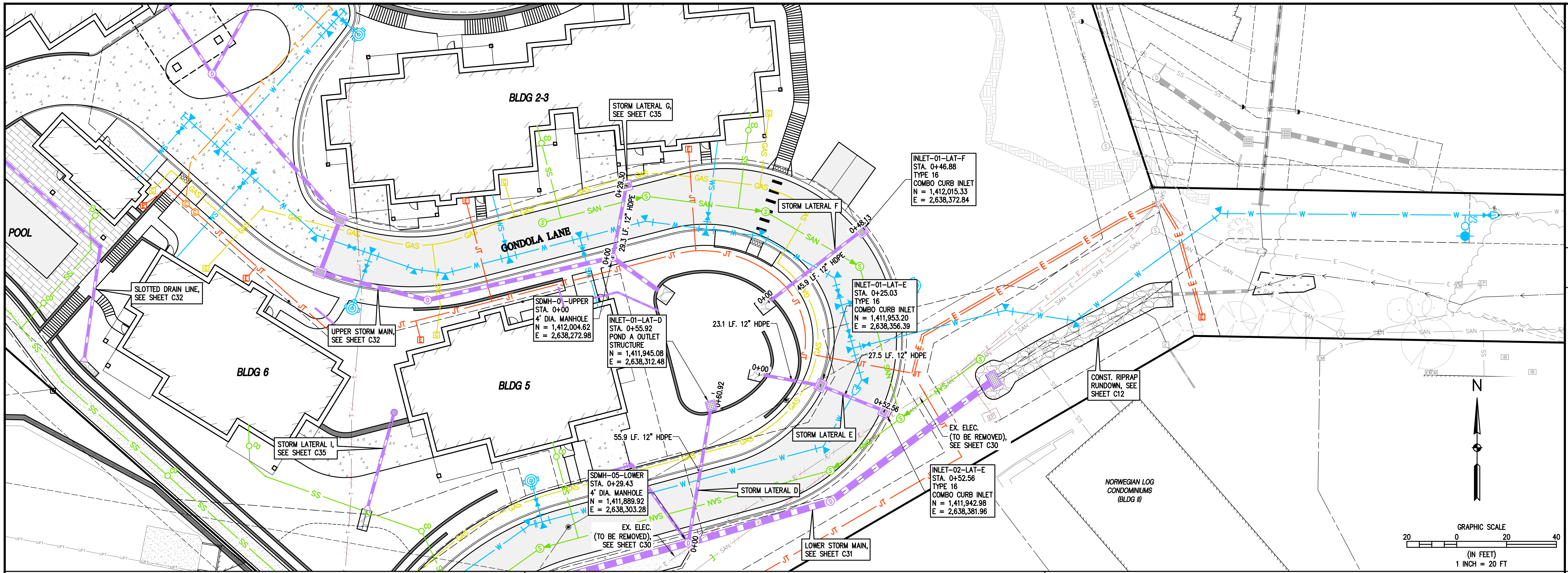

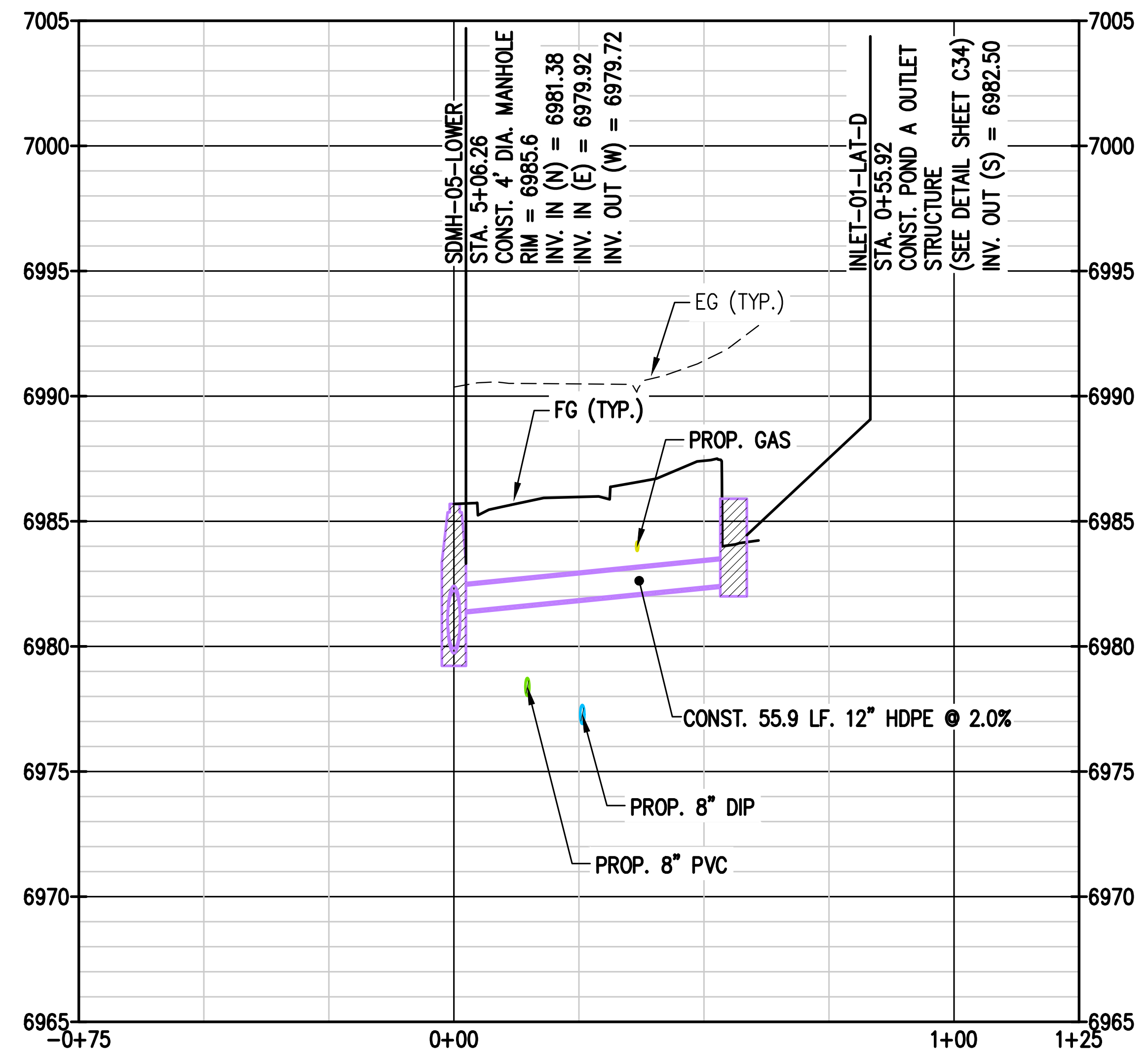

1 C34 | C34 STORM LATERAL 'D'

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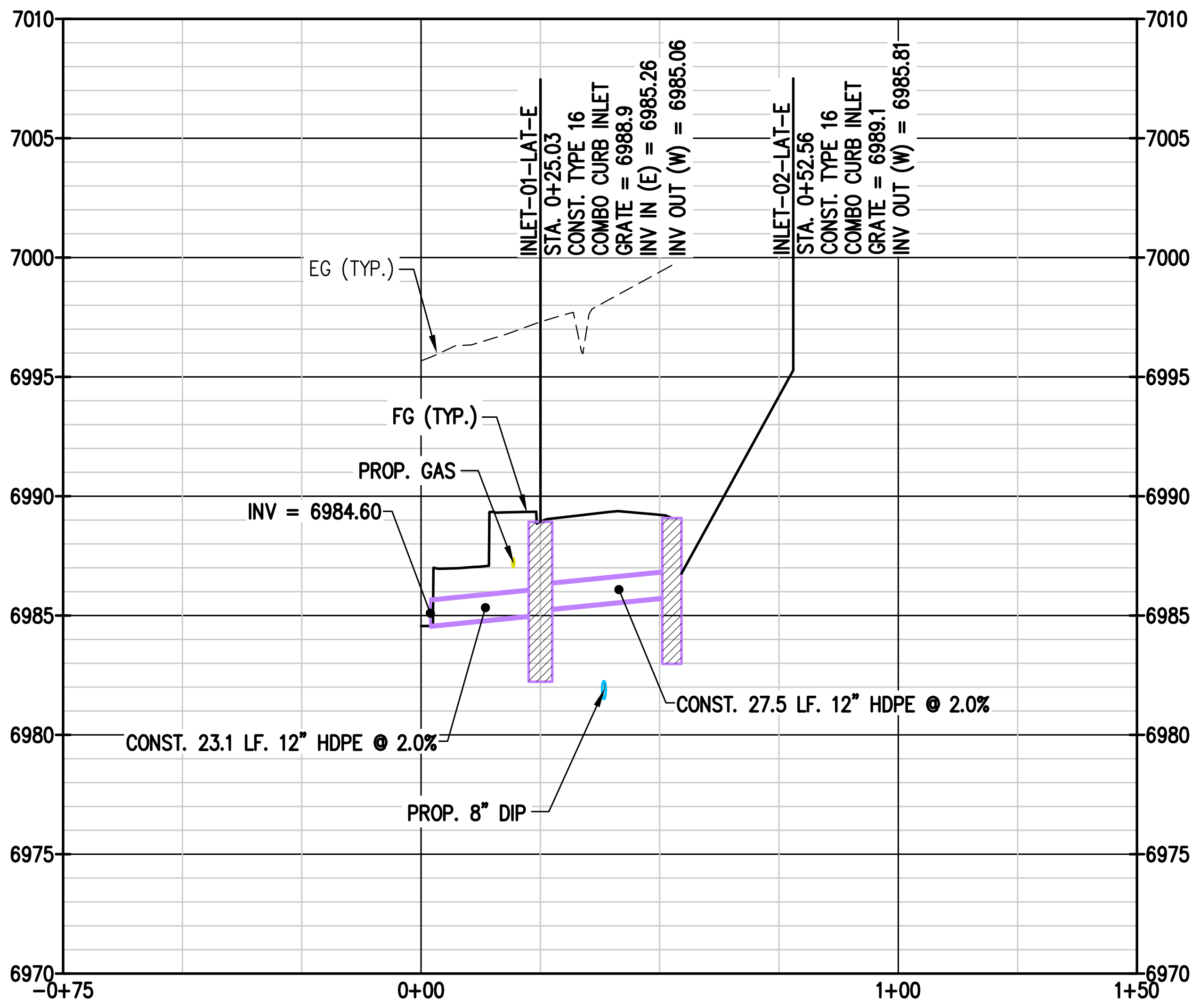
VERT: 1 INCH = 6 FT



2 C34 | C34 STORM LATERAL 'E'

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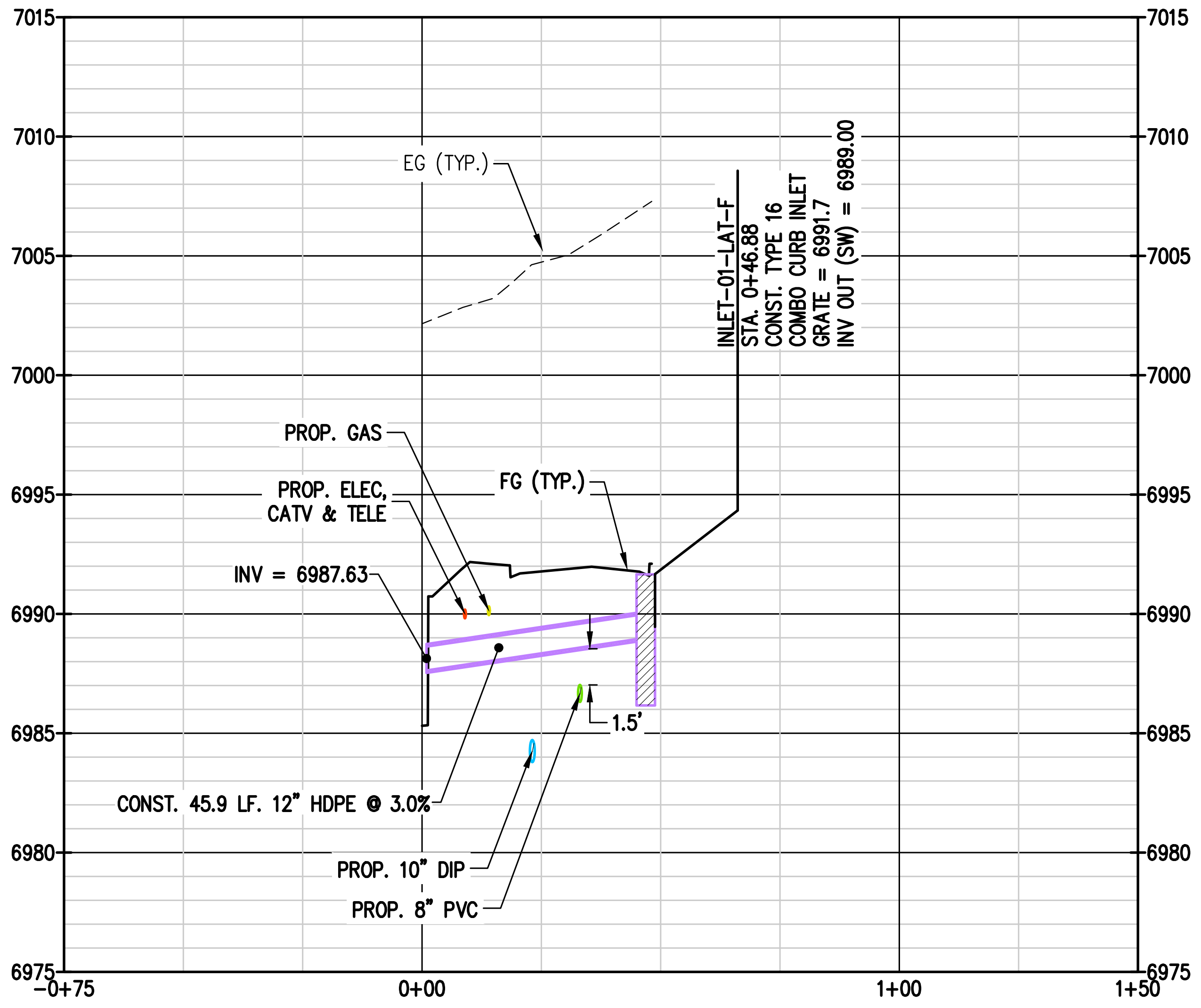

3 C34 | C34 STORM LATERAL 'F'

GRAPHIC SCALE
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(IN FEET)
HORIZ: 1 INCH = 30 FT
VERT: 1 INCH = 6 FT

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STEAMBOAT ESQUIAR LP
CITY OF STEAMBOAT SPRINGS
ROUTT COUNTY
THE ASTRID
2410 SKI TRAIL LANE
STORM SEWER PLAN & PROFILE – LATERALS D & E & F

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SURVEY FIRM LANDMARK, INC
SURVEY DATE 06/03/22
JOB NO. C020235
DRAWING NAME 20235 P&P-STORM LATERALS-CD.dwg
SHEET 34 OF 64
C34

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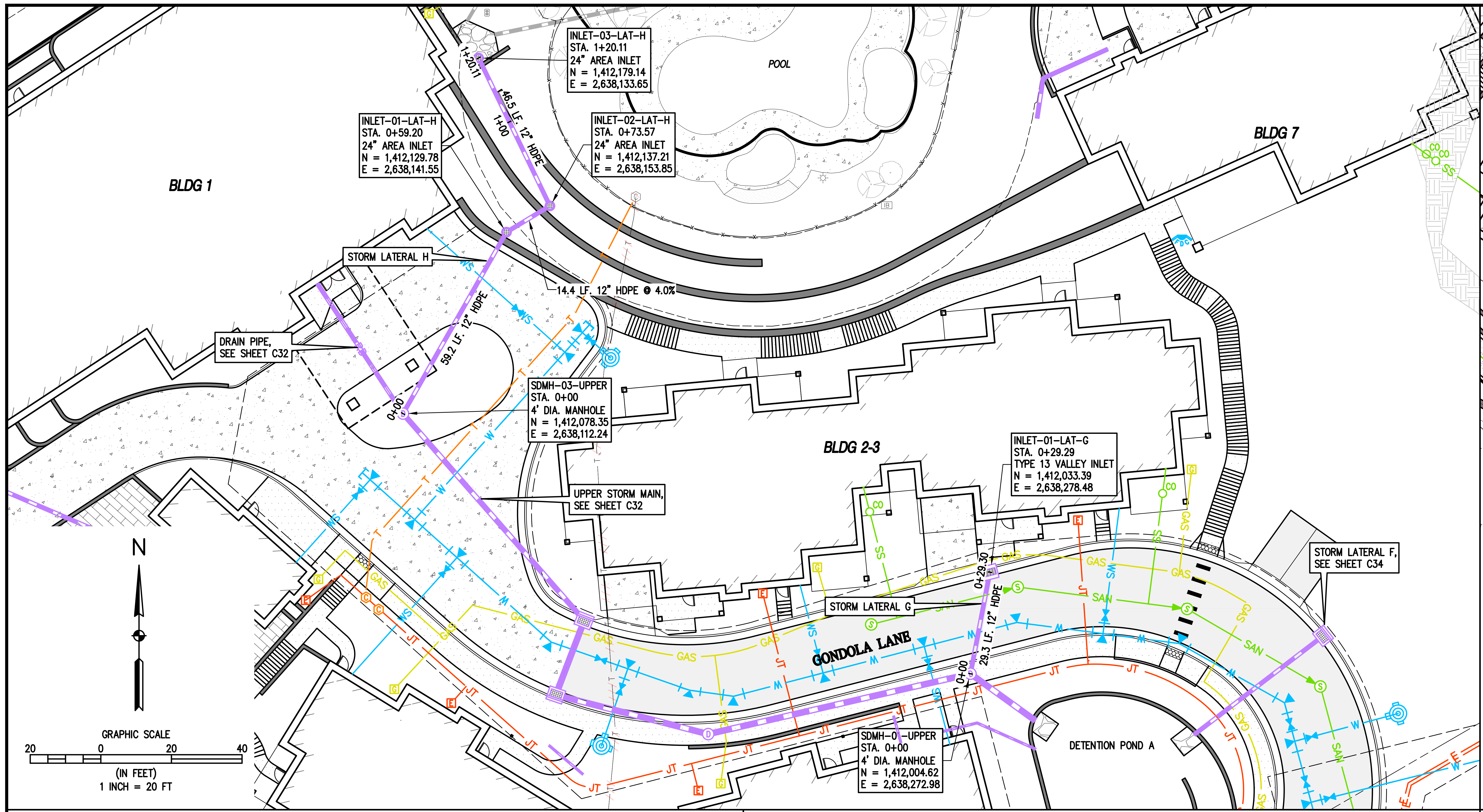
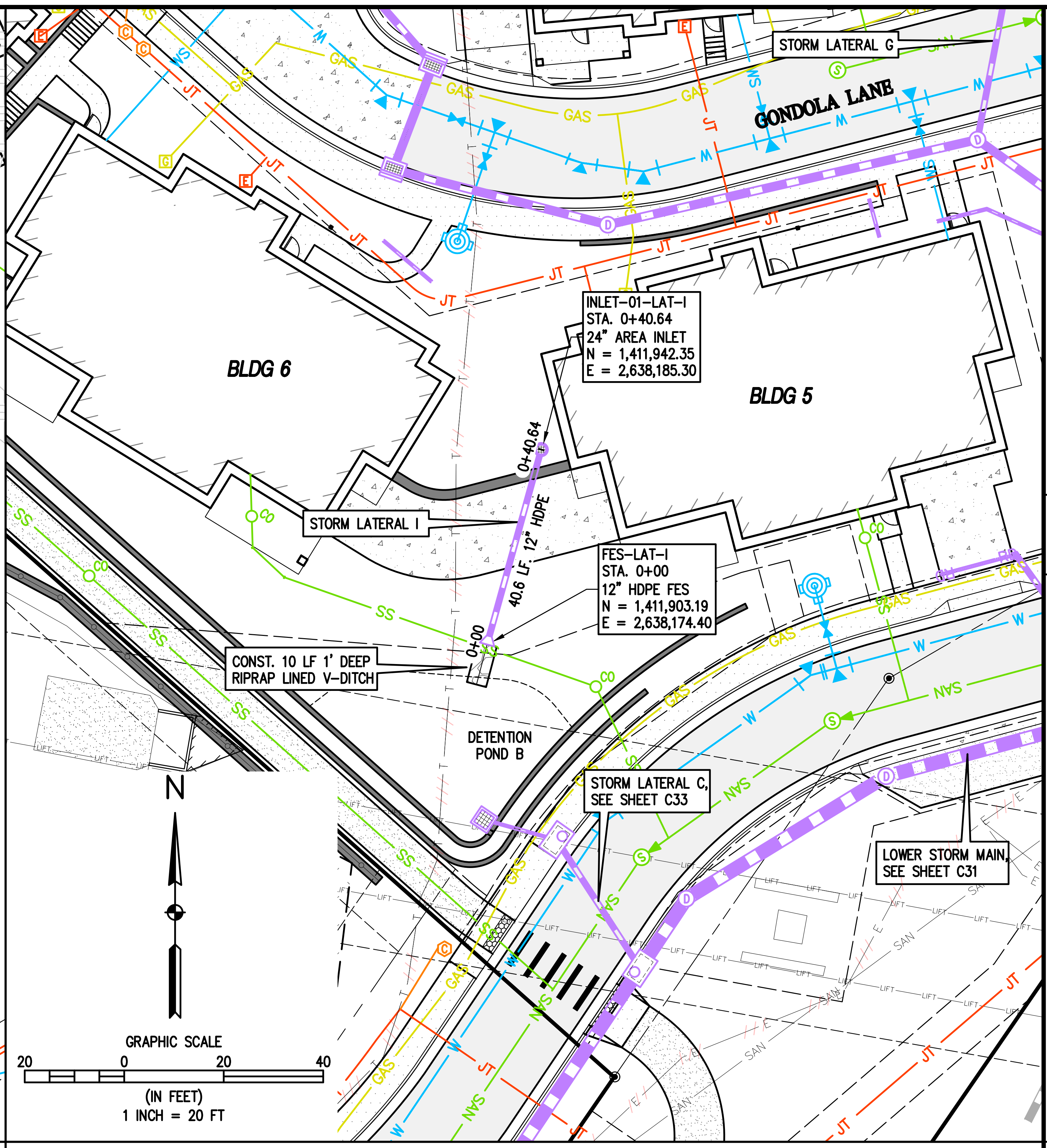
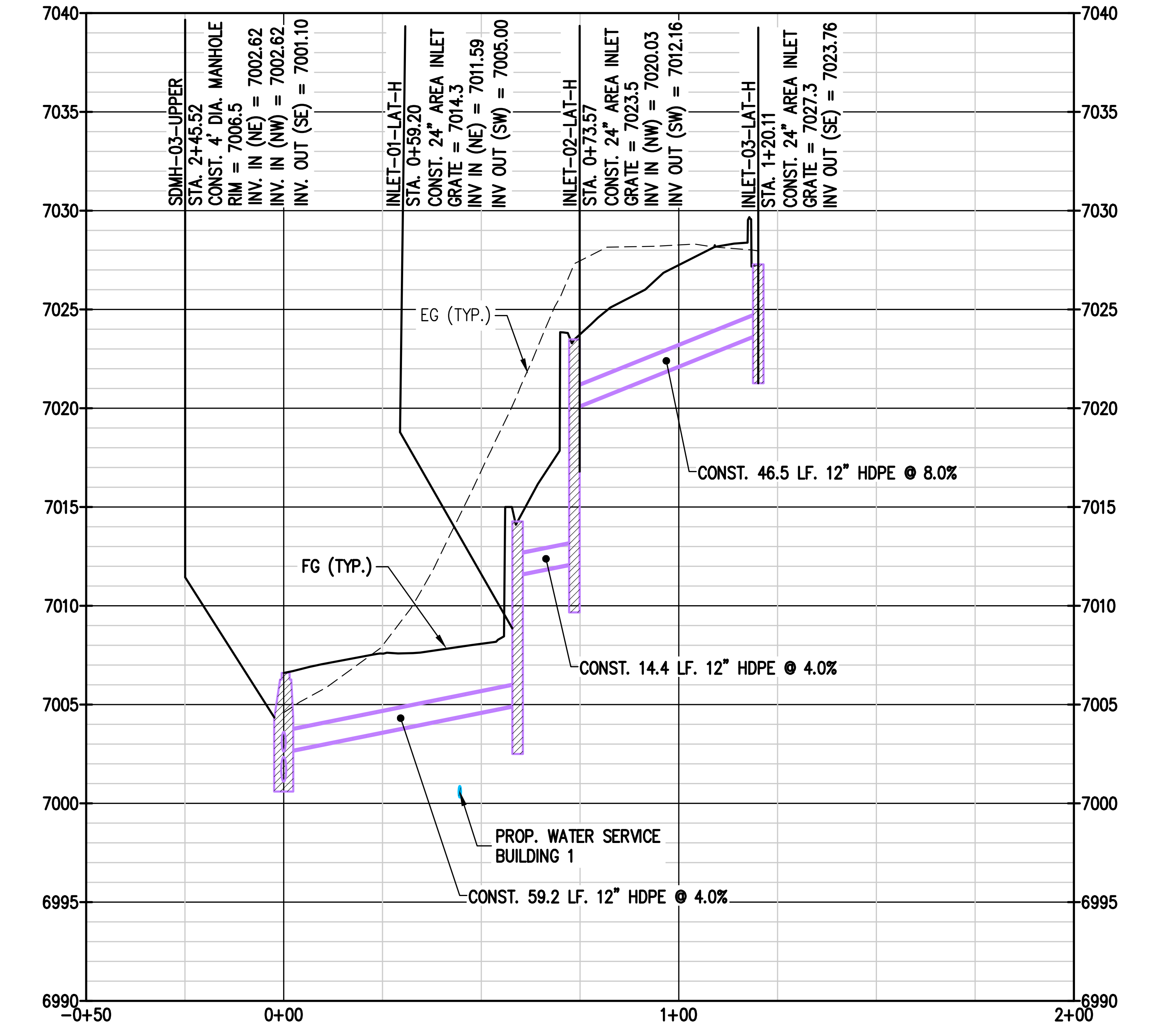




AREA INLETS TO BE NYLOPLAST DRAIN BASIN WITH 2' SUMP AND CAST IRON GRATE



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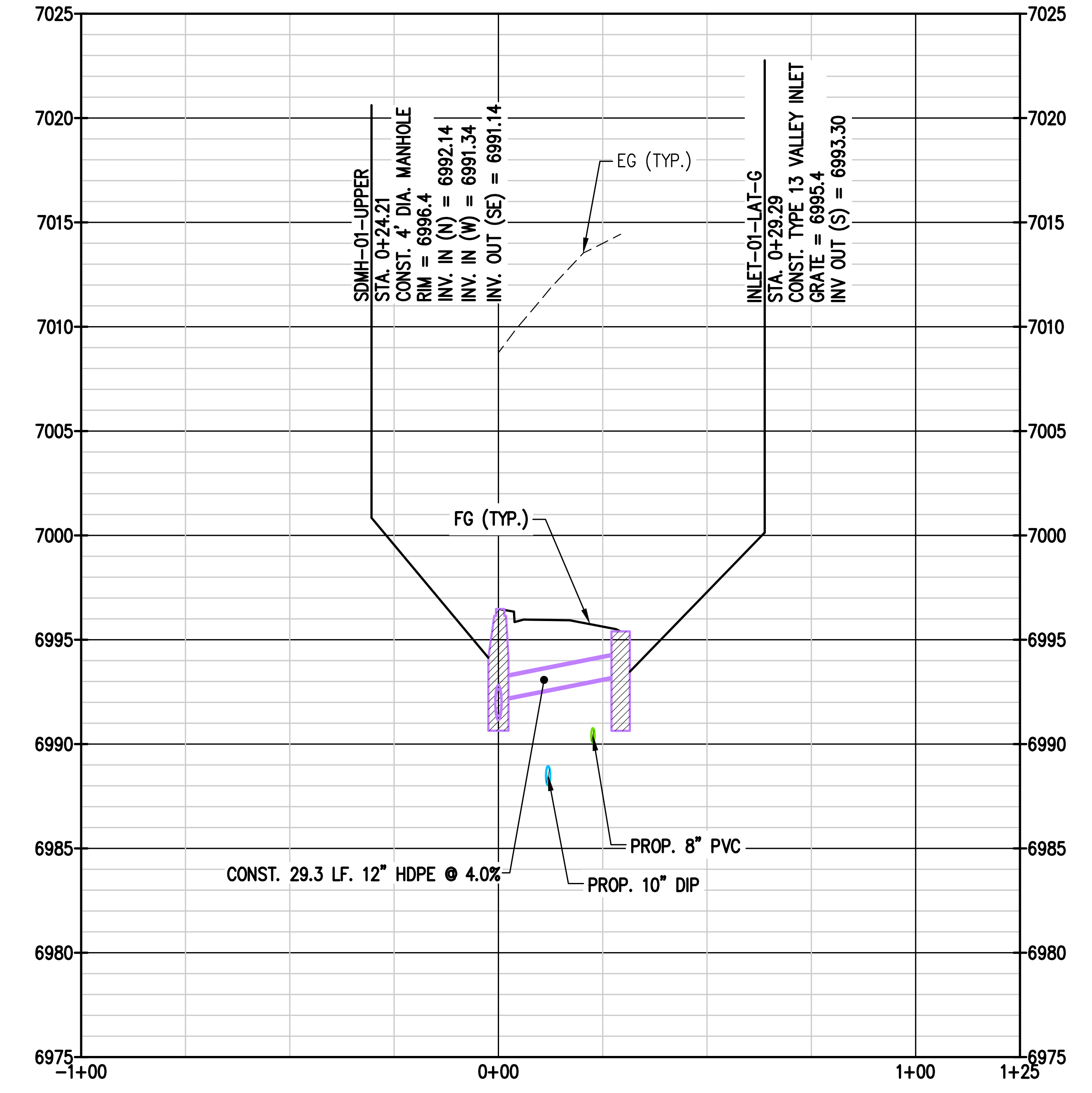
1 C35 C35 STORM LATERAL 'H'



GRAPHIC SCALE
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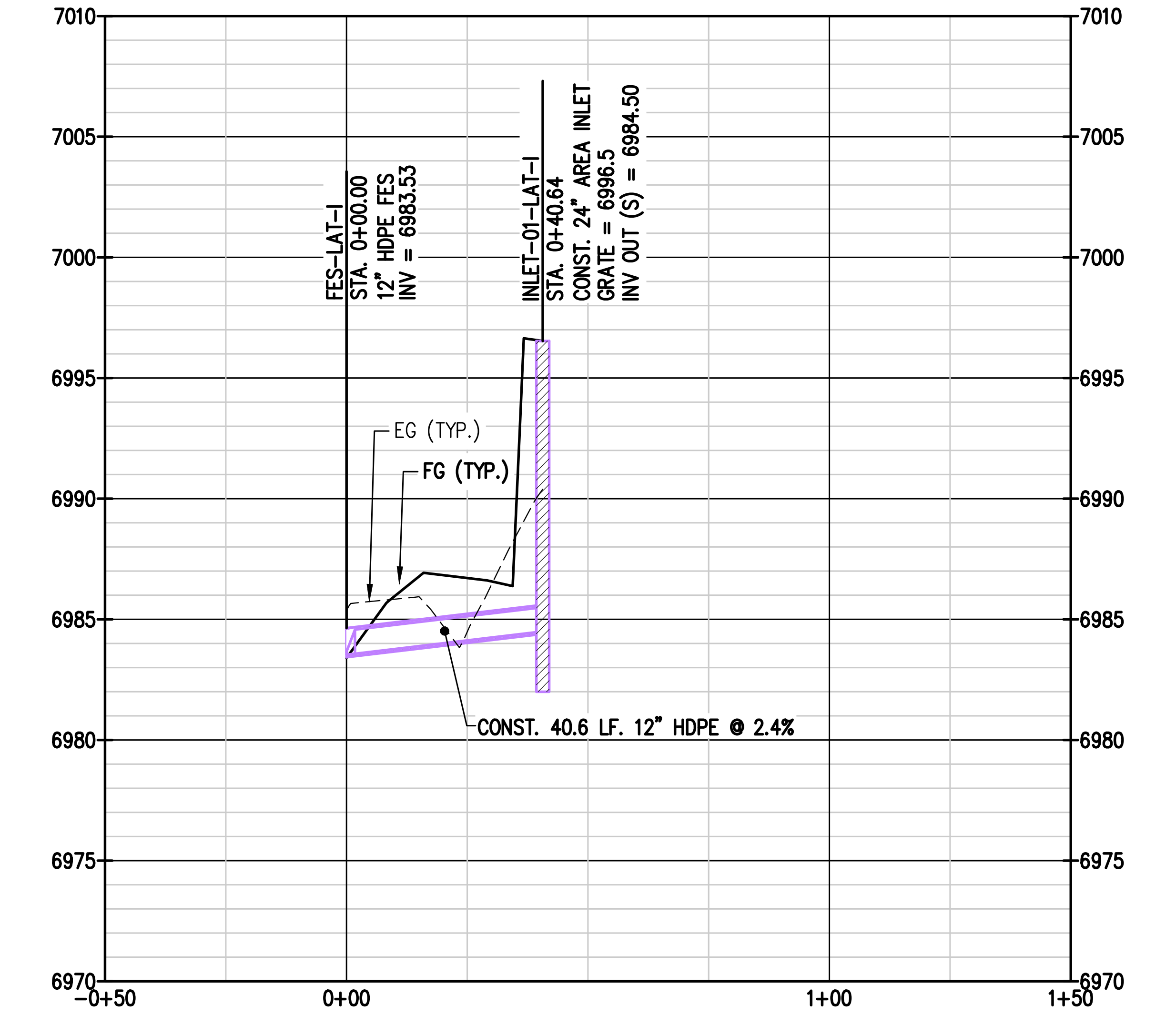
2 C35 C35 STORM LATERAL 'G'

AREA INLETS TO BE NYLOPLAST DRAIN BASIN WITH 2' SUMP AND CAST IRON GRATE



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VERT: 1 INCH = 6 FT

3 C35 C35 STORM LATERAL 'I'

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STEAMBOAT ESQUIAR LP
CITY OF STEAMBOAT SPRINGS
ROUTT COUNTY
THE ASTRID
2410 SKI TRAIL LANE
STORM SEWER PLAN & PROFILE - LATERALS G & H & I

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2-29-24
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INITIAL SUBMITTAL	2/29/2024
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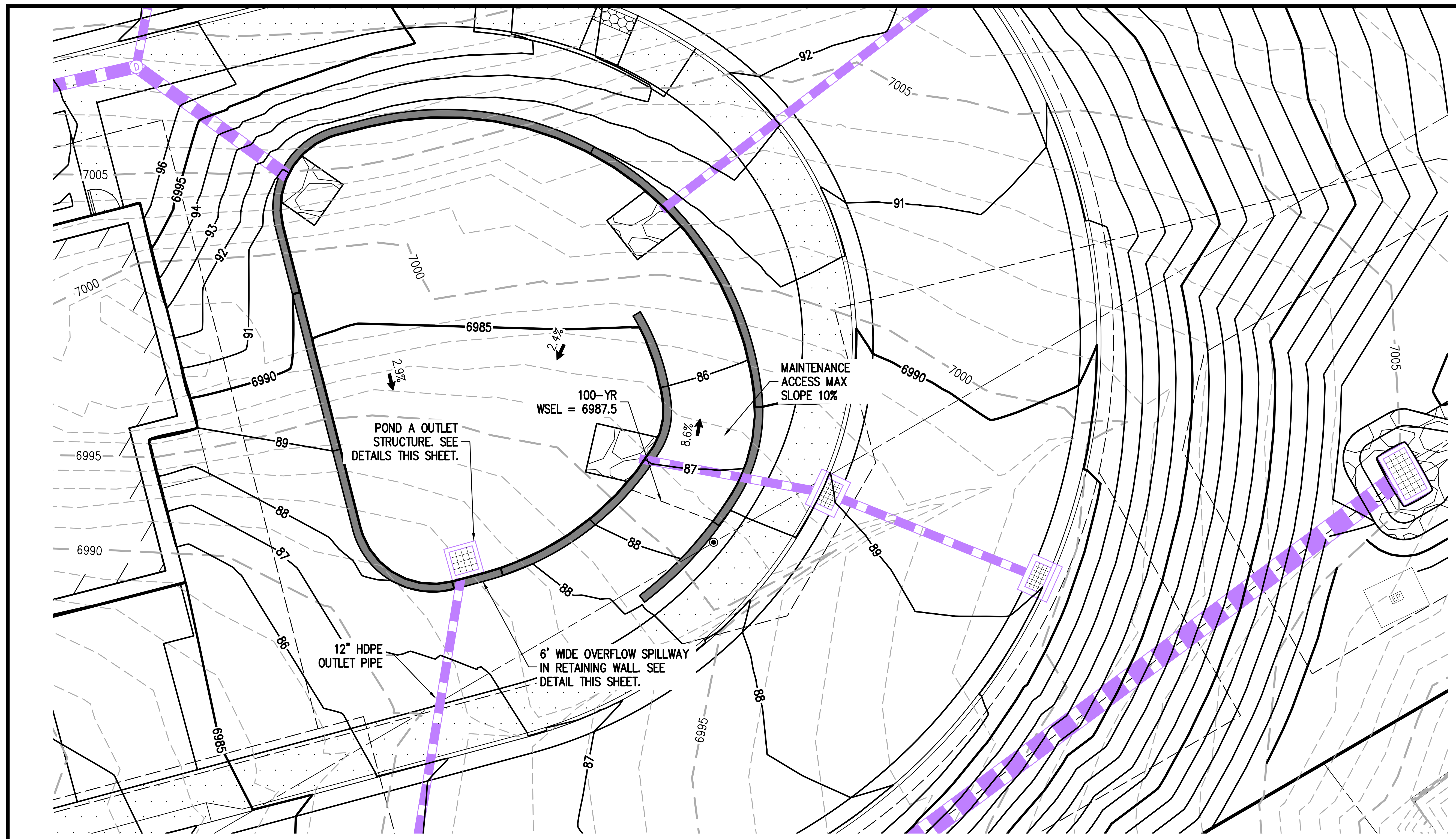
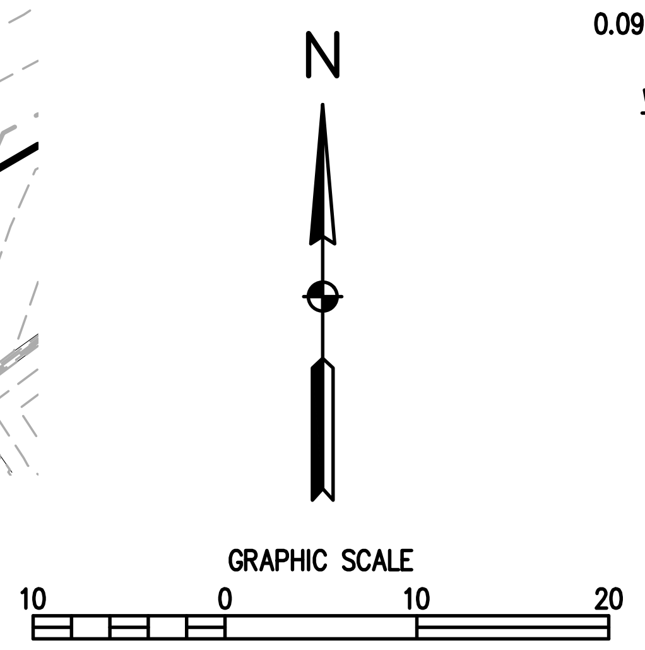
SURVEY FIRM LANDMARK, INC	SURVEY DATE 06/03/22
JOB NO.	C020235
DRAWING NAME	20235 P&P-STORM LATERALS-CD.dwg
SHEET	35 OF 64

C35

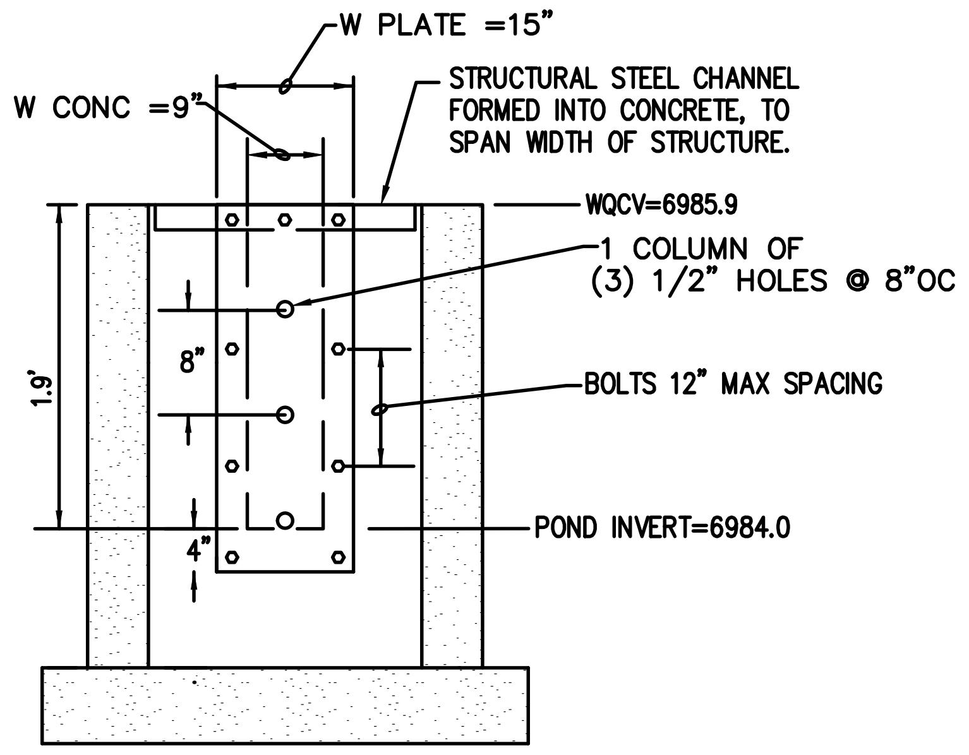


1 C36 C36 POND A EXTENDED DETENTION BASIN PLAN

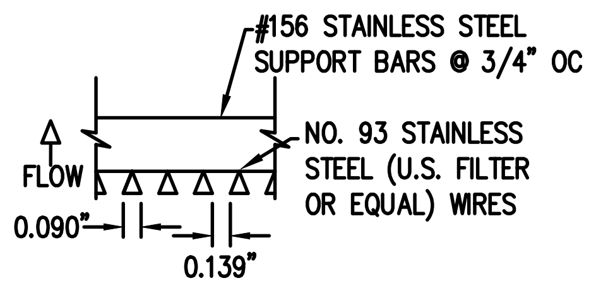


GRAPHIC SCALE
(IN FEET)
1 INCH = 10 FT

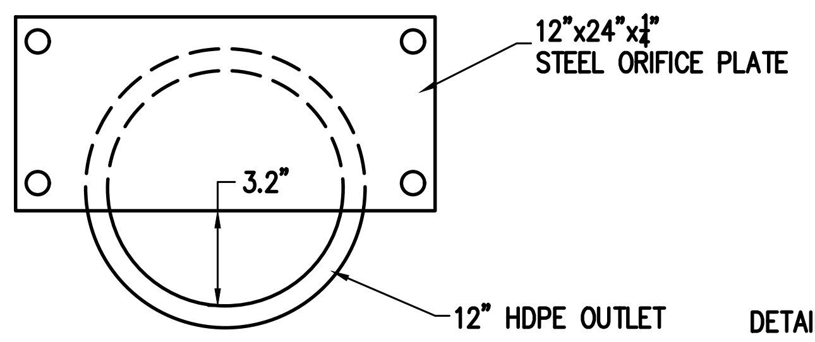
2 C36 C36 EMERGENCY SPILLWAY DETAIL
NOT TO SCALE



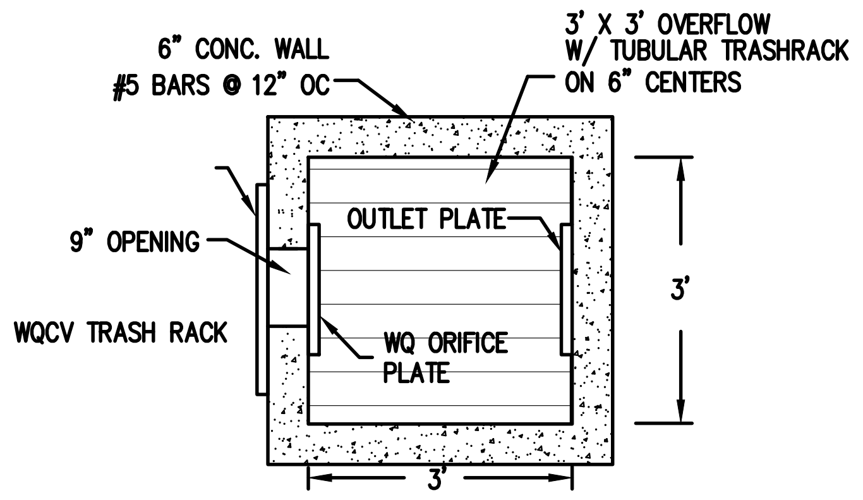
WATER QUALITY ORIFICE



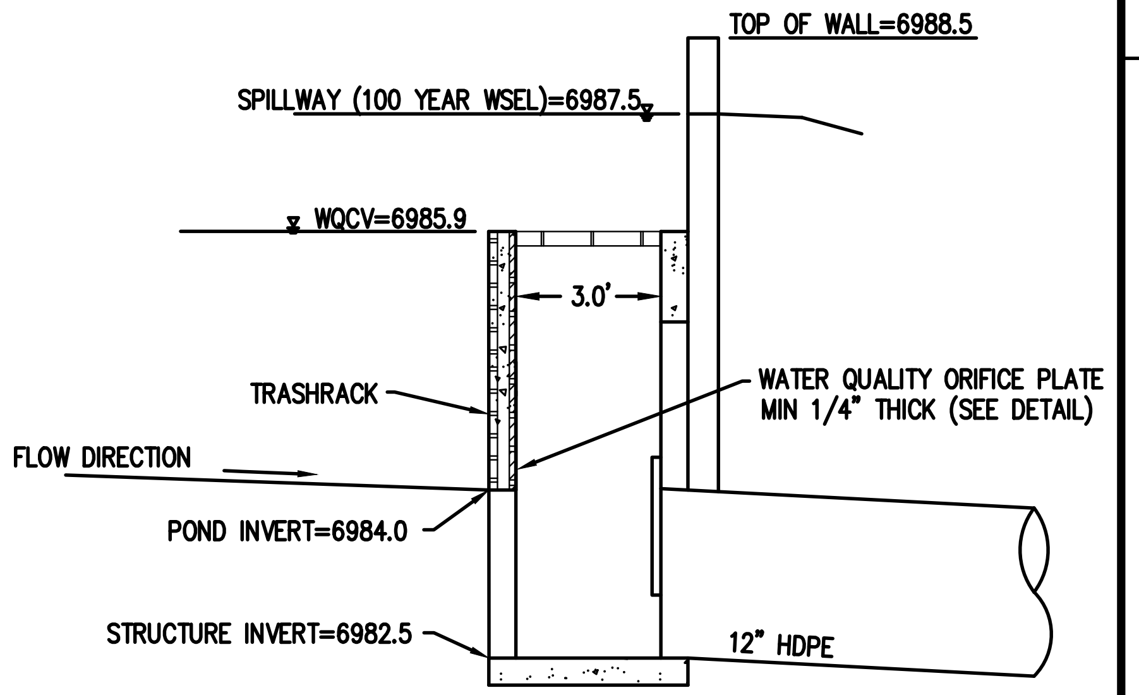
WQCV TRASH RACK DETAIL



3 C36 C36 100-YEAR ORIFICE PLATE
NOT TO SCALE



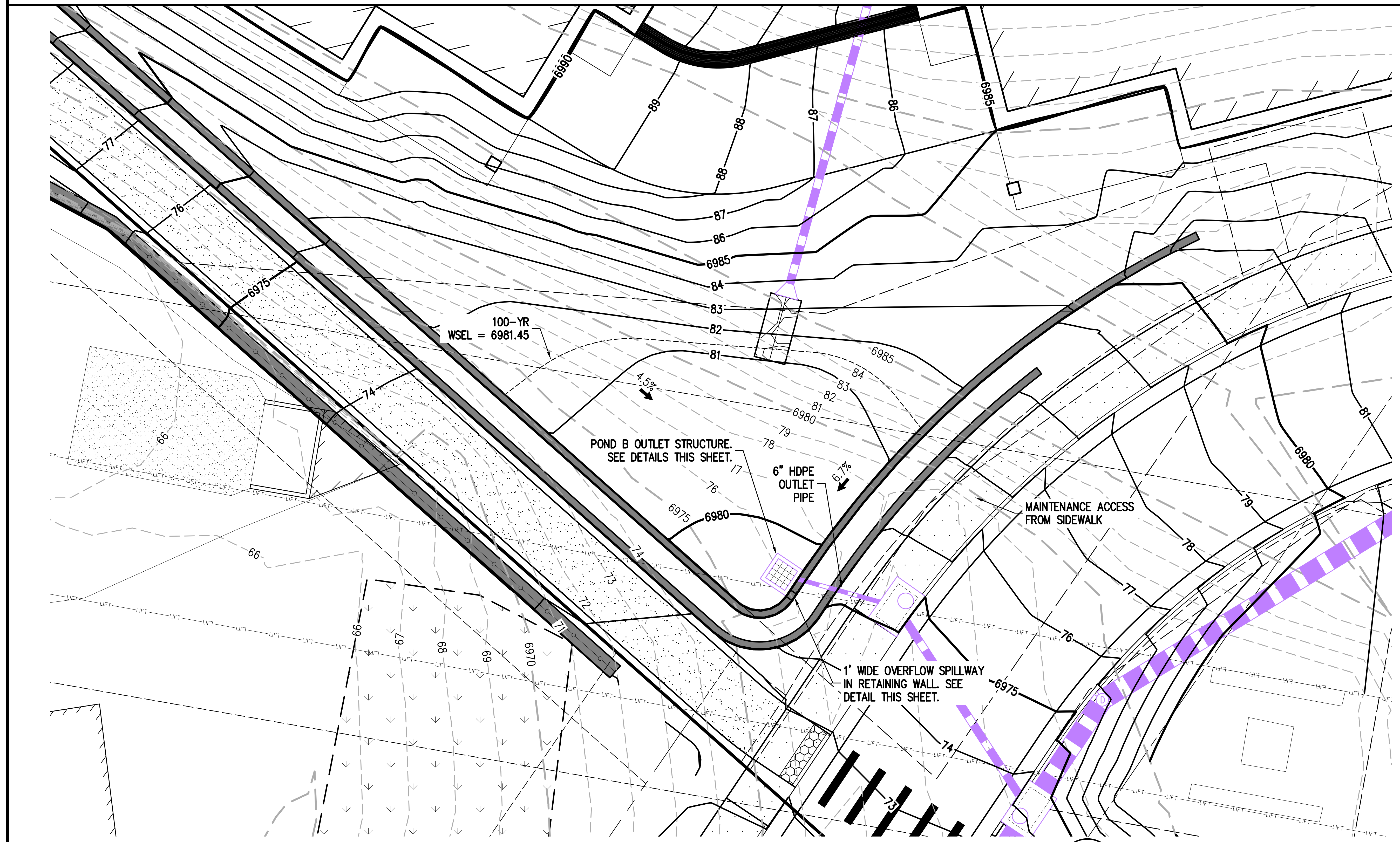
PLAN VIEW



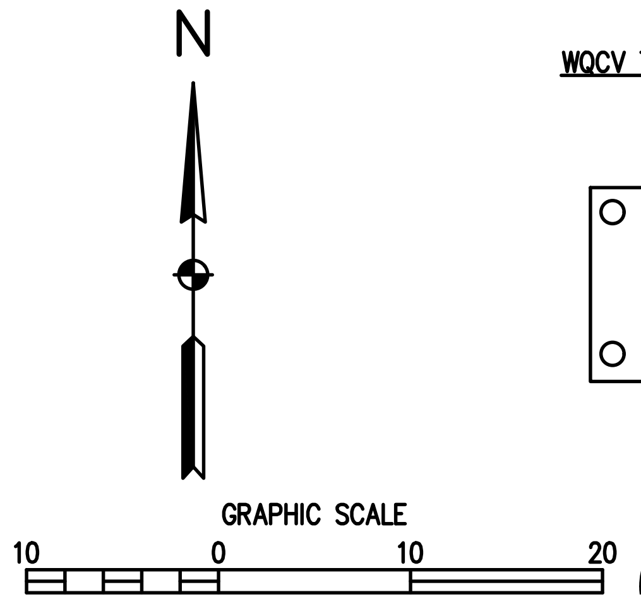
4 C36 C36 WATER QUALITY POND OUTLET STRUCTURE
NOT TO SCALE

DETAIL NOTES:

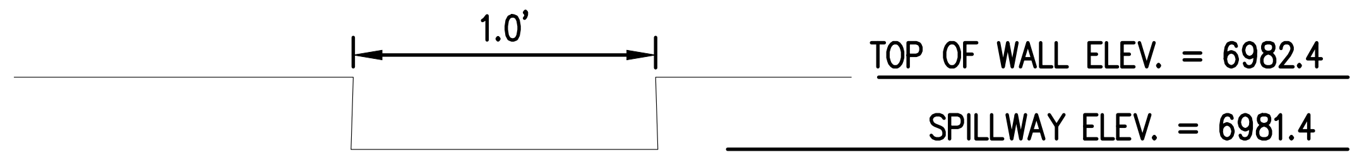
1. OVERFLOW TRASH RACKS SHALL BE MOUNTED USING STAINLESS STEEL HARDWARE AND PROVIDED WITH HINGED AND LOCKABLE OR BOLTABLE ACCESS PANELS.
2. OVERFLOW TRASH RACKS SHALL BE STAINLESS STEEL, ALUMINUM, OR STEEL. STEEL TRASH RACKS SHALL BE DIP GALVANIZED AND MY BE HOT POWDER COATED AFTER GALVANIZING.
3. WATER QUALITY CAPTURE VOLUME WELL-SCREEN TRASH RACKS SHALL BE STAINLESS STEEL AND SHALL BE ATTACHED BY INTERMITTENT WELDS ALONG THE EDGE OF THE MOUNTING FRAME.



5 C36 C36 POND B EXTENDED DETENTION BASIN PLAN



GRAPHIC SCALE
(IN FEET)
1 INCH = 10 FT



6 C36 C36 EMERGENCY SPILLWAY DETAIL
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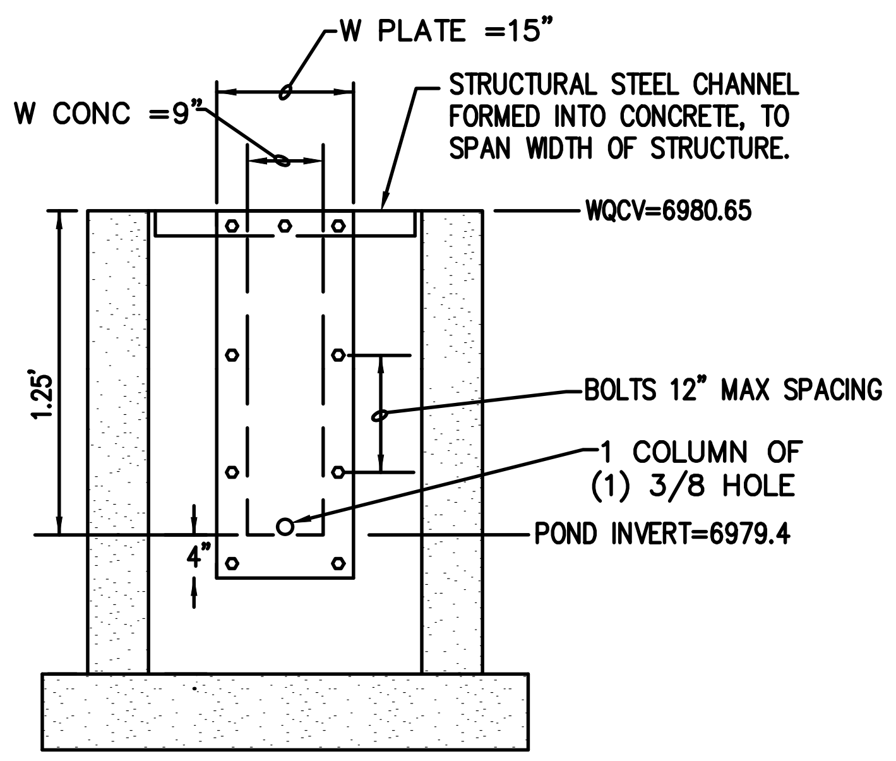
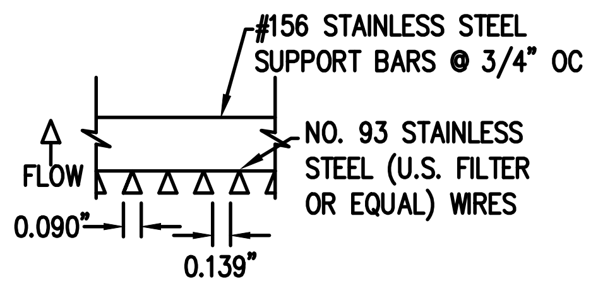
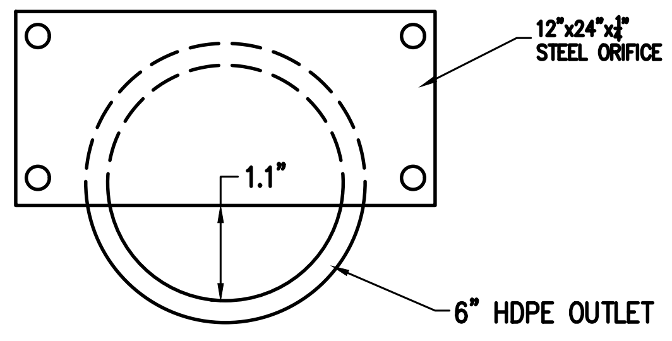


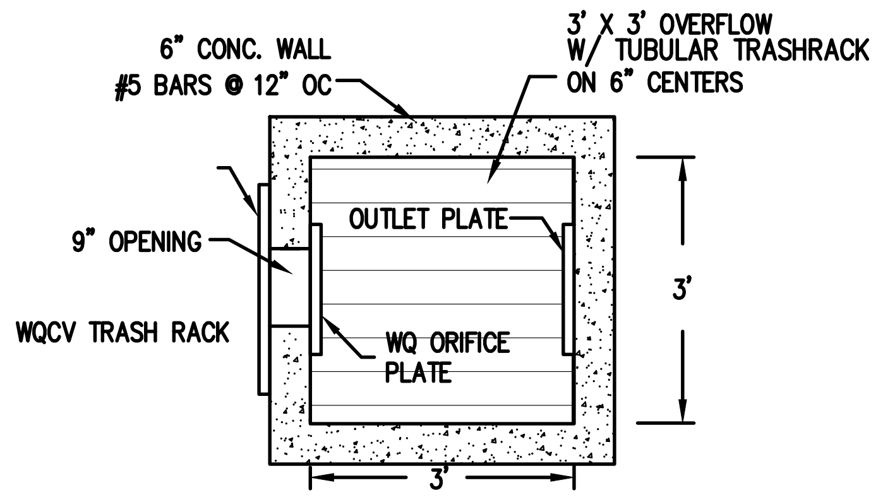
WATER QUALITY ORIFICE



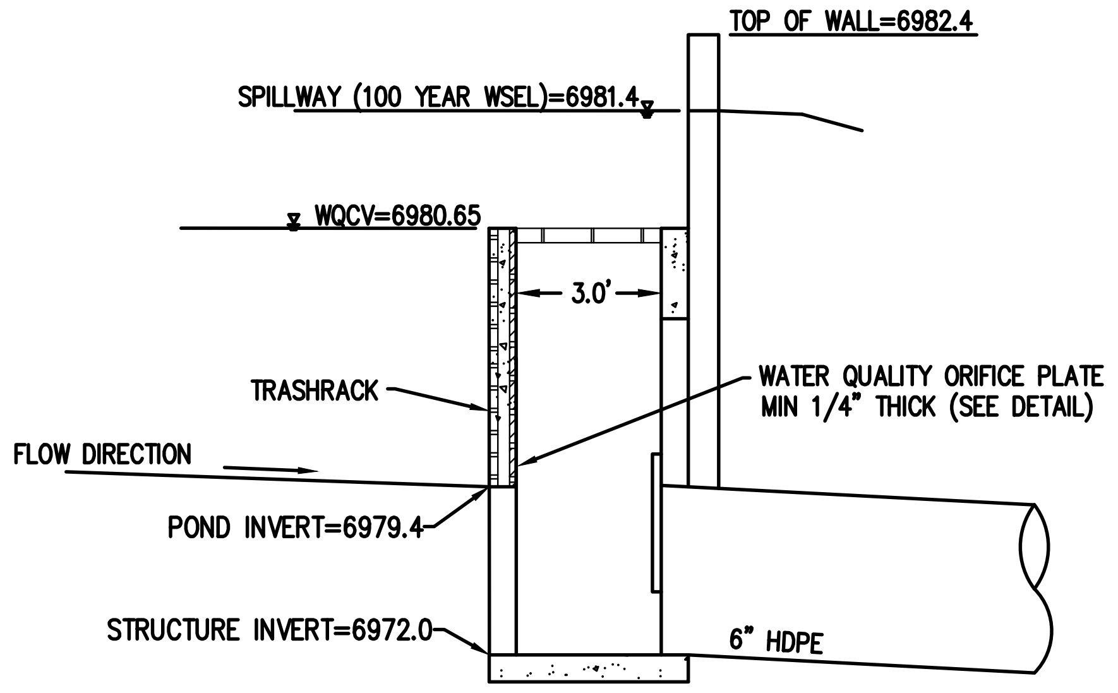
WQCV TRASH RACK DETAIL



7 C36 C36 100-YEAR ORIFICE PLATE
NOT TO SCALE



PLAN VIEW



8 C36 C36 WATER QUALITY POND OUTLET STRUCTURE
NOT TO SCALE

DETAIL NOTES:

1. OVERFLOW TRASH RACKS SHALL BE MOUNTED USING STAINLESS STEEL HARDWARE AND PROVIDED WITH HINGED AND LOCKABLE OR BOLTABLE ACCESS PANELS.
2. OVERFLOW TRASH RACKS SHALL BE STAINLESS STEEL, ALUMINUM, OR STEEL. STEEL TRASH RACKS SHALL BE DIP GALVANIZED AND MY BE HOT POWDER COATED AFTER GALVANIZING.
3. WATER QUALITY CAPTURE VOLUME WELL-SCREEN TRASH RACKS SHALL BE STAINLESS STEEL AND SHALL BE ATTACHED BY INTERMITTENT WELDS ALONG THE EDGE OF THE MOUNTING FRAME.

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CHECKED BY MRB

REVISION DESCRIPTION	PREPARED BY	DATE
INITIAL SUBMITTAL FOR CITY REVIEW	SMB	2/29/24

STEAMBOAT ESQUIAR LP

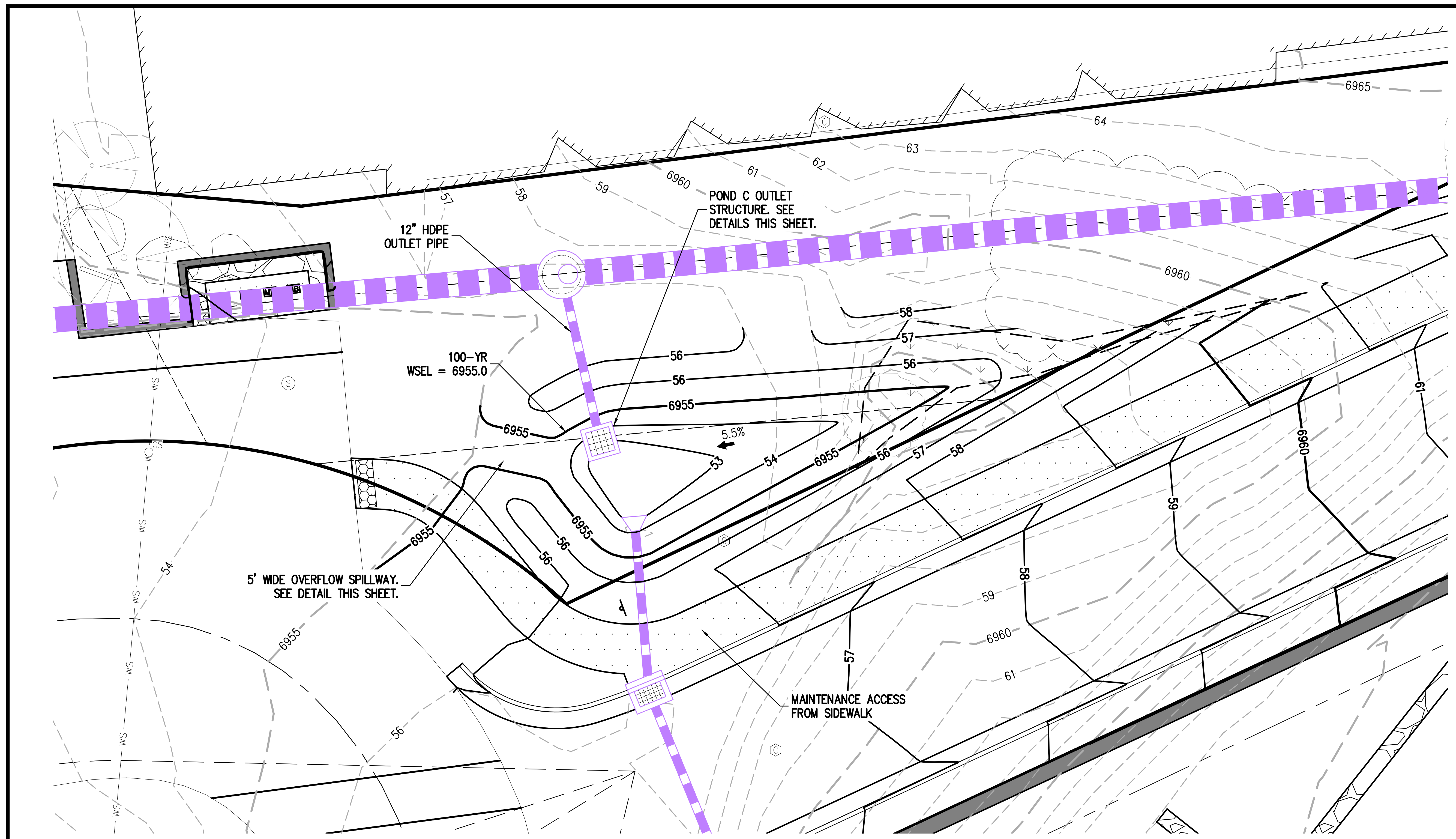
CITY OF STEAMBOAT SPRINGS
ROUTT COUNTY

THE ASTRID
2410 SKI TRAIL LANE
STORMWATER POND & OUTLET DETAILS PONDS A & B

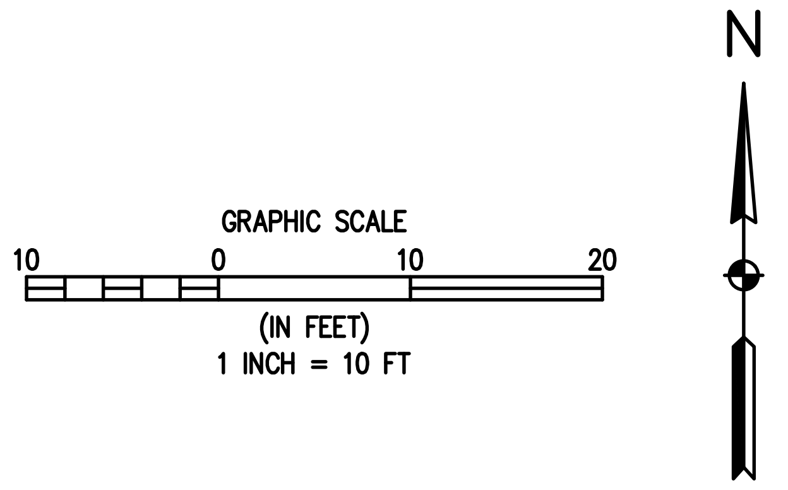
PREPARED UNDER THE DIRECT SUPERVISION OF
FOR REVIEW NOT FOR CONSTRUCTION
2-29-24
FOR AND ON BEHALF OF BASELINE CORPORATION

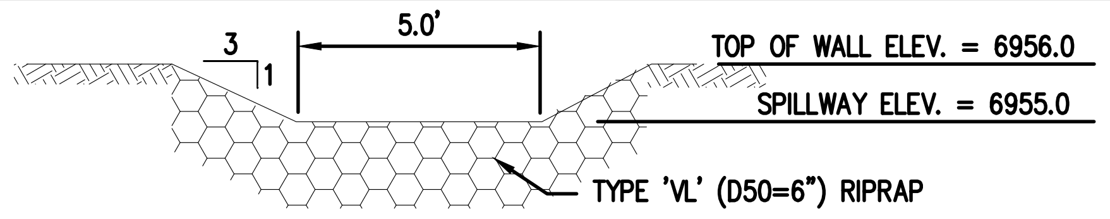
INITIAL SUBMITTAL	2/29/2024
DRAWING SIZE	24" X 36"
SURVEY FIRM LANDMARK, INC	SURVEY DATE 06/03/22
JOB NO.	C020235
DRAWING NAME 20235 Pond & Outlets details.dwg	
SHEET 36 OF 64	

C36



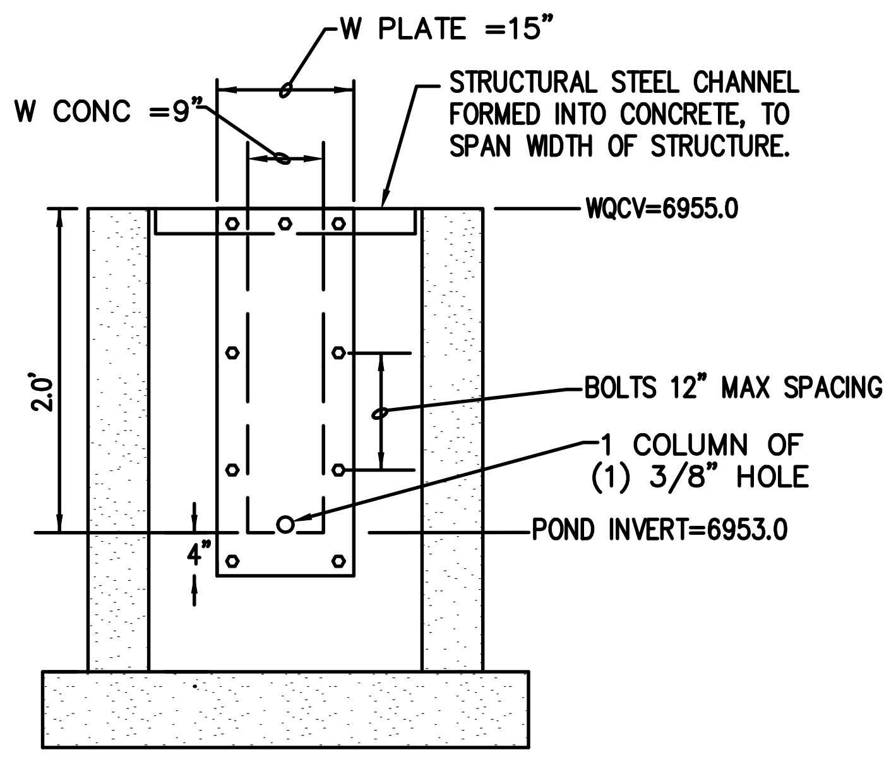
1 POND C EXTENDED DETENTION BASIN PLAN
C37 | C37



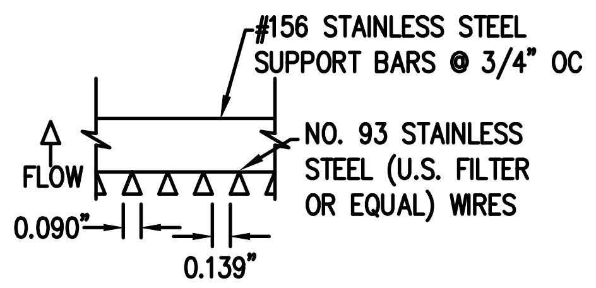


2 EMERGENCY SPILLWAY DETAIL
C37 | C37

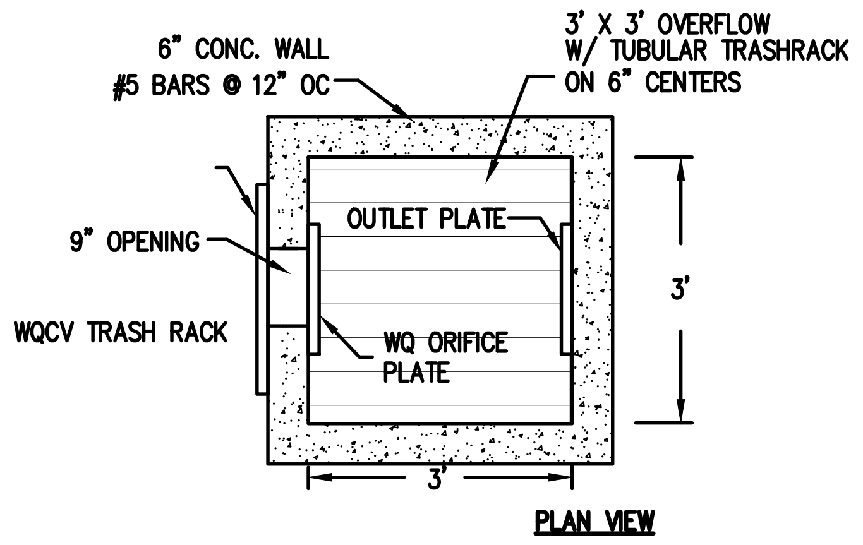
NOT TO SCALE



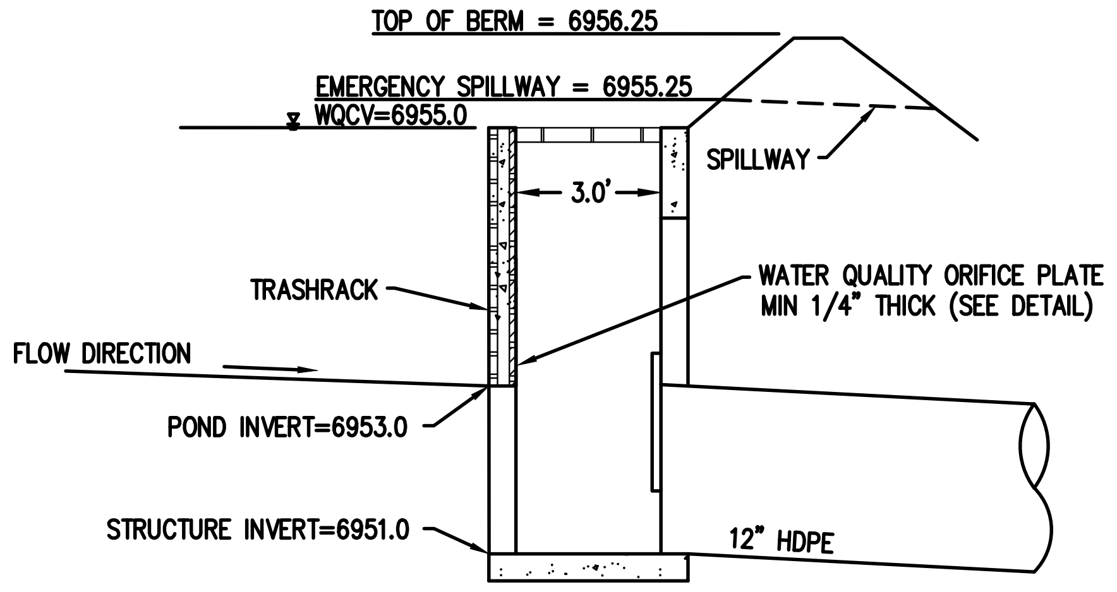
WATER QUALITY ORIFICE



WQCV TRASH RACK DETAIL



PLAN VIEW



3 WATER QUALITY POND OUTLET STRUCTURE
C37 | C37

NOT TO SCALE

DETAIL NOTES:
1. OVERFLOW TRASH RACKS SHALL BE MOUNTED USING STAINLESS STEEL HARDWARE AND PROVIDED WITH HINGED AND LOCKABLE OR BOLTABLE ACCESS PANELS.
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3. WATER QUALITY CAPTURE VOLUME WELL-SCREEN TRASH RACKS SHALL BE STAINLESS STEEL AND SHALL BE ATTACHED BY INTERMITTENT WELDS ALONG THE EDGE OF THE MOUNTING FRAME.

O:\CO20235 Astrid-Edgemont Ph2\Drawings\Construction Documents\20235 Pond & Outlets details.dwg, 2/29/2024 7:08:08 PM, Steve Batchelder

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CHECKED BY MRB

REVISION DESCRIPTION	PREPARED BY	DATE
INITIAL SUBMITTAL FOR CITY REVIEW	SMB	2/29/24

STEAMBOAT ESQUIAR LP

CITY OF STEAMBOAT SPRINGS
ROUTT COUNTY

THE ASTRID
2410 SKI TRAIL LANE
STORMWATER POND & OUTLET DETAILS POND C

PREPARED UNDER THE DIRECT SUPERVISION OF

NOT FOR CONSTRUCTION
2-29-24

FOR AND ON BEHALF OF BASELINE CORPORATION

INITIAL SUBMITTAL 2/29/2024
DRAWING SIZE 24" X 36"
SURVEY FIRM LANDMARK, INC
SURVEY DATE 06/03/22
JOB NO. CO20235
DRAWING NAME 20235 Pond & Outlets details.dwg
SHEET 37 OF 64
C37

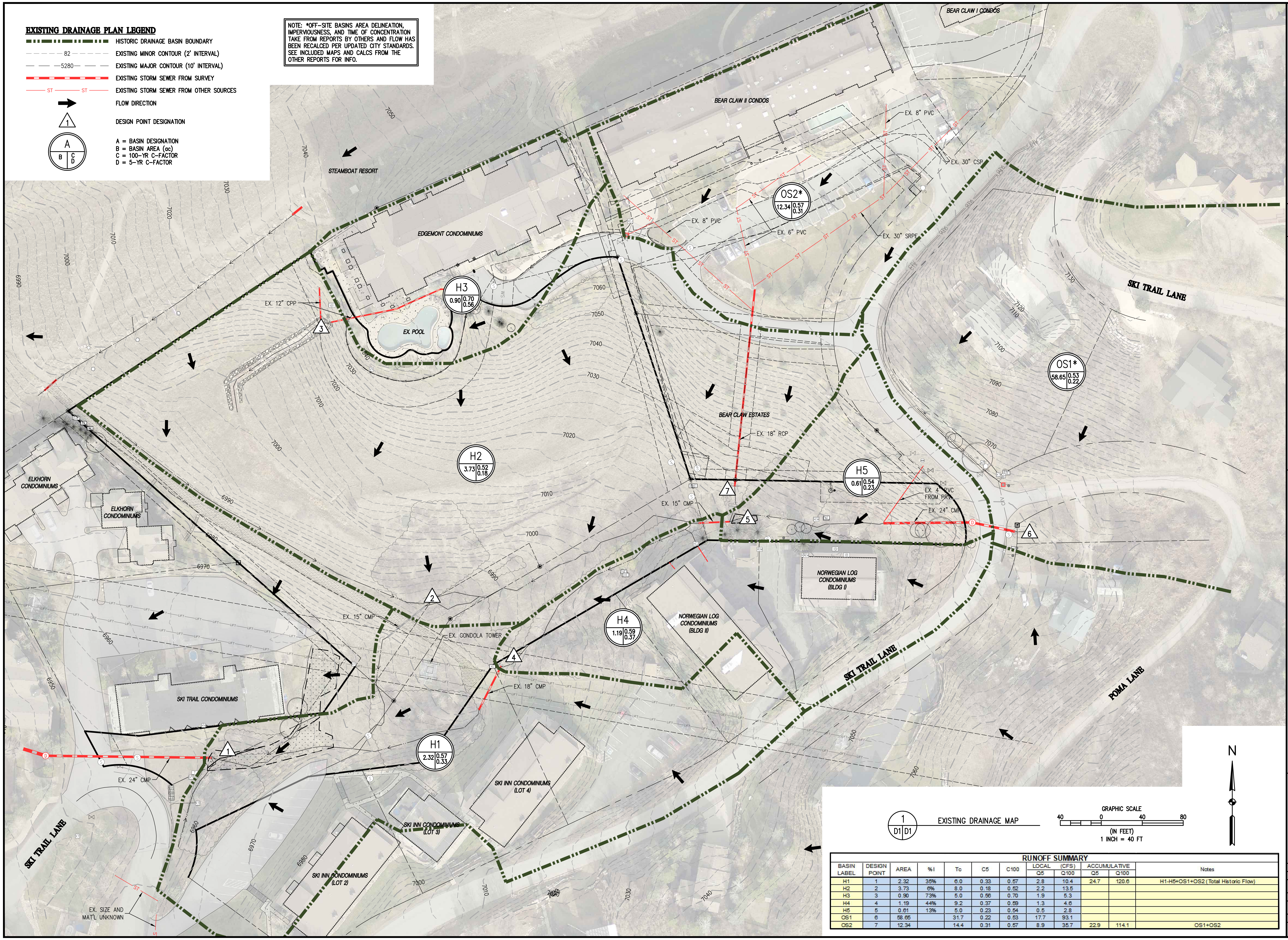
ATTACHMENT 5

EXISTING AND PROPOSED DRAINAGE MAPS

EXISTING DRAINAGE PLAN LEGEND

▬ ▪ ▪ ▬	HISTORIC DRAINAGE BASIN BOUNDARY
— — 82 — —	EXISTING MINOR CONTOUR (2' INTERVAL)
— —5280— —	EXISTING MAJOR CONTOUR (10' INTERVAL)
🟥	EXISTING STORM SEWER FROM SURVEY
— ST — ST —	EXISTING STORM SEWER FROM OTHER SOURCES
→	FLOW DIRECTION
△1	DESIGN POINT DESIGNATION
A / B | C D	A = BASIN DESIGNATION B = BASIN AREA (ac) C = 100-YR C-FACTOR D = 5-YR C-FACTOR

NOTE: *OFF-SITE BASINS AREA DELINEATION, IMPERVIOUSNESS, AND TIME OF CONCENTRATION TAKE FROM REPORTS BY OTHERS AND FLOW HAS BEEN RECALCED PER UPDATED CITY STANDARDS. SEE INCLUDED MAPS AND CALCS FROM THE OTHER REPORTS FOR INFO.



1 D1 D1 EXISTING DRAINAGE MAP

GRAPHIC SCALE
40 0 40 80
(IN FEET)
1 INCH = 40 FT

RUNOFF SUMMARY

BASIN LABEL	DESIGN POINT	AREA	%I	Tc	C5	C100	LOCAL (CFS) Q5	LOCAL (CFS) Q100	ACCUMULATIVE Q5	ACCUMULATIVE Q100	Notes
H1	1	2.32	35%	6.0	0.33	0.57	2.8	10.4	24.7	120.6	H1-H5+OS1+OS2 (Total Historic Flow)
H2	2	3.73	6%	8.0	0.18	0.52	2.2	13.5			
H3	3	0.90	73%	5.0	0.56	0.70	1.9	5.3			
H4	4	1.19	44%	9.2	0.37	0.59	1.3	4.6			
H5	5	0.61	13%	5.0	0.23	0.54	0.5	2.8			
OS1	6	58.65		31.7	0.22	0.53	17.7	93.1			
OS2	7	12.34		14.4	0.31	0.57	8.9	35.7	22.9	114.1	OS1+OS2

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DRAWN BY SMB
CHECKED BY LM

REVISION DESCRIPTION	PREPARED BY	DATE

STEAMBOAT ESQUIAR LP

STEAMBOAT SPRINGS ROUTT COUNTY

ASTRID SITE DEVELOPMENT
2410 SKI TRAIL LANE
EXISTING DRAINAGE MAP

PREPARED UNDER THE DIRECT SUPERVISION OF

FOR AND ON BEHALF OF BASELINE CORPORATION

INITIAL SUBMITTAL	12/22/22
DRAWING SIZE	24" X 36"
SURVEY FIRM LANDMARK, INC.	SURVEY DATE 06/03/22
JOB NO.	C020235
DRAWING NAME 20235 EX DRAIN.dwg	
SHEET 1 OF 2	

D1

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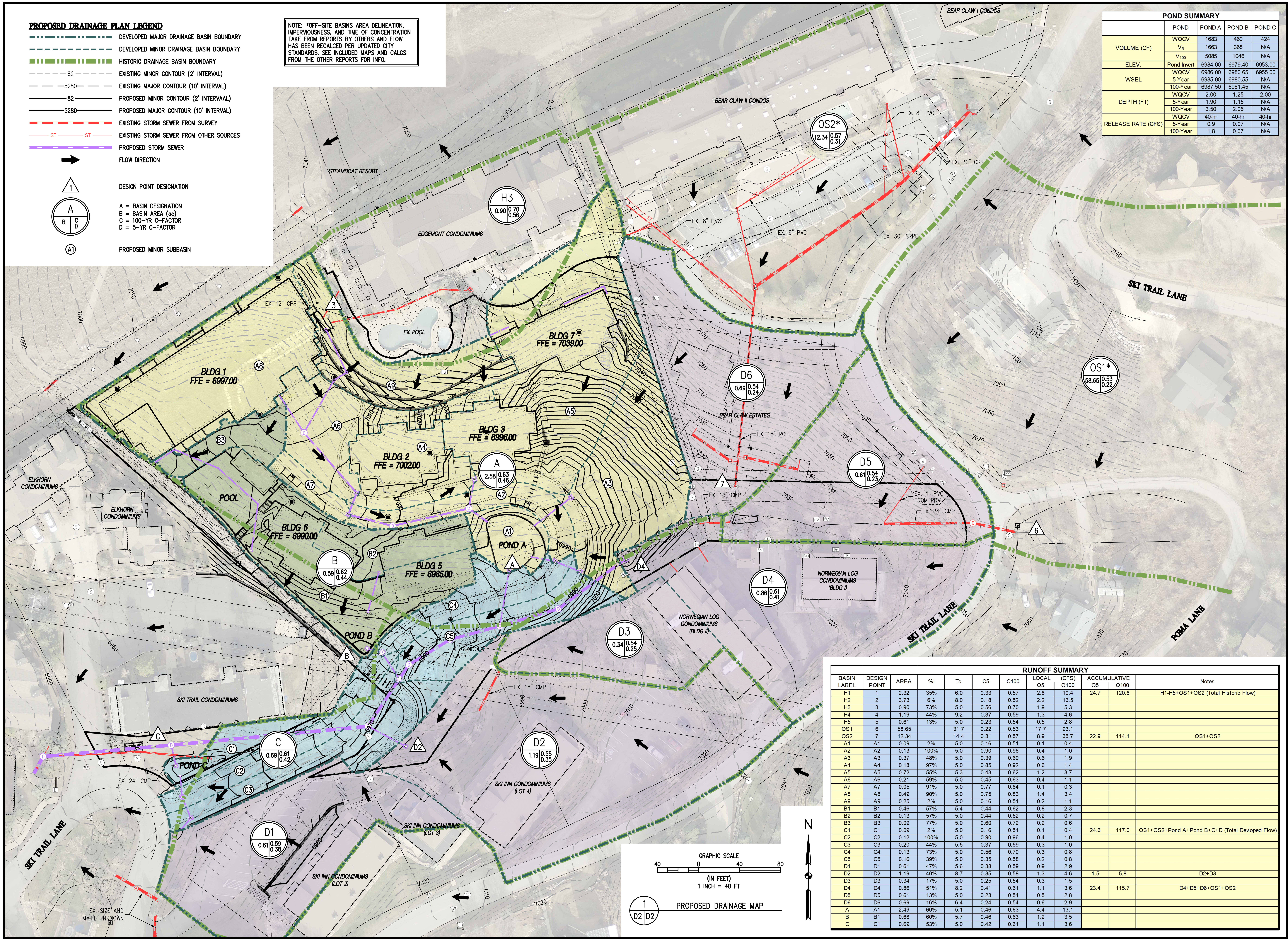
PROPOSED DRAINAGE PLAN LEGEND

- DEVELOPED MAJOR DRAINAGE BASIN BOUNDARY
- DEVELOPED MINOR DRAINAGE BASIN BOUNDARY
- HISTORIC DRAINAGE BASIN BOUNDARY
- 82 EXISTING MINOR CONTOUR (2' INTERVAL)
- 5280 EXISTING MAJOR CONTOUR (10' INTERVAL)
- 82 PROPOSED MINOR CONTOUR (2' INTERVAAL)
- 5280 PROPOSED MAJOR CONTOUR (10' INTERVAL)
- EXISTING STORM SEWER FROM SURVEY
- ST ST EXISTING STORM SEWER FROM OTHER SOURCES
- PROPOSED STORM SEWER
- → FLOW DIRECTION
- 1 DESIGN POINT DESIGNATION
- A / B C D: A = BASIN DESIGNATION, B = BASIN AREA (ac), C = 100-YR C-FACTOR, D = 5-YR C-FACTOR
- (A1) PROPOSED MINOR SUBBASIN

NOTE: *OFF-SITE BASINS AREA DELINEATION, IMPERVIOUSNESS, AND TIME OF CONCENTRATION TAKE FROM REPORTS BY OTHERS AND FLOW HAS BEEN RECALCED PER UPDATED CITY STANDARDS. SEE INCLUDED MAPS AND CALCS FROM THE OTHER REPORTS FOR INFO.



1
D2 D2
PROPOSED DRAINAGE MAP

POND SUMMARY

	POND	POND A	POND B	POND C
VOLUME (CF)	WQCV	1683	460	424
	V_5	1663	368	N/A
	V_{100}	5085	1046	N/A
ELEV.	Pond Invert	6984.00	6979.40	6953.00
WSEL	WQCV	6986.00	6980.65	6955.00
	5-Year	6985.90	6980.55	N/A
	100-Year	6987.50	6981.45	N/A
DEPTH (FT)	WQCV	2.00	1.25	2.00
	5-Year	1.90	1.15	N/A
	100-Year	3.50	2.05	N/A
RELEASE RATE (CFS)	WQCV	40-hr	40-hr	40-hr
	5-Year	0.9	0.07	N/A
	100-Year	1.8	0.37	N/A

RUNOFF SUMMARY

BASIN LABEL	DESIGN POINT	AREA	%I	Tc	C5	C100	LOCAL (CFS) Q5	Q100	ACCUMULATIVE Q5	Q100	Notes
H1	1	2.32	35%	6.0	0.33	0.57	2.8	10.4	24.7	120.6	H1-H5+OS1+OS2 (Total Historic Flow)
H2	2	3.73	6%	8.0	0.18	0.52	2.2	13.5			
H3	3	0.90	73%	5.0	0.56	0.70	1.9	5.3			
H4	4	1.19	44%	9.2	0.37	0.59	1.3	4.6			
H5	5	0.61	13%	5.0	0.23	0.54	0.5	2.8			
OS1	6	58.65		31.7	0.22	0.53	17.7	93.1			
OS2	7	12.34		14.4	0.31	0.57	8.9	35.7	22.9	114.1	OS1+OS2
A1	A1	0.09	2%	5.0	0.16	0.51	0.1	0.4			
A2	A2	0.13	100%	5.0	0.90	0.96	0.4	1.0			
A3	A3	0.37	48%	5.0	0.39	0.60	0.6	1.9			
A4	A4	0.18	97%	5.0	0.85	0.92	0.6	1.4			
A5	A5	0.72	55%	5.3	0.43	0.62	1.2	3.7			
A6	A6	0.21	59%	5.0	0.45	0.63	0.4	1.1			
A7	A7	0.05	91%	5.0	0.77	0.84	0.1	0.3			
A8	A8	0.49	90%	5.0	0.75	0.83	1.4	3.4			
A9	A9	0.25	2%	5.0	0.16	0.51	0.2	1.1			
B1	B1	0.46	57%	5.4	0.44	0.62	0.8	2.3			
B2	B2	0.13	57%	5.0	0.44	0.62	0.2	0.7			
B3	B3	0.09	77%	5.0	0.60	0.72	0.2	0.6			
C1	C1	0.09	2%	5.0	0.16	0.51	0.1	0.4	24.6	117.0	OS1+OS2+Pond A+Pond B+C+D (Total Devloped Flow)
C2	C2	0.12	100%	5.0	0.90	0.96	0.4	1.0			
C3	C3	0.20	44%	5.5	0.37	0.59	0.3	1.0			
C4	C4	0.13	73%	5.0	0.56	0.70	0.3	0.8			
C5	C5	0.16	39%	5.0	0.35	0.58	0.2	0.8			
D1	D1	0.61	47%	5.6	0.38	0.59	0.9	2.9			
D2	D2	1.19	40%	8.7	0.35	0.58	1.3	4.6	1.5	5.8	D2+D3
D3	D3	0.34	17%	5.0	0.25	0.54	0.3	1.5			
D4	D4	0.86	51%	8.2	0.41	0.61	1.1	3.6	23.4	115.7	D4+D5+D6+OS1+OS2
D5	D5	0.61	13%	5.0	0.23	0.54	0.5	2.8			
D6	D6	0.69	16%	6.4	0.24	0.54	0.6	2.9			
A	A1	2.49	60%	5.1	0.46	0.63	4.4	13.1			
B	B1	0.68	60%	5.7	0.46	0.63	1.2	3.5			
C	C1	0.69	53%	5.0	0.42	0.61	1.1	3.6			

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REVISION DESCRIPTION	PREPARED BY	DATE
REVISIONS PER DRT #1 COMMENTS	SMB	5/19/2023
REVISIONS FOR CONSTRUCTION DOCUMENTS	SMB	2/29/2024

ROUTT COUNTY

STEAMBOAT ESQUIAR LP

ASTRID SITE DEVELOPMENT
2410 SKI TRAIL LANE
PROPOSED DRAINAGE MAP

STEAMBOAT SPRINGS

PREPARED UNDER THE DIRECT SUPERVISION OF

FOR AND ON BEHALF OF BASELINE CORPORATION

INITIAL SUBMITTAL 12/22/22
DRAWING SIZE 24" X 36"
SURVEY FIRM LANDMARK, INC.
SURVEY DATE 06/03/22
JOB NO. C020235
DRAWING NAME 20235 PRO DRAIN.dwg
SHEET D OF 2
D2

ATTACHMENT 6

OFF-SITE BASINS MAP AND CALCS (FROM OTHER REPORTS)

LEGEND

━	PROJECT BOUNDARY
─	10-FT CONTOUR
	CULVERT W/ END SECTIONS & RIPRAP
─	DITCH / SWALE
⇨	DRAINAGE ARROW
△ 1	DESIGN POINT
B2 0.32 0.85	BASIN DESIGNATION COMPOSITE CURVE NUMBER OR BASIN IMPERVIOUSNESS BASIN AREA, ACRES
H1 31.6 25.6 42.2	HISTORIC OR OFFSITE BASIN DESIGNATION BASIN AREA, ACRES 25-YR RUNOFF, CFS 100-YR RUNOFF, CFS
▬ ▬	EXISTING BASIN BOUNDARY

Stormwater Peak Flows		
	Historical (cfs)	
Location	25-Year	100-Year
H1	44.9	77.3
H2	11.7	19.1
H3	10.3	16.8
H4	4.3	6.8
H5	5.2	7.3
H6	2.6	3.5
DP3*	64.0	106.8

*Peak flows to DP3 are calculated from a combined basin encompassing sub-basins H1-H6 and do not represent a summation of individual sub-basin flows

NO.	DATE	REVISIONS	INT

Steamboat Springs, CO

Edgemont
Figure 1
Existing Conditions Area Drainage

DATE: 04-06-07 DGN. BY: ADR
JOB NO. 1994-003 DWN. BY: ADR
FILE: Edgemont CHK. BY:

Vertical Scale: 1" = NA

Contour Interval = 10 Feet

Horizontal Scale
150 0 75 150 300
1" = 150'
(Orginal Graphic Scale)

LANDMARK
CONSULTANTS, INC.

141 9th Street, P.O. Box 774943
Steamboat Springs, Colorado 80477
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SHEET NO.
1
OF 1

[redacted] [redacted] [redacted] [redacted] [redacted] [redacted]

RATIONAL METHOD RUNOFF ANALYSIS

Job # 1994-003
Job Name Edgemont
Designed by: ADR
Checked by:

Date: March 7, 2007
Revised: July 9, 2007

LANDMARK
CONSULTANTS, INC.

H1 - Existing

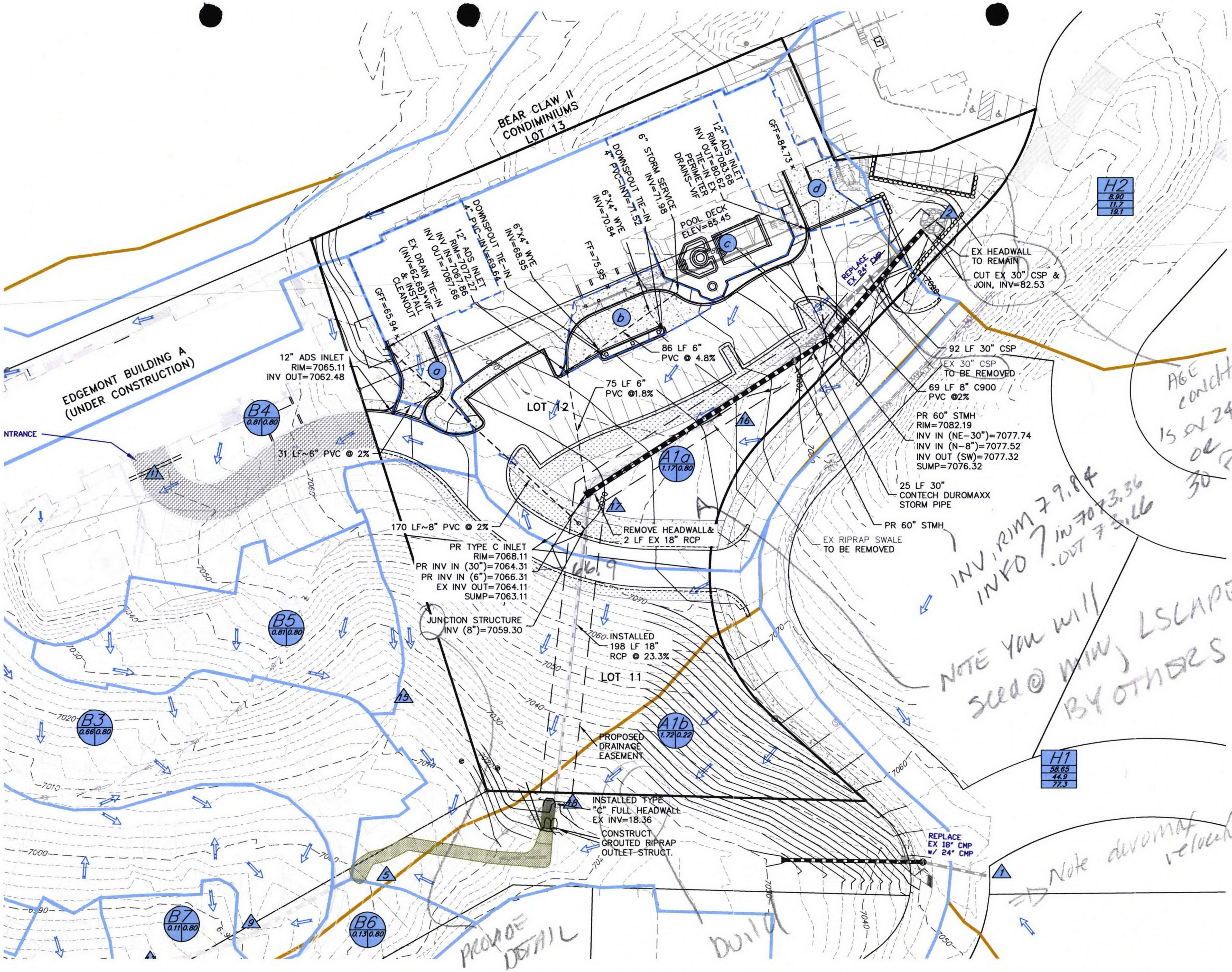
BASIN INPUT				TIME OF CONCENTRATION								RESULTS			
	Area, ac	% imp	Soil Type	Sheet Flow		Shallow Flow		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Undeveloped Areas	58.55	5%	C	Surface	Dense Shrubs	Paved, Y/N	N	Hyd. Rad., ft	0.20	Minimum	2-YR	0.08	0.9	58.65	4.2
Paved Roads, Parking, Roofs	0.10	100%		Length, ft	300	Length, ft	900	Length, ft	1562	Tc, min	5-YR	0.18	1.3	58.65	14.2
Commercial	0.00	95%	P2	Slope, ft/ft	0.2700	Slope, ft/ft	0.45	Slope, ft/ft	0.33	10.0	10-YR	0.28	1.7	58.65	27.2
Gravel Parking	0.00	40%	1.4	Manning's n	0.4	Velocity, ft/s	10.8	Manning's n	0.030	Final	**25-YR**	**0.39**	**1.9**	**58.65**	**44.9**
Residential	0.00	80%						Velocity, ft/s	9.8	Tc, min					
	58.65	5%		Ti, min=	27.6	Ts, min=	1.4	Tt, min=	2.7	31.7	**100-YR**	**0.52**	**2.5**	**58.65**	**77.3**

H2 - Existing

BASIN INPUT				TIME OF CONCENTRATION								RESULTS			
	Area, ac	% imp	Soil Type	Sheet Flow		Shallow Flow		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Undeveloped Areas	7.32	5%	C	Surface	Prarie Grass	Paved, Y/N	N	Hyd. Rad., ft	0.20	Minimum	2-YR	0.18	1.4	8.90	2.3
Paved Roads, Parking, Roofs	1.58	100%		Length, ft	300	Length, ft	600	Length, ft	50	Tc, min	5-YR	0.27	2.0	8.90	4.8
Commercial	0.00	90%	P2	Slope, ft/ft	0.2700	Slope, ft/ft	0.35	Slope, ft/ft	0.2	5.0	10-YR	0.35	2.5	8.90	7.9
Gravel Parking	0.00	**50%**	1.4	Manning's n	0.15	Velocity, ft/s	9.5	Manning's n	0.030	Final	**25-YR**	**0.45**	**2.9**	**8.90**	**11.7**
Residential	0.00	80%						Velocity, ft/s	7.6	Tc, min					
	8.90	22%		Ti, min=	12.6	Ts, min=	1.0	Tt, min=	0.1	**13.8**	**100-YR**	**0.56**	**3.9**	**8.90**	**19.1**

H3 - Existing

BASIN INPUT				TIME OF CONCENTRATION								RESULTS			
	Area, ac	% imp	Soil Type	Sheet Flow		Shallow Flow		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Undeveloped Areas	6.73	5%	C	Surface	Prarie Grass	Paved, Y/N	N	Hyd. Rad., ft	0.20	Minimum	2-YR	0.17	1.4	7.94	1.8
Paved Roads, Parking, Roofs	1.20	100%		Length, ft	300	Length, ft	640	Length, ft	0	Tc, min	5-YR	0.26	2.0	7.94	4.1
Commercial	0.00	90%	P2	Slope, ft/ft	0.2700	Slope, ft/ft	0.26	Slope, ft/ft	0.02	5.0	10-YR	0.34	2.5	7.94	6.8
Gravel Parking	0.00	50%	1.4	Manning's n	0.15	Velocity, ft/s	8.2	Manning's n	0.030	Final	**25-YR**	**0.44**	**2.9**	**7.94**	**10.3**
Residential	0.00	80%						Velocity, ft/s	2.4	Tc, min					
	7.94	19%		Ti, min=	12.6	Ts, min=	1.3	Tt, min=	0.0	**13.9**	**100-YR**	**0.55**	**3.8**	**7.94**	**16.8**



66.9

AGE condition
IS OK 24
or
30 ?

INV, RIM 79.84
INFO ? IN 7073.36
.OUT 73.66

NOTE YOU WILL
SEED @ MIN, LSCAPE
BY OTHERS

PROVIDE
DETAIL

build

=> Note duromax
velocities?

LEGEND

- EX. 2-FT CONTOUR
- 6800 EX. 10-FT CONTOUR
- PR. 2-FT CONTOUR
- PR. 10-FT CONTOUR
- CULVERT W/ END SECTIONS & RIPRAP
- DITCH / SWALE
- DRAINAGE ARROW
- PR. BASIN BOUNDARY
- HISTORIC BASIN BOUNDARY
- REVISED PR BASIN BOUNDARY
- DESIGN POINT
- B2 0.32 0.85 — BASIN DESIGNATION; COMPOSITE CURVE NUMBER OR BASIN IMPERVIOUSNESS; BASIN AREA, ACRES
- H1 31.6 25.6 42.2 — HISTORIC OR OFFSITE BASIN DESIGNATION; BASIN AREA, ACRES; 25-YR RUNOFF, CFS; 100-YR RUNOFF, CFS
- a — ADDITIONAL DRAIN BASIN (FOR ADDENDUM)

NO.	DATE	REVISIONS	INT

DB Bear Paw, LLC
Steamboat Springs, CO

Bear Claw II Access Improvements

Revised Drainage Plan

DATE: 06/18/09 DGN. BY: DCS
JOB NO. 1188-012 DWN. BY: DCS
DWG. NO. 1188-012 DR SURV. BY: LCI

Vertical Scale: 1" = NA

Contour Interval = Feet

Horizontal Scale

1" = 60'

LANDMARK
CONSULTANTS, INC.

141 9th Street ~ P.O. Box 774943
Steamboat Springs, Colorado 80477
Phone (970) 871-9494 ~ Fax (970) 871-9299
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SHEET NO.
1
OF 1

RATIONAL METHOD RUNOFF ANALYSIS

Job # 1994-003
Job Name Edgemont
Designed by: ADR
Checked by:

Date: March 7, 2007
Revised: June 18, 2009
Revised For: Bear Claw II CD's (revised)
Revised By: DCS

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DP 17=H2+A1.a+b+c+d

BASIN INPUT				TIME OF CONCENTRATION								RESULTS			
	Area, ac	% imp	Soil Type	Sheet Flow		Shallow Flow		Channel Flow		Tc, min	Event	C	*i*, in/hr	A, acres	Q, cfs
Undeveloped Areas	7.32	5%	C	Surface	Prarie Grass	Paved, Y/N	N	Hyd. Rad., ft	0.20	Minimum	2-YR	0.23	1.4	10.39	3.3
Paved Roads, Parking, Roofs	1.96	100%		Length, ft	300	Length, ft	600	Length, ft	50	Tc, min	5-YR	0.31	2.0	10.39	6.4
Commercial	0.00	95%	P2	Slope, ft/ft	0.2700	Slope, ft/ft	0.35	Slope, ft/ft	0.2	5.0	10-YR	0.38	2.5	10.39	9.9
Gravel Parking	0.00	40%	1.4	Manning's n	0.15	Velocity, ft/s	9.5	Manning's n	0.030	Final	**25-YR**	**0.47**	**2.9**	**10.39**	**14.2**
Residential	1.12	80%						Velocity, ft/s	7.6	Tc, min					
	10.39	31%		Ti, min=	12.6	Ts, min=	1.0	Tt, min=	0.1	**14.2**	**100-YR**	**0.57**	**3.8**	**10.39**	**22.5**
				Pipe Flow	PIPE	Length, ft	Velocity (ft/s)	Tt, min							
					1	92	9.7	0.2							
					2	25	22.1	0.0							
					3	154	10.0	0.3							

32 /
[illegible]

DP 18=H2+A1.a+a+b+c+d+A1.b

BASIN INPUT				TIME OF CONCENTRATION								RESULTS			
	Area, ac	% imp	Soil Type	Sheet Flow		Shallow Flow		Channel Flow		Tc, min	Event	C	*i*, in/hr	A, acres	Q, cfs
Undeveloped Areas	8.74	5%	C	Surface	Prarie Grass	Paved, Y/N	N	Hyd. Rad., ft	0.20	Minimum	2-YR	0.23	1.4	12.34	3.9
Paved Roads, Parking, Roofs	2.43	100%		Length, ft	300	Length, ft	600	Length, ft	50	Tc, min	5-YR	0.31	2.0	12.34	7.5
Commercial	0.00	95%	P2	Slope, ft/ft	0.2700	Slope, ft/ft	0.35	Slope, ft/ft	0.2	5.0	10-YR	0.38	2.5	12.34	11.7
Gravel Parking	0.00	40%	1.4	Manning's n	0.15	Velocity, ft/s	9.5	Manning's n	0.030	Final	**25-YR**	**0.47**	**2.9**	**12.34**	**16.8**
Residential	1.17	80%						Velocity, ft/s	7.6	Tc, min					
	12.34	31%		Ti, min=	12.6	Ts, min=	1.0	Tt, min=	0.1	14.4	**100-YR**	**0.57**	**3.8**	**12.34**	**26.6**
				Pipe Flow	PIPE	Length, ft	Velocity (ft/s)	Tt, min							
					1	92	9.7	0.2							
					2	25	22.1	0.0							
					3	154	10.0	0.3							
					4	198	19.7	0.2							

ATTACHMENT 7

RUNOFF CALCULATIONS AND SUMMARY TABLE

SF-1
RUNOFF COEFFICIENTS

PROJECT NAME: Astrid
PROJECT NUMBER: 20235
CALCULATED BY: SMB
CHECKED BY: CSR

DATE: 2/28/2024

LAND USE:	LAWNS AND GOLF COURSES	ROOF AREA	PAVED AREA	GRAVEL AREA			
% IMPERVIOUS	2%	90%	100%	40%	0%	0%	0%
1.25-YEAR COEFF.	0.01	0.71	0.88	0.25	0.00	0.00	0.00
2-YEAR COEFF.	0.06	0.73	0.89	0.28	0.00	0.00	0.00
5-YEAR COEFF.	0.16	0.75	0.90	0.35	0.00	0.00	0.00
10-YEAR COEFF.	0.26	0.77	0.92	0.42	0.00	0.00	0.00
100-YEAR COEFF.	0.51	0.83	0.96	0.58	0.00	0.00	0.00

HYDROLOGIC SOIL TYPE = C

DESIGN BASIN	DESIGN POINT	LAWNS AND GOLF COURSES	ROOF AREA	PAVED AREA	GRAVEL AREA				TOTAL AREA	PERCENT IMPERV.	RUNOFF COEFFICIENTS				
		(AC)	(AC)	(AC)	(AC)	(AC)	(AC)	(AC)	(AC)	(%)	$C_{1.25}$	C_2	C_5	C_{10}	C_{100}
H1	1	1.50	0.27	0.54					**2.32**	35%	0.22	0.25	0.33	0.40	0.57
H2	2	3.59		0.14					**3.73**	6%	0.03	0.08	0.18	0.28	0.52
H3	3	0.21	0.39	0.30					**0.90**	73%	0.50	0.52	0.56	0.60	0.70
H4	4	0.66	0.17	0.36					**1.19**	44%	0.28	0.31	0.37	0.44	0.59
H5	5	0.54		0.07					**0.61**	13%	0.09	0.13	0.23	0.31	0.54
HISTORIC BASIN		**6.51**	**0.83**	**1.42**	**0.00**	**0.00**	**0.00**	**0.00**	**8.76**	**26%**	**0.16**	**0.20**	**0.28**	**0.36**	**0.56**
SUBTOTAL		74.3%	9.5%	16.2%					100%						
A1	A1	0.09							**0.09**	2%	0.01	0.06	0.16	0.26	0.51
A2	A2	0.00		0.13					**0.13**	100%	0.88	0.89	0.90	0.92	0.96
A3	A3	0.18	0.12	0.07					**0.37**	48%	0.30	0.33	0.39	0.45	0.60
A4	A4	-0.01	0.12	0.07					**0.18**	97%	0.83	0.84	0.85	0.87	0.92
A5	A5	0.31	0.26	0.16					**0.72**	55%	0.34	0.37	0.43	0.48	0.62
A6	A6	0.09	0.02	0.10					**0.21**	59%	0.36	0.40	0.45	0.50	0.63
A7	A7	0.00		0.04					**0.05**	91%	0.73	0.75	0.77	0.79	0.84
A8	A8	0.00	0.49						**0.49**	90%	0.71	0.73	0.75	0.77	0.83
A9	A9	0.25							**0.25**	2%	0.01	0.06	0.16	0.26	0.51
DEVELOPED BASIN A		**0.92**	**1.01**	**0.56**	**0.00**	**0.00**	**0.00**	**0.00**	**2.49**	**60%**	**0.36**	**0.41**	**0.46**	**0.51**	**0.63**
SUBTOTAL		36.8%	40.7%	22.5%					100%						
B1	B1	0.18	0.18	0.09					**0.46**	57%	0.35	0.39	0.44	0.49	0.62
B2	B2	0.05	0.08						**0.13**	57%	0.35	0.39	0.44	0.49	0.62
B3	B3	0.02		0.07					**0.09**	77%	0.54	0.56	0.60	0.64	0.72
DEVELOPED BASIN B		**0.25**	**0.26**	**0.16**	**0.00**	**0.00**	**0.00**	**0.00**	**0.68**	**60%**	**0.36**	**0.41**	**0.46**	**0.51**	**0.63**
SUBTOTAL		37.1%	38.8%	24.1%					100%						
C1	C1	0.09							**0.09**	2%	0.01	0.06	0.16	0.26	0.51
C2	C2	0.00		0.12					**0.12**	100%	0.88	0.89	0.90	0.92	0.96
C3	C3	0.10		0.08	0.02				**0.20**	44%	0.28	0.31	0.37	0.44	0.59
C4	C4	0.04		0.09					**0.13**	73%	0.50	0.52	0.56	0.60	0.70
C5	C5	0.10		0.06					**0.16**	39%	0.25	0.28	0.35	0.42	0.58
DEVELOPED BASIN C		**0.32**	**0.00**	**0.35**	**0.02**	**0.00**	**0.00**	**0.00**	**0.69**	**53%**	**0.33**	**0.36**	**0.42**	**0.47**	**0.61**
SUBTOTAL		46.8%		51.0%	2.3%				100%						
D1	D1	0.32	0.09	0.21					**0.61**	47%	0.29	0.32	0.38	0.45	0.59
D2	D2	0.71	0.17	0.31					**1.19**	40%	0.25	0.28	0.35	0.42	0.58
D3	D3	0.28	0.05	0.00					**0.34**	17%	0.11	0.15	0.25	0.33	0.54
D4	D4	0.42	0.07	0.37					**0.86**	51%	0.32	0.35	0.41	0.47	0.61
D5	D5	0.54		0.07					**0.61**	13%	0.09	0.13	0.23	0.31	0.54
D6	D6	0.59		0.10					**0.69**	16%	0.11	0.15	0.24	0.32	0.54
DEVELOPED BASIN D		**2.87**	**0.37**	**1.06**	**0.00**	**0.00**	**0.00**	**0.00**	**4.30**	**34%**	**0.21**	**0.24**	**0.32**	**0.40**	**0.57**
SUBTOTAL		66.7%	8.7%	24.6%					100%						
A	A1	0.92	1.01	0.56					**2.49**	60%	0.36	0.41	0.46	0.51	0.63
B	B1	0.25	0.26	0.16					**0.68**	60%	0.36	0.41	0.46	0.51	0.63
C	C1	0.32		0.35	0.02				**0.69**	53%	0.33	0.36	0.42	0.47	0.61
DEVELOPED MAJOR		**1.49**	**1.28**	**1.08**	**0.02**	**0.00**	**0.00**	**0.00**	**3.86**	**59%**	**0.35**	**0.40**	**0.45**	**0.50**	**0.63**
BASIN SUBTOTAL		38.6%	33.1%	27.9%	0.4%				100%						

STANDARD FORM SF-2
TIME OF CONCENTRATION

PROJECT NAME: Astrid
PROJECT NUMBER: 20235
CALCULATED BY: SMB
CHECKED BY: CSR

DATE: 2/28/2024

SUB-BASIN DATA			INITIAL TIME (T_i)			TRAVEL TIME (T_t)							FIRST DESIGN POINT T_c CHECK (URBANIZED BASINS)				FINAL T_c	RUNOFF COEFF.	
DESIGN BASIN (1)	AREA Ac (2)	C_5 (3)	LENGTH (L_o) Ft (4)	SLOPE (S) % (5)	T_i Min. (6)	LENGTH Ft. (7)	SLOPE (S_w) % (8)	Land Surface (9)	K (10)	VEL fps (11)	T_t Min. (12)	COMP. T_c (13)	URBAN BASIN? (14)	i (15)	CHANNELIZED LENGTH (16)	T_c = Eq 6-5 Min. (17)	Min. (18)	C_{10} (19)	C_{100} (20)
H1	2.32	0.33	80	25.0%	4.3	490	11.0%	Grassed Waterway	15.0	5.0	1.6	**6.0**	Yes	0.35	490	21.8	**6.0**	0.40	0.57
H2	3.73	0.18	140	27.0%	6.6	305	6.0%	Grassed Waterway	15.0	3.7	1.4	**8.0**	No	0.06			**8.0**	0.28	0.52
H3	0.90	0.56	50	20.0%	2.6	300	12.0%	Paved Areas	20.0	6.9	0.7	**3.3**	Yes	0.73	300	14.4	**5.0**	0.60	0.70
H4	1.19	0.37	250	16.0%	8.4	270	14.0%	Grassed Waterway	15.0	5.6	0.8	**9.2**	Yes	0.44	270	19.3	**9.2**	0.44	0.59
H5	0.61	0.23	75	50.0%	3.8	160	10.0%	Grassed Waterway	15.0	4.7	0.6	**4.3**	No	0.13			**5.0**	0.31	0.54
DP6-DP1						880	11.0%	Grassed Waterway	15.0	5.0	2.9	**2.9**					**5.0**		
A1	0.09	0.16	10	5.0%	3.2	56	2.0%	Short Pasture/Lawn	7.0	1.0	0.9	**4.1**	No	0.02			**5.0**	0.26	0.51
A2	0.13	0.90	10	2.0%	0.9	250	5.0%	Paved Areas	20.0	4.5	0.9	**1.9**	Yes	1.00	250	9.8	**5.0**	0.92	0.96
A3	0.37	0.39	60	33.0%	3.1	250	15.0%	Grassed Waterway	15.0	5.8	0.7	**3.9**	Yes	0.48	250	18.4	**5.0**	0.45	0.60
A4	0.18	0.85	60	10.0%	1.6	180	5.0%	Paved Areas	20.0	4.5	0.7	**2.3**	Yes	0.97	180	10.1	**5.0**	0.87	0.92
A5	0.72	0.43	50	6.0%	4.8	180	15.0%	Grassed Waterway	15.0	5.8	0.5	**5.3**	Yes	0.55	180	17.2	**5.3**	0.48	0.62
A6	0.21	0.45	10	2.0%	3.0	50	25.0%	Grassed Waterway	15.0	7.5	0.1	**3.1**	Yes	0.59	50	16.1	**5.0**	0.50	0.63
A7	0.05	0.77	10	2.0%	1.5	90	5.0%	Paved Areas	20.0	4.5	0.3	**1.9**	Yes	0.91	90	10.8	**5.0**	0.79	0.84
A8	0.49	0.75	90	10.0%	2.8	100	2.0%	Paved Areas	20.0	2.8	0.6	**3.4**	Yes	0.90	100	11.2	**5.0**	0.77	0.83
A9	0.25	0.16	40	33.0%	3.4	180	6.0%	Grassed Waterway	15.0	3.7	0.8	**4.2**	No	0.02			**5.0**	0.26	0.51
B1	0.46	0.44	70	10.0%	4.7	150	6.0%	Grassed Waterway	15.0	3.7	0.7	**5.4**	Yes	0.57	150	16.9	**5.4**	0.49	0.62
B2	0.13	0.44	10	5.0%	2.2	50	25.0%	Grassed Waterway	15.0	7.5	0.1	**2.3**	Yes	0.57	50	16.4	**5.0**	0.49	0.62
B3	0.09	0.60	10	2.0%	2.3	80	14.0%	Paved Areas	20.0	7.5	0.2	**2.5**	Yes	0.77	80	13.1	**5.0**	0.64	0.72
C1	0.09	0.16	15	10.0%	3.1	90	10.0%	Grassed Waterway	15.0	4.7	0.3	**3.4**	No	0.02			**5.0**	0.26	0.51
C2	0.12	0.90	10	2.0%	0.9	240	7.0%	Paved Areas	20.0	5.3	0.8	**1.7**	Yes	1.00	240	9.7	**5.0**	0.92	0.96
C3	0.20	0.37	60	10.0%	4.8	200	7.0%	Paved Areas	20.0	5.3	0.6	**5.5**	Yes	0.44	200	19.3	**5.5**	0.44	0.59
C4	0.13	0.56	10	2.0%	2.5	210	7.0%	Paved Areas	20.0	5.3	0.7	**3.2**	Yes	0.73	210	14.3	**5.0**	0.60	0.70
C5	0.16	0.35	10	2.0%	3.5	210	7.0%	Paved Areas	20.0	5.3	0.7	**4.1**	Yes	0.39	210	20.2	**5.0**	0.42	0.58
D1	0.61	0.38	120	20.0%	5.3	60	6.0%	Grassed Waterway	15.0	3.7	0.3	**5.6**	Yes	0.47	60	18.2	**5.6**	0.45	0.59
D2	1.19	0.35	280	20.0%	8.5	80	12.0%	Grassed Waterway	15.0	5.2	0.3	**8.7**	Yes	0.40	80	19.5	**8.7**	0.42	0.58
D3	0.34	0.25	40	20.0%	3.6	140	15.0%	Grassed Waterway	15.0	5.8	0.4	**4.0**	No	0.17			**5.0**	0.33	0.54
D4	0.86	0.41	250	16.0%	8.0	80	14.0%	Grassed Waterway	15.0	5.6	0.2	**8.2**	Yes	0.51	80	17.5	**8.2**	0.47	0.61
D5	0.61	0.23	75	50.0%	3.8	160	10.0%	Grassed Waterway	15.0	4.7	0.6	**4.3**	No	0.13			**5.0**	0.31	0.54
D6	0.69	0.24	140	27.0%	6.2	60	10.0%	Grassed Waterway	15.0	4.7	0.2	**6.4**	No	0.16			**6.4**	0.32	0.54
A	2.49	0.46	95	20.0%	4.2	340	10.0%	Paved Areas	20.0	6.3	0.9	**5.1**	Yes	0.60	340	16.9	**5.1**	0.51	0.63
B	0.68	0.46	50	5.0%	4.9	175	6.0%	Grassed Waterway	15.0	3.7	0.8	**5.7**	Yes	0.60	175	16.5	**5.7**	0.51	0.63
C	0.69	0.42	24	50.0%	1.7	430	7.4%	Paved Areas	20.0	5.4	1.3	**3.0**	Yes	0.53	430	18.6	**5.0**	0.47	0.61

$t_i = 0.395\,(1.1 - C_5)\,L_o^{1/2} / S^{1/3}$

$V = K\,S_w^{0.5}$

$$T_t = \frac{L}{60\,V}$$

$t_c = (26-17i) + L_t / (60\,(14i + 9)\,\sqrt{(S_t)})$

BASELINE
Engineering · Planning · Surveying

STANDARD FORM SF-3
STORM DRAINAGE DESIGN - RATIONAL METHOD 5-YEAR EVENT

PROJECT NAME: Astrid
PROJECT NUMBER: 20235
CALCULATED BY: SMB
CHECKED BY: CSR

DATE: 2/28/2024

P_1 (1-Hour Rainfall) = 0.82 in. (5-yr)

STORM LINE	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		DESIGN BASIN	AREA (AC)	RUNOFF COEFF C_5	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc (min)	Σ(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	tt (min)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	1	H1	2.32	0.33	6.0	0.77	3.61	**2.8**	34.65	19.26	1.28	**24.7**									
	2	H2	3.73	0.18	8.0	0.69	3.18	**2.2**													
	3	H3	0.90	0.56	5.0	0.50	3.86	**1.9**													
	4	H4	1.19	0.37	9.2	0.44	2.97	**1.3**													
	5	H5	0.61	0.23	5.0	0.14	3.86	**0.5**													
	6	OS1	58.65	0.22	31.7	12.90	1.37	**17.7**													
	7	OS2	12.34	0.31	14.4	3.83	2.33	**8.9**	31.7	16.73	1.37	**22.9**									
	A1	A1	0.09	0.16	5.0	0.01	3.86	**0.1**													
	A2	A2	0.13	0.90	5.0	0.11	3.86	**0.4**													
	A3	A3	0.37	0.39	5.0	0.15	3.86	**0.6**													
	A4	A4	0.18	0.85	5.0	0.15	3.86	**0.6**													
	A5	A5	0.72	0.43	5.3	0.31	3.77	**1.2**													
	A6	A6	0.21	0.45	5.0	0.09	3.86	**0.4**													
	A7	A7	0.05	0.77	5.0	0.03	3.86	**0.1**													
	A8	A8	0.49	0.75	5.0	0.37	3.86	**1.4**													
	A9	A9	0.25	0.16	5.0	0.04	3.86	**0.2**													
	B1	B1	0.46	0.44	5.4	0.20	3.76	**0.8**													
	B2	B2	0.13	0.44	5.0	0.06	3.86	**0.2**													
	B3	B3	0.09	0.60	5.0	0.05	3.86	**0.2**													
	C1	C1	0.09	0.16	5.0	0.01	3.86	**0.1**	34.65	18.39	1.28	**24.6**									
	C2	C2	0.12	0.90	5.0	0.11	3.86	**0.4**													
	C3	C3	0.20	0.37	5.5	0.07	3.73	**0.3**													
	C4	C4	0.13	0.56	5.0	0.07	3.86	**0.3**													
	C5	C5	0.16	0.35	5.0	0.05	3.86	**0.2**													
	D1	D1	0.61	0.38	5.6	0.24	3.70	**0.9**													
	D2	D2	1.19	0.35	8.7	0.41	3.05	**1.3**	8.74	0.50	3.05	**1.5**									
	D3	D3	0.34	0.25	5.0	0.08	3.86	**0.3**													
	D4	D4	0.86	0.41	8.2	0.35	3.14	**1.1**	32.50	17.39	1.35	**23.4**									
	D5	D5	0.61	0.23	5.0	0.14	3.86	**0.5**													
	D6	D6	0.69	0.24	6.4	0.17	3.51	**0.6**													
	A1	A	2.49	0.46	5.1	1.14	3.82	**4.4**													
	B1	B	0.68	0.46	5.7	0.31	3.68	**1.2**													
	C1	C	0.69	0.42	5.0	0.29	3.86	**1.1**													

BASELINE
Engineering · Planning · Surveying

STANDARD FORM SF-3
STORM DRAINAGE DESIGN - RATIONAL METHOD 100-YEAR EVENT

PROJECT NAME: Astrid
PROJECT NUMBER: 20235
CALCULATED BY: SMB
CHECKED BY: CSR

DATE: 2/28/2024

P_1 (1-Hour Rainfall) = **1.79** in. (100-yr)

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
STORM LINE	DESIGN POINT	DESIGN BASIN	AREA (AC)	RUNOFF COEFF C_{100}	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc (min)	Σ(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	tt (min)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	1	H1	2.32	0.57	6.0	1.32	7.88	**10.4**	34.65	43.04	2.80	**120.6**									
	2	H2	3.73	0.52	8.0	1.94	6.94	**13.5**													
	3	H3	0.90	0.70	5.0	0.63	8.42	**5.3**													
	4	H4	1.19	0.59	9.2	0.70	6.48	**4.6**													
	5	H5	0.61	0.54	5.0	0.33	8.42	**2.8**													
	6	OS1	58.65	0.53	31.7	31.08	2.99	**93.1**													
	7	OS2	12.34	0.57	14.4	7.03	5.08	**35.7**	31.7	38.12	2.99	**114.1**									
	A1	A1	0.09	0.51	5.0	0.05	8.42	**0.4**													
	A2	A2	0.13	0.96	5.0	0.12	8.42	**1.0**													
	A3	A3	0.37	0.60	5.0	0.22	8.42	**1.9**													
	A4	A4	0.18	0.92	5.0	0.17	8.42	**1.4**													
	A5	A5	0.72	0.62	5.3	0.45	8.24	**3.7**													
	A6	A6	0.21	0.63	5.0	0.13	8.42	**1.1**													
	A7	A7	0.05	0.84	5.0	0.04	8.42	**0.3**													
	A8	A8	0.49	0.83	5.0	0.41	8.42	**3.4**													
	A9	A9	0.25	0.51	5.0	0.13	8.42	**1.1**													
	B1	B1	0.46	0.62	5.4	0.29	8.20	**2.3**													
	B2	B2	0.13	0.62	5.0	0.08	8.42	**0.7**													
	B3	B3	0.09	0.72	5.0	0.07	8.42	**0.6**													
	C1	C1	0.09	0.51	5.0	0.04	8.42	**0.4**	34.65	40.94	2.80	**117.0**									
	C2	C2	0.12	0.96	5.0	0.11	8.42	**1.0**													
	C3	C3	0.20	0.59	5.5	0.12	8.15	**1.0**													
	C4	C4	0.13	0.70	5.0	0.09	8.42	**0.8**													
	C5	C5	0.16	0.58	5.0	0.09	8.42	**0.8**													
	D1	D1	0.61	0.59	5.6	0.36	8.09	**2.9**													
	D2	D2	1.19	0.58	8.7	0.69	6.65	**4.6**	8.7	0.87	6.65	**5.8**									
	D3	D3	0.34	0.54	5.0	0.18	8.42	**1.5**													
	D4	D4	0.86	0.61	8.2	0.52	6.86	**3.6**	32.50	39.34	2.94	**115.7**									
	D5	D5	0.61	0.54	5.0	0.33	8.42	**2.8**													
	D6	D6	0.69	0.54	6.4	0.37	7.65	**2.9**													
	A1	A	2.49	0.63	5.1	1.57	8.35	**13.1**													
	B1	B	0.68	0.63	5.7	0.43	8.04	**3.5**													
	C1	C	0.69	0.61	5.0	0.42	8.42	**3.6**													

PROJECT: Astrid
JOB NO.: 20235
CALC. BY: SMB
CHK BY: CSR

BASELINE
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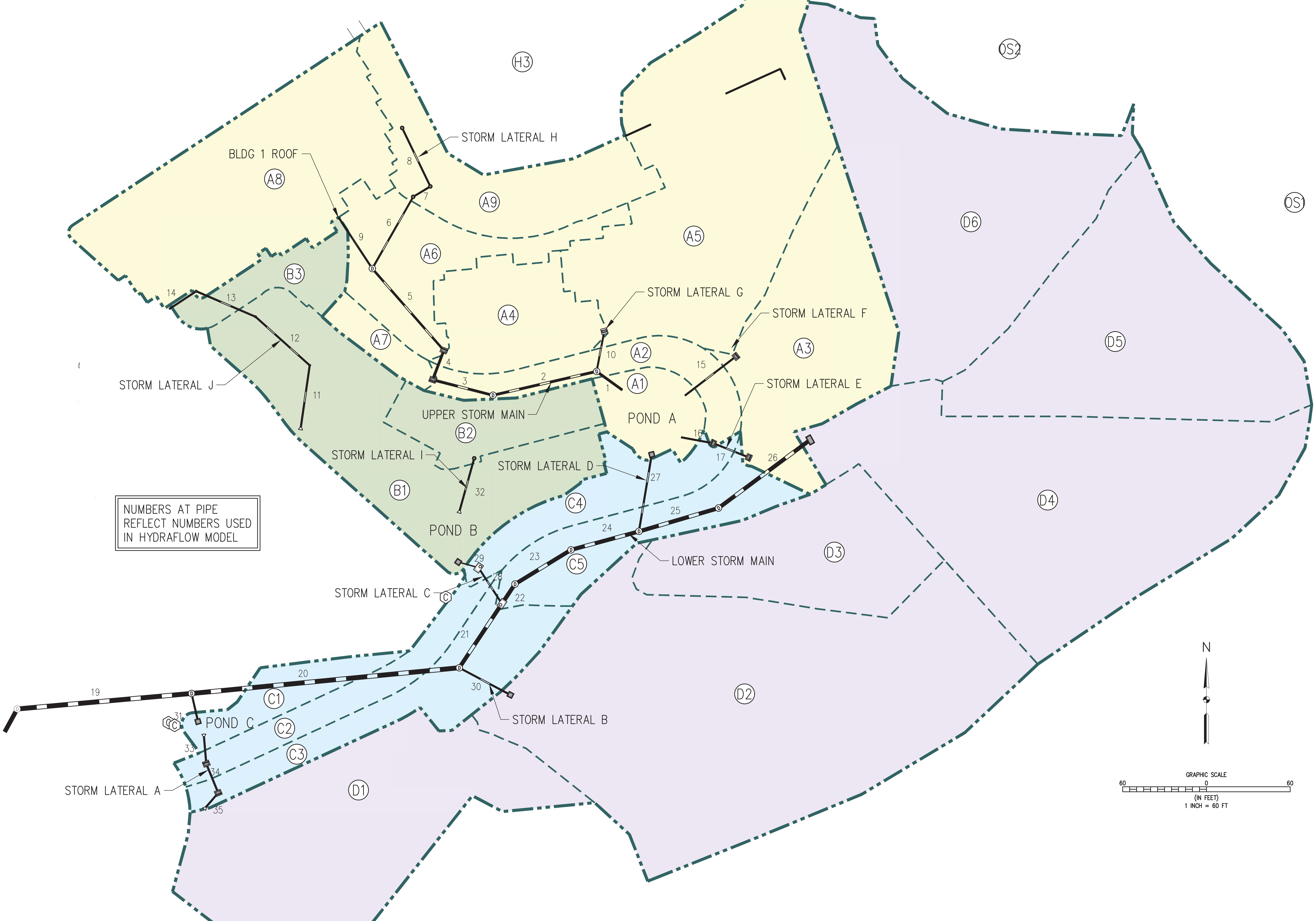
RUNOFF SUMMARY

BASIN LABEL	DESIGN POINT	AREA	%I	Tc	C5	C100	LOCAL	(CFS)	ACCUMULATIVE		Notes
							Q5	Q100	Q5	Q100	
H1	1	2.32	35%	6.0	0.33	0.57	2.8	10.4	24.7	120.6	H1-H5+OS1+OS2 (Total Historic Flow)
H2	2	3.73	6%	8.0	0.18	0.52	2.2	13.5			
H3	3	0.90	73%	5.0	0.56	0.70	1.9	5.3			
H4	4	1.19	44%	9.2	0.37	0.59	1.3	4.6			
H5	5	0.61	13%	5.0	0.23	0.54	0.5	2.8			
OS1	6	58.65		31.7	0.22	0.53	17.7	93.1			
OS2	7	12.34		14.4	0.31	0.57	8.9	35.7	22.9	114.1	OS1+OS2
A1	A1	0.09	2%	5.0	0.16	0.51	0.1	0.4			
A2	A2	0.13	100%	5.0	0.90	0.96	0.4	1.0			
A3	A3	0.37	48%	5.0	0.39	0.60	0.6	1.9			
A4	A4	0.18	97%	5.0	0.85	0.92	0.6	1.4			
A5	A5	0.72	55%	5.3	0.43	0.62	1.2	3.7			
A6	A6	0.21	59%	5.0	0.45	0.63	0.4	1.1			
A7	A7	0.05	91%	5.0	0.77	0.84	0.1	0.3			
A8	A8	0.49	90%	5.0	0.75	0.83	1.4	3.4			
A9	A9	0.25	2%	5.0	0.16	0.51	0.2	1.1			
B1	B1	0.46	57%	5.4	0.44	0.62	0.8	2.3			
B2	B2	0.13	57%	5.0	0.44	0.62	0.2	0.7			
B3	B3	0.09	77%	5.0	0.60	0.72	0.2	0.6			
C1	C1	0.09	2%	5.0	0.16	0.51	0.1	0.4	24.6	117.0	OS1+OS2+Pond A+Pond B+C+D (Total Devloped Flow)
C2	C2	0.12	100%	5.0	0.90	0.96	0.4	1.0			
C3	C3	0.20	44%	5.5	0.37	0.59	0.3	1.0			
C4	C4	0.13	73%	5.0	0.56	0.70	0.3	0.8			
C5	C5	0.16	39%	5.0	0.35	0.58	0.2	0.8			
D1	D1	0.61	47%	5.6	0.38	0.59	0.9	2.9			
D2	D2	1.19	40%	8.7	0.35	0.58	1.3	4.6	1.5	5.8	D2+D3
D3	D3	0.34	17%	5.0	0.25	0.54	0.3	1.5			
D4	D4	0.86	51%	8.2	0.41	0.61	1.1	3.6	23.4	115.7	D4+D5+D6+OS1+OS2
D5	D5	0.61	13%	5.0	0.23	0.54	0.5	2.8			
D6	D6	0.69	16%	6.4	0.24	0.54	0.6	2.9			
A	A1	2.49	60%	5.1	0.46	0.63	4.4	13.1			
B	B1	0.68	60%	5.7	0.46	0.63	1.2	3.5			
C	C1	0.69	53%	5.0	0.42	0.61	1.1	3.6			

🟦 = FORMULA CELLS
🟨 = USER INPUT CELLS

ATTACHMENT 8

STORM CONVEYANCE COMPUTATIONS



NUMBERS AT PIPE
REFLECT NUMBERS USED
IN HYDRAFLOW MODEL

Storm Sewer Tabulation

100-Year

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	22.571	0.00	2.08	0.00	0.00	1.50	0.0	5.9	7.9	11.93	36.00	7.10	18	10.01	6988.88	6991.14	6990.29	6992.45	0.00	6996.48	Pipe - (1)
2	1	76.247	0.00	1.90	0.00	0.00	1.34	0.0	5.6	8.1	10.78	26.06	7.25	18	5.25	6991.34	6995.34	6992.45	6996.60	6996.48	7000.74	Pipe - (2)
3	2	44.549	0.05	1.90	0.84	0.04	1.34	5.0	5.5	8.1	10.87	19.73	7.50	18	3.01	6995.54	6996.88	6996.60	6998.14	7000.74	7002.56	Pipe - (3)
4	3	22.572	0.21	1.85	0.63	0.13	1.30	5.0	5.4	8.2	10.58	16.06	7.31	18	1.99	6997.08	6997.53	6998.14	6998.78	7002.56	7002.59	Pipe - (4)
5	4	77.936	0.00	1.64	0.00	0.00	1.16	0.0	5.3	8.3	9.61	14.55	8.39	15	4.32	6997.73	7001.10	6998.78	7002.27	7002.59	7006.60	Pipe - (5)
6	5	59.198	0.25	1.15	0.51	0.13	0.76	5.0	5.2	8.3	6.31	7.74	9.56	12	4.02	7002.62	7005.00	7003.31	7005.96	7006.60	7014.27	Pipe - (6)
7	6	14.370	0.00	0.90	0.00	0.00	0.63	0.0	5.1	8.3	5.26	7.69	8.72	12	3.97	7011.59	7012.16	7012.20	7013.09	7014.27	7023.48	Pipe - (7)
8	7	46.537	0.90	0.90	0.70	0.63	0.63	5.0	5.0	8.4	5.30	10.92	10.38	12	8.02	7020.03	7023.76	7020.52	7024.69	7023.48	7027.28	Pipe - (8)
9	5	43.976	0.49	0.49	0.83	0.41	0.41	5.0	5.0	8.4	3.42	5.46	6.24	12	2.00	7002.62	7003.50	7003.19	7004.29	7006.60	0.00	Pipe - (9)
10	1	29.288	0.18	0.18	0.92	0.17	0.17	5.0	5.0	8.4	1.39	7.68	5.14	12	3.96	6992.14	6993.30	6992.45	6993.80	6996.48	6995.40	Pipe - (10)
11	End	46.593	0.00	0.09	0.00	0.00	0.06	0.0	8.0	7.0	0.45	3.88	1.69	12	1.01	6988.76	6989.23	6989.40	6989.51	6989.87	6994.00	Pipe - (11)
12	11	52.220	0.00	0.09	0.00	0.00	0.06	0.0	6.7	7.5	0.49	5.44	3.44	12	1.99	6989.43	6990.47	6989.63	6990.76	6994.00	6994.01	Pipe - (12)
13	12	46.184	0.00	0.09	0.00	0.00	0.06	0.0	5.6	8.1	0.52	5.44	3.51	12	1.99	6990.68	6991.60	6990.89	6991.90	6994.01	7002.00	Pipe - (13)
14	13	23.030	0.09	0.09	0.72	0.06	0.06	5.0	5.0	8.4	0.55	3.34	2.90	12	3.00	6994.76	6995.45	6995.03	6995.76	7002.00	0.00	Pipe - (14)
15	End	45.942	0.72	0.72	0.62	0.45	0.45	5.3	5.3	8.2	3.68	6.66	5.13	12	2.98	6987.63	6989.00	6988.54	6989.82	0.00	6991.66	Pipe - (15)
16	End	23.077	0.13	0.50	0.96	0.12	0.35	5.0	5.2	8.3	2.88	5.45	4.36	12	1.99	6984.60	6985.06	6985.46	6985.79	0.00	6988.93	Pipe - (16)
17	16	27.535	0.37	0.37	0.60	0.22	0.22	5.0	5.0	8.4	1.87	5.45	4.19	12	2.00	6985.26	6985.81	6985.79	6986.39	6988.93	6989.09	Pipe - (17)
18	End	18.628	0.00	75.07	0.00	0.00	40.61	0.0	33.0	2.9	120.1	80.73	17.01	36	4.99	6934.01	6934.94	6936.98	6938.97	0.00	6944.92	Pipe - (18)
19	18	119.241	0.00	75.07	0.00	0.00	40.61	0.0	32.9	2.9	120.4	155.7	17.04	36	4.65	6936.77	6942.31	6942.83	6946.15	6944.92	6956.50	Pipe - (19)
20	19	198.895	0.00	74.98	0.00	0.00	40.56	0.0	32.7	2.9	120.8	139.2	17.65	36	3.71	6947.67	6955.05	6950.35	6958.00	6956.50	6969.40	Pipe - (20)
21	20	55.202	0.16	73.45	0.58	0.09	39.69	5.0	32.7	2.9	118.4	139.2	27.98	30	9.82	6962.48	6967.90	6964.25	6970.39	6969.40	6974.10	Pipe - (21)
22	21	16.776	0.00	73.16	0.00	0.00	39.51	0.0	32.7	2.9	117.5	140.6	23.94	30	10.02	6967.90	6969.58	6970.39	6972.07	6974.10	6975.90	Pipe - (22)

Project File: 20235 Storm Sewers 100-yr.stm

Number of lines: 35

Run Date: 2/28/2024

NOTES:Intensity = 87.89 / (Inlet time + 7.84) ^ 0.92; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewer Tabulation

100-Year

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
23	22	47.080	0.00	73.16	0.00	0.00	39.51	0.0	32.6	2.9	117.6	140.5	24.41	30	10.00	6969.77	6974.48	6972.07	6976.97	6975.90	6981.54	Pipe - (23)
24	23	50.434	0.00	73.16	0.00	0.00	39.51	0.0	32.6	2.9	117.7	140.5	24.47	30	9.99	6974.68	6979.72	6976.97	6982.21	6981.54	6985.69	Pipe - (24)
25	24	59.439	0.00	73.16	0.00	0.00	39.51	0.0	32.6	2.9	116.0	116.3	24.12	30	6.85	6979.92	6983.99	6982.21	6986.48	6985.69	6990.37	Pipe - (25)
26	25	81.895	73.16	73.16	0.54	39.51	39.51	32.5	32.5	2.9	116.1	140.5	24.15	30	10.00	6984.19	6992.38	6986.48	6994.87	6990.37	7002.00	Pipe - (26)
27	24	55.919	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.80	5.46	3.23	12	2.00	6981.38	6982.50	6982.21	6983.07	6985.69	6986.00	Pipe - (27)
28	21	30.735	0.13	0.13	0.70	0.09	0.09	5.0	5.0	8.4	1.17	5.48	4.45	12	2.02	6970.62	6971.24	6970.93	6971.70	6974.10	6975.25	Pipe - (28)
29	28	15.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.40	5.46	2.49	12	2.00	6971.44	6971.74	6971.70	6972.00	6975.25	6980.65	Pipe - (29)
30	20	41.468	1.53	1.53	0.57	0.87	0.87	8.7	8.7	6.7	5.82	12.20	11.45	12	10.01	6965.50	6969.65	6965.99	6970.60	6969.40	6971.84	Pipe - (30)
31	19	22.413	0.09	0.09	0.51	0.05	0.05	5.0	5.0	8.4	0.39	5.93	3.34	12	2.36	6950.47	6951.00	6950.64	6951.26	6956.50	6955.00	Pipe - (31)
32	End	40.645	0.13	0.13	0.62	0.08	0.08	5.0	5.0	8.4	0.68	5.96	2.03	12	2.39	6983.53	6984.50	6984.20	6984.84	6984.64	6996.54	Pipe - (32)
33	End	21.256	0.12	0.93	0.96	0.12	0.59	5.0	5.7	8.0	4.74	5.16	6.25	12	1.79	6953.00	6953.38	6953.95	6954.28	6954.05	6956.22	Pipe - (33)
34	33	22.625	0.20	0.81	0.59	0.12	0.48	5.5	5.7	8.0	3.84	3.80	5.51	12	0.97	6953.58	6953.80	6954.41	6954.63	6956.22	6956.22	Pipe - (34)
35	34	15.400	0.61	0.61	0.59	0.36	0.36	5.6	5.6	8.1	2.90	9.83	5.14	12	6.49	6954.00	6955.00	6954.63	6955.73	6956.22	6956.10	Pipe - (35)

Project File: 20235 Storm Sewers 100-yr.stm

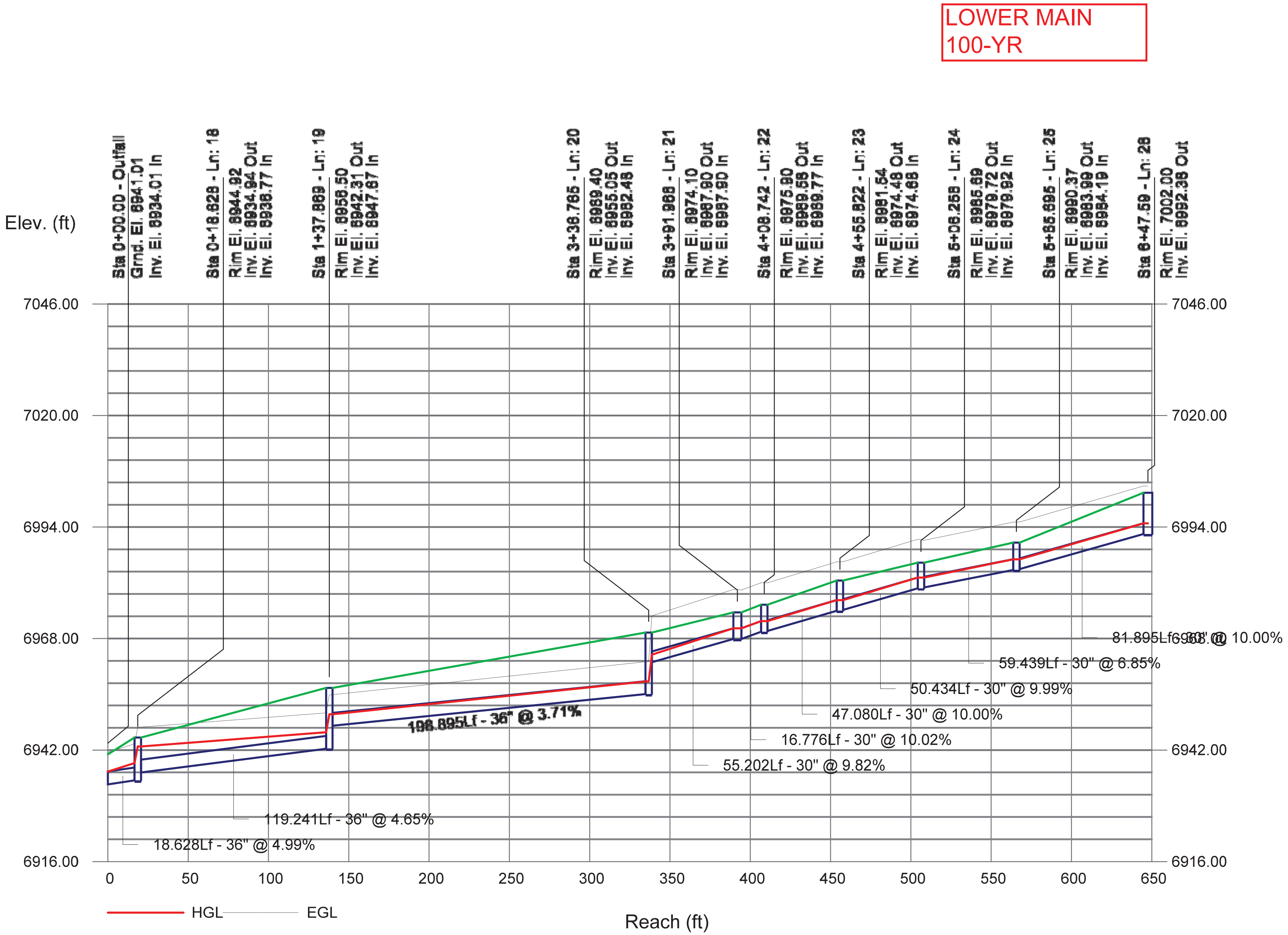
Number of lines: 35

Run Date: 2/28/2024

NOTES:Intensity = 87.89 / (Inlet time + 7.84) ^ 0.92; Return period =Yrs. 100 ; c = cir e = ellip b = box

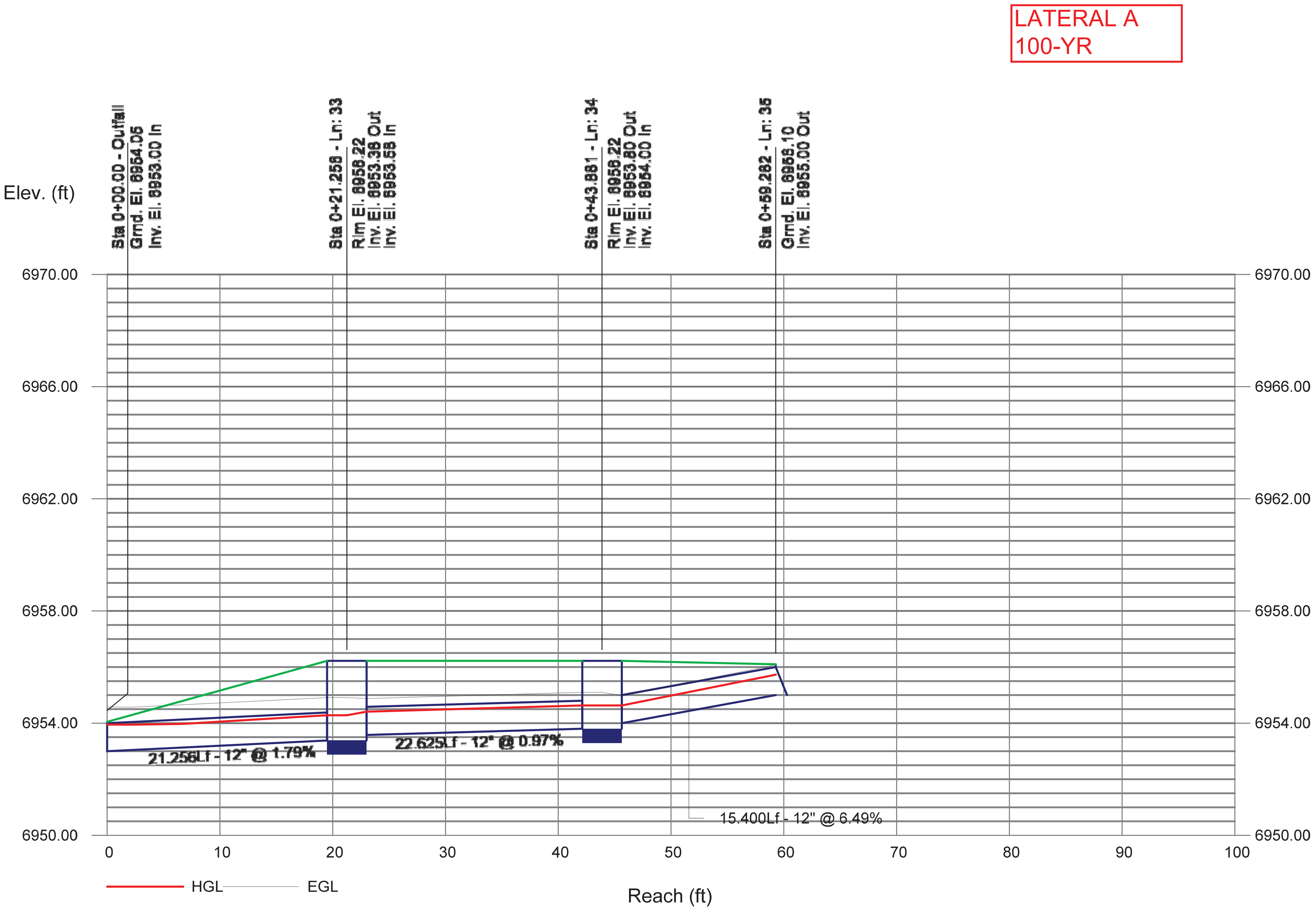
Storm Sewer Profile

Proj. file: 20235 Storm Sewers 100-yr.stm



Storm Sewer Profile

Proj. file: 20235 Storm Sewers 100-yr.stm



Storm Sewer Profile

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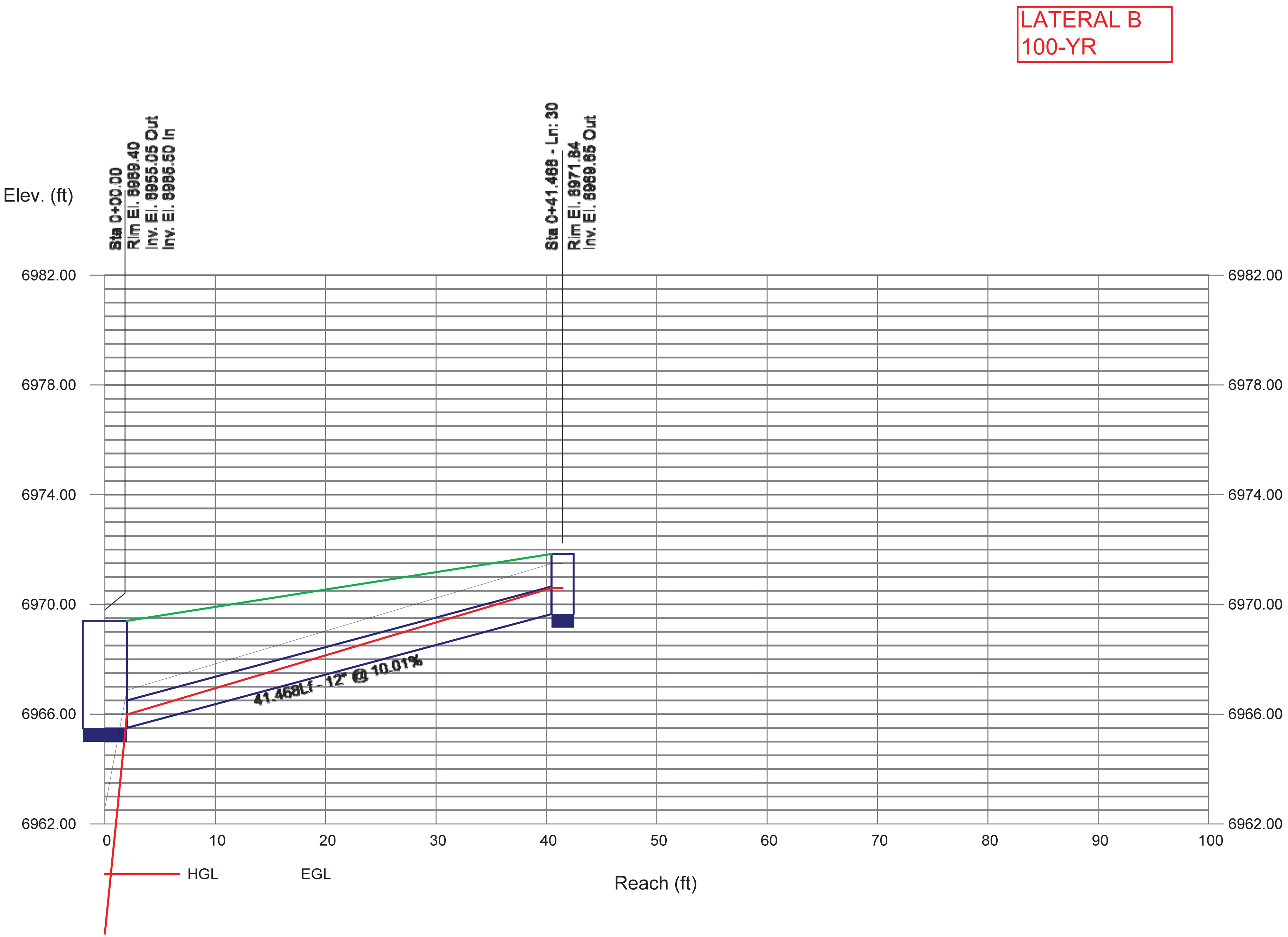
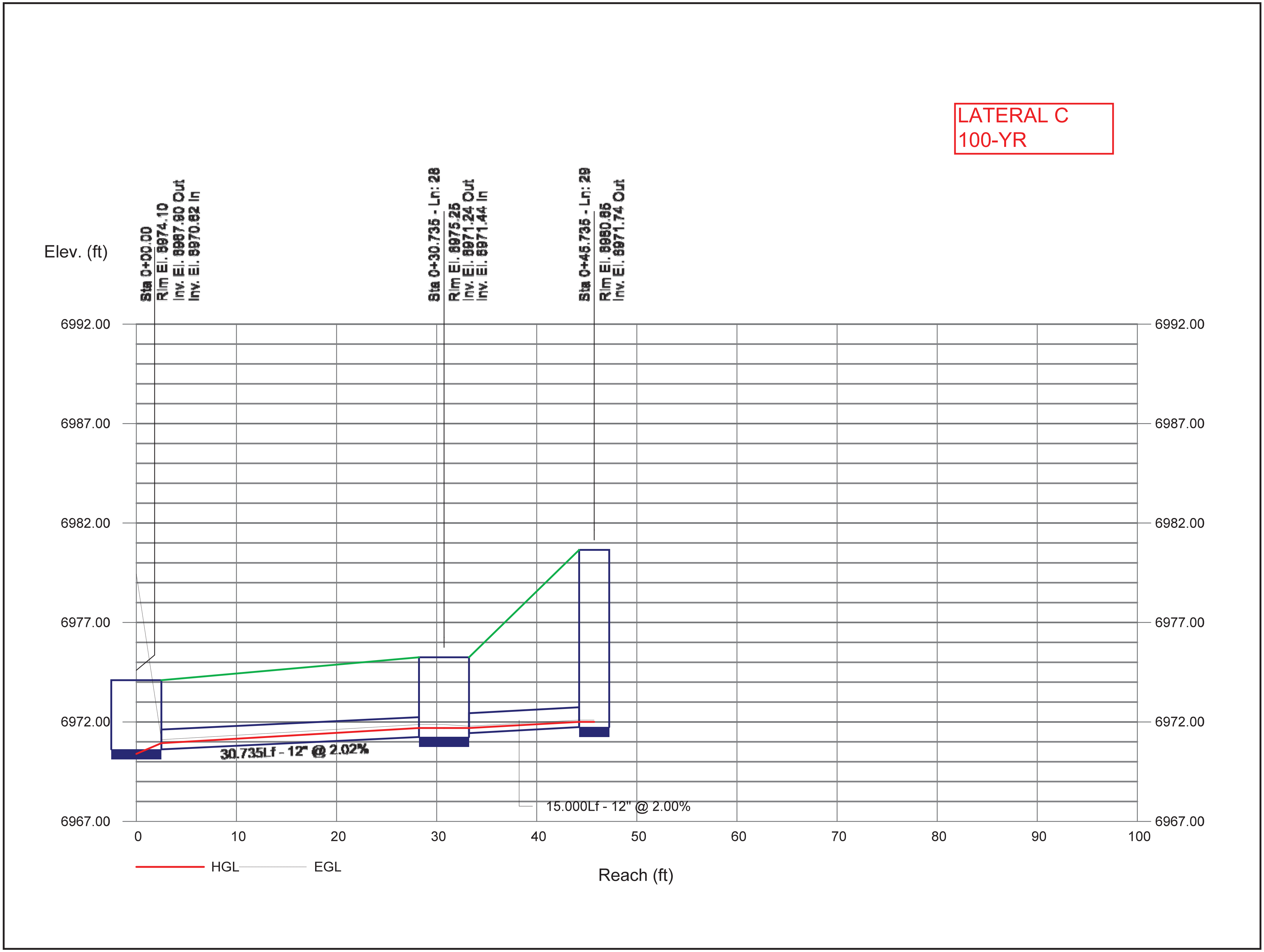


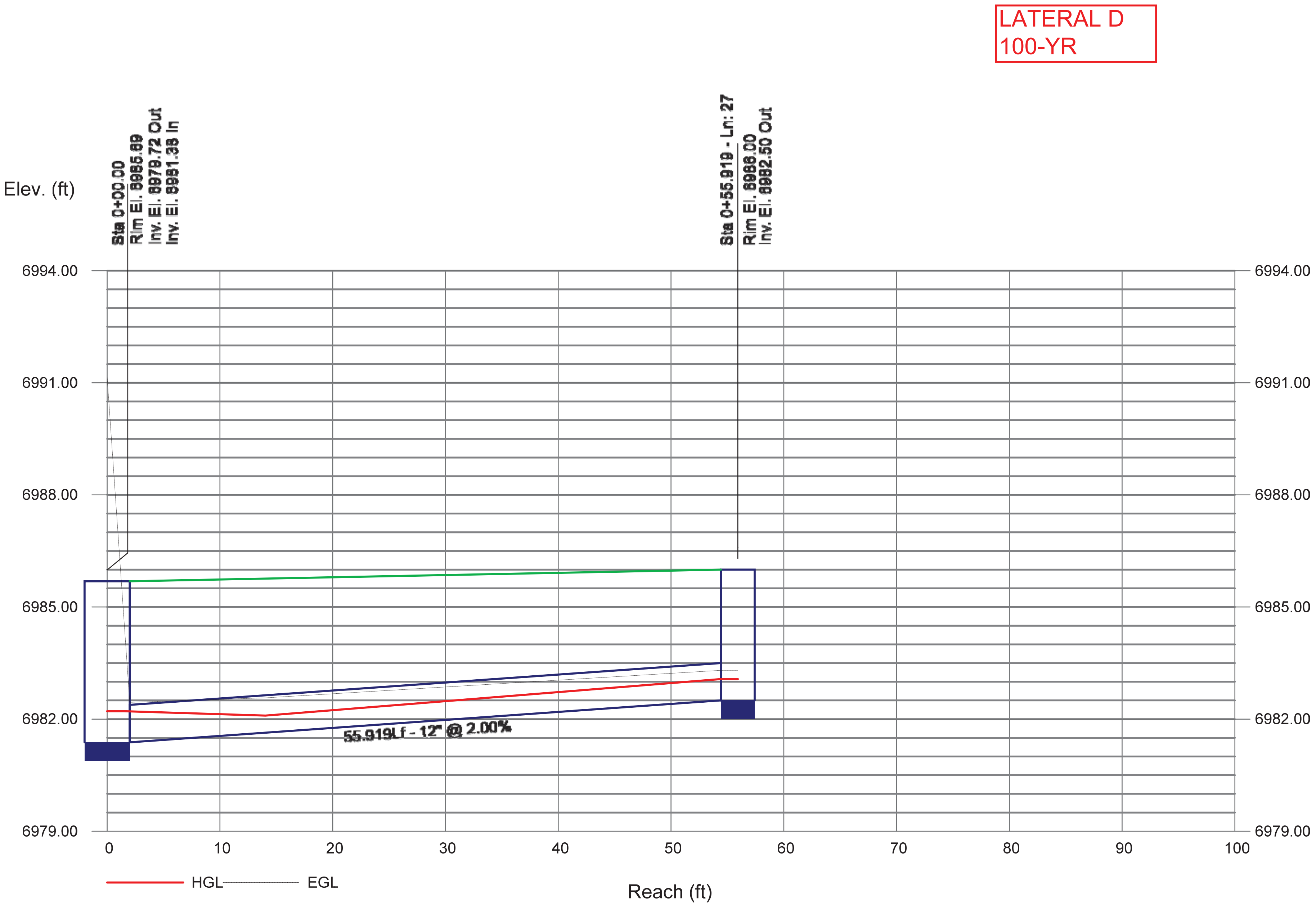
Storm Sewer Profile

Proj. file: 20235 Storm Sewers 100-yr.stm



Storm Sewer Profile

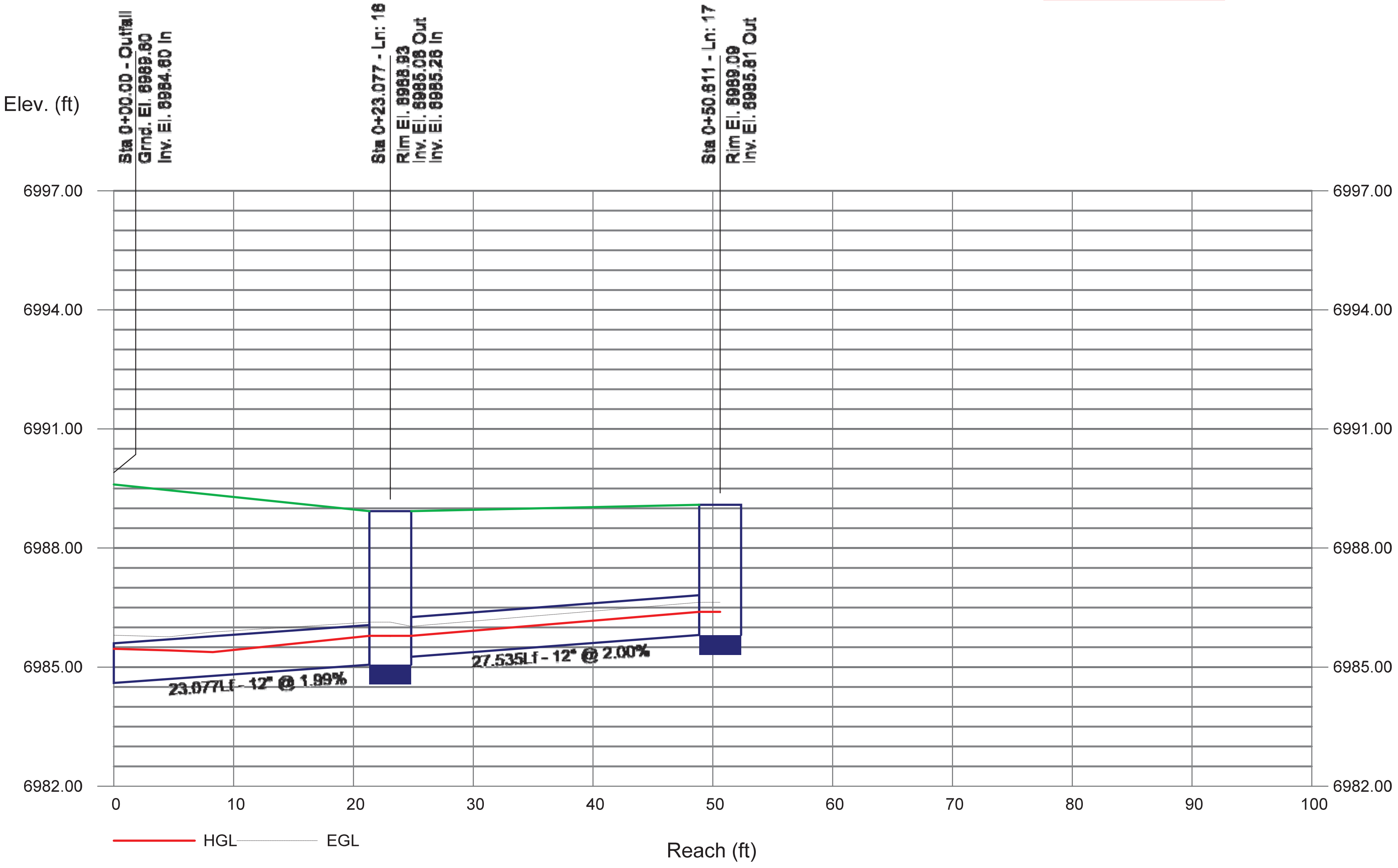
Proj. file: 20235 Storm Sewers 100-yr.stm



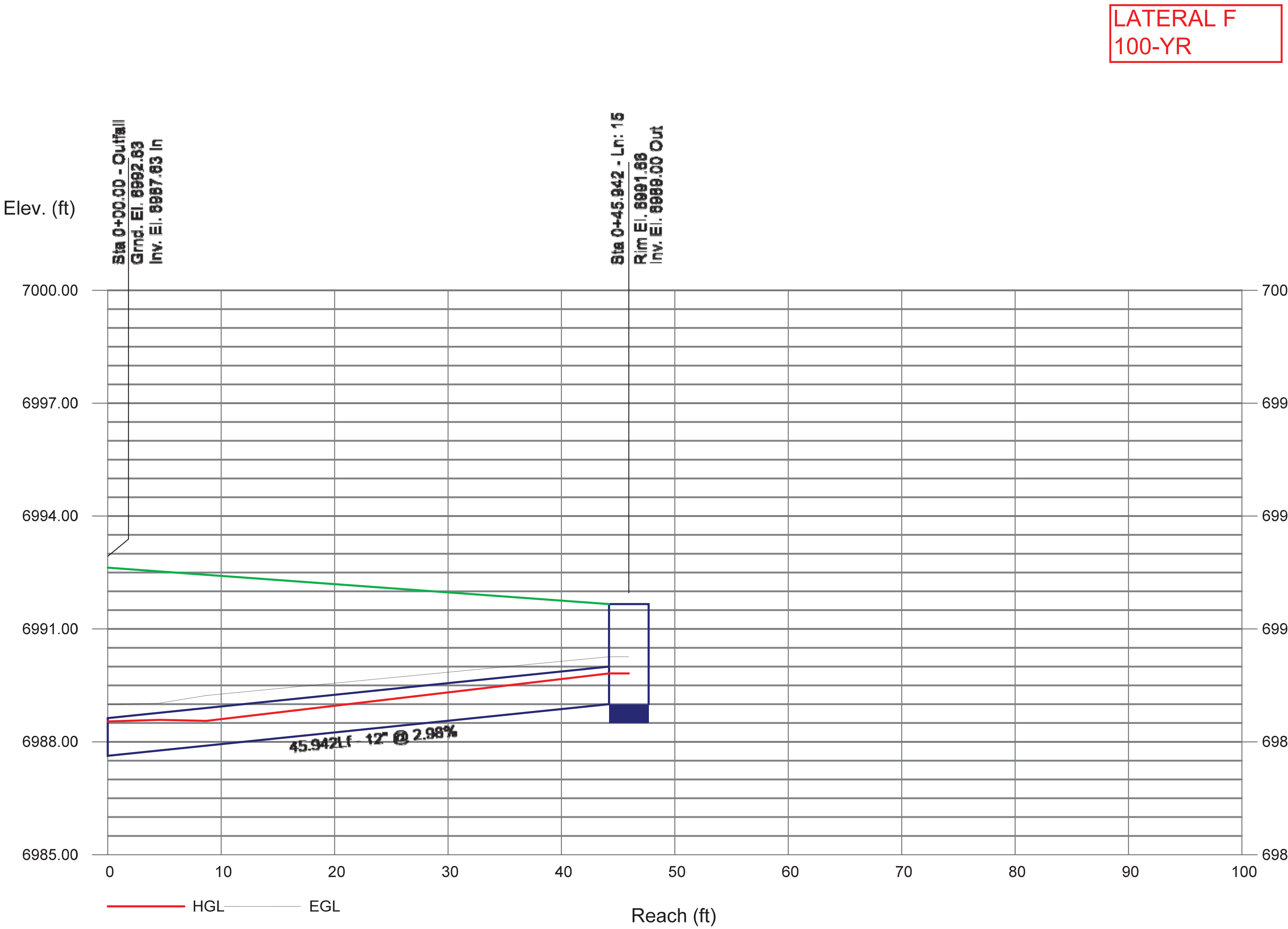
Storm Sewer Profile

Proj. file: 20235 Storm Sewers 100-yr.stm

LATERAL E
100-YR



Storm Sewer Profile



Storm Sewer Profile

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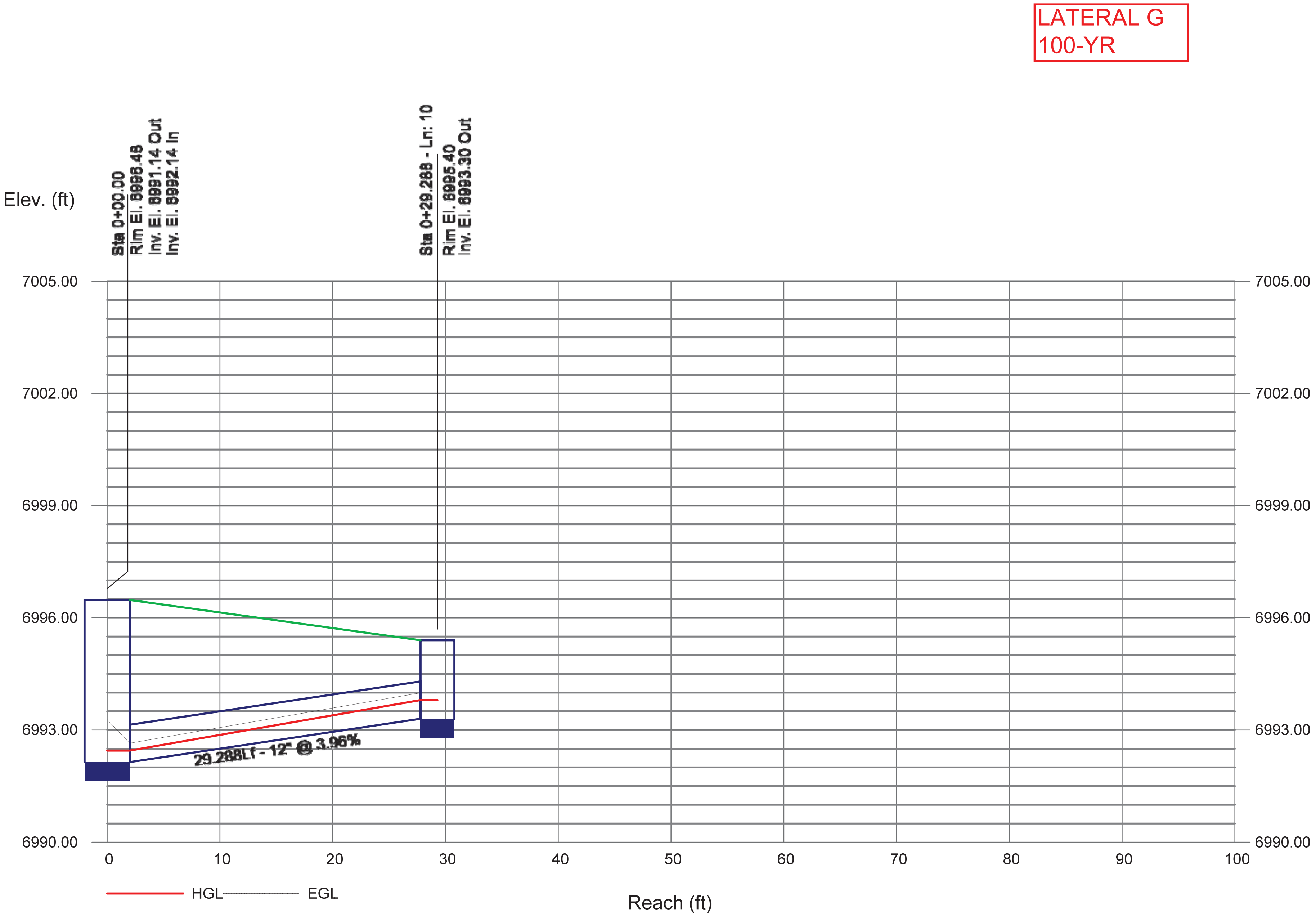

Storm Sewer Profile

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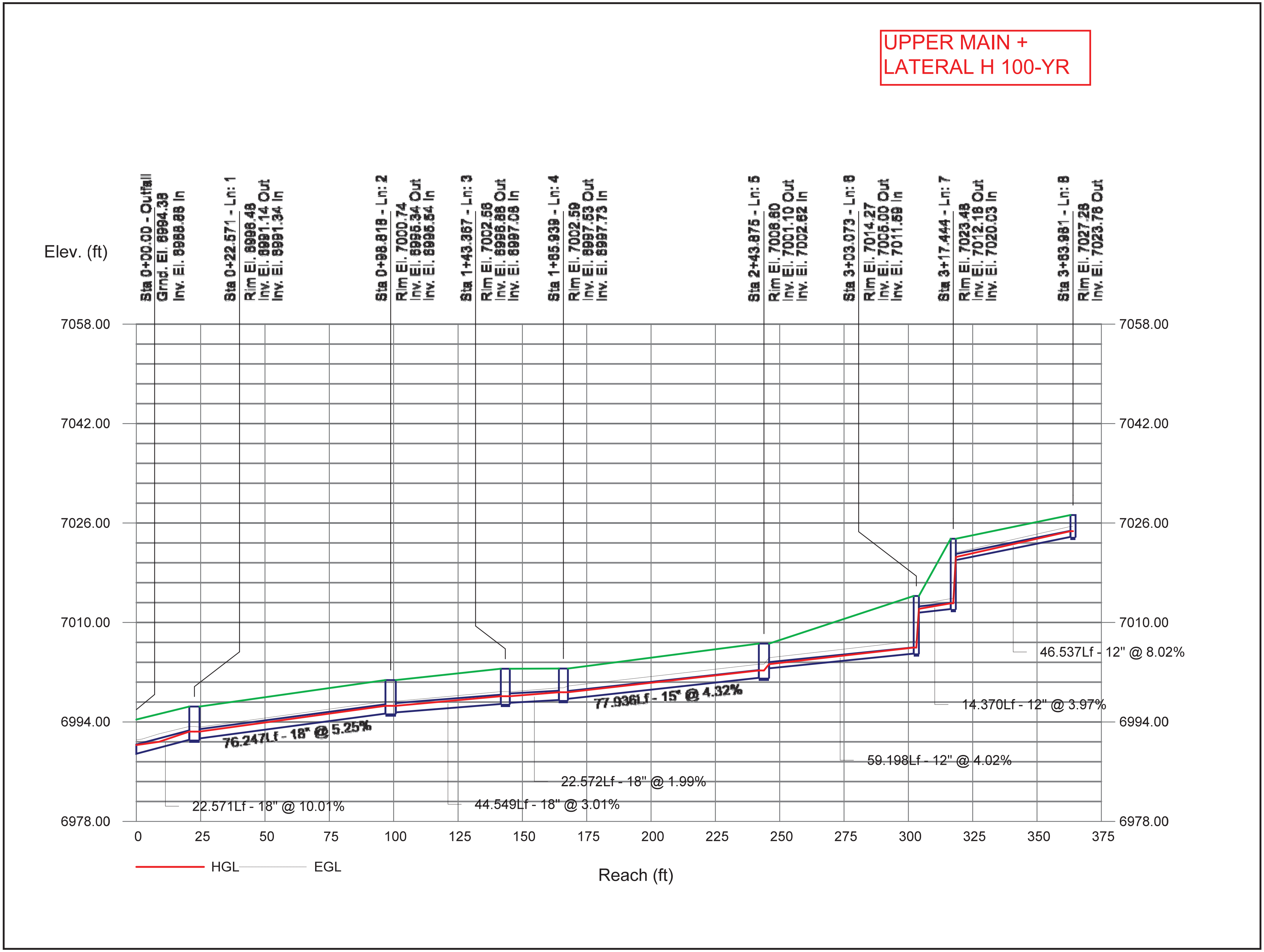

Storm Sewer Profile

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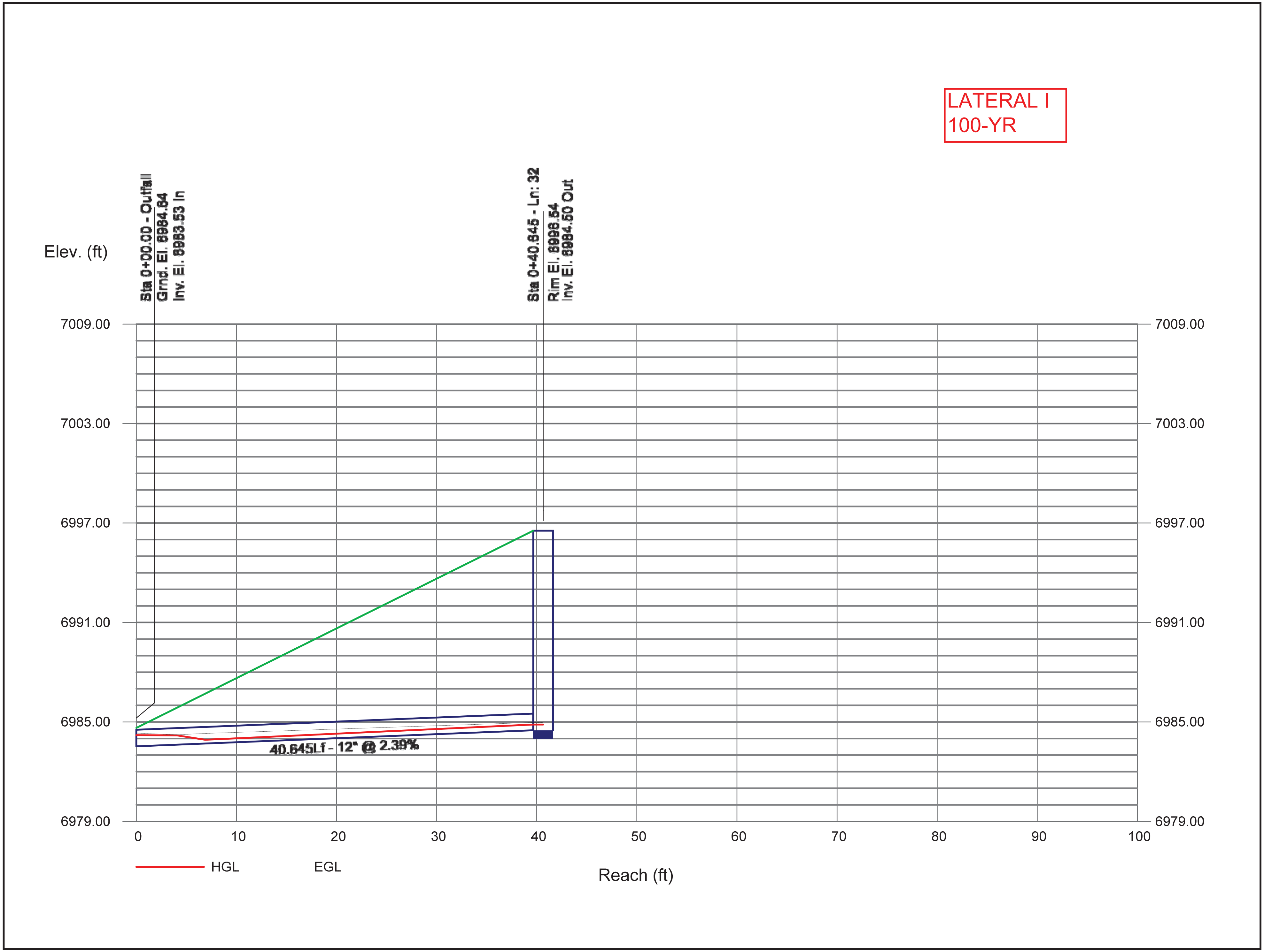
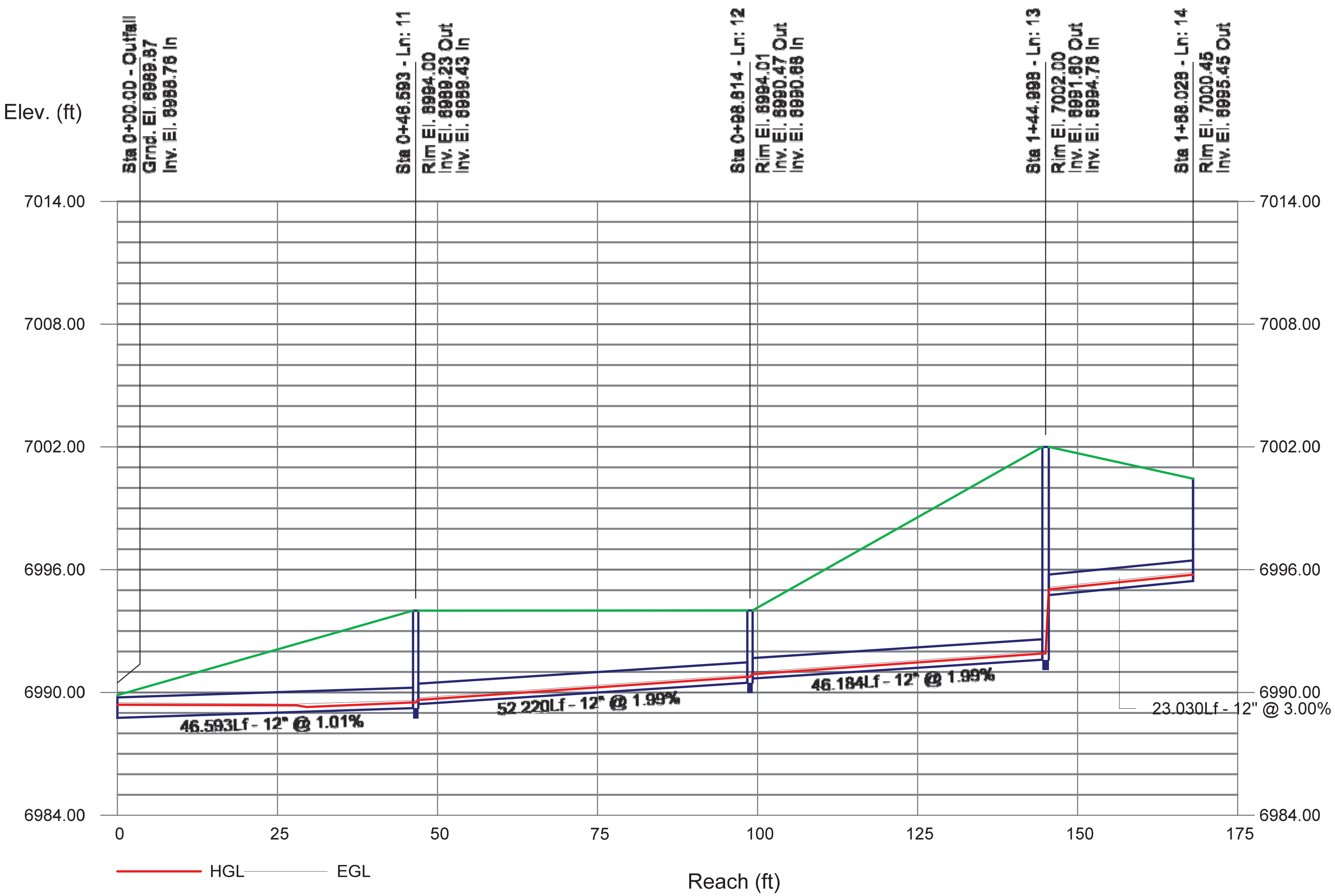


Storm Sewer Profile

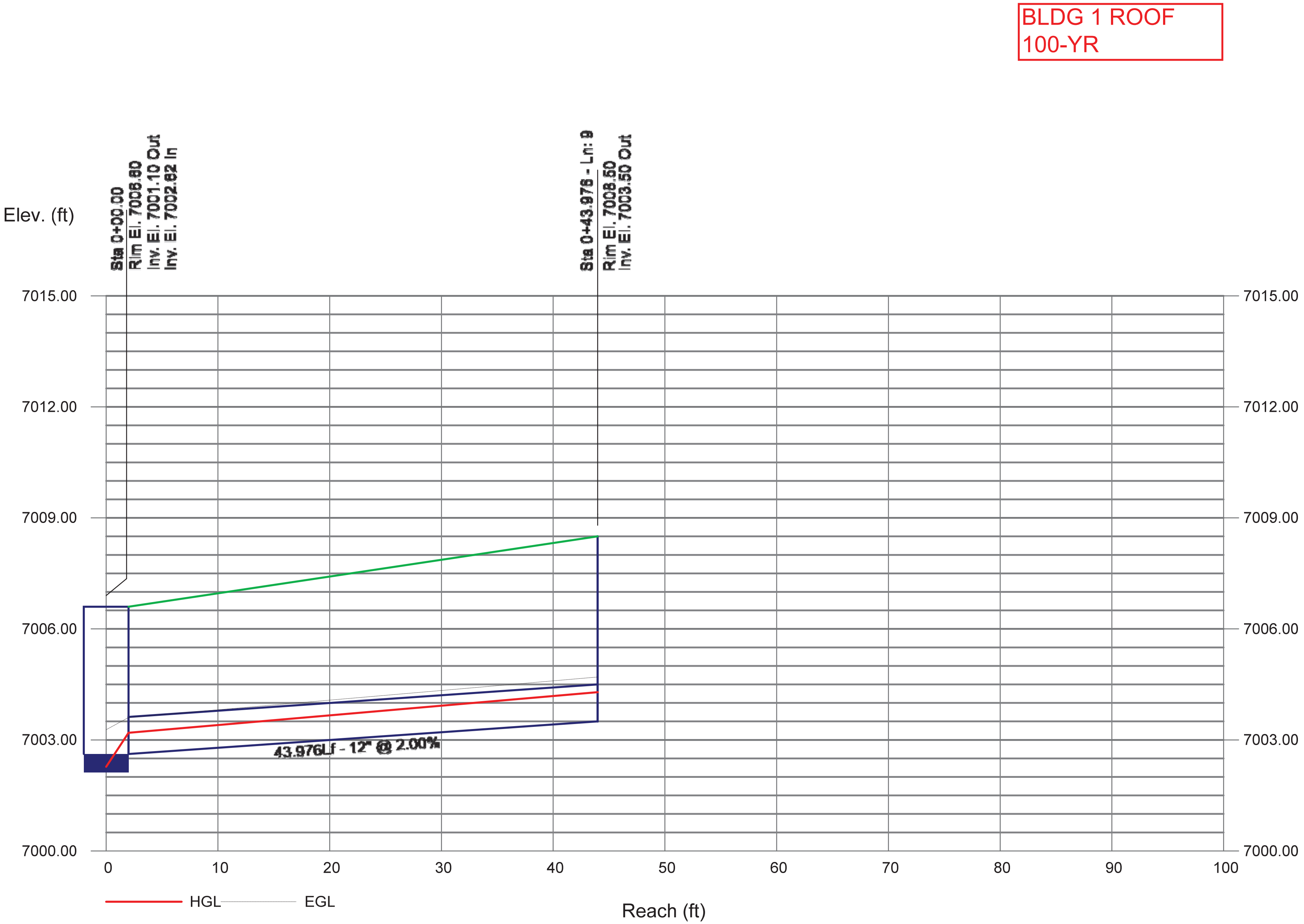
Proj. file: 20235 Storm Sewers 100-yr.stm

LATERAL J
100-YR



Storm Sewer Profile

Proj. file: 20235 Storm Sewers 100-yr.stm



Storm Sewer Tabulation

Station		Len (ft)	Drng Area		Rnoff coeff (C)	Area x C		Tc		Rain (I) (in/hr)	Total flow (cfs)	Cap full (cfs)	Vel (ft/s)	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr (ac)	Total (ac)		Incr	Total	Inlet (min)	Syst (min)					Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	22.571	0.00	2.08	0.00	0.00	1.20	0.0	7.4	3.3	3.94	36.00	3.34	18	10.01	6988.88	6991.14	6990.29	6991.90	0.00	6996.48	Pipe - (1)
2	1	76.247	0.00	1.90	0.00	0.00	1.04	0.0	6.8	3.4	3.57	26.06	5.10	18	5.25	6991.34	6995.34	6991.90	6996.06	6996.48	7000.74	Pipe - (2)
3	2	44.549	0.05	1.90	0.77	0.04	1.04	5.0	6.5	3.5	3.65	19.73	5.49	18	3.01	6995.54	6996.88	6996.06	6997.61	7000.74	7002.56	Pipe - (3)
4	3	22.572	0.21	1.85	0.45	0.09	1.01	5.0	6.3	3.5	3.56	16.06	5.32	18	1.99	6997.08	6997.53	6997.61	6998.25	7002.56	7002.59	Pipe - (4)
5	4	77.936	0.00	1.64	0.00	0.00	0.91	0.0	5.8	3.6	3.33	14.55	5.67	15	4.32	6997.73	7001.10	6998.25	7001.83	7002.59	7006.60	Pipe - (5)
6	5	59.198	0.25	1.15	0.16	0.04	0.54	5.0	5.4	3.7	2.04	7.74	6.18	12	4.02	7002.62	7005.00	7002.97	7005.61	7006.60	7014.27	Pipe - (6)
7	6	14.370	0.00	0.90	0.00	0.00	0.50	0.0	5.3	3.8	1.90	7.69	6.04	12	3.97	7011.59	7012.16	7011.93	7012.75	7014.27	7023.48	Pipe - (7)
8	7	46.537	0.90	0.90	0.56	0.50	0.50	5.0	5.0	3.9	1.94	10.92	7.25	12	8.02	7020.03	7023.76	7020.32	7024.35	7023.48	7027.28	Pipe - (8)
9	5	43.976	0.49	0.49	0.75	0.37	0.37	5.0	5.0	3.9	1.42	5.46	4.71	12	2.00	7002.62	7003.50	7002.97	7004.00	7006.60	0.00	Pipe - (9)
10	1	29.288	0.18	0.18	0.85	0.15	0.15	5.0	5.0	3.9	0.59	7.68	4.26	12	3.96	6992.14	6993.30	6992.33	6993.62	6996.48	6995.40	Pipe - (10)
11	End	46.593	0.00	0.09	0.00	0.00	0.05	0.0	12.8	2.5	0.13	3.88	1.04	12	1.01	6988.76	6989.23	6989.40	6989.38	6989.87	6994.00	Pipe - (11)
12	11	52.220	0.00	0.09	0.00	0.00	0.05	0.0	9.4	2.9	0.16	5.44	2.50	12	1.99	6989.43	6990.47	6989.55	6990.63	6994.00	6994.01	Pipe - (12)
13	12	46.184	0.00	0.09	0.00	0.00	0.05	0.0	6.4	3.5	0.19	5.44	2.62	12	1.99	6990.68	6991.60	6990.81	6991.78	6994.01	7002.00	Pipe - (13)
14	13	23.030	0.09	0.09	0.60	0.05	0.05	5.0	5.0	3.9	0.21	3.34	2.21	12	3.00	6994.76	6995.45	6994.93	6995.64	7002.00	0.00	Pipe - (14)
15	End	45.942	0.72	0.72	0.43	0.31	0.31	5.3	5.3	3.8	1.17	6.66	2.46	12	2.98	6987.63	6989.00	6988.54	6989.46	0.00	6991.66	Pipe - (15)
16	End	23.077	0.13	0.50	0.90	0.12	0.26	5.0	5.6	3.7	0.96	5.45	2.25	12	1.99	6984.60	6985.06	6985.46	6985.47	0.00	6988.93	Pipe - (16)
17	16	27.535	0.37	0.37	0.39	0.14	0.14	5.0	5.0	3.9	0.56	5.45	3.58	12	2.00	6985.26	6985.81	6985.48	6986.12	6988.93	6989.09	Pipe - (17)
18	End	18.628	0.00	75.07	0.00	0.00	17.47	0.0	35.2	1.3	23.16	80.73	4.79	36	4.99	6934.01	6934.94	6936.98	6936.49	0.00	6944.92	Pipe - (18)
19	18	119.241	0.00	75.07	0.00	0.00	17.47	0.0	34.6	1.3	23.46	155.7	11.09	36	4.65	6936.77	6942.31	6937.56	6943.87	6944.92	6956.50	Pipe - (19)
20	19	198.895	0.00	74.98	0.00	0.00	17.46	0.0	33.6	1.3	23.93	139.2	10.54	36	3.71	6947.67	6955.05	6948.51	6956.63	6956.50	6969.40	Pipe - (20)
21	20	55.202	0.16	73.45	0.35	0.06	16.96	5.0	33.4	1.3	23.36	139.2	13.95	30	9.82	6962.48	6967.90	6963.17	6969.54	6969.40	6974.10	Pipe - (21)
22	21	16.776	0.00	73.16	0.00	0.00	16.83	0.0	33.4	1.3	23.12	140.6	6.78	30	10.02	6967.90	6969.58	6969.54	6971.22	6974.10	6975.90	Pipe - (22)

Project File: 20235 Storm Sewers 5-yr.stm

Number of lines: 35

Run Date: 2/28/2024

NOTES:Intensity = 40.26 / (Inlet time + 7.84) ^ 0.92; Return period =Yrs. 5 ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
23	22	47.080	0.00	73.16	0.00	0.00	16.83	0.0	33.2	1.3	23.21	140.5	7.35	30	10.00	6969.77	6974.48	6971.22	6976.12	6975.90	6981.54	Pipe - (23)
24	23	50.434	0.00	73.16	0.00	0.00	16.83	0.0	33.0	1.3	23.30	140.5	7.39	30	9.99	6974.68	6979.72	6976.12	6981.36	6981.54	6985.69	Pipe - (24)
25	24	59.439	0.00	73.16	0.00	0.00	16.83	0.0	32.8	1.3	22.51	116.3	7.20	30	6.85	6979.92	6983.99	6981.36	6985.60	6985.69	6990.37	Pipe - (25)
26	25	81.895	73.16	73.16	0.23	16.83	16.83	32.5	32.5	1.3	22.66	140.5	7.33	30	10.00	6984.19	6992.38	6985.60	6994.00	6990.37	7002.00	Pipe - (26)
27	24	55.919	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.90	5.46	4.11	12	2.00	6981.38	6982.50	6981.66	6982.90	6985.69	6986.00	Pipe - (27)
28	21	30.735	0.13	0.13	0.56	0.07	0.07	5.0	5.0	3.9	0.38	5.48	3.21	12	2.02	6970.62	6971.24	6970.80	6971.50	6974.10	6975.25	Pipe - (28)
29	28	15.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.10	5.46	2.18	12	2.00	6971.44	6971.74	6971.53	6971.87	6975.25	6980.65	Pipe - (29)
30	20	41.468	1.53	1.53	0.33	0.50	0.50	8.7	8.7	3.1	1.54	12.20	7.15	12	10.01	6965.50	6969.65	6965.74	6970.18	6969.40	6971.84	Pipe - (30)
31	19	22.413	0.09	0.09	0.16	0.01	0.01	5.0	5.0	3.9	0.06	5.93	1.91	12	2.36	6950.47	6951.00	6950.54	6951.10	6956.50	6955.00	Pipe - (31)
32	End	40.645	0.13	0.13	0.44	0.06	0.06	5.0	5.0	3.9	0.22	5.96	1.24	12	2.39	6983.53	6984.50	6984.20	6984.69	6984.64	6996.54	Pipe - (32)
33	End	21.256	0.12	0.93	0.90	0.11	0.41	5.0	6.1	3.6	1.48	5.16	2.77	12	1.79	6953.00	6953.38	6953.95	6953.90	6954.05	6956.22	Pipe - (33)
34	33	22.625	0.20	0.81	0.37	0.07	0.31	5.5	5.8	3.6	1.11	3.80	3.75	12	0.97	6953.58	6953.80	6953.95	6954.24	6956.22	6956.22	Pipe - (34)
35	34	15.400	0.61	0.61	0.38	0.23	0.23	5.6	5.6	3.7	0.86	9.83	4.42	12	6.49	6954.00	6955.00	6954.24	6955.39	6956.22	6956.10	Pipe - (35)

Project File: 20235 Storm Sewers 5-yr.stm

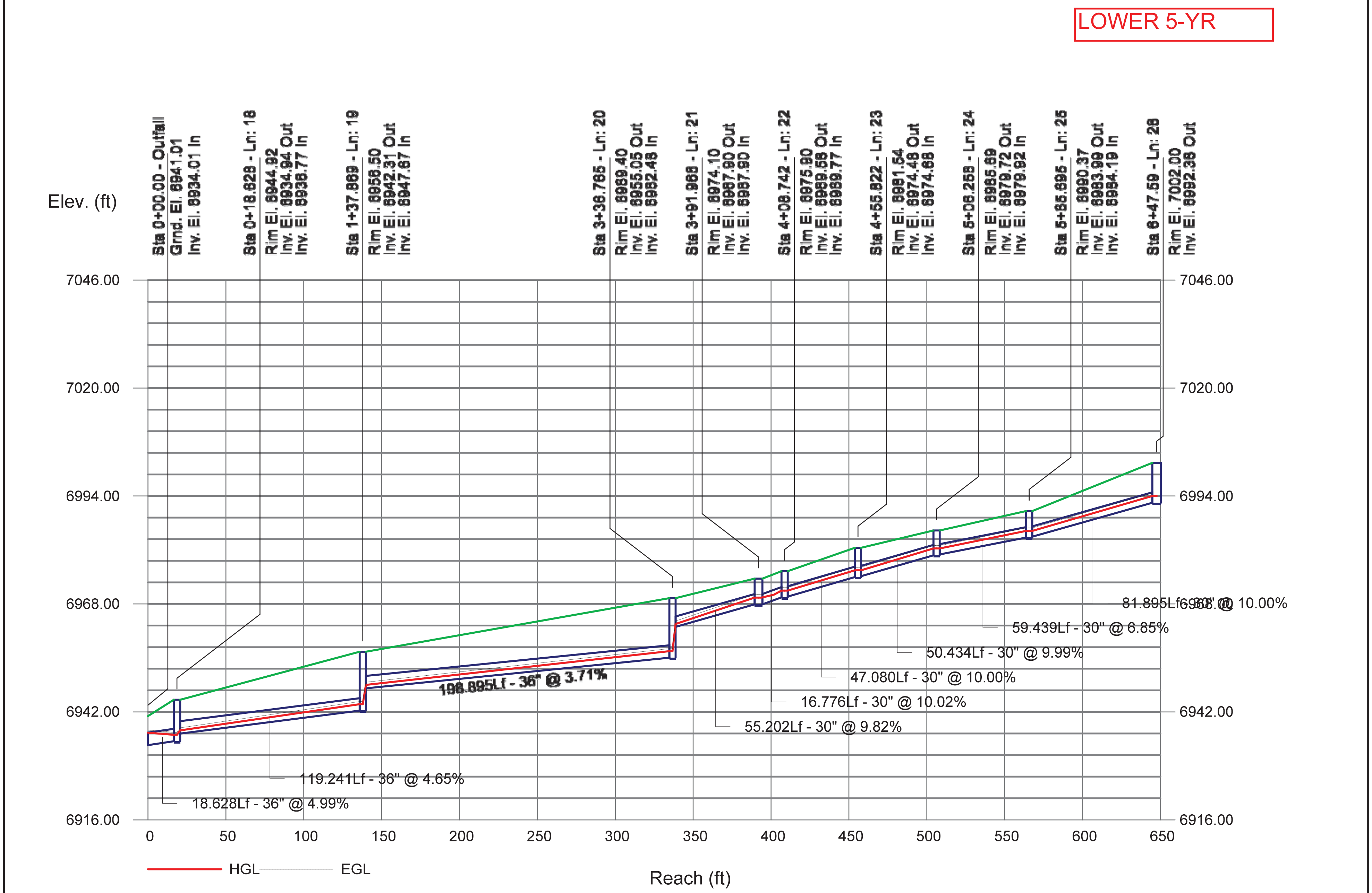
Number of lines: 35

Run Date: 2/28/2024

NOTES:Intensity = 40.26 / (Inlet time + 7.84) ^ 0.92; Return period =Yrs. 5 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: 20235 Storm Sewers 5-yr.stm



Storm Sewer Profile

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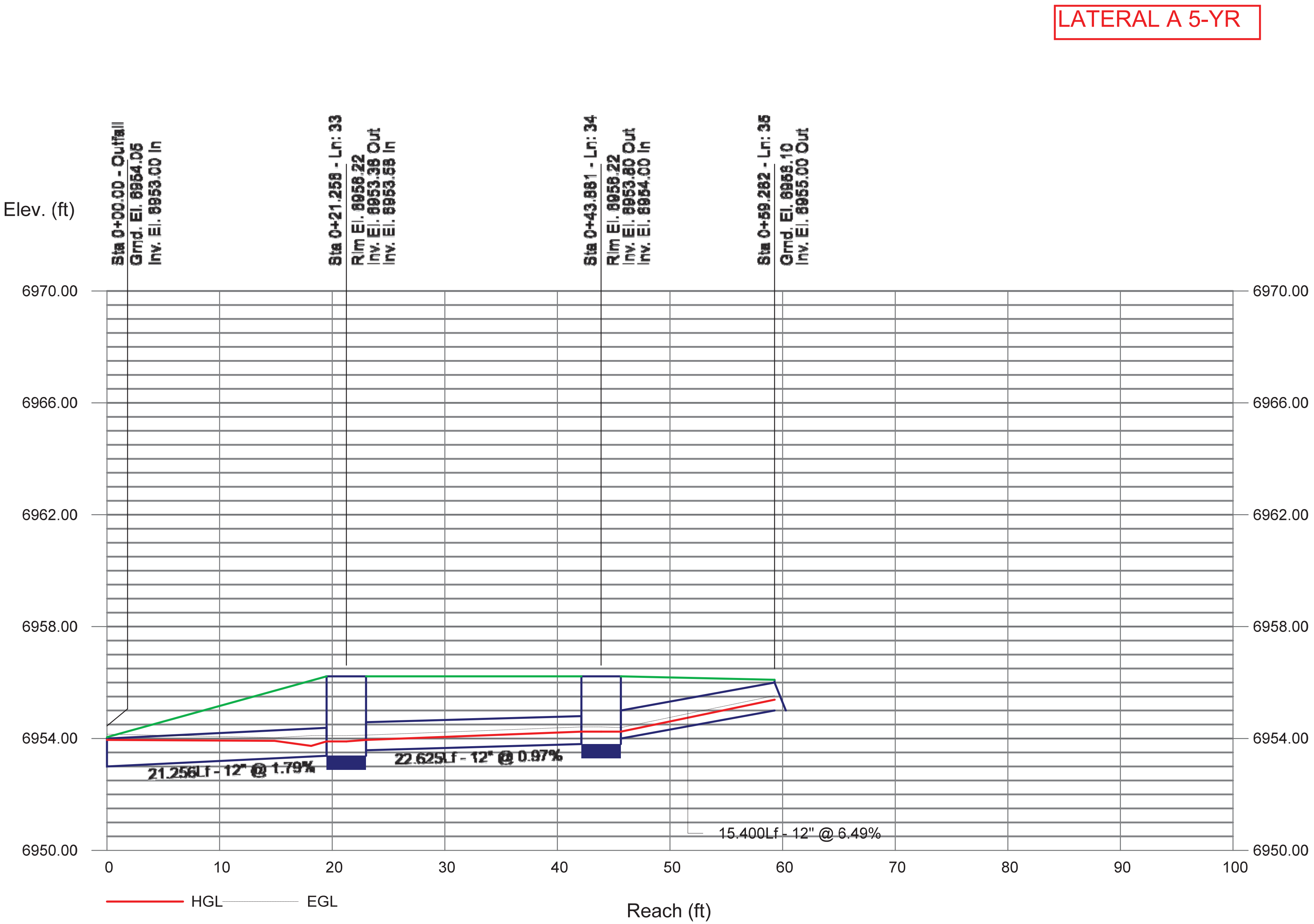

Storm Sewer Profile

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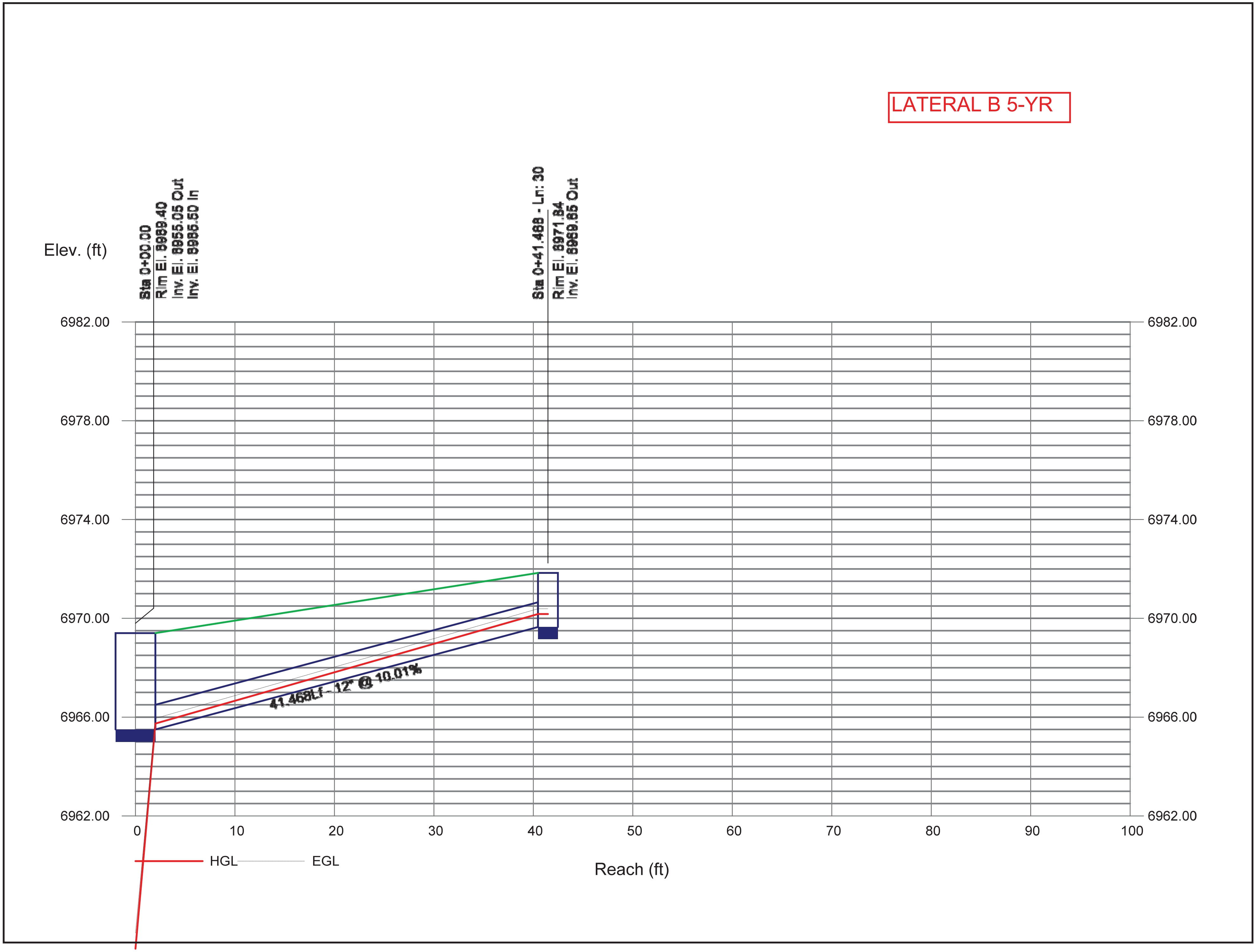

Storm Sewer Profile

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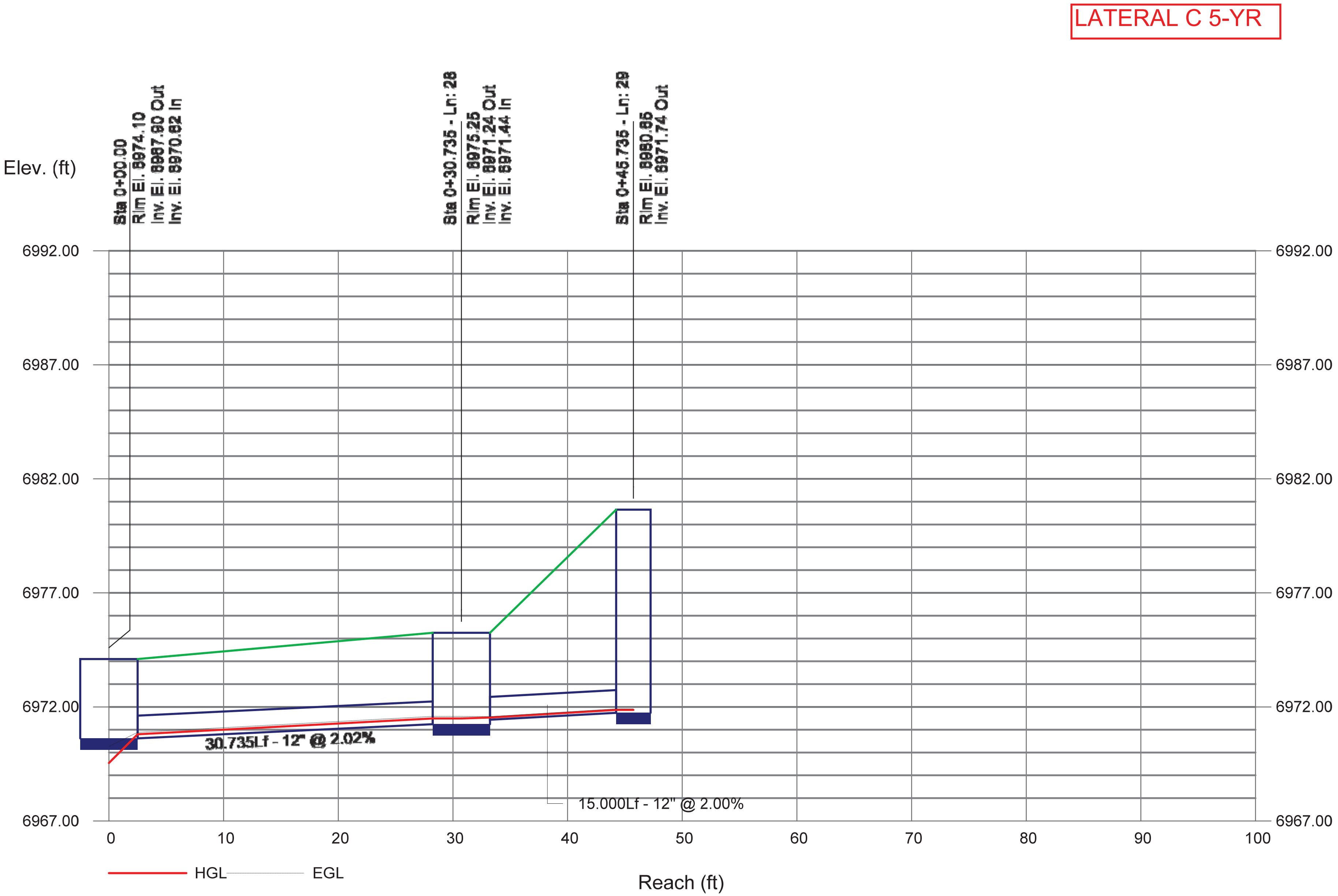

Storm Sewer Profile

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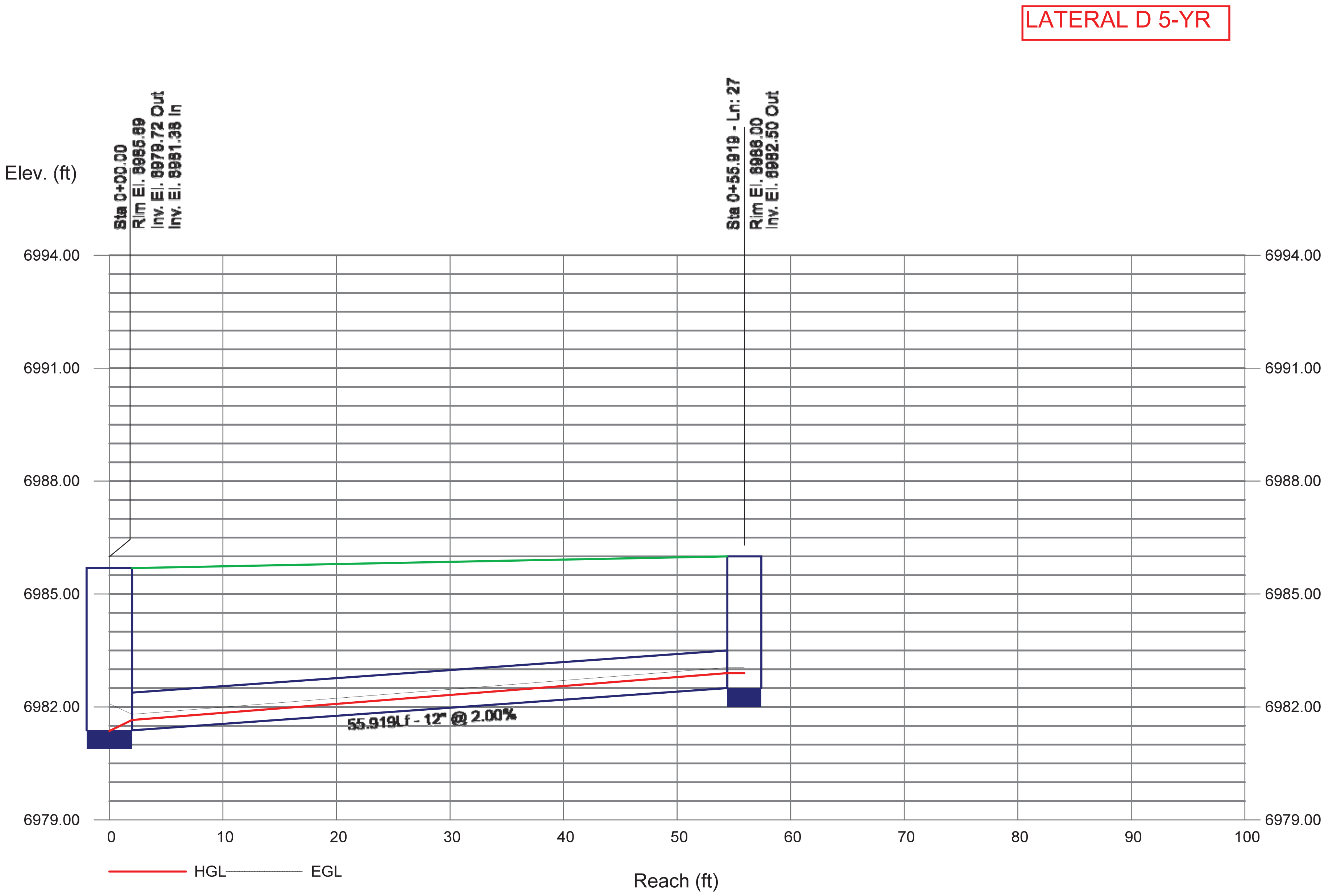

Storm Sewer Profile

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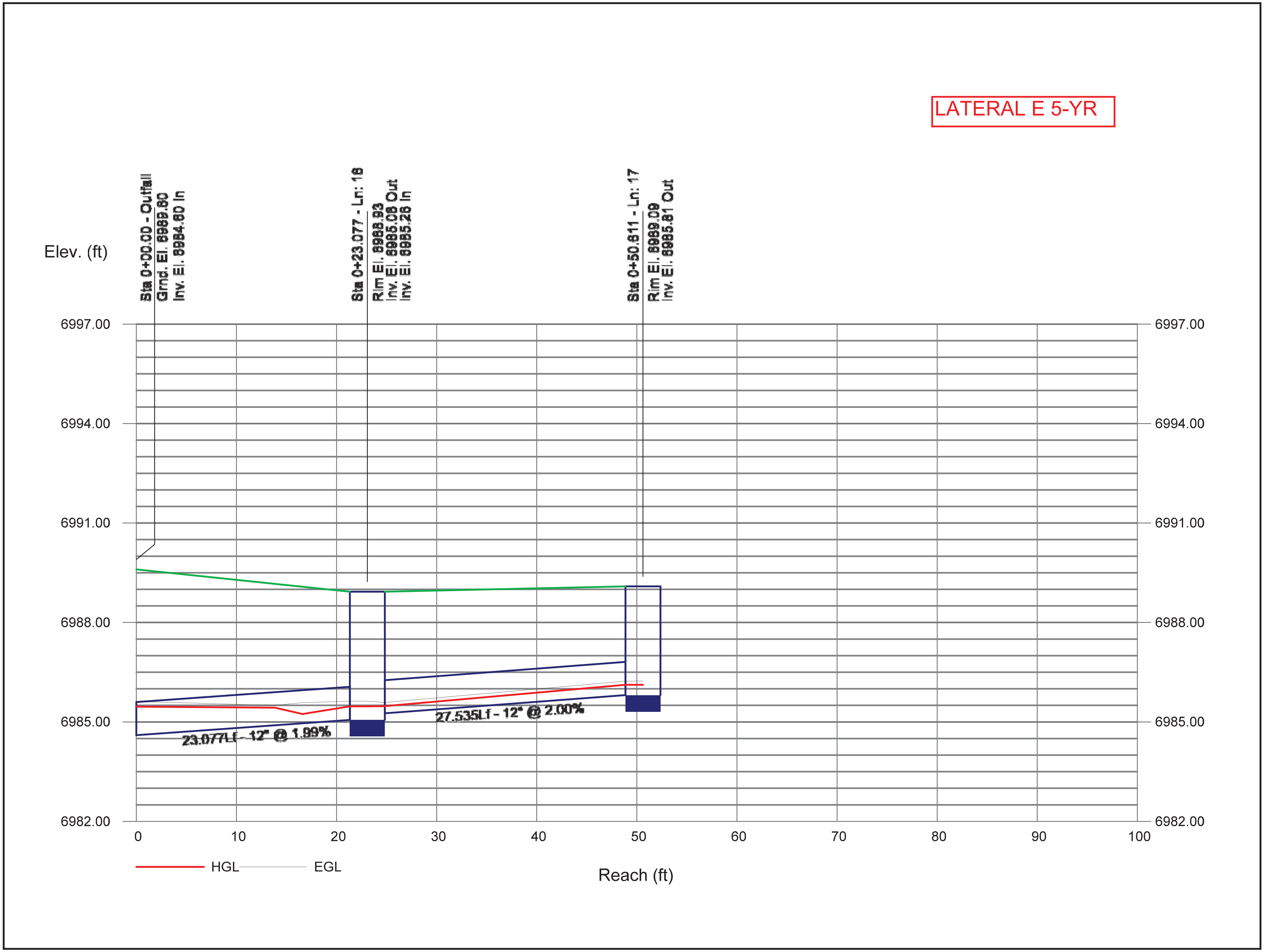

Storm Sewer Profile

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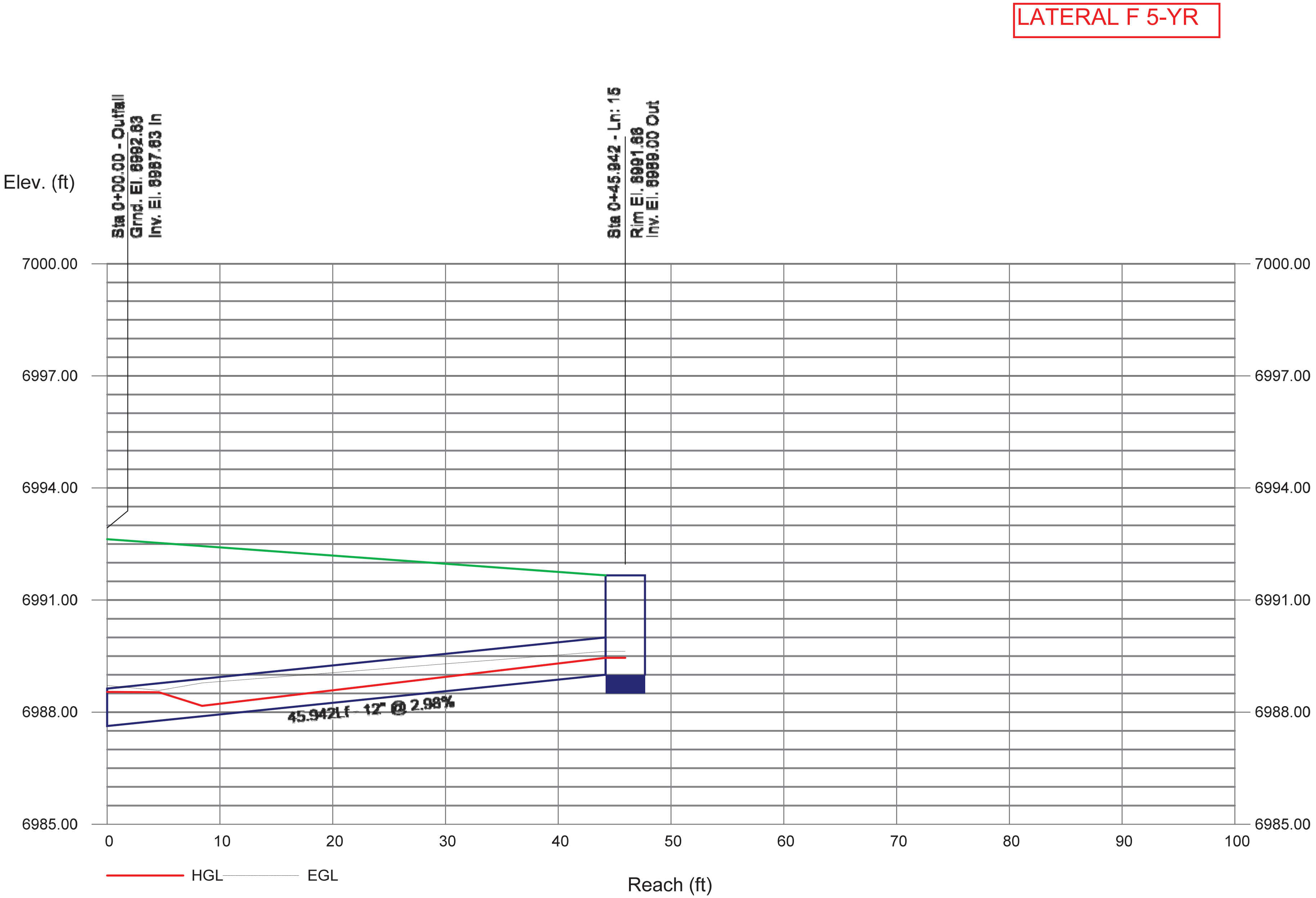

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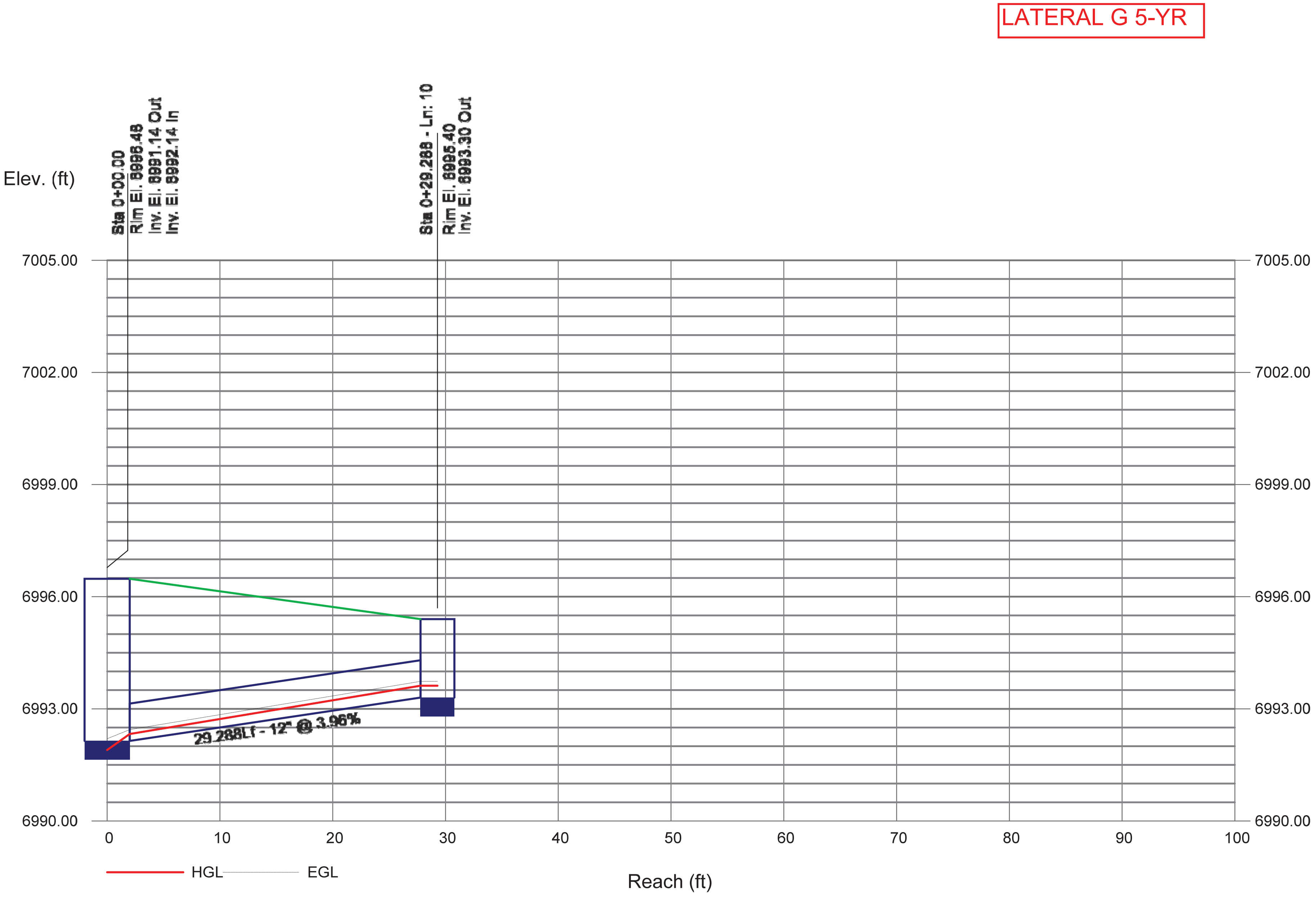

Storm Sewer Profile

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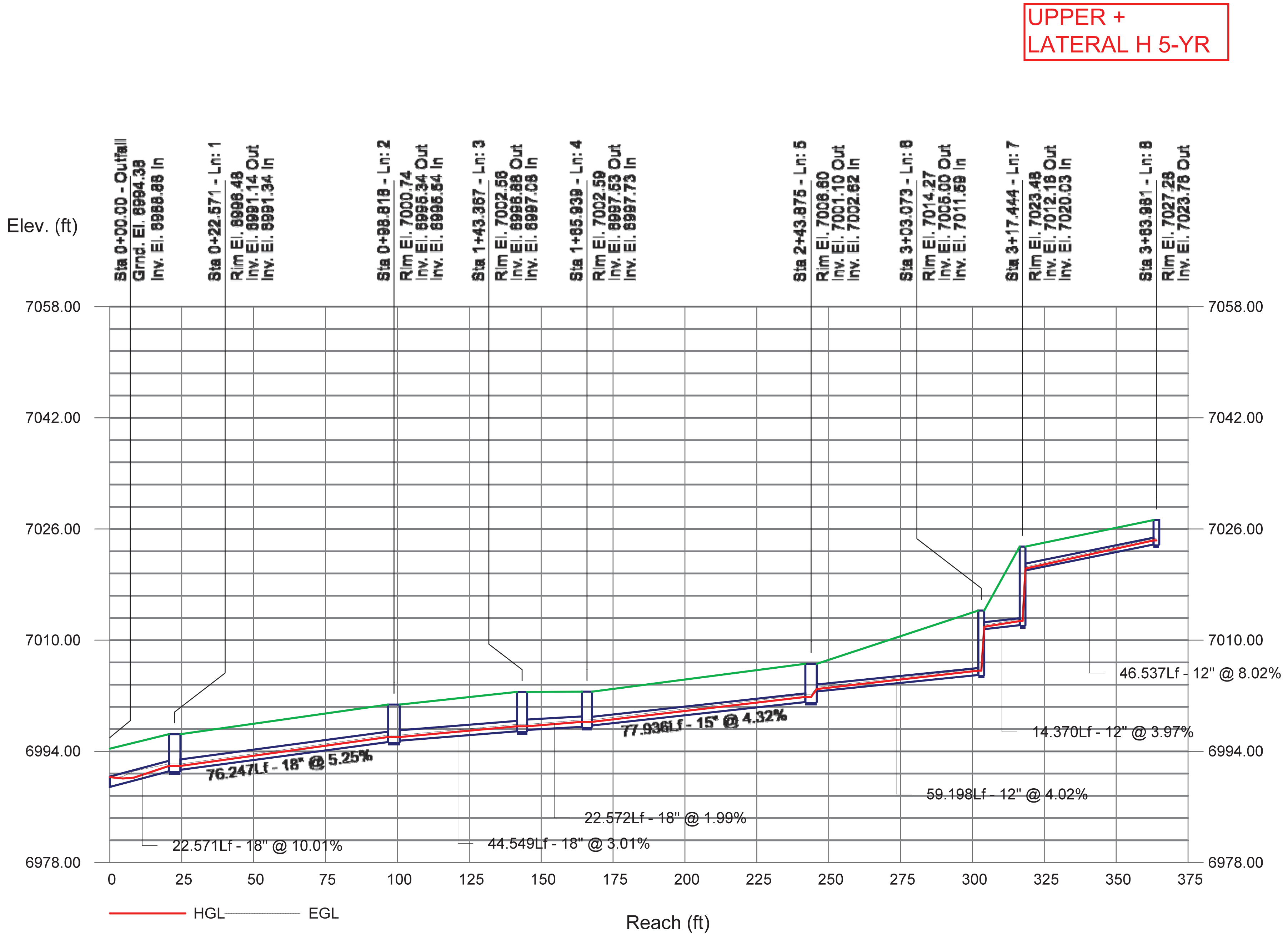

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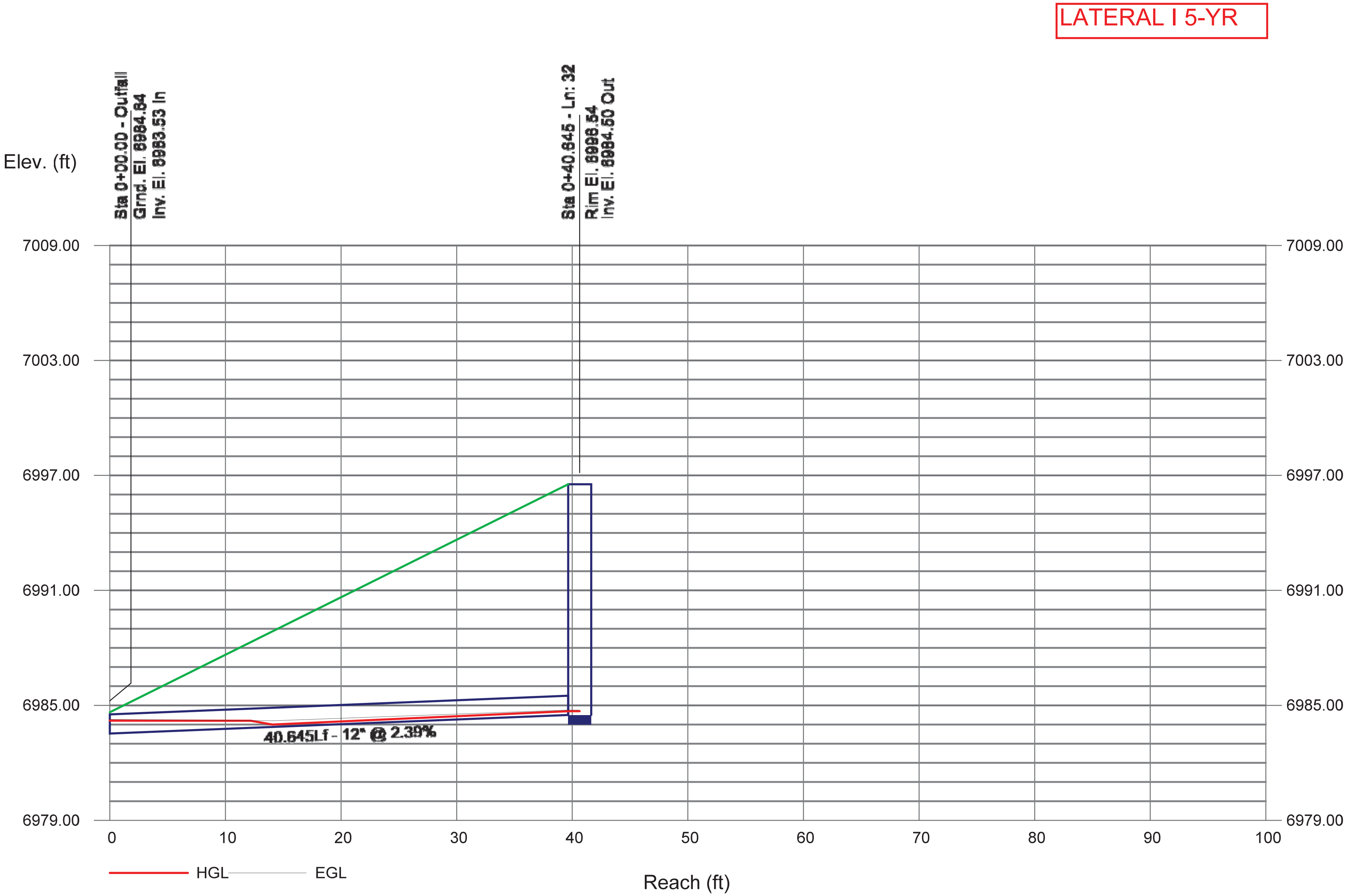

Storm Sewer Profile

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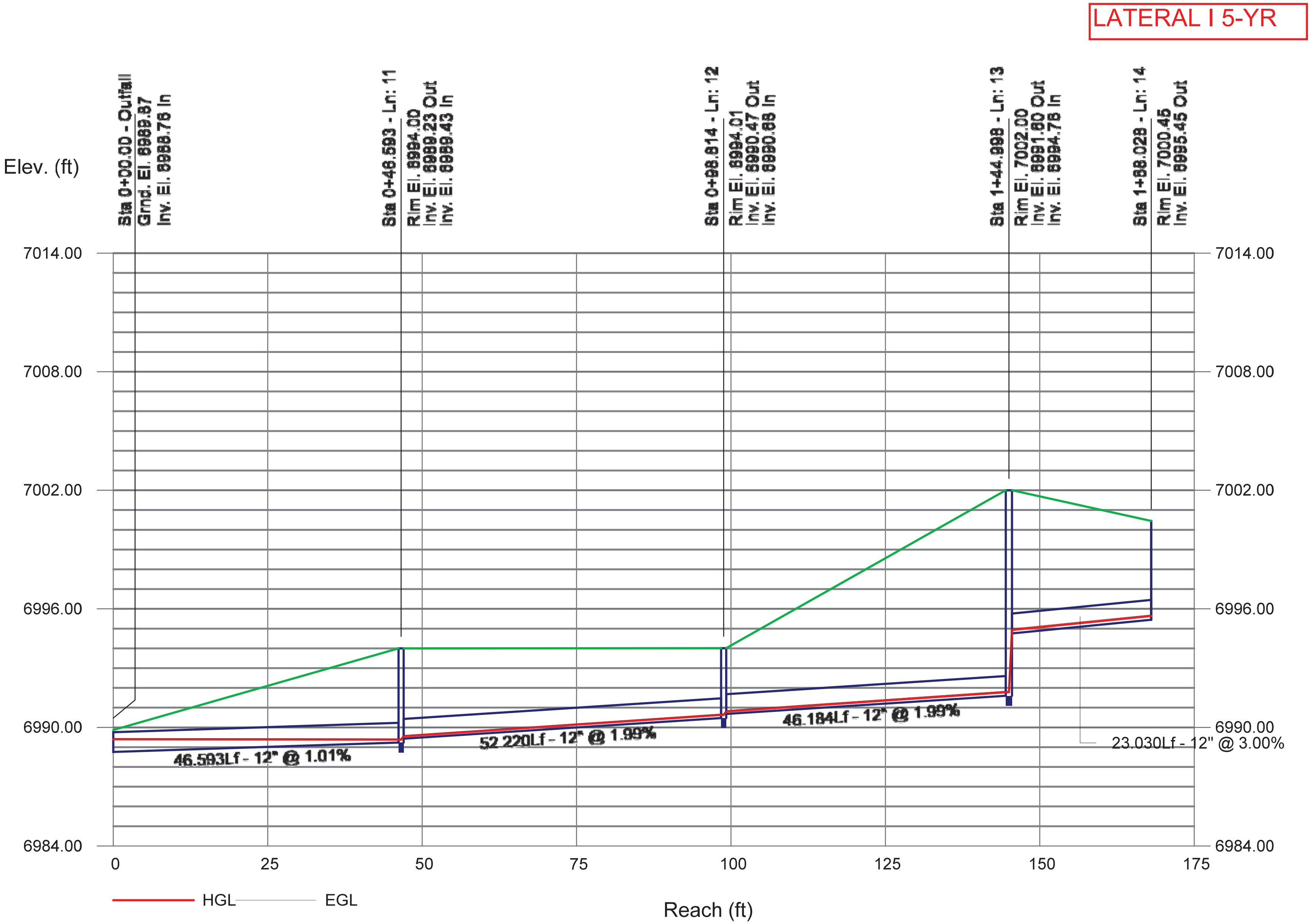

Storm Sewer Profile

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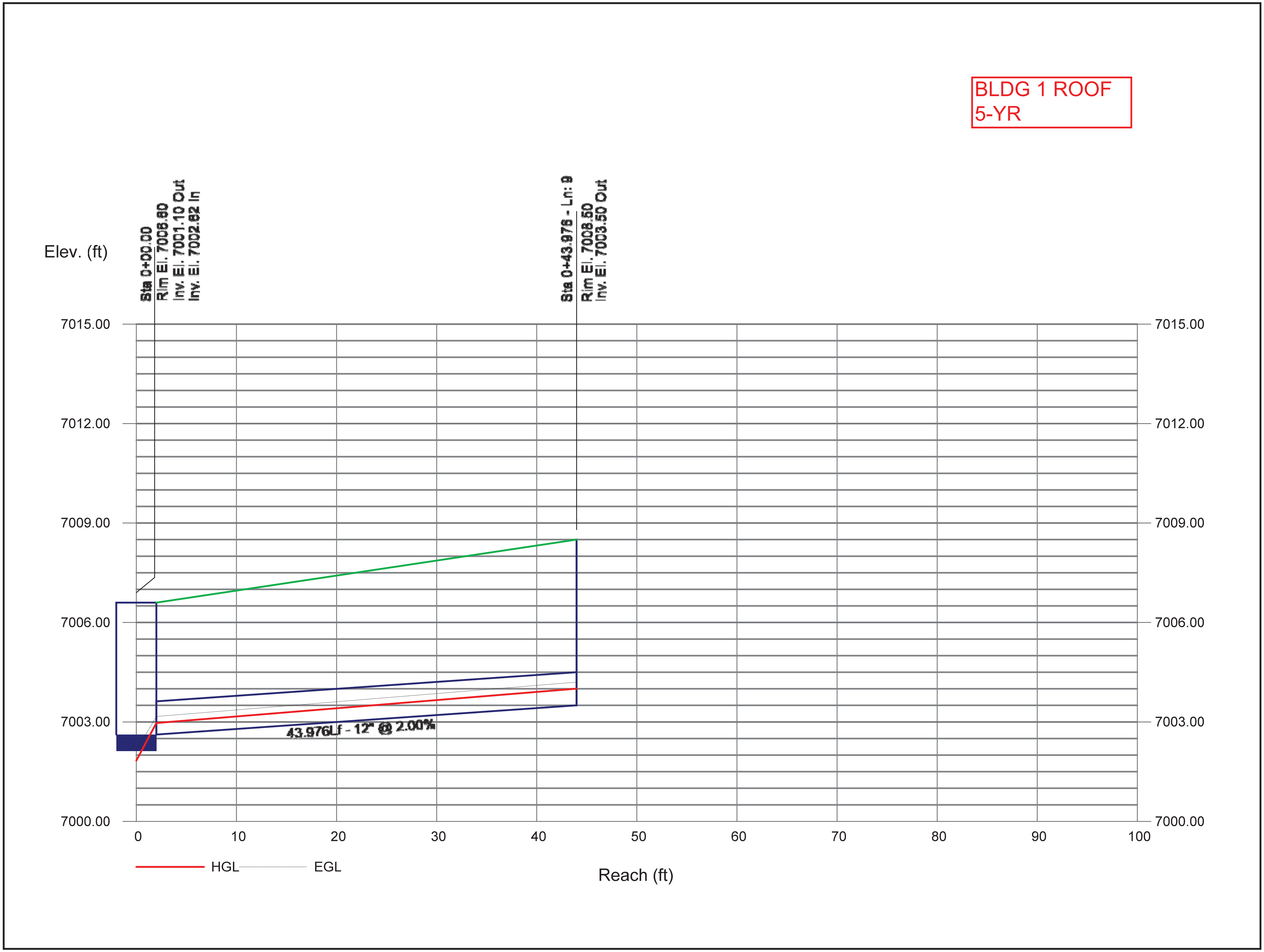


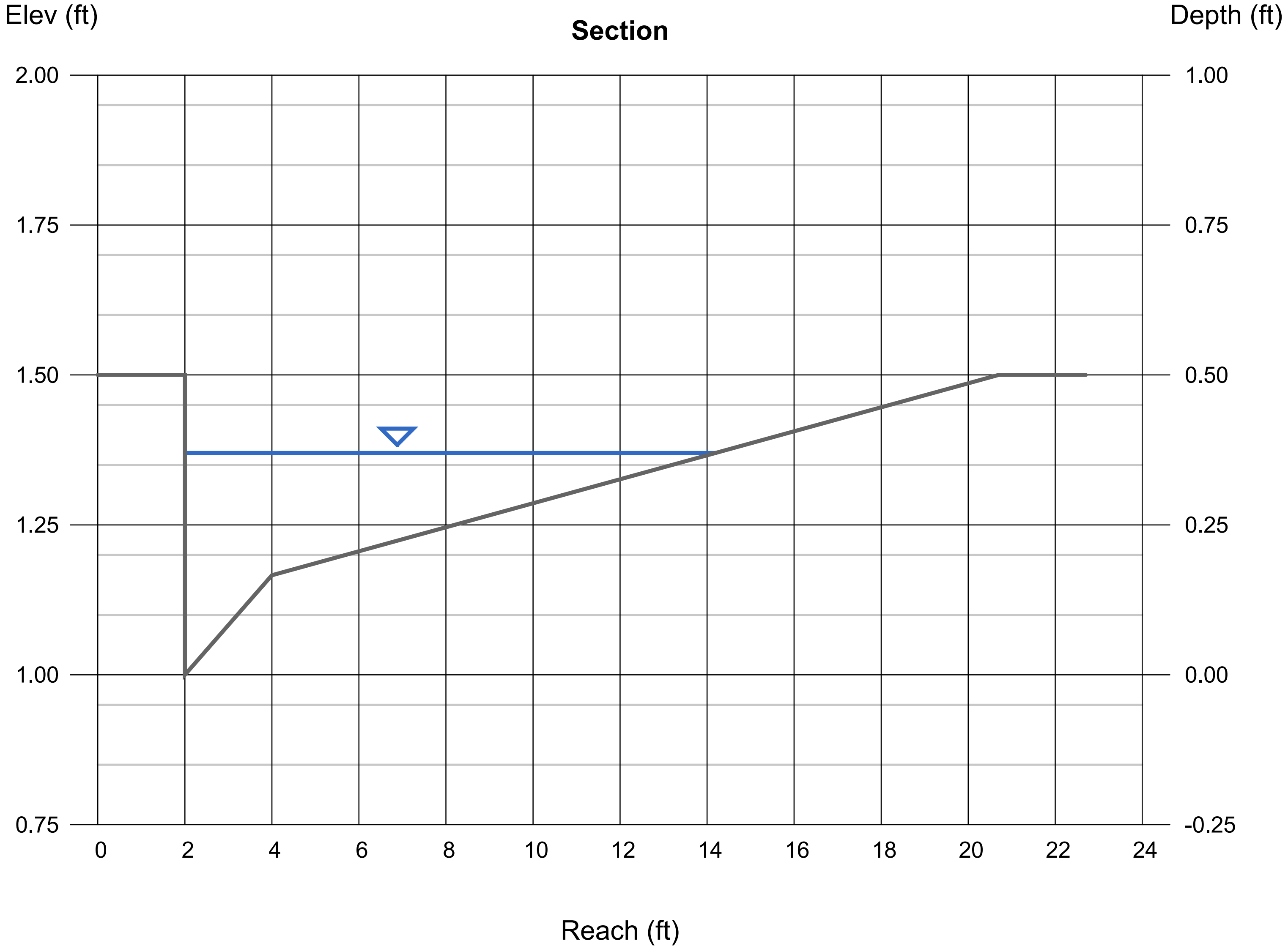
Channel Report

Half Road Capacity at 4%

Gutter
Cross Sl, Sx (ft/ft) = 0.020
Cross Sl, Sw (ft/ft) = 0.083
Gutter Width (ft) = 2.00
Invert Elev (ft) = 1.00
Slope (%) = 4.00
N-Value = 0.015

Calculations
Compute by: Known Depth
Known Depth (ft) = 0.37

Highlighted
Depth (ft) = 0.37
Q (cfs) = 10.39
Area (sqft) = 1.61
Velocity (ft/s) = 6.44
Wetted Perim (ft) = 12.58
Crit Depth, Yc (ft) = 0.53
Spread Width (ft) = 12.20
EGL (ft) = 1.01



Inlet Report

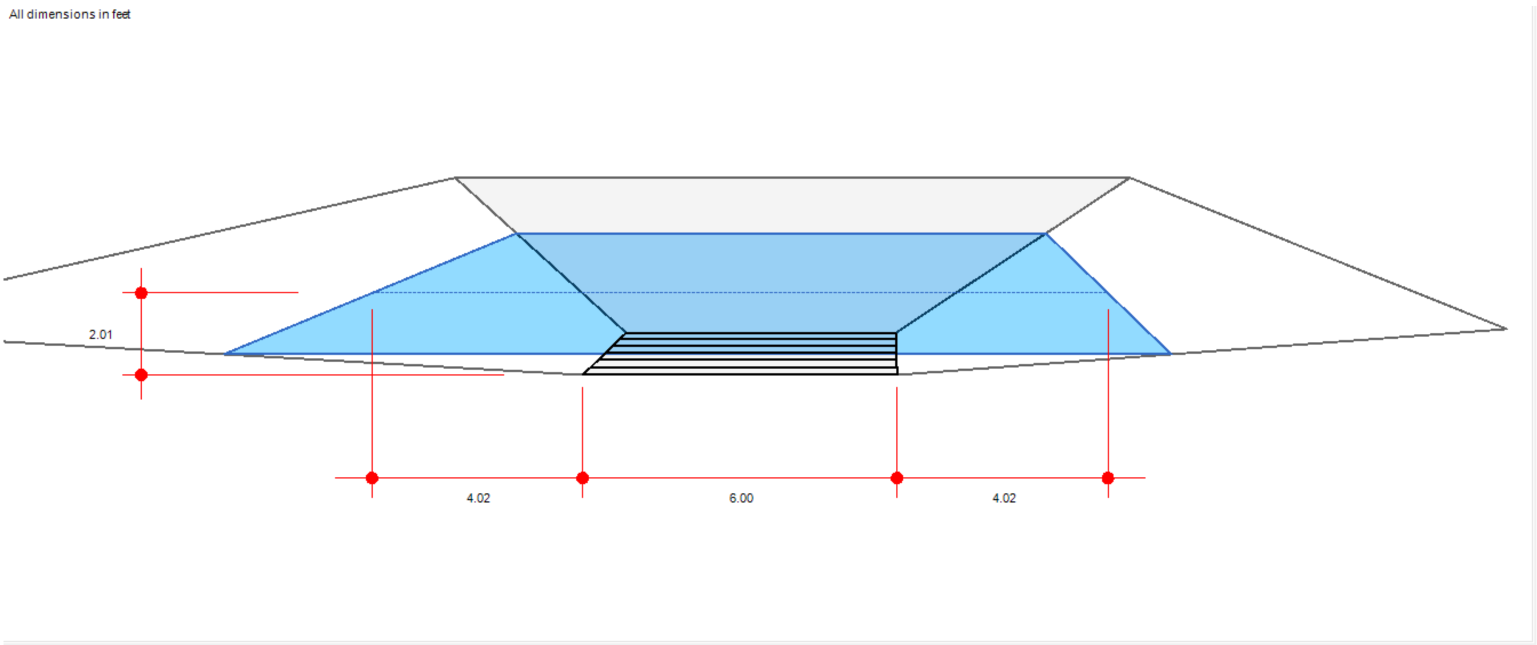
Off-Site Inlet DP D4

Drop Grate Inlet
Location = Sag
Curb Length (ft) = -0-
Throat Height (in) = -0-
Grate Area (sqft) = 12.60
Grate Width (ft) = 6.00
Grate Length (ft) = 3.00

Gutter
Slope, Sw (ft/ft) = 0.500
Slope, Sx (ft/ft) = 0.500
Local Depr (in) = -0-
Gutter Width (ft) = 6.00
Gutter Slope (%) = -0-
Gutter n-value = -0-

Calculations
Compute by: Known Q
Q (cfs) = 96.00

Highlighted
Q Total (cfs) = 96.00
Q Capt (cfs) = 96.00
Q Bypass (cfs) = -0-
Depth at Inlet (in) = 24.13
Efficiency (%) = 100
Gutter Spread (ft) = 14.04
Gutter Vel (ft/s) = -0-
Bypass Spread (ft) = -0-
Bypass Depth (in) = -0-



MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	Inlet A8	Inlet A7	Inlet A4
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade
Inlet Type	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.4	0.1	0.9
Major Q_{Known} (cfs)	1.0	0.3	2.3

Bypass (Carry-Over) Flow from Upstream

Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	User-Defined
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.1
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.3

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**0.4**	**0.1**	**1.0**
Major Total Design Peak Flow, Q (cfs)	**1.0**	**0.3**	**2.6**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.1	0.0	0.3
Major Flow Bypassed Downstream, Q_b (cfs)	0.3	0.1	1.1

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	Inlet A3	Inlet A2	Inlet C5
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade
Inlet Type	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.6	0.4	0.2
Major Q_{Known} (cfs)	2.1	1.0	0.8

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	User-Defined	User-Defined	User-Defined
Minor Bypass Flow Received, Q_b (cfs)	0.3	0.0	0.2
Major Bypass Flow Received, Q_b (cfs)	1.1	0.1	1.5

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**0.9**	**0.4**	**0.4**
Major Total Design Peak Flow, Q (cfs)	**3.2**	**1.1**	**2.3**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.2	0.1	0.1
Major Flow Bypassed Downstream, Q_b (cfs)	1.5	0.4	1.3

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	Inlet C4	Inlet C3	Inlet C2
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	In Sump	In Sump
Inlet Type	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.3	0.3	0.4
Major Q_{Known} (cfs)	0.8	1.0	1.0

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	User-Defined	User-Defined	User-Defined
Minor Bypass Flow Received, Q_b (cfs)	0.1	0.1	0.3
Major Bypass Flow Received, Q_b (cfs)	0.4	1.3	0.6

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

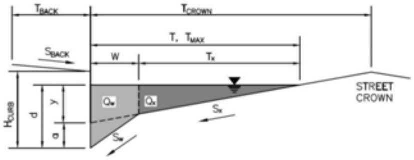
CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**0.4**	**0.4**	**0.7**
Major Total Design Peak Flow, Q (cfs)	**1.2**	**2.3**	**1.6**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.1	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	0.6	N/A	N/A

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:
Inlet ID: Inlet A8



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	12.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.060	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

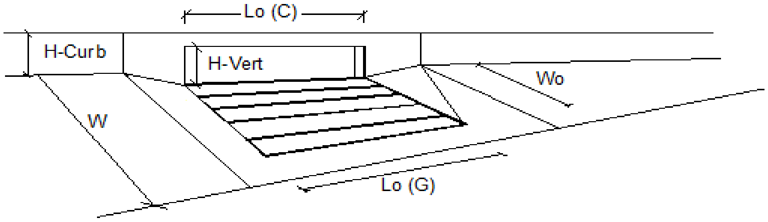
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**12.3**	**12.3**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.36 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 0.99 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	Denver No. 16 Combination		MINOR	MAJOR	
Type of Inlet		Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.3**	**0.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**0.3**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**82**	**68**	**%**

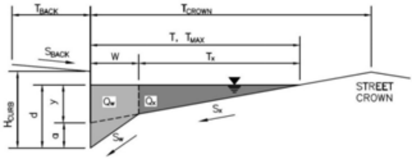
MHFD-Inlet, Version 5.02 (August 2022)

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Inlet ID: Inlet A7



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	12.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.060		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

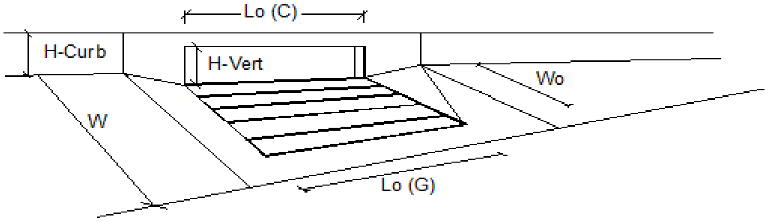
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**12.3**	**12.3**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.14 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 0.33 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	Denver No. 16 Combination		MINOR	MAJOR	
Type of Inlet		Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	

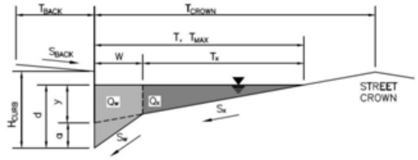
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.1**	**0.3**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**92**	**83**	**%**

MHFD-Inlet, Version 5.02 (August 2022)

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:
Inlet ID: Inlet A4



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	12.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.040	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

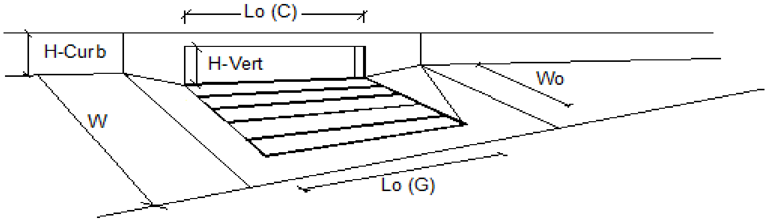
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**10.0**	**10.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.00 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 2.58 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



Denver No. 16 Combination ▾

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.7**	**1.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.3**	**1.1**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**67**	**58**	**%**

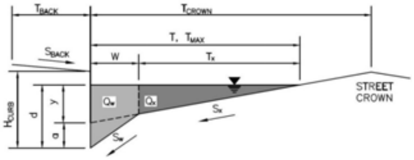
MHFD-Inlet, Version 5.02 (August 2022)

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Inlet ID: Inlet A3



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	12.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.040	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

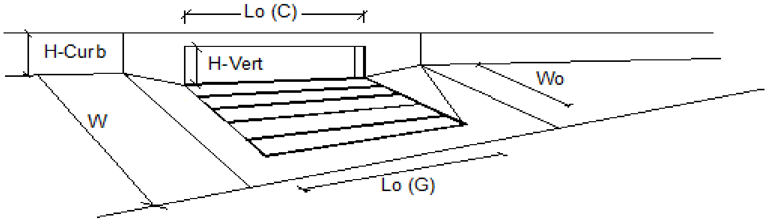
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**10.0**	**10.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.89 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 3.19 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



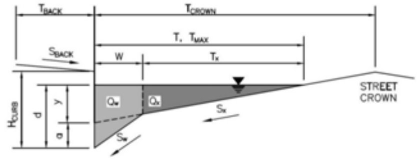
Design Information (Input)	Denver No. 16 Combination		MINOR	MAJOR	
Type of Inlet		Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**0.7**	**1.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.2**	**1.5**	**cfs**
Capture Percentage = Q_a/Q_o		**C% =**	**78**	**53**	**%**

MHFD-Inlet, Version 5.02 (August 2022)

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:
Inlet ID: Inlet A2



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	12.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.040	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

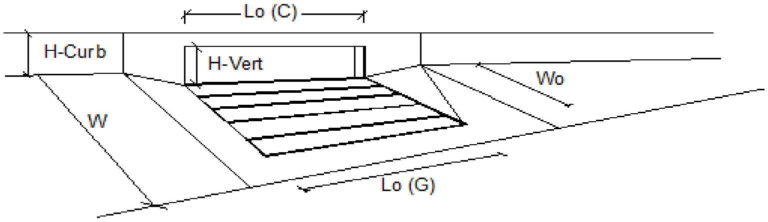
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**10.0**	**10.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.40 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.10 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	Denver No. 16 Combination		MINOR	MAJOR	
Type of Inlet		Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.3**	**0.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**0.4**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**87**	**62**	**%**

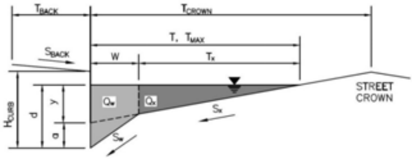
MHFD-Inlet, Version 5.02 (August 2022)

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Inlet ID: Inlet C5



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	12.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.100	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

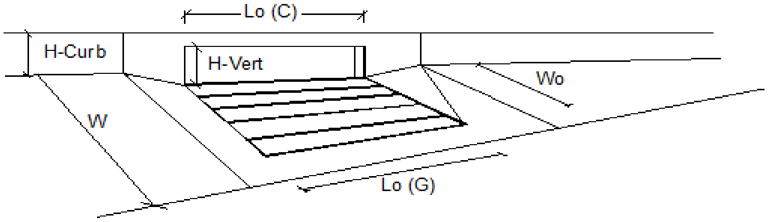
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**12.4**	**12.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.40 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 2.30 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



Denver No. 16 Combination

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	

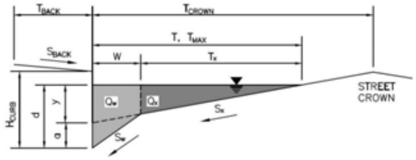
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.3**	**1.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**1.3**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**71**	**43**	**%**

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Inlet ID: Inlet C4



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	12.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.100	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

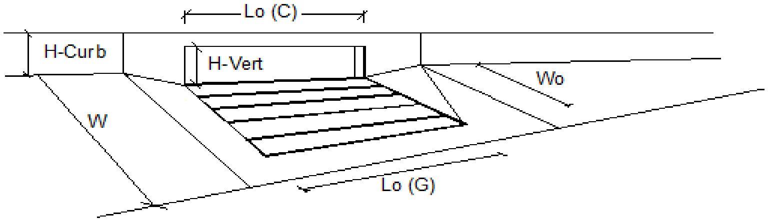
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**12.4**	**12.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.40 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.20 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	Denver No. 16 Combination	MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	0.4	1.2	cfs
Water Spread Width	T =	1.3	2.0	ft
Water Depth at Flowline (outside of local depression)	d =	1.8	2.0	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	1.000	1.000	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	0.0	cfs
Discharge within the Gutter Section W	Q_W =	0.4	1.2	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.00	0.17	sq ft
Velocity within the Gutter Section W	V_W =	0.0	7.2	fps
Water Depth for Design Condition	d_{LOCAL} =	3.8	4.0	inches

Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	3.00	3.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.992	0.981	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	1.86	1.86	fps
Interception Rate of Frontal Flow	R_f =	0.68	0.52	
Interception Rate of Side Flow	R_x =	0.07	0.05	
Interception Capacity	Q_i =	0.3	0.6	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.50	0.50	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	1.50	1.50	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	1.07	1.07	fps
Interception Rate of Frontal Flow	R_f =	0.60	0.45	
Interception Rate of Side Flow	R_x =	0.02	0.01	
Actual Interception Capacity	**Q_a =**	**0.2**	**0.5**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.2**	**0.7**	**cfs**

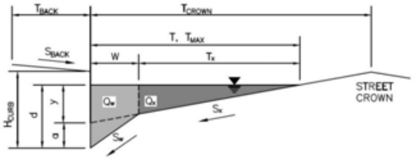
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.166	0.166	ft/ft
Required Length L_T to Have 100% Interception	L_T =	2.06	4.27	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	2.06	3.00	ft
Interception Capacity	Q_i =	0.0	0.1	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.17	0.17	
Effective (Unclogged) Length	L_e =	2.06	2.50	ft
Actual Interception Capacity	**Q_a =**	**0.0**	**0.1**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.1**	**0.6**	**cfs**

Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.3**	**0.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**0.6**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**71**	**52**	**%**

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:
Inlet ID: Inlet C3



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	12.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

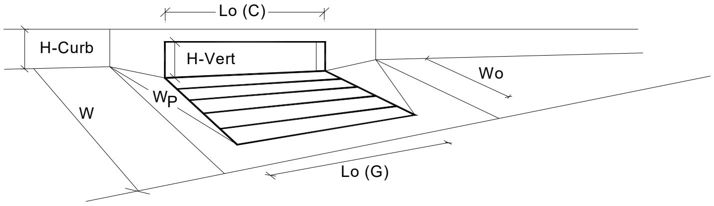
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is not applicable to Sump Condition
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input) Denver No. 16 Combination ▼		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	4.4	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.50	6.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.39	0.39	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.20	0.20	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.69	0.69	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.69	0.69	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**2.4**	**2.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	0.4	2.3	cfs

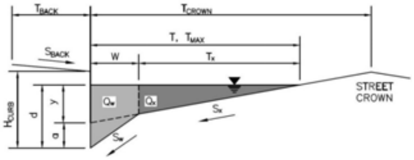
MHFD-Inlet, Version 5.02 (August 2022)

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Inlet ID: Inlet C2



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	12.0	ft
Gutter Width	W =	6.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

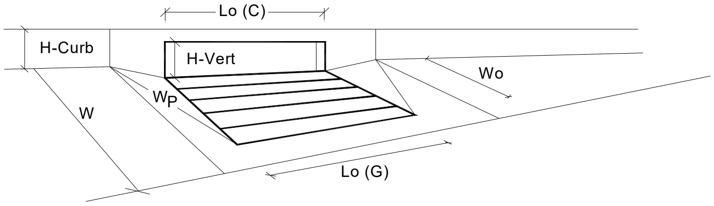
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is not applicable to Sump Condition
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



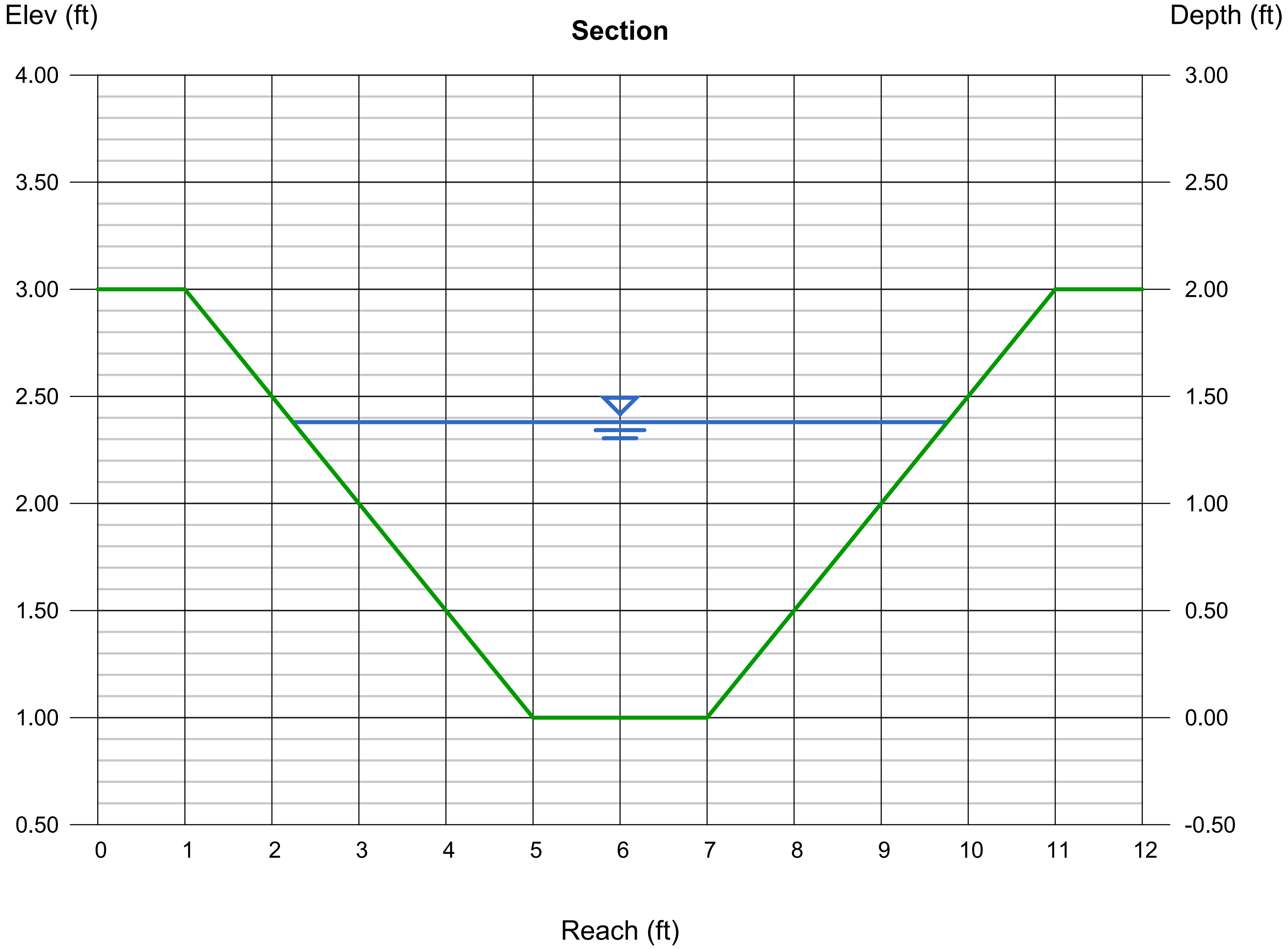
Design Information (Input) Denver No. 16 Combination		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.50	6.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	6.00	6.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.57	0.57	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.02	0.02	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.94	0.94	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.94	0.94	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**2.8**	**2.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	0.7	1.6	cfs

Channel Report

OFF-SITE DITCH

Trapezoidal	
Bottom Width (ft)	= 2.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 1.00
Slope (%)	= 16.60
N-Value	= 0.030
Calculations	
Compute by:	Known Q
Known Q (cfs)	= 114.00

Highlighted	
Depth (ft)	= 1.38
Q (cfs)	= 114.00
Area (sqft)	= 6.57
Velocity (ft/s)	= 17.35
Wetted Perim (ft)	= 8.17
Crit Depth, Yc (ft)	= 2.00
Top Width (ft)	= 7.52
EGL (ft)	= 6.06



BASELINE
Engineering · Planning · Surveying

OUTLET PIPE RIPRAP EROSION PROTECTION

DATE: 2/29/2024
CALCULATED BY: SMB
CHECKED BY: CSR
PROJECT NAME: THE ASTRID
PROJECT NUMBER: CO20235

These calculations are applicable if tailwater exists when the conduit is in operation. It also accounts for length adjustment if the Froude parameter is above 6 per UDFCD.

Use Figure 9-35 to determine an expansion factor.

$$\theta = \tan^{-1}\left(\frac{1}{2(Expansion\ Factor)}\right)$$

ID	Diameter (D or W) (in)	Tailwater Depth (Y_t) (ft)	Flow (Q) (cfs)	Y_t/D	$Q/D^{2.5}$	Expansion Factor	Expansion Angle (θ) (rad)	$Q/D^{2.5}$ <=6 Check
UPPER MAIN	18	1	11.9	0.6666667	4.3	5.5	0.091	OK
LATERAL F	12	0.5	3.7	0.5	3.7	5.5	0.091	OK
LATERAL E	12	0.5	2.9	0.5	2.9	6	0.083	OK
LATERAL I	12	0.5	0.7	0.5	0.7	6.6	0.076	OK
LATERAL J	12	0.5	0.45	0.5	0.5	6.6	0.076	OK

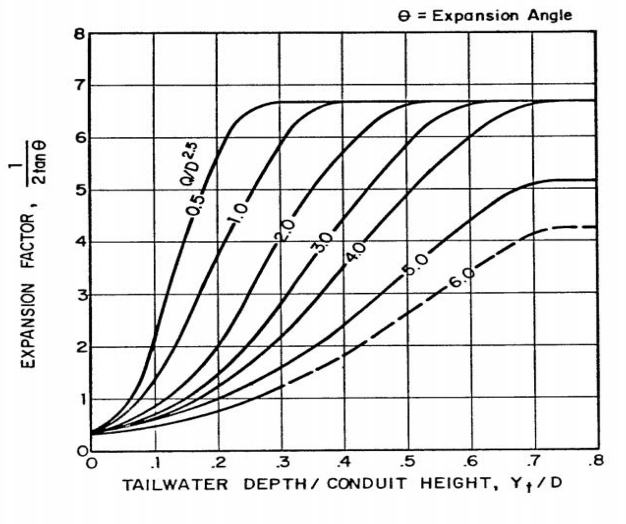


Figure 9-35. Expansion factor for circular conduits

Calculate the length and width required.

$$L_p = \left(\frac{1}{2tan\theta}\right)\left(\frac{A_t}{Y_t} - W\right) \qquad T = 2(L_p \tan\theta) + W$$

ID	Soil Type	Velocity (V) (ft/s)	Req'd Area (A_t) (ft^2)	Min L_p (ft)	Max L_p (ft)	Calculated Length of Protection (L_p) (ft)	Design L_p (ft)	Calculated DS Width (T) (ft)
UPPER MAIN	Non-cohesive	5	2.38	4.5	15.0	4.8400	4.8	2.38
LATERAL F	Non-cohesive	5	0.74	3.0	10.0	2.6400	3.0	1.55
LATERAL E	Non-cohesive	5	0.58	3.0	10.0	0.9600	3.0	1.50
LATERAL I	Non-cohesive	5	0.14	3.0	10.0	-4.7520	3.0	1.45
LATERAL J	Non-cohesive	5	0.09	3.0	10.0	-5.4120	3.0	1.45

ATTACHMENT 9

POND CALCULATIONS

BASELINE
Engineering · Planning · Surveying

STORM STORAGE CALCULATIONS
DETENTION POND A

PROJECT NAME: Astrid
PROJECT NUMBER: 20235
CALCULATED BY: SMB
CHECKED BY: CSR

DATE: 2/28/2024

%I = 59.9%

EQUATION: Q5=0.10 A
EQUATION: Q100=0.54 A

Onsite Area =	**4.33**	**ACRES**
Pond A Area =	**2.49**	**ACRES**
Total 5-yr Release =	**0.4**	**CFS**
Total 100-yr Release =	**2.3**	**CFS**
Pond A 5-yr Release =	**0.9**	**CFS**
Pond A 100-yr Release =	**1.8**	**CFS**

(Total Release + H3 - C - Pond B - A2 and A3)

	Tc =	5.1	MIN
Basin A	Q5 =	4.4	CFS
Basin A	Q100 =	13.1	CFS
Basin H3 Bypass	Q5 =	1.9	CFS
Basin H3 Bypass	Q100 =	5.3	CFS
Basin C Free Release	Q5 =	1.1	CFS
Basin C Free Release	Q100 =	3.6	CFS
Pond B Release	Q5 =	0.1	CFS
Pond B Release	Q100 =	0.4	CFS
Basin A2 + A3 Inlet Bypass	Q5 =	0.3	CFS
Basin A2 + A3 Inlet Bypass	Q100 =	1.9	CFS

5-YR STORM CALCULATIONS

EQUATION: Vi5=CIA*Tc*60 — **Vi5 = 1936 CF** (Basin A + H3)

RELEASE @ Q5 = 0.9 CFS (Total Release + H3 - C - Pond B - A2 & A3)

EQUATION: Vo5=Q5*Tc*60 — **Vo5 = 273 CF**

EQUATION: V5=Vi5-Vo5 — **V5 = 1663 CF**

100-YR STORM CALCULATIONS

EQUATION: Vi100=CIA*Tc*60 — **V100 = 5640 CF** (Basin A + H3)

RELEASE @ Q 100= 1.8 CFS (Total Release + H3 - C - Pond B - A2 & A3)

EQUATION: Vo100=Q100*Tc*60 — **Vo100 = 554 CF**

EQUATION: V100=Vi100-Vo100 — **V100 = 5085 CF**

WATER QUALITY STORAGE VOL.

$$WQCV = 0.79Aa(0.91I^3 - 1.19I^2 + 0.78I)/12$$

Drain Time	Coefficient,a
40 hours	1.00

WQCV = 0.039 AC-FT
= 1683 CF

TOTAL REQUIRED VOLUME = 5085 CF (100-yr including WQCV)

PROJECT : Astrid
PROJECT LOCATION: Pond A
DATE : 2/28/2024
PROJECT NO. : 20235
BY : SMB

Provided Volume

Stage (ft)	Contour Elevation (ft)	Area (ft^2)	1/3 (A1 + A2 + (A1A2)$^{1/2}$) D	Total Volume (ft^3)	Total Volume (ac-ft)
0.00	6984.00	0		0.0	0.000
1.00	6985.00	1,010	336.7	336.7	0.008
2.00	6986.00	2,167	1,552.1	1,888.8	0.043
3.00	6987.00	2,297	2,231.7	4,120.5	0.095
4.00	6988.00	2,424	2,360.2	6,480.7	0.149

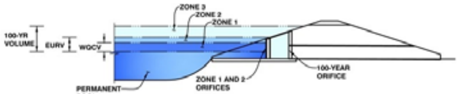
	WSEL	Depth (ft)	Area (ft^2)	Volume (ft^3)	Volume (ac-ft)
WQCV =	6986.00	2.00	2,167.00	1,888.81	0.043
EURV =					
2-yr =					
5-yr =	6985.90	1.90	2,051.30	1,733.59	0.040
10-yr =					
100-yr =	6987.50	3.50	2,360.50	5,300.60	0.122

🟩 = FORMULA CELLS
🟦 = USER INPUT CELLS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **The Astrid**
Basin ID: **Pond A**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**			
Watershed Area =	2.49	acres		
Watershed Length =	500	ft		
Watershed Length to Centroid =	220	ft		
Watershed Slope =	0.060	ft/ft		
Watershed Imperviousness =	59.90%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	0.0%	percent		
Percentage Hydrologic Soil Groups C/D =	100.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.039	acre-feet	0.039	acre-feet
Excess Urban Runoff Volume (EURV) =	0.143	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.55 in.) =	0.053	acre-feet	0.55	inches
5-yr Runoff Volume (P1 = 0.82 in.) =	0.087	acre-feet	0.82	inches
10-yr Runoff Volume (P1 = 1.04 in.) =	0.119	acre-feet	1.04	inches
25-yr Runoff Volume (P1 = 1.69 in.) =	0.250	acre-feet		inches
50-yr Runoff Volume (P1 = 1.99 in.) =	0.310	acre-feet		inches
100-yr Runoff Volume (P1 = 1.79 in.) =	0.276	acre-feet	1.79	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.552	acre-feet		inches
Approximate 2-yr Detention Volume =	0.059	acre-feet		
Approximate 5-yr Detention Volume =	0.100	acre-feet		
Approximate 10-yr Detention Volume =	0.124	acre-feet		
Approximate 25-yr Detention Volume =	0.189	acre-feet		
Approximate 50-yr Detention Volume =	0.205	acre-feet		
Approximate 100-yr Detention Volume =	0.182	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.039	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.039	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Total detention volume is less than 100-year volume.

Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 1.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	1	0.000		
6985	--	1.00	--	--	--	1,010	0.023	505	0.012
6986	--	2.00	--	--	--	2,167	0.050	2,094	0.048
6987	--	3.00	--	--	--	2,297	0.053	4,326	0.099
6988	--	4.00	--	--	--	2,424	0.056	6,686	0.154
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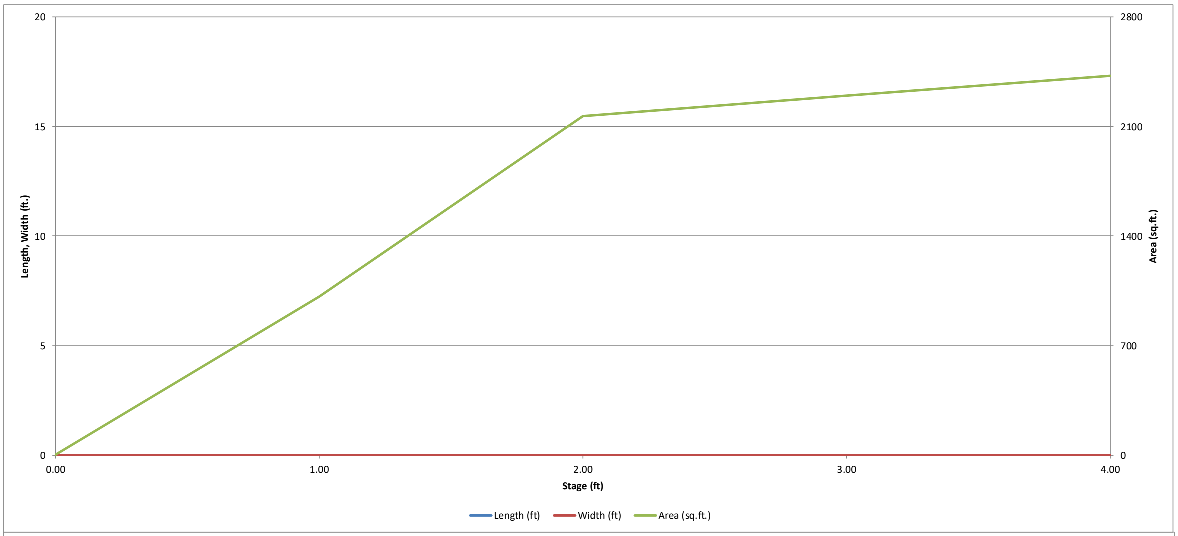
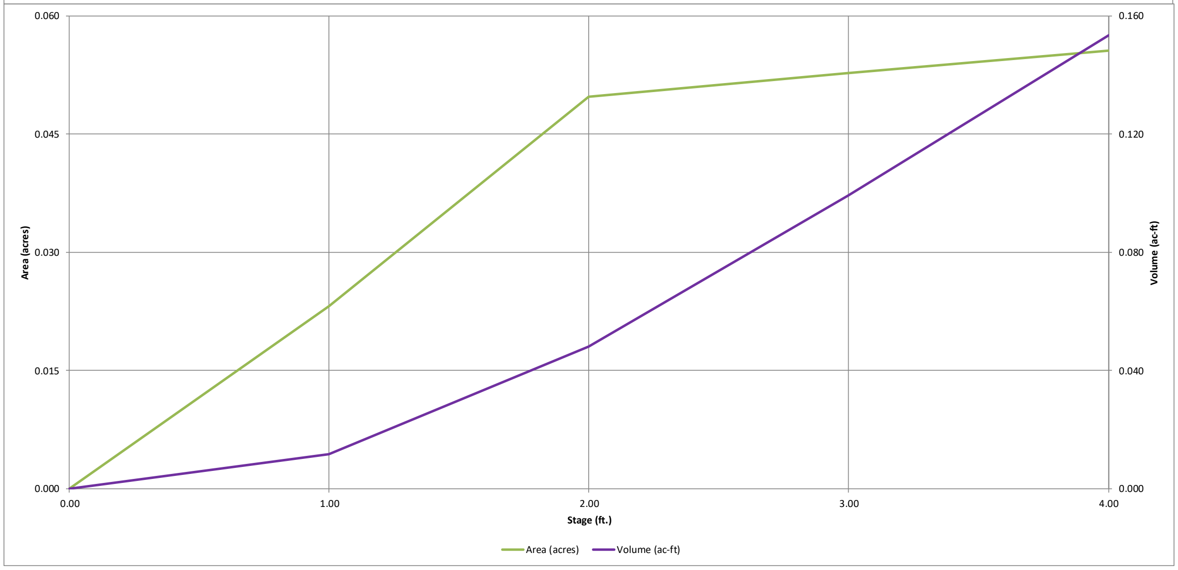
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

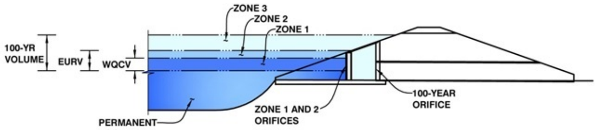




DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **The Astrid**
Basin ID: **Pond A**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.81	0.039	Orifice Plate
Zone 2			
Zone 3			
Total (all zones)		0.039	

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	1.90	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	8.00	inches
Orifice Plate: Orifice Area per Row =	0.22	sq. inches (diameter = 1/2 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.528E-03	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.70	1.40					
Orifice Area (sq. inches)	0.22	0.22	0.22					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =			inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =			ft^2
Vertical Orifice Centroid =			feet

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

	Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =			feet
Overflow Weir Grate Slope =			H:V
Horiz. Length of Weir Sides =			feet
Overflow Grate Type =			
Debris Clogging % =			%

Calculated Parameters for Overflow Weir

	Not Selected	Not Selected	
Height of Grate Upper Edge, H_t =			feet
Overflow Weir Slope Length =			feet
Grate Open Area / 100-yr Orifice Area =			
Overflow Grate Open Area w/o Debris =			ft^2
Overflow Grate Open Area w/ Debris =			ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =			inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Not Selected	Not Selected	
Outlet Orifice Area =			ft^2
Outlet Orifice Centroid =			feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=		ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =		feet
Spillway End Slopes =		H:V
Freeboard above Max Water Surface =		feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=		feet
Stage at Top of Freeboard =		feet
Basin Area at Top of Freeboard =		acres
Basin Volume at Top of Freeboard =		acre-ft

Routed Hydrograph Results

The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.55	0.82	1.04	1.69	1.99	1.79	3.14
CUHP Runoff Volume (acre-ft) =	0.039	0.143	0.053	0.087	0.119	0.250	0.310	0.276	0.552
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.053	0.087	0.119	0.250	0.310	0.276	0.552
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.1	2.0	2.8	2.4	5.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.01	0.04	0.82	1.12	0.95	2.36
Peak Inflow Q (cfs) =	N/A	N/A	1.0	1.7	2.2	5.0	6.2	5.6	11.0
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.1	0.3	0.0	0.0	0.0	0.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	N/A	N/A	N/A	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	72	45	57	66	99	115	106	>120
Time to Drain 99% of Inflow Volume (hours) =	**41**	78	48	62	72	109	>120	116	>120
Maximum Ponding Depth (ft) =	1.81	3.82	2.03	2.68	3.26	4.00	4.00	4.00	4.00
Area at Maximum Ponding Depth (acres) =	0.04	0.06	0.05	0.05	0.05	0.06	0.06	0.06	0.06
Maximum Volume Stored (acre-ft) =	0.039	0.144	0.049	0.083	0.113	0.154	0.154	0.154	0.154

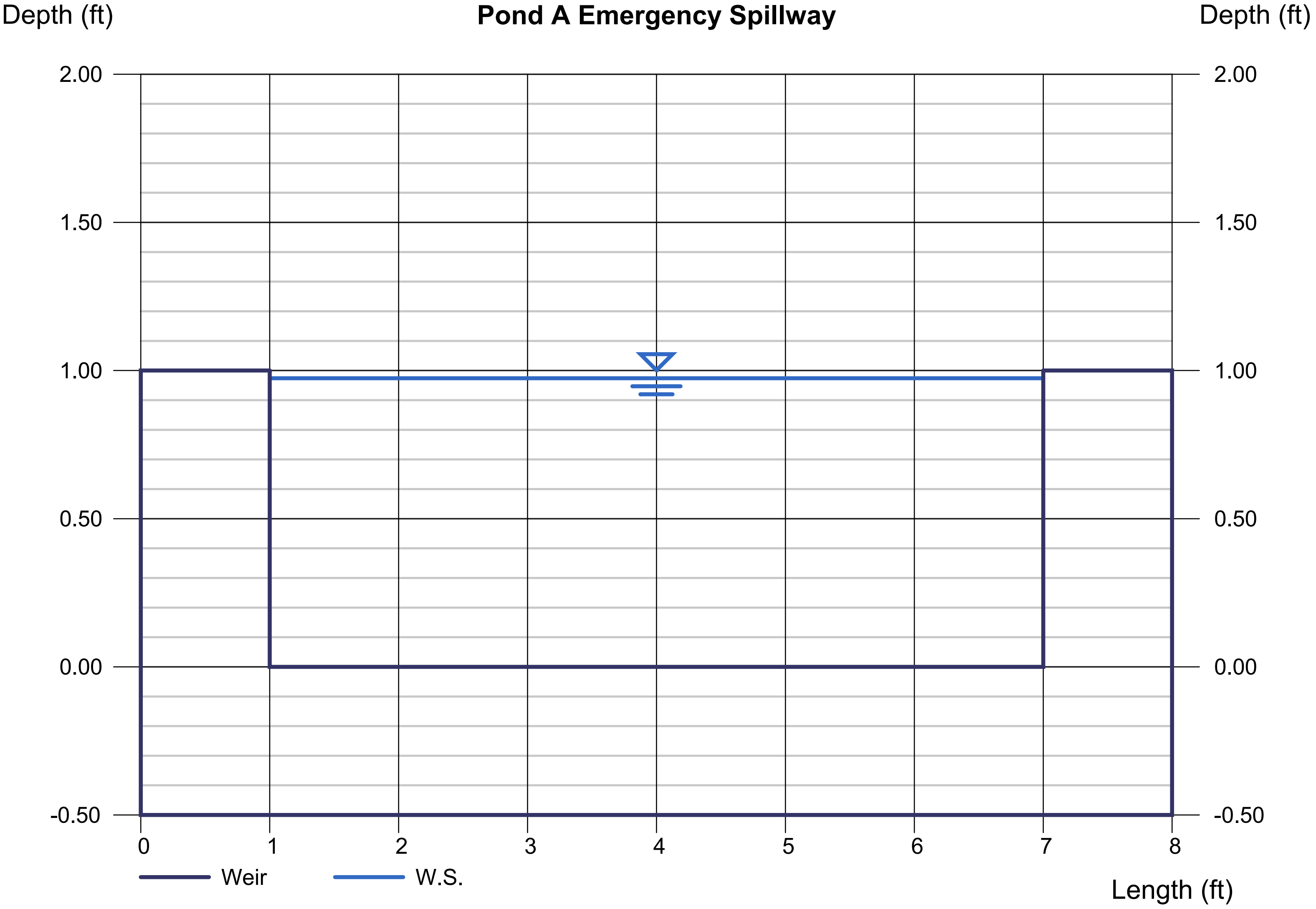
Weir Report

Pond A Emergency Spillway

Rectangular Weir
Crest = Sharp
Bottom Length (ft) = 6.00
Total Depth (ft) = 1.00

Calculations
Weir Coeff. Cw = 3.33
Compute by: Known Q
Known Q (cfs) = 19.20

Highlighted
Depth (ft) = 0.97
Q (cfs) = 19.20
Area (sqft) = 5.84
Velocity (ft/s) = 3.29
Top Width (ft) = 6.00



STORM STORAGE CALCULATIONS
DETENTION POND B

PROJECT NAME: Astrid
PROJECT NUMBER: 20235
CALCULATED BY: SMB
CHECKED BY: CSR

DATE: 2/28/2024

	DESIGN DRAINAGE AREA	Pond B Area =	**0.68**	**ACRES**
CALCULATED % IMPERVIOUSNESS =	59.8%	Tc =	5.7	MIN
		Q5=	1.15	
		Q100=	3.45	
5-YR STORM CALCULATIONS				
EQUATION: Vi5=CIA*Tc*60		**Vi5 =**	**391**	**CF**
EQUATION: Q5=0.10 A		**RELEASE @ Q5 =**	**0.07**	**CFS**
EQUATION: Vo5=Q5*Tc*60		**Vo5 =**	**23**	**CF**
EQUATION: V5=Vi5-Vo5		**V5 =**	**368**	**CF**
100-YR STORM CALCULATIONS				
EQUATION: Vi100=CIA*Tc*60		**V100 =**	**1171**	**CF**
EQUATION: Q100=0.54 A		**RELEASE @ Q 100=**	**0.37**	**CFS**
EQUATION: Vo100=Q100*Tc*60		**Vo100 =**	**125**	**CF**
EQUATION: V100=Vi100-Vo100		**V100 =**	**1046**	**CF**
WATER QUALITY STORAGE VOL.	Drain Time Coefficient,a			
	40 hours 1.00			
$WQCV = 0.79Aa(0.91I^3 - 1.19I^2 + 0.78I)/12$		**WQCV =**	**0.011**	**AC-FT**
		=	**460**	**CF**
		TOTAL REQUIRED VOLUME =	**1046**	**CF** (100-yr including WQCV)

PROJECT : Astrid
PROJECT LOCATION: Pond B
DATE : 2/28/2024
PROJECT NO. : 20235
BY : SMB

Provided Volume

Stage (ft)	Contour Elevation (ft)	Area (ft^2)	1/3 (A1 + A2 + $(A1A2)^{1/2}$) D	Total Volume (ft^3)	Total Volume (ac-ft)
0.00	6979.40	0		0.0	0.000
0.60	6980.00	141	28.2	28.2	0.001
1.60	6981.00	847	444.5	472.7	0.011
2.60	6982.00	1,325	1,077.1	1,549.9	0.036
3.60	6983.00	1,666	1,492.2	3,042.1	0.070

	WSEL	Depth (ft)	Area (ft^2)	Volume (ft^3)	Volume (ac-ft)
WQCV =	6980.65	1.25	599.90	317.14	0.007
EURV =					
2-yr =					
5-yr =	6980.55	1.15	529.30	272.69	0.006
10-yr =					
100-yr =	6981.45	2.05	1,062.10	957.43	0.022

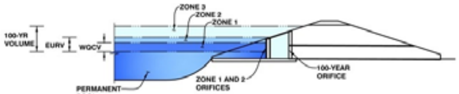
🟩 = FORMULA CELLS
🟦 = USER INPUT CELLS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **The Astrid**

Basin ID: **Pond B**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type = **EDB**
Watershed Area = 0.68 acres
Watershed Length = 200 ft
Watershed Length to Centroid = 110 ft
Watershed Slope = 0.060 ft/ft
Watershed Imperviousness = 59.80% percent
Percentage Hydrologic Soil Group A = 0.0% percent
Percentage Hydrologic Soil Group B = 0.0% percent
Percentage Hydrologic Soil Groups C/D = 100.0% percent
Target WQCV Drain Time = 40.0 hours
Location for 1-hr Rainfall Depths = User Input

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.011	acre-feet	0.011	acre-feet
Excess Urban Runoff Volume (EURV) =	0.039	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.55 in.) =	0.014	acre-feet	0.55	inches
5-yr Runoff Volume (P1 = 0.82 in.) =	0.023	acre-feet	0.82	inches
10-yr Runoff Volume (P1 = 1.04 in.) =	0.031	acre-feet	1.04	inches
25-yr Runoff Volume (P1 = 1.79 in.) =	0.071	acre-feet	1.79	inches
50-yr Runoff Volume (P1 = 1.99 in.) =	0.081	acre-feet		inches
100-yr Runoff Volume (P1 = 2.31 in.) =	0.100	acre-feet		inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.145	acre-feet		inches
Approximate 2-yr Detention Volume =	0.016	acre-feet		
Approximate 5-yr Detention Volume =	0.027	acre-feet		
Approximate 10-yr Detention Volume =	0.034	acre-feet		
Approximate 25-yr Detention Volume =	0.055	acre-feet		
Approximate 50-yr Detention Volume =	0.056	acre-feet		
Approximate 100-yr Detention Volume =	0.064	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) = 0.011 acre-feet
Select Zone 2 Storage Volume (Optional) = acre-feet
Select Zone 3 Storage Volume (Optional) = acre-feet
Total Detention Basin Volume = 0.011 acre-feet
Initial Surcharge Volume (ISV) = user ft^3
Initial Surcharge Depth (ISD) = user ft
Total Available Detention Depth (H_{total}) = user ft
Depth of Trickle Channel (H_{TC}) = user ft
Slope of Trickle Channel (S_{TC}) = user ft/ft
Slopes of Main Basin Sides (S_{main}) = user H:V
Basin Length-to-Width Ratio ($R_{L/W}$) = user

Total detention volume is less than 100-year volume.

Initial Surcharge Area (A_{ISV}) = user ft^2
Surcharge Volume Length (L_{ISV}) = user ft
Surcharge Volume Width (W_{ISV}) = user ft
Depth of Basin Floor (H_{FLOOR}) = user ft
Length of Basin Floor (L_{FLOOR}) = user ft
Width of Basin Floor (W_{FLOOR}) = user ft
Area of Basin Floor (A_{FLOOR}) = user ft^2
Volume of Basin Floor (V_{FLOOR}) = user ft^3
Depth of Main Basin (H_{MAIN}) = user ft
Length of Main Basin (L_{MAIN}) = user ft
Width of Main Basin (W_{MAIN}) = user ft
Area of Main Basin (A_{MAIN}) = user ft^2
Volume of Main Basin (V_{MAIN}) = user ft^3
Calculated Total Basin Volume (V_{total}) = **user** acre-feet

Depth Increment = 1.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	1	0.000		
6980	--	0.60	--	--	--	141	0.003	43	0.001
6981	--	1.60	--	--	--	847	0.019	537	0.012
6982	--	2.60	--	--	--	1,325	0.030	1,623	0.037
6983	--	3.60	--	--	--	1,666	0.038	3,118	0.072
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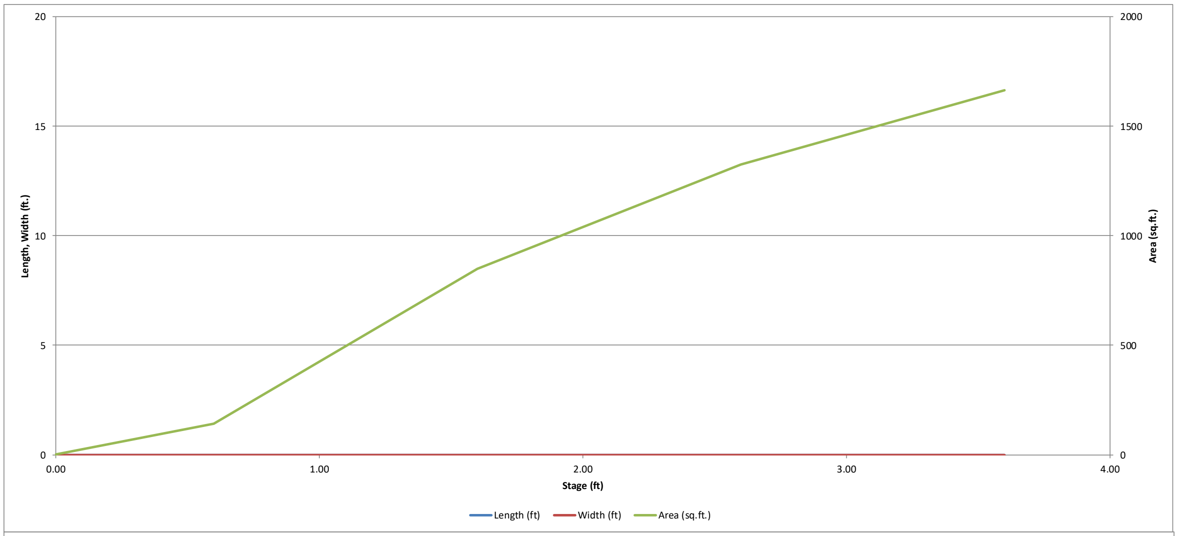
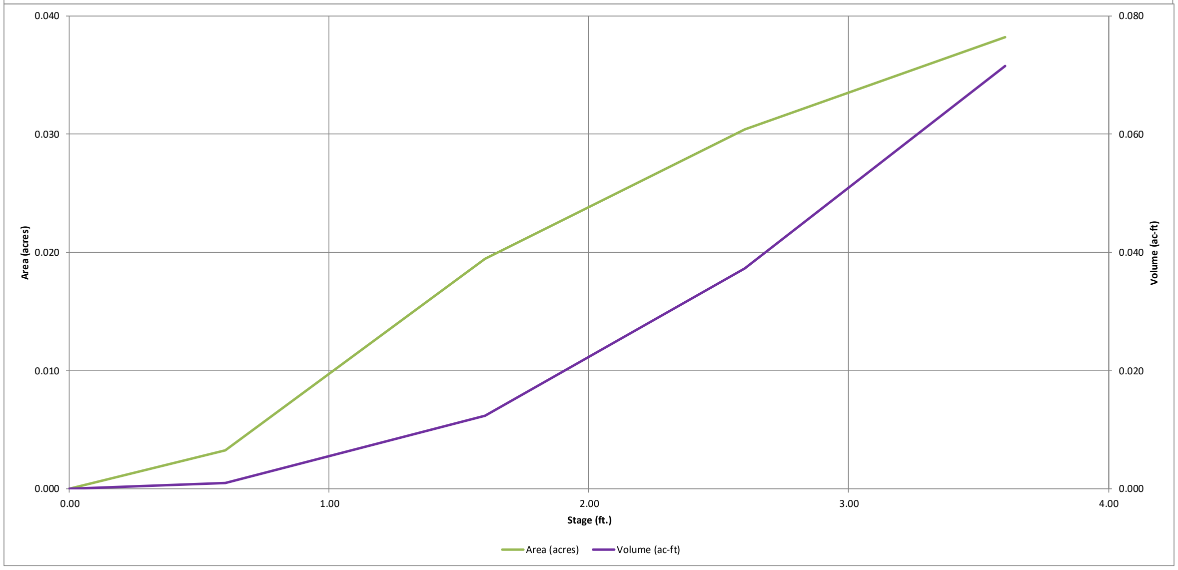
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

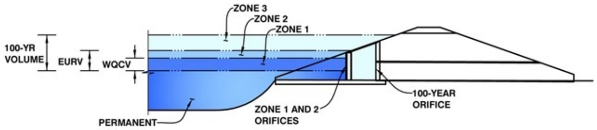




DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: The Astrid
Basin ID: Pond B



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.54	0.011	Orifice Plate
Zone 2			
Zone 3			
Total (all zones)		0.011	

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth = N/A ft (distance below the filtration media surface)
Underdrain Orifice Diameter = N/A inches

Calculated Parameters for Underdrain

Underdrain Orifice Area = N/A ft^2
Underdrain Orifice Centroid = N/A feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Centroid of Lowest Orifice = 0.00 ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = 1.25 ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = 18.00 inches
Orifice Plate: Orifice Area per Row = 0.12 sq. inches (diameter = 3/8 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row = 8.333E-04 ft^2
Elliptical Half-Width = N/A feet
Elliptical Slot Centroid = N/A feet
Elliptical Slot Area = N/A ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00							
Orifice Area (sq. inches)	0.12							

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =			inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =			ft^2
Vertical Orifice Centroid =			feet

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

	Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =			feet
Overflow Weir Grate Slope =			H:V
Horiz. Length of Weir Sides =			feet
Overflow Grate Type =			
Debris Clogging % =			%

Calculated Parameters for Overflow Weir

	Not Selected	Not Selected	
Height of Grate Upper Edge, H_t =			feet
Overflow Weir Slope Length =			feet
Grate Open Area / 100-yr Orifice Area =			
Overflow Grate Open Area w/o Debris =			ft^2
Overflow Grate Open Area w/ Debris =			ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =			inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Not Selected	Not Selected	
Outlet Orifice Area =			ft^2
Outlet Orifice Centroid =			feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage= ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length = feet
Spillway End Slopes = H:V
Freeboard above Max Water Surface = feet

Calculated Parameters for Spillway

Spillway Design Flow Depth= feet
Stage at Top of Freeboard = feet
Basin Area at Top of Freeboard = acres
Basin Volume at Top of Freeboard = acre-ft

Routed Hydrograph Results

The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.55	0.82	1.04	1.79	1.99	2.31	3.14
CUHP Runoff Volume (acre-ft) =	0.011	0.039	0.014	0.023	0.031	0.071	0.081	0.100	0.145
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.014	0.023	0.031	0.071	0.081	0.100	0.145
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.7	0.9	1.1	1.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.01	0.05	1.03	1.26	1.67	2.63
Peak Inflow Q (cfs) =	N/A	N/A	0.3	0.5	0.6	1.6	1.9	2.2	3.2
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.7	0.2	0.0	0.0	0.0	0.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	N/A	N/A	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	31	86	38	57	73	>120	>120	>120	>120
Time to Drain 99% of Inflow Volume (hours) =	**33**	89	40	59	75	>120	>120	>120	>120
Maximum Ponding Depth (ft) =	1.54	2.66	1.64	2.04	2.36	3.55	3.60	3.60	3.60
Area at Maximum Ponding Depth (acres) =	0.02	0.03	0.02	0.02	0.03	0.04	0.04	0.04	0.04
Maximum Volume Stored (acre-ft) =	0.011	0.039	0.013	0.022	0.030	0.070	0.072	0.072	0.072

Weir Report

Pond B Emergency Spillway

Rectangular Weir

Crest = Sharp

Bottom Length (ft) = 1.00

Total Depth (ft) = 1.00

Calculations

Weir Coeff. Cw = 3.33

Compute by: Known Q

Known Q (cfs) = 2.80

Highlighted

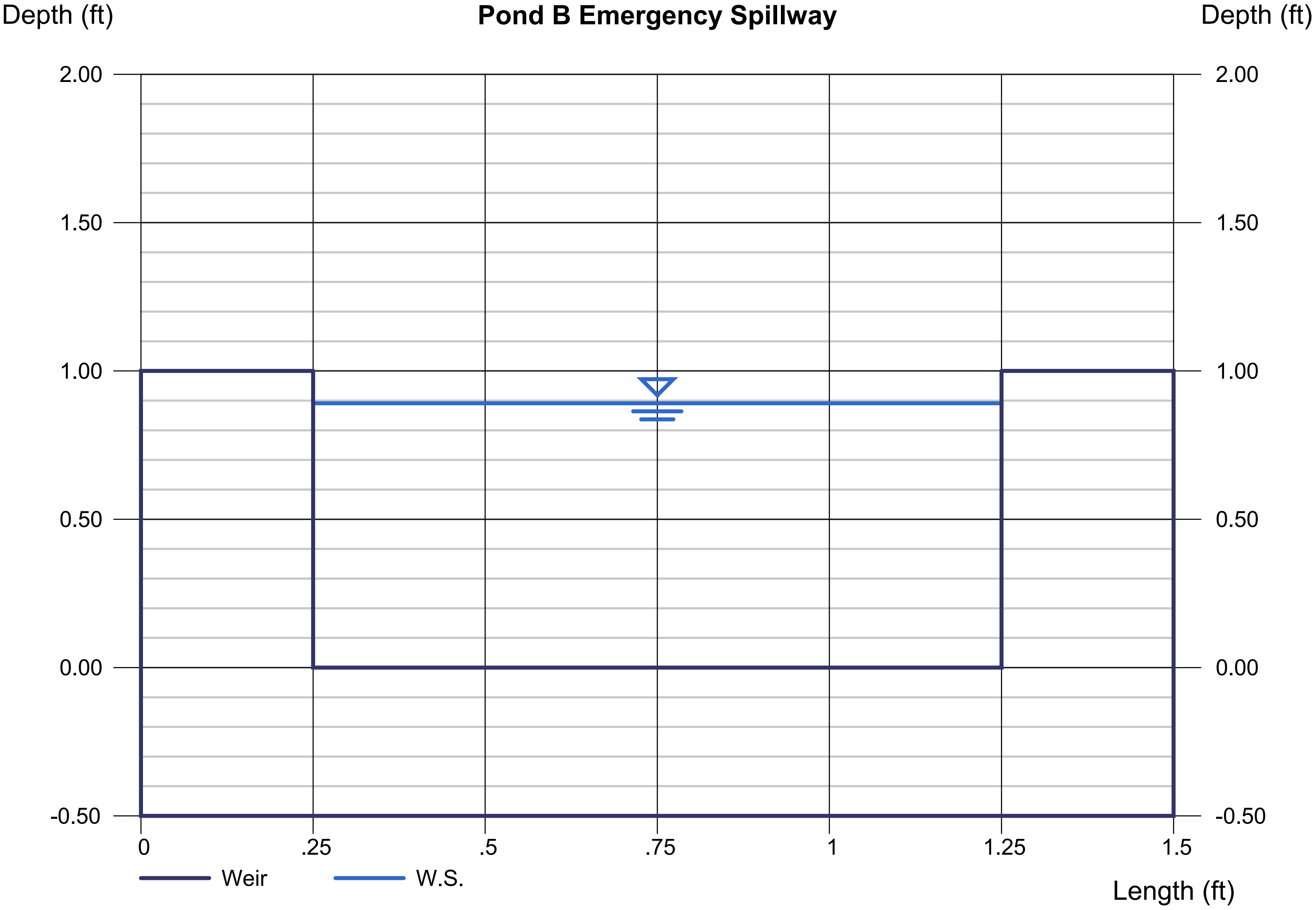
Depth (ft) = 0.89

Q (cfs) = 2.800

Area (sqft) = 0.89

Velocity (ft/s) = 3.14

Top Width (ft) = 1.00



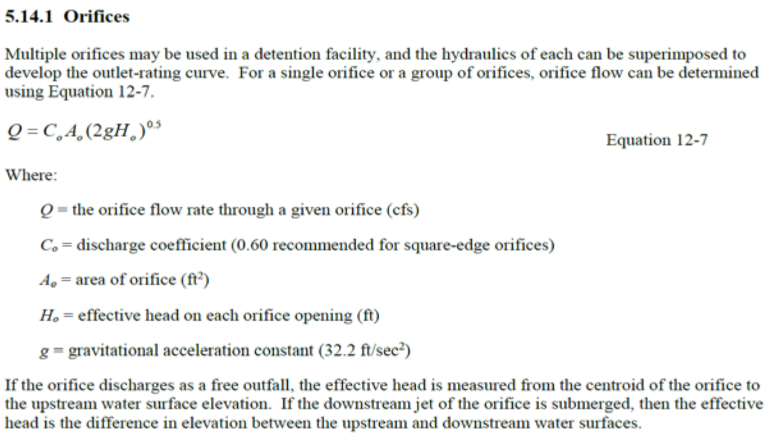
BASELINE
Engineering - Planning - Surveying

100-Year Orifice Plate on Outlet Pipe from Pond Outlet Structure

PROJECT NAME: Astrid
PROJECT NUMBER: CO20233
CALCULATED BY: SMB
CHECKED BY: MB

DATE: 2/28/2024

POND	PONDING DEPTH	OUTLET PIPE DIAMETER	OUTLET PIPE RADIUS	ORIFICE PLATE HEIGHT	ORIFICE PLATE HEIGHT	ORIFICE AREA	DEPTH TO OUTLET INVERT	ANGLE	CENTROID	EFFECTIVE HEAD	RELEASE RATE
	(FT)	(FT)	(FT)	(IN)	(FT)	(SQFT)	(FT)		(FT)	(FT)	(CFS)
A	3.5	1	0.5	**3.2**	0.267	0.168	1.5	2.17	0.16	4.84	**1.8**
B	2.05	0.5	0.25	**1.1**	0.092	0.025	8.9	1.77	0.05	10.90	**0.4**



5.14.1 Orifices

Multiple orifices may be used in a detention facility, and the hydraulics of each can be superimposed to develop the outlet-rating curve. For a single orifice or a group of orifices, orifice flow can be determined using Equation 12-7.

$$Q = C_o A_o (2gH_o)^{0.5}$$

Equation 12-7

Where:

Q = the orifice flow rate through a given orifice (cfs)

C_o = discharge coefficient (0.60 recommended for square-edge orifices)

A_o = area of orifice (ft^2)

H_o = effective head on each orifice opening (ft)

g = gravitational acceleration constant (32.2 ft/sec^2)

If the orifice discharges as a free outfall, the effective head is measured from the centroid of the orifice to the upstream water surface elevation. If the downstream jet of the orifice is submerged, then the effective head is the difference in elevation between the upstream and downstream water surfaces.

BASELINE
Engineering · Planning · Surveying

STORM STORAGE CALCULATIONS
DETENTION POND C

PROJECT NAME: Astrid
PROJECT NUMBER: 20235
CALCULATED BY: SMB
CHECKED BY: CSR

DATE: 2/29/2024

DESIGN DRAINAGE AREA Pond C Area = **0.69** **ACRES**

CALCULATED % IMPERVIOUSNESS = 52.8%

Tc = 5.0 MIN
Q5= 0.42
Q100= 0.61

5-YR STORM CALCULATIONS

EQUATION: Vi5=CIA*Tc*60	**Vi5 =**		**CF**
EQUATION: Q5=0.10 A	**RELEASE @ Q5 =**		**CFS**
EQUATION: Vo5=Q5*Tc*60	**Vo5 =**		**CF**
EQUATION: V5=Vi5-Vo5	**V5 =**	**NA**	**CF**

100-YR STORM CALCULATIONS

EQUATION: Vi100=CIA*Tc*60	**V100 =**		**CF**
EQUATION: Q100=0.54 A	**RELEASE @ Q 100=**		**CFS**
EQUATION: Vo100=Q100*Tc*60	**Vo100 =**		**CF**
EQUATION: V100=Vi100-Vo100	**V100 =**	**NA**	**CF**

WATER QUALITY STORAGE VOL.

$$WQCV = 0.79Aa(0.91I^3 - 1.19I^2 + 0.78I)/12$$

Drain Time	Coefficient,a
40 hours	1.00

WQCV = **0.010 AC-FT**
= **424 CF**

TOTAL REQUIRED VOLUME = **424 CF** (WQCV Only)

PROJECT : Astrid
PROJECT LOCATION: Pond C
DATE : 5/18/2023
PROJECT NO. : 20235
BY : SMB

Provided Volume

Stage (ft)	Contour Elevation (ft)	Area (ft^2)	1/3 (A1 + A2 + (A1A2)$^{1/2}$) D	Total Volume (ft^3)	Total Volume (ac-ft)
0.00	6953.00	41		0.0	0.000
1.00	6954.00	219	118.3	118.3	0.003
2.00	6955.00	513	355.7	474.0	0.011
3.00	6956.00	909	701.6	1,175.6	0.027

	WSEL	Depth (ft)	Area (ft^2)	Volume (ft^3)	Volume (ac-ft)
WQCV =	6955.00	2.00	513.00	473.98	0.011
EURV =					
2-yr =					
5-yr =					
10-yr =					
100-yr =					

🟩 = FORMULA CELLS
🟦 = USER INPUT CELLS

PROJECT: Astrid
JOB NO.: 20235
CALC. BY: SMB
CHK BY: CSR

POND SUMMARY

	POND	POND A	POND B	POND C
VOLUME (CF)	WQCV	1683	460	424
	V_5	1663	368	N/A
	V_{100}	5085	1046	N/A
ELEV.	Pond Invert	6984.00	6979.40	6953.00
WSEL	WQCV	6986.00	6980.65	6955.00
	5-Year	6985.90	6980.55	N/A
	100-Year	6987.50	6981.45	N/A
DEPTH (FT)	WQCV	2.00	1.25	2.00
	5-Year	1.90	1.15	N/A
	100-Year	3.50	2.05	N/A
RELEASE RATE (CFS)	WQCV	40-hr	40-hr	40-hr
	5-Year	0.9	0.07	N/A
	100-Year	1.8	0.37	N/A

ATTACHMENT 10

TABLES USED FOR REPORT

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.

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

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

$$t_c = t_i + t_t \qquad (1)$$

Where:

t_c = time of concentration (min)
t_i = initial or overland flow time (min)
t_t = travel time in the ditch, channel, gutter, storm drain, etc. (min)

The initial or overland flow time, t_i, may be calculated using the following equation:

$$t_i = 0.395\ (1.1 - C_5)\ L_o^{1/2} / S^{1/3} \qquad (2)$$

Where:

t_i = initial or overland flow time (min)
C_5 = runoff coefficient for 5-year return period
L_o = length of overland flow, (ft, 300 max)
S = average slope along the initial flow path (percent)

Equation 2 was developed for use with the Rational Method. The 5-year runoff coefficient, C_5, is presented in Table 5.6.1, along with C values for other return periods.

Table 5.6.1. Design Runoff Coefficients

Percent Impervious	Runoff Coefficients, C_x						
	1.25-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
0%	0.003	0.04	0.15	0.25	0.37	0.44	0.50
5%	0.03	0.08	0.18	0.28	0.39	0.46	0.52
10%	0.06	0.11	0.21	0.30	0.41	0.47	0.53
15%	0.10	0.14	0.24	0.32	0.43	0.49	0.54
20%	0.13	0.17	0.26	0.34	0.44	0.50	0.55
25%	0.16	0.20	0.28	0.36	0.46	0.51	0.56
30%	0.18	0.22	0.30	0.38	0.47	0.52	0.57
35%	0.22	0.25	0.33	0.40	0.48	0.53	0.57
40%	0.25	0.28	0.35	0.42	0.50	0.54	0.58
45%	0.28	0.31	0.37	0.44	0.51	0.55	0.59
50%	0.31	0.34	0.40	0.46	0.53	0.57	0.60
55%	0.34	0.37	0.43	0.48	0.55	0.58	0.62
60%	0.36	0.41	0.46	0.51	0.57	0.60	0.63
65%	0.42	0.45	0.49	0.54	0.59	0.62	0.65
70%	0.47	0.49	0.53	0.57	0.62	0.65	0.68
75%	0.52	0.54	0.58	0.62	0.66	0.68	0.71
80%	0.58	0.60	0.63	0.66	0.70	0.72	0.74
85%	0.64	0.66	0.68	0.71	0.75	0.77	0.79
90%	0.71	0.73	0.75	0.77	0.80	0.82	0.83
95%	0.79	0.80	0.82	0.84	0.87	0.88	0.89
100%	0.88	0.89	0.90	0.92	0.94	0.95	0.96

The overland flow length, L_o, is generally defined as the length over which the flow characteristics appear as sheet flow or very shallow flow in broad, grassed swales. Changes in land slope, surface characteristics, and small drainage ditches or gullies will tend to force the overland flow into a combined flow condition, which results in higher flow velocities and shorter travel times. The initial flow time in both urban and non-urban areas shall be limited to the time to travel 300 feet.

For watersheds longer than 300 feet, the travel time, t_t, must be added to the overland flow time. Travel time can be calculated using Manning's equation and the hydraulic properties of the storm drain, gutter, swale, ditch, or channel or can be approximated using Equation 3 for average velocity and Table 5.6.2 for the conveyance factor:

$$V = K\,S_w^{0.5} \tag{3}$$

Where:

V = velocity (fps)
S_w = watercourse slope (ft/ft)
K = conveyance factor

The minimum conveyance factor, K, that shall be used for a developed site shall be 7, corresponding to short pasture and lawns.

Table 5.6.2. Travel Time Conveyance Factors

Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/Field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterways	15
Paved areas and shallow swales	20

Reference: UDFCD (2016)

The time of concentration, t_c is the sum of the initial flow time, t_i and the travel time, t_t. The minimum recommended t_c for non-urban watersheds is 10 minutes.

Urbanized Watersheds

Overland flow in urbanized watersheds can occur from the back of the lot to the street, in parking lots, in landscape areas, or within park areas and can be calculated using the procedure described for non-urbanized watersheds. Travel time, t_t, to the first design point or inlet is often determined based on the conveyance coefficient for paved areas and shallow swales but can be estimated using Manning's equation.

The time of concentration for the first design point in an urbanized watershed shall not exceed the time of concentration calculated using Equation 4, which was developed using rainfall/runoff data collected in urbanized regions (USDCM, 2016).

$$t_c = (26\text{-}17i) + L_t \,/\, (60\ (14i + 9)\ \sqrt{(S_t)}) \tag{4}$$

Where:

t_c = minimum time of concentration for the first design point (min)
L_t = length of channelized flow path (ft)
i = imperviousness as a decimal
S_t = slope of the channelized flow path (ft)

Table 5.6.3. Recommended Imperviousness Values

Land Use or Cover	Percent Impervious
Commercial/Mixed Use	
Downtown and Base Areas*	95
All Other Commercial Areas	75
Residential	
Single Family	
2.5 acres or larger lot size	12
0.75 – 2.5 acres lot size	20
0.25 – 0.75 acres lot size	30
0.25 acres or smaller lot size	45
Multifamily and Resort Residential	75
Industrial	
Light industrial	80
Heavy industrial	90
Parks, cemeteries	10
Playgrounds	25
Schools	55
Railroad yards	50
Undeveloped Areas	
Historic Flow analysis	2
Greenbelts, agriculture	2
Off-site flow analysis	45
(when land use not defined)	
Streets & Surfacing	
Paved (concrete/asphalt)	100
Road base or recycled asphalt	80
Gravel (uniformly graded)	40
Drives and walks	90
Roofs	90
Lawns and golf courses (all soils)	2

Reference: UDFCD (2016)
*Downtown and Base Area Commercial defined as CO, G1, and G2 zoned parcels

5.6.2.3 HEC Models

The USACE HEC has developed models designed to simulate various hydrologic and hydraulic processes. The HEC-1 Flood Hydrograph Package was the first hydrologic model developed. Its successor, HEC-HMS (Hydrologic Modeling System), is designed to simulate the precipitation-runoff processes of branching watershed systems. It is designed to be applicable in a wide range of geographic areas for modeling the widest possible range of hydrologic conditions. This includes large river basin water supply and flood hydrology, and small urban or natural watershed runoff.

Either program is acceptable for use in the City of Steamboat Springs. The designer is referred to the HEC-1 and HEC-HMS User's Manuals for additional guidance. The following subsections offer guidance for determining some of the inputs to the HEC programs.

5.11.1 INTRODUCTION

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. This controlled discharge rate is the lesser of available downstream capacity and historic site runoff rates. Detention helps to control flood peaks in urbanized areas. Use of detention includes individual site options such as a channel or small landscaped basin and regional options serving multiple sites such as construction of a large pond or reservoir.

5.11.2 DETENTION VERSUS RETENTION

Stormwater storage reservoirs are either detention or retention basins. A detention basin detains water temporarily, releasing it slowly through a pipe or channel. Because of its ability to release flow during inflow, the required storage volume is reduced. Detention basins also have a positive means of outflow, eliminating problems that come with a residual pool. Alternately, a retention basin retains water without any release during inflow. Once the storm event is over, basin drainage may occur due to evaporation and percolation into the soil. The use of retention basins is not permitted within the City of Steamboat Springs.

5.11.3 HISTORIC AND PRE-DEVELOPMENT FLOWS

Historic runoff from a site is generally the amount of runoff a site produced during a given storm prior to anything being constructed on the site. When there is no construction on a site (i.e., no man-made imperviousness), and the Rational Method is being used to determine peak runoff, historic flow rates shall be calculated using the flow rates listed in **Table 5.11.1**.

For the purposes of these criteria, when a site already has improvements constructed upon it, defined as a “Pre-development” condition , that construction may be considered part of the site’s historic condition and historic flows for these sites shall be computed based on a composite C value determined in accordance with Section 5.6, Storm Runoff. Prior to any redevelopment of a parcel, any previous detention identified as part of the prior development proposal shall be factored into the runoff calculations for the site in question and accounted for with the revised runoff characteristics in order to preserve the pre-development runoff rates as identified in any previous drainage studies. If a HEC model of the watershed exists, it can be used to generate historic runoff rates by changing the imperviousness of the watershed to historic conditions (as defined above) as specified in Section 5.6, Storm Runoff.
Total allowable peak runoff rates from a developed, redeveloped, or significantly remodeled site shall be the pre-development flow rates for the minor and major design storm events.

Table 5.11.1 Historic Flow Rates (cfs/acre)

CONTROL FREQUENCY	SOIL GROUP		
	A	B	C and D
Minor Storm	0.04	0.08	0.10
Major Storm	0.27	0.46	0.54

The predominant soil group for the watershed area tributary to the detention pond shall be used for determining the historic flow rates. Information on the soils in Steamboat Springs can be found in published SCS Soil Surveys.

Calculating the WQCV is required to design a facility that meets the WQCV standard. Two variables are required to calculate the WQCV. The first is the total imperviousness of the area being considered. Sometimes this area is the area draining to the treatment facility. Other times, the WQCV for the entire site must first be calculated as part of the calculations required to meet another design standard. Recommended imperviousness values are in Section 5.6. The total imperviousness of a site can be determined by taking an area-weighted average of the different imperviousness values for the site. Total imperviousness can also be adjusted to an effective imperviousness if certain practices are implemented as part of the site design. Effective imperviousness applicability and calculations are discussed below the calculation for the WQCV.

The second variable is the design drain time of the treatment facility. Recommendations for design drain time for different types of WQCV treatment facilities can be found in Volume 3 of the USDCM. The most commonly used WQCV facility is an extended detention basin, for which the recommended drain time is 40 hours. WQCV drain time coefficients are in Table 5.12.2 below. The general equation to calculate the WQCV in Steamboat Springs is expressed as:

$$WQCV = 0.79Aa(0.91I^3 - 1.19I^2 + 0.78I)/12 \tag{1}$$

Where:

WQCV = water quality capture volume (acre-feet)

a = WQCV drain time coefficient

i = imperviousness as a decimal percentage

A = area draining to the treatment facility in acres

Table 5.12.2. Drain Time Coefficients for WQCV Calculations

Drain Time	Coefficient, a
12 hours	0.8
24 hours	0.9
40 hours	1.0

The WQCV equation was initially developed based on rainfall data from the Denver metro area. However, the precipitation depth of the average runoff producing storm in Steamboat Springs is 0.34 while in Denver it is 0.43. The WQCV equation above includes a coefficient of 0.79 to adjust the equation for use in Steamboat Springs. A map showing the variance in the average runoff producing storm across Colorado is shown as Figure 5.12.2.

Effective Imperviousness

The imperviousness value used in the WQCV calculation for sites that implement low impact development (LID) principles such as green infrastructure and MDCIA may be reduced to reflect the site's effective imperviousness. The effective imperviousness is dependent on the level of MDCIA implemented for high-level planning applications. Level 1 includes designing impervious surfaces to drain over a grass buffer or other pervious surface prior to reaching any stormwater conveyance system. Level 2 is an enhancement to Level 1 and includes eliminating curb and gutter or using slotted curbs; low-velocity pervious grass- or rock-lined swales instead of storm sewers, and pervious street shoulders. Guidance on calculating effective imperviousness for Level 1 and Level 2 MDCIA can be found in Volume 3 of the USDCM.

ATTACHMENT 11

FINAL DRAINAGE STUDY CHECKLIST (STANDARD FORM NO. 3)

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.
_N/A_ 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
- ✓ 1. Indicate gutter capacity.
- ✓ 2. Indicate curb capacity.
- ✓ 3. Indicate design velocity
- ✓ 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.
- ✓ 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.
__✓__ 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.).
__N/A__ 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.
__N/A__ 6. Show floodplain limits and information.
__✓__ 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: Steve Batchelder 12/19/2022
Date

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

ATTACHMENT 12

EXHIBIT A – SCOPE APPROVAL FORM (STANDARD FORM NO. 5)

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:	Astrid Site Development
Project location:	2410 Ski Trail Lane
Developer name/contact info:	Steamboat Esquiar LP, W. Brodie Sherman brodie@fusefv.com
Drainage engineer name/contact info:	Steve Batchelder steve@baselinecorp.com
Application Type:	Development Plan
Proposed Land Use:	A mix of resort multifamily structures.

Project Site Parameters	
Total parcel area (acres):	4.33
Disturbed area (acres):	3.46
Existing impervious area (acres, if applicable):	0.13 Acre (3% IMP)
Proposed new impervious area (acres):	1.98 Acre
Proposed total impervious area (acres):	2.11 Acre (61% IMP)
Proposed number of project outfalls:	1
Number of additional parking spaces:	95+/- (Garage spaces)
Description and site percentage of existing cover/land use(s):	Most of the site is undeveloped native grasses.
Description and site percentage of proposed cover/land use(s):	Multi-family condos and associated drives, walks, landscape, and pool over approx 85% of the site.
Expected maximum proposed conveyance gradient (%):	10%
Description of size (acres) and cover/land use(s) of offsite areas draining to the site	71 acres of residential/condos and ski resort at 9.5% Imp.

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:	3 on-site 2 off-site
Presence of pass through flow (circle):	YES ● NO ○
Description of proposed stormwater conveyance on site:	Storm Sewer and Detention Ponds. Routing off-site flow through ditches and storm sewer to historical discharge point
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:	The site outlets near Ski Trail Lane in storm sewer to Burgess Creek. Per the Master Plan there are various problem areas in Burgess Creek downstream from the site some of which have already been addressed.
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:	Hydraflow Storm Sewer Extension for 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.:	N/A
Concept-level permanent stormwater treatment facility design details (type, location of facilities, proprietary structure selection, treatment train concept, etc.):	Extended Detention Basin, WQCV
Proposed LID measures to reduce runoff volume:	N/A
Will treatment evaluation include off-site, pass through flow (circle):	YES ● NO ○

Approvals

Baseline Engineering, Steve Batchelder 12/8/22 303-324-2624

Prepared By: Date Phone number
(Insert drainage engineer name & firm)

Approved By:

See Attached Approval Letter

Printed Name: Date
City Engineer

City of Steamboat Springs

December 13, 2022

Baseline Engineering
1169 Hilltop Ln Suite 204
Steamboat Springs, CO 80487

RE: Approval Letter for Preconsultation - Drainage Scope Approval Form or Waiver Request for Astrid Site Development (PL20220630)

Dear Baseline Engineering,

The following are approved:

1. Drainage & Stormwater Treatment Scope Approval Form

If you have any questions or concerns please contact me at (970) 871-8271 or via email at esoltis@steamboatsprings.net.

Sincerely,

Emrick Soltis, P.E.
Community Development Engineer

ATTACHMENT 13

EXHIBIT B – STROM WATER QUALITY PLAN

PROJECT:

ASTRID SITE DEVELOPMENT PLAN
2410 SKI TRAIL LANE
CITY OF STEAMBOAT SPRINGS, ROUTT COUNTY, STATE OF COLORADO

STORMWATER QUALITY PLAN

PREPARED BY:

BASELINE ENGINEERING CORPORATION
STEVE BATCHELDER, PE
1169 HILLTOP PARKWAY, SUITE 204
STEAMBOAT SPRINGS, COLORADO 80487
970-879-1825

DRAFT 1ST SUBMITTAL: DECEMBER 22, 2022
DRAFT 2ND SUBMITTAL: MAY 19, 2023
FINAL SUBMITTAL: FEBRUARY 29, 2024

JOB # CO20235

INDEX

CERTIFICATION STATEMENT

I HEREBY AFFIRM THAT THIS STORMWATER QUALITY PLAN FOR ASTRID SITE DEVELOPMENT PROJECT 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.

Steven M Batchelder

STEVEN M. BATCHELDER

37112

2/29/24

REGISTERED PROFESSIONAL ENGINEER

STATE OF COLORADO NO.

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.

ASTRID SITE DEVELOPMENT PLAN

STORMWATER QUALITY PLAN

I INTRODUCTION

A. LOCATION

1. The project area is located at 2410 Ski Trail Lane adjacent to Steamboat Resort. The north limits of the site are adjacent to the ski resort and The Edgemont development. The eastern limits are adjacent to the Bear Claw II and Bear Claw Estates developments which has Lot 11B currently under construction. To the south are the Norwegian Log and Ski Inn Condominiums. Finally on the west are the Ski Trail and Elkhorn at Steamboat Condominiums. The project area is in the northeast quarter of the northwest quarter of Section 27, Township 6 North, Range 84 West of the 6th P.M., City of Steamboat Springs, Routt County, Colorado.

B. DESCRIPTION OF PROPERTY

1. The site is approximately 4.33 acres including the existing right-of-way at the location of the access off of Ski Trail Lane. Total Drainage Area including off-site area is approximately 80 acres. Whereas the proposed project disturbance is roughly 3.5 acres.

2. The site is currently undeveloped and ground cover consists mostly of native grass. There is a lot of relief across the site. The upper end of the site near the Edgemont is at an elevation of 7068 and the lower end of the site near Ski Trail Lane is at 6956 for a difference of 112 feet across the site. Slopes vary from approximately 1% to 50%. A gravel ski/resort access currently cuts through the southwest of the site and there is also a tower for the Steamboat Gondola on the southeast portion of the property.

3. The subject property is zoned as Resort Residential Two, High Density. The directly adjacent properties (except for the resort) are zoned either Resort Residential One or Resort Residential Two.

4. According to the Soil Survey, the project area consists entirely of Routt loam, which is poorly drained and Hydrologic Soil Type C. The offsite flows consist mainly of Hydrologic Soil Type C. See soils map in the appendix for more info.

5. Per FEMA FIRM 08107C0883D with an effective date of 02/04/2005, the project is

entirely outside of the floodway/floodplain of Burgess Creek.

6. There are no irrigation facilities on or adjacent to the property.

7. There are approximately 4,370 square feet of delineated wetlands on the site near the access to the site off of Ski Trail Lane. Of which there will be roughly 2,250 square feet of permanent disturbance of wetlands.

C. PURPOSE OF THIS STORMWATER QUALITY PLAN

1. This plan is meant to identify site-generated stormwater flow and potential site contaminants, including sediment. The Stormwater Quality Plan presents the design details for all permanent stormwater treatment facilities required to minimize the potential for pollutants to leave the site in accordance with the City's MS4 permit.

2. The site is over an acre so a permanent stormwater quality facility is required.

3. There are six multi-family/condo buildings proposed on the property as well as associated drives, sidewalk, sanitary sewer, water, storm sewer, dry utilities, landscaping, and a pool and associated building.

4. This report was prepared in conjunction with the Site Development Plans dated 05/19/2023 by Eric Smith Associates and Baseline Engineering for Steamboat Esquiar LP. And subsequently updated for the Construction Documents prepared by Baseline Engineering dated 02/29/2024.

D. REFERENCED DRAINAGE REPORTS

1. The "City of Steamboat Springs Citywide Stormwater Master Plan" was referenced in the preparation of this report.

2. The "Addendum to Final Drainage Study for Edgemont and Related Access Improvements for Bear Claw II," by Landmark Consultants, Inc. Dated June 18,2009

3. The "Draft Drainage Study for Edgemont" by Landmark Consultants, Inc. Dated April 9, 2007, Revised July 7, 2007

4. The "Final Drainage Study for Bear Claw II Sub-division" by Landmark Consultants, Inc. Dated June 19, 2018, Revised February 18, 2019

II DRAINAGE CRITERIA AND METHODOLOGY USED

A. DESIGN RAINALL AND STORM FREQUENCY

1. In accordance with City Drainage Criteria, the major storm is the 100-year recurrence interval storm and the minor storm is the 5-year recurrence interval storm.

2. The values of 0.82 inches and 1.79 inches for the 5-year storm and 100-year storm respectively were used for the drainage per the City's Drainage Criteria.

B. RUNOFF CALCULATION METHOD

1. The Proposed and Existing basins, including off-site basins are around 80 acres, below the 160 acre maximum for the rational method; therefore the rational method has been used to calculate peak flows for both proposed and existing conditions per section 5.6.2.2 of the City's Engineering Standards.

C. CULVERT, INLET, AND STORM SEWER ANALYSIS

1. Street and Inlet capacities were studied using MHFD-Inlet v5.01, April 2021, by the Mile High Flood District.

2. Hydraflow Storm Sewers Extension for Autodesk Civil 3D, was utilized to create hydraulic models of the storm sewer system.

D. DETENTION DISCHARGE AND STORAGE METHODOLOGY

1. Stormwater detention has been designed using the FAA method as outlined in section 5.11.7.2 in the City's Engineering Standards. The allowable release rates have been determined by using Table 5.11.1 in the City's Engineering Standards which are based on soil groups. The Water Quality Capture Volume was determined from the equation in section 5.12.7.1 of the City's Engineering Standards using a 40-hour drain time.

III PROPOSED CONDITIONS

A. DRAINAGE PATTERNS & BASINS

1. The proposed improvements include a large 7 story building with 2 garage floors along the property line adjacent to the ski resort. There are 5 other condo buildings that are 4 stories each and then a pool and associated 2 story building. In addition, there are proposed drives, sidewalk, sanitary sewer, water, storm sewer, dry utilities, and landscaping. The proposed site is approximately 60% impervious and the disturbed area is roughly 3.50 acres of the 4.33 acre site.

2. There are two Major Basins that will be treated and one that due to grading constraint will be treated, but not able to detain the 100-year storm event. The drainage basins to be treated are Basin A which is 2.49 acres in size and Basin B which is 0.68 acres. The portion of the site that will remain untreated is Basin C which is 0.69 acres or 15.5% of the entire site which is under the 20% requirement of the site that can be untreated.

B. POTENTIAL SITE CONTANMINANTS

1. The potential site contaminants during construction will include sediment, asphalt pavement, fuel spills during vehicle refueling, fluids from leaking vehicles, off-site vehicle tracking, and concrete.

2. The potential site contaminants after construction is complete will include sediment, fluids from leaking vehicles, and landscaping products.

C. DETENTION/WATER QUALITY PONDS

1. Pond A is the main detention pond on site and has a capture area of 2.49 acres as well as off-site flow from Basin H3 of 1.9 cfs for the 5-year storm and 5.3 cfs for the 100-year. Pond B has a capture area of 0.68 acres and no bypass flow. Basin C is unable to be detained due to lack of available area and will be free released. According to the city's standards only 5% of the site may be free released and the release rates from the pond must be reduced accordingly. Basin C is 0.67 acres and 15% of the site. Since there is not adequate real estate for an additional pond and grades make it impossible to use the other ponds, we are proposing to over-size Pond A since it has the off-site flow from Basin H3 and then release the pond at a reduced rate to make up for the free release of Basin C. The release rate from Pond A is also being reduced by the bypass free release flow of the inlets at Basins A2 and A3 of 0.3 cfs for the 5-year storm and 1.9 cfs for the 100-year storm. The ponds were sized using the FAA method as outlined in the city's standards.

2. Pond A
   Taking into account over-sizing the pond for the off-stie flow from Basin H3 as

discussed above, the required volume for the pond is 1663 cubic feet for the 5-year storm and 5085 cubic feet for the 100-year storm. The water quality capture volume (WQCV) was calculated to be 1683 cubic feet. The pond will have vertical walls all around due to constrained area with a bottom slope of 3% and a depth of 3.5 feet for the 100-year storm. The proposed release rate from the pond was calculated to be 0.9 cfs for the 5-year storm and 1.8 cfs for the 100-year storm taking into account the free release and offsite flows as discussed above. See calculations in the appendix for details. The WQCV will be released through and orifice plate over 40 hours. The outlet structure will be built into the retaining wall and tie into the storm sewer in the access road. The emergency spillway was sized for the 100-year flow of Basins A and H3 of 19.2 cfs. The spillway will be a rectangular weir in the retaining wall 6 feet wide and 1 foot high. The spillway will release directly into the access road.

3. Pond B

   The required volumes for Pond B are 391 cubic feet for the 5-year storm and 1046 cubic feet for the 100-year storm. The WQCV was calculated to be 460 cubic feet. The pond will have a vertical wall on the south side and a minimum bottom slope of 2% and a depth of 2.0 feet for the 100-year storm. The allowable release rate based on the soil type of C is 0.07 cfs for the 5-year storm and 0.37 cfs for the 100-year storm. The WQCV will be released through and orifice plate over 40 hours. The emergency spillway was sized for the 100-year flow of Basins B of 2.8 cfs. The spillway will be a rectangular weir in the retaining wall 1 foot wide and 1 foot high. The spillway will release directly into the access road.

4. Pond C

   Pond C is a Water Quality Pond only and will not provide detention as stated above since Pond A is oversized and the flow leaving the site will remain unchanged. The required WQCV is 424 cubic feet. The slopes of the pond are 3:1 and the bottom has a minimum slope of 2%. The depth of the pond is 2 feet and the WQCV will be released through an orifice plate over 40 hours

5. The ponds will be in drainage easements and will be privately maintained by the HOA that will be formed for this development.

D. CONSTRUCTION PHASING

1. There will be 4 phases of construction. All three detention/water quality ponds are in the first phase and will need to be in place to catch runoff before it leaves the site.

IV OPERATION AND MAINTENANCE PLAN REQUIREMENTS

A. POST CONSTRUCTION STORMWATER QUALITY FEATURES

1. The Detention/Water Quality ponds will need to be maintained on a regular basis to ensure that the sediment build up does not impact how the pond is meant to function.

B. CONSTRUCTION BMP'S

1. Construction BMP's will include a stabilized vehicle tracking control pad, silt fence or sediment control logs, inlet and outlet control, ditch check dams, and concrete washout area.

2. A Construction SWMP will be submitted under separate cover prior to construction.

C. MAINTENANCE SCHEDULE & RESPONSIBILITY

1. Maintenance during construction will be performed by the General Contractor or his designee. Inspections on construction BMPs should be performed every 14 days and immediately following storm events. An inspection report shall be prepared for each inspection. Maintenance shall be performed as identified in the inspection report.

2. Once construction is complete, the owner will be responsible for maintenance of the storm water conveyance and treatment features within the Property. Storm sewer system components shall be inspected, repaired, and cleaned on a routine basis to ensure the system functions as intended. See below for the minimum required inspection and maintenance schedule

EXTENDED DETENTION BASIN

Activity	Required Frequency
Inspection for debris at outlet, sediment in the forebay, and damage to structures or embankments; maintain or repair as necessary	Twice annually
Remove sediment from forebay, trickle channel(s), and micropool; aeration of vegetated areas	Annually
Mowing	As needed to maintain 6” height and

	control weeds
Irrigation and application of fertilizer, herbicide, and pesticide	As needed to maintain vegetative health

Notes: Maintenance frequency is highly dependent on construction activity within the tributary area, associated erosion control measures, and the design of the facility. More frequent removal of accumulated sediment may be required, but detention basins are generally low maintenance facilities.

ATTACHMENT 1

STORMWATER QUALITY PLAN CHECKLIST (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).
__N/A__ 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: Steve Batchelder   12/21/22
Date

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

ATTACHMENT 2

PROJECT SHEET AND DESIGN CHECKLIST

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: Astrid Site Development Plan		
Project Location: 2410 Ski Trail Lane		
Submitted Date: 12/22/22		Submitted By: Baseline Engineering
Acreage Disturbed: 4.33 acres		
Existing Impervious: 2%		New Net Impervious: 60%
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:

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	2570 CF	3.86 AC	Ponds A, B, & C
Pollutant Removal			
Runoff Reduction			

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: Astrid Site Development Plan

Preparer	City	Requirements	
NO		Facilities provide treatment and/or infiltration of the WQCV for 100% of the site	
		% of site treated: 92.5%	
		Facility Type: Extended Det. Basin	Facility Location: Ponds A, B, & C
		See Drainage Report section:	

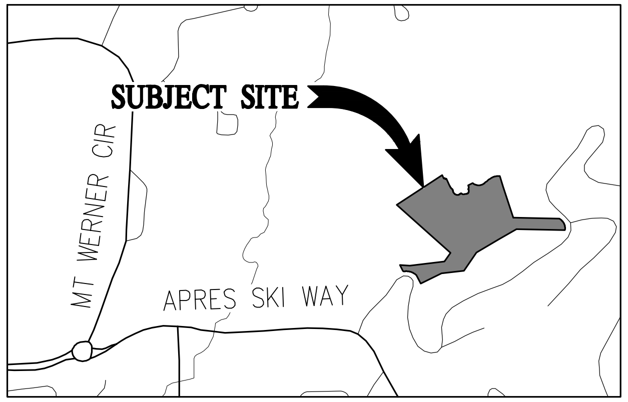
If less than 100% of the site is treated, complete the following:

Preparer	City	Requirements	
		% of site not treated by control measures (not to exceed 20% or 1 acre):	
		7.5 %	0.29 (Basins C4 and C5) Size (acres)
		Provide explanation of why the excluded area is impractical to treat: The inlets for these basins are adjacent to the storm sewer main and instead of tying directly into the main a separate storm sewer would be required to reach pond C downstream.	
		Provide explanation of why another facility is not practicable for the untreated area: There is not sufficient room for another facility. Pond C has been added to treat most of the IPA prior to being discharged offsite.	

ATTACHMENT 3

OWNERSHIP AND MAINTENANCE PLAN

ASTRID SITE DEVELOPMENT PLAN
EXTENDED DETENTION BASIN
DRAFT OWNERSHIP AND MAINTENANCE PLAN
CONSTRUCTED IN [MONTH, YEAR]



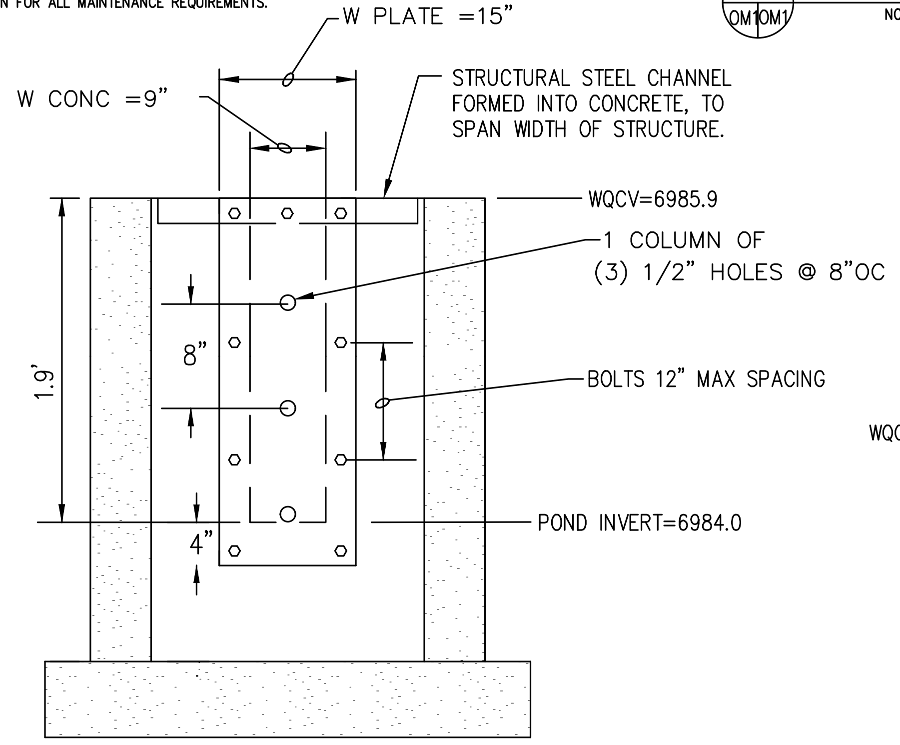
VICINITY MAP
SCALE: 1" = 1000'

NOTES:
1. FOR ADDITIONAL DESIGN INFORMATION, REFER TO THE CONSTRUCTION PLANS FOR THIS PROJECT.
2. SEE DETAILED NOTES ON THE SECOND SHEET OF THIS PLAN FOR ALL MAINTENANCE REQUIREMENTS.

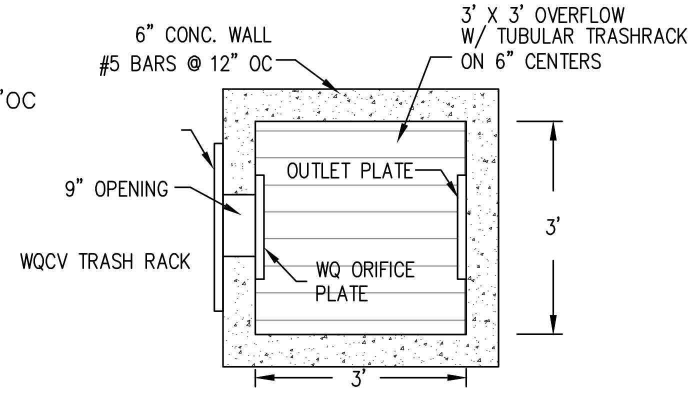
LEGEND

▨	AREA TO BE MOWED (SEE NOTE 4 NEXT SHEET)

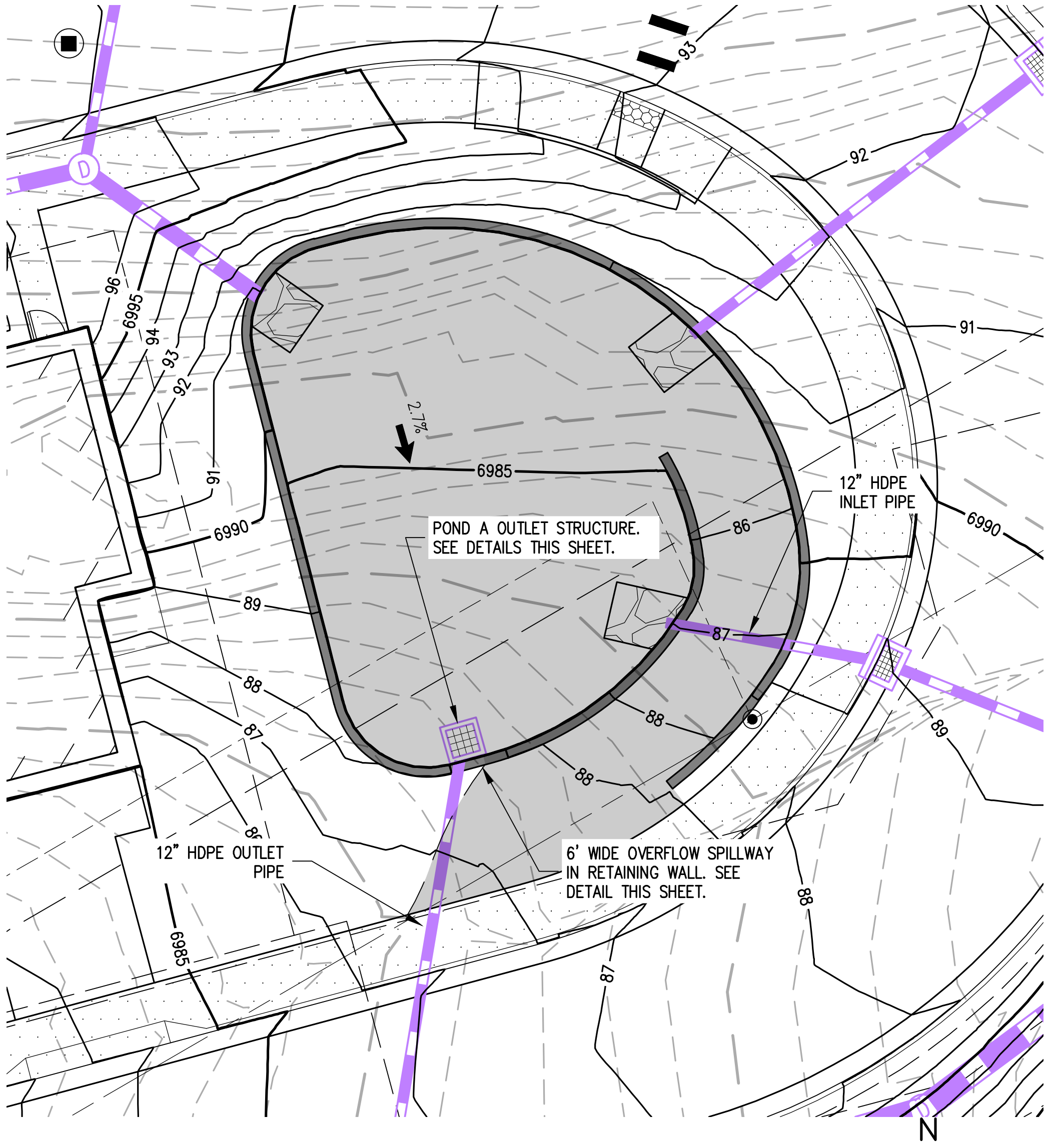
2 OM1 OM1 EMERGENCY SPILLWAY DETAIL
NO SCALE



WATER QUALITY ORIFICE



PLAN VIEW



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1 OM1 OM1 POND A EXTENDED DETENTION BASIN PLAN

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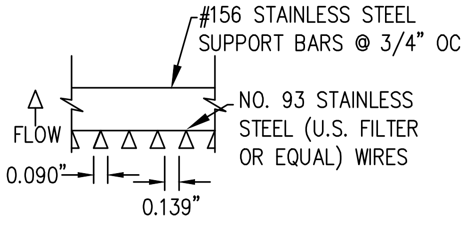
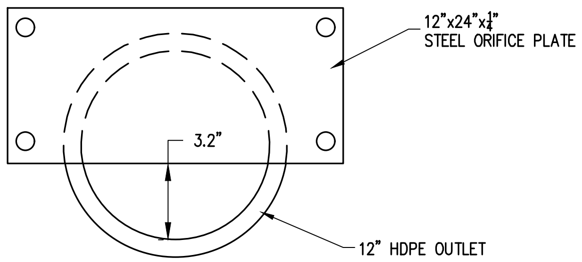
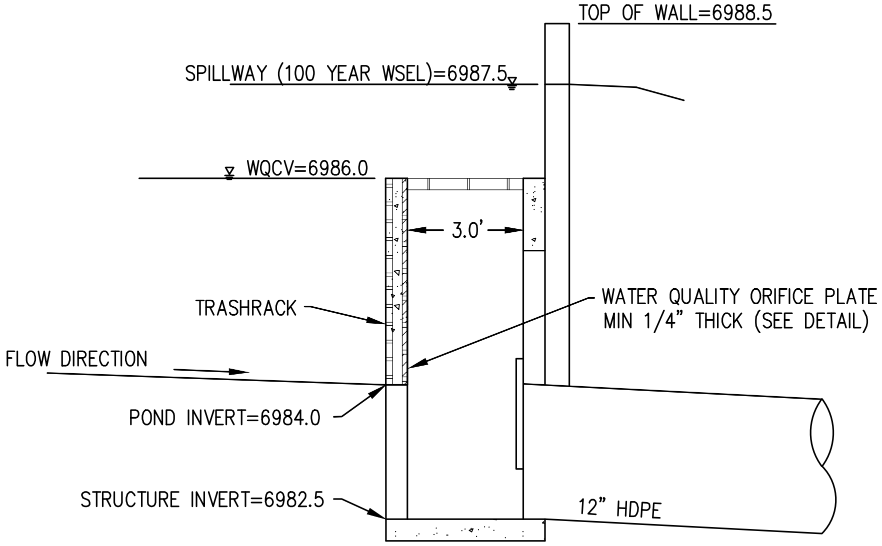
(IN FEET)
1 INCH = 20 FT



WQCV TRASH RACK DETAIL



4 OM1 OM1 100-YEAR ORIFICE PLATE
NOT TO SCALE



3 OM1 OM1 WATER QUALITY POND OUTLET STRUCTURE
NO SCALE

DETAIL NOTES:
1. OVERFLOW TRASH RACKS SHALL BE MOUNTED USING STAINLESS STEEL HARDWARE AND PROVIDED WITH HINGED AND LOCKABLE OR BOLTABLE ACCESS PANELS.
2. OVERFLOW TRASH RACKS SHALL BE STAINLESS STEEL, ALUMINUM, OR STEEL. STEEL TRASH RACKS SHALL BE DIP GALVANIZED AND MY BE HOT POWDER COATED AFTER GALVANIZING.
3. WATER QUALITY CAPTURE VOLUME WELL-SCREEN TRASH RACKS SHALL BE STAINLESS STEEL AND SHALL BE ATTACHED BY INTERMITTENT WELDS ALONG THE EDGE OF THE MOUNTING FRAME.

O:\C020235 Astrid-Edgemont Ph2\Drawings\Drainage Maps\20235 PRO DRAIN.dwg, 2/29/2024 3:41:03 PM, Steve Batchelder

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DESIGNED BY SMB
DRAWN BY SMB
CHECKED BY MB

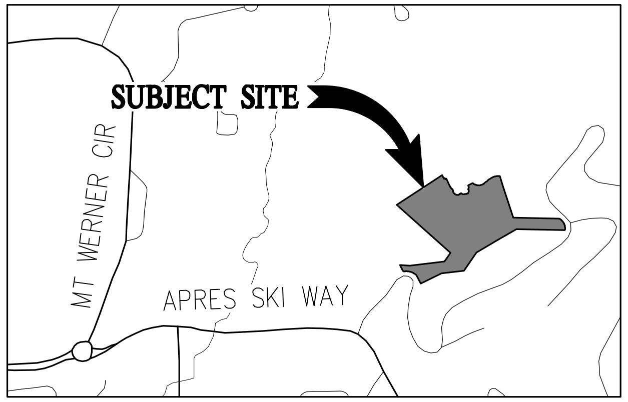
REVISION DESCRIPTION	PREPARED BY	DATE
CONSTRUCTION DOCUMENT SUBMITTAL	SMB	2/29/2024

STEAMBOAT ESQUAIR LP
ASTRID SITE DEVELOPMENT PLAN
4210 SKI TRAIL LANE
OWNERSHIP & MAINTENANCE PLAN – POND A
ROUTT COUNTY
STEAMBOAT SPRINGS

INITIAL SUBMITTAL	12/22/22
DRAWING SIZE	11" X 17"
SURVEY FIRM LANDMARK CONS.	SURVEY DATE 06/03/22
JOB NO.	C020235
DRAWING NAME 20235 PRO DRAIN.dwg	
SHEET 1 OF 4	

OM1

ASTRID SITE DEVELOPMENT PLAN
EXTENDED DETENTION BASIN
DRAFT OWNERSHIP AND MAINTENANCE PLAN
CONSTRUCTED IN [MONTH, YEAR]



VICINITY MAP
SCALE: 1" = 1000'

NOTES:
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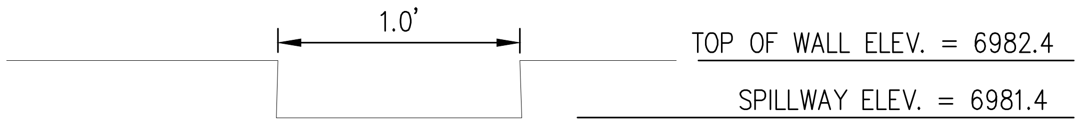
LEGEND

▨	AREA TO BE MOWED (SEE NOTE 4 NEXT SHEET)



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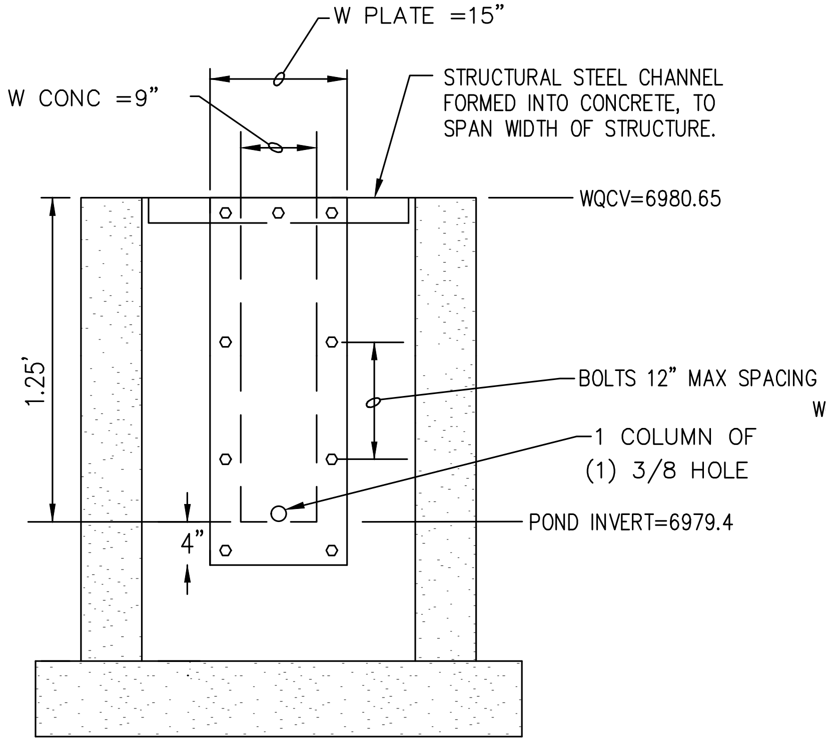
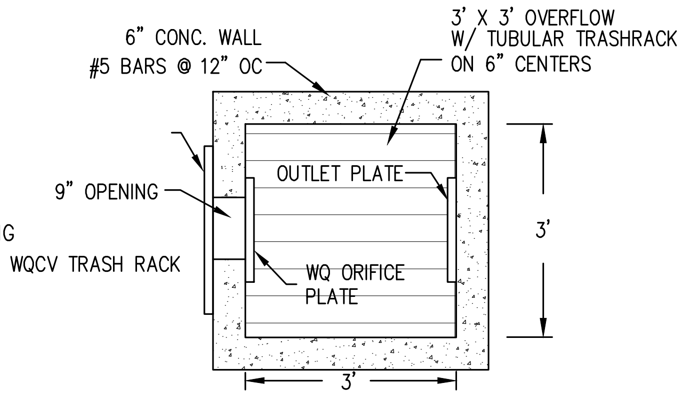
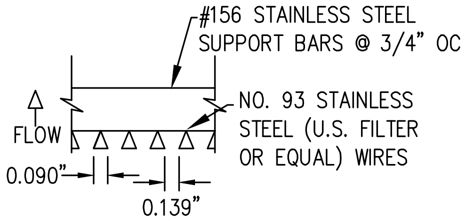
NO SCALE



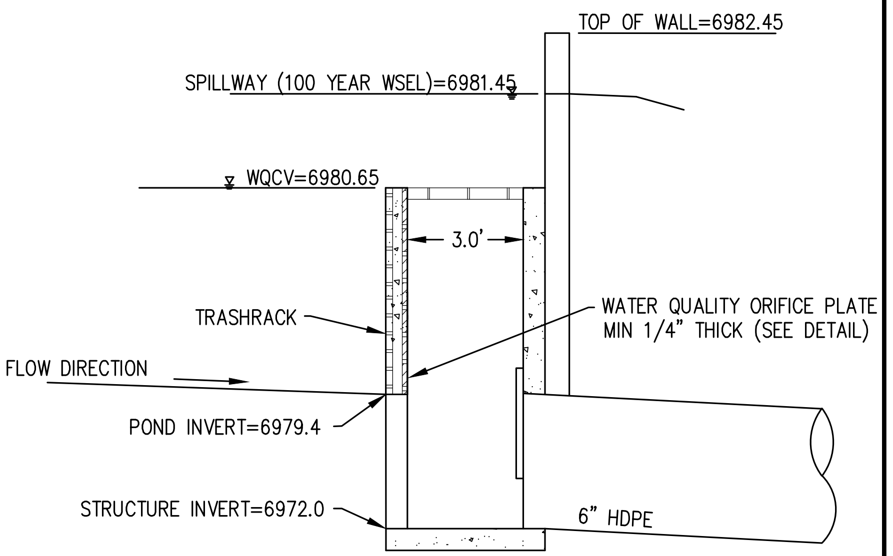
WATER QUALITY ORIFICE



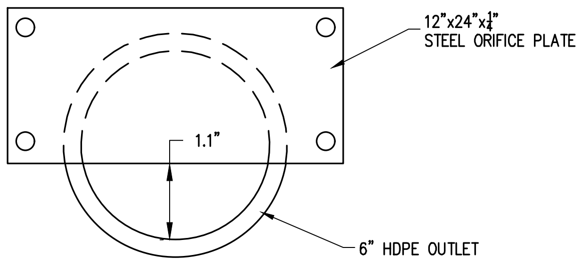
PLAN VIEW



WQCV TRASH RACK DETAIL



3 OM2 OM2 WATER QUALITY POND OUTLET STRUCTURE
NO SCALE



4 OM2 OM2 100-YEAR ORIFICE PLATE
NOT TO SCALE

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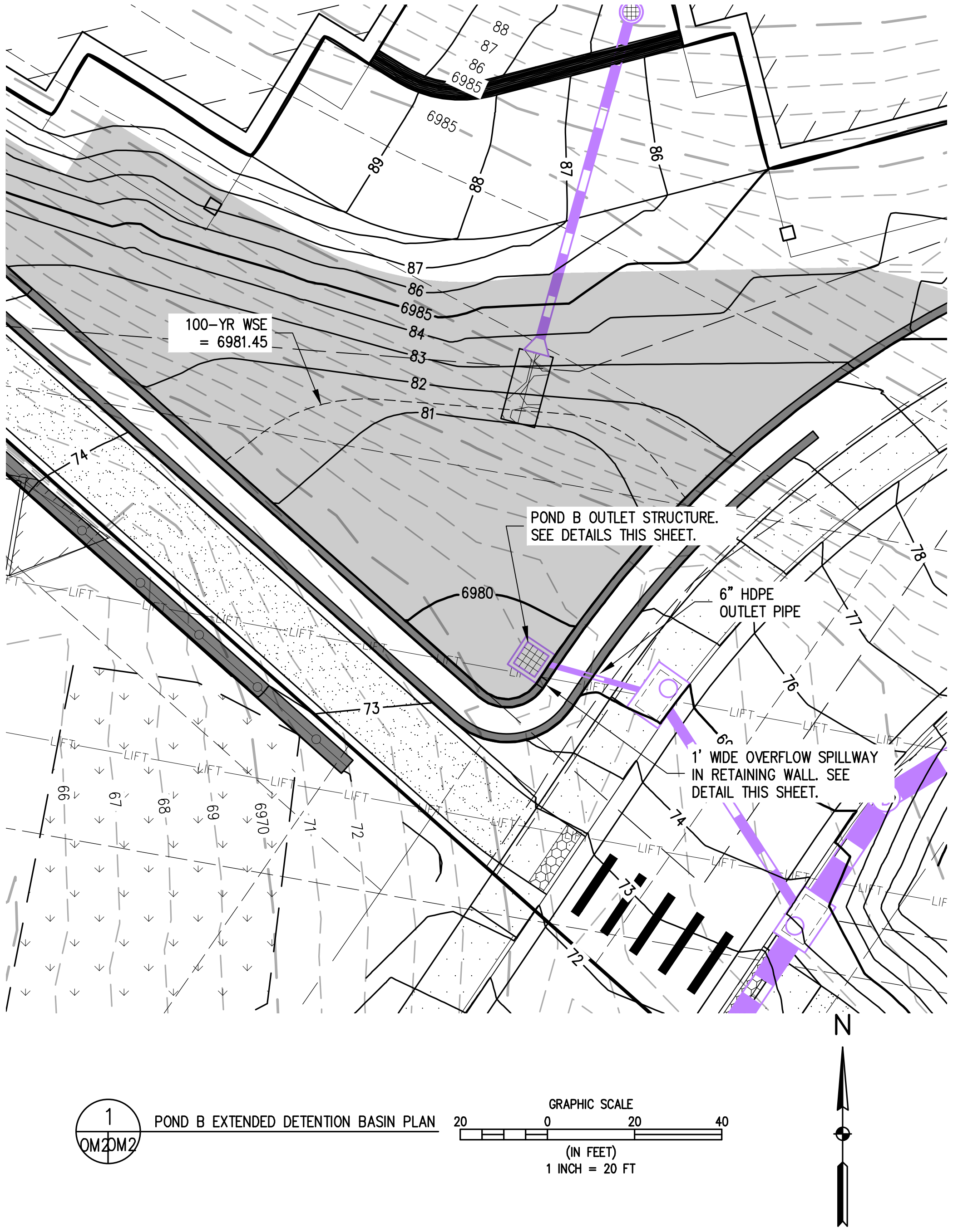

1 OM2 OM2 POND B EXTENDED DETENTION BASIN PLAN

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REVISION DESCRIPTION	PREPARED BY	DATE
CONSTRUCTION DOCUMENT SUBMITTAL	SMB	2/29/2024

STEAMBOAT ESQUAIR LP
ASTRID SITE DEVELOPMENT PLAN
4210 SKI TRAIL LANE
OWNERSHIP & MAINTENANCE PLAN – POND B
STEAMBOAT SPRINGS
ROUTT COUNTY

INITIAL SUBMITTAL 12/22/22
DRAWING SIZE 11" X 17"
SURVEY FIRM LANDMARK CONS.
SURVEY DATE 06/03/22
JOB NO. C020235
DRAWING NAME 20235 PRO DRAIN.dwg
SHEET 2 OF 4
OM2

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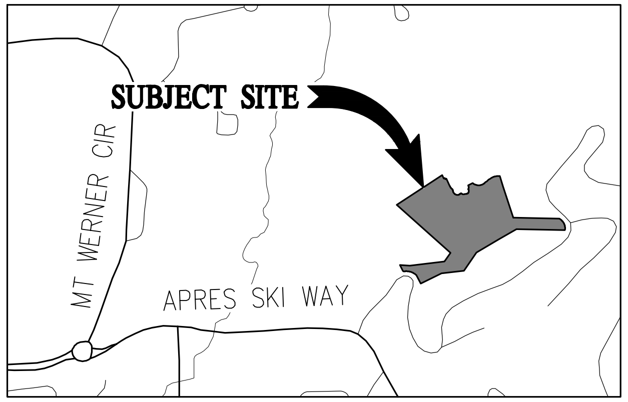
ASTRID SITE DEVELOPMENT PLAN
EXTENDED DETENTION BASIN
DRAFT OWNERSHIP AND MAINTENANCE PLAN
CONSTRUCTED IN [MONTH, YEAR]



VICINITY MAP
SCALE: 1" = 1000'

NOTES:
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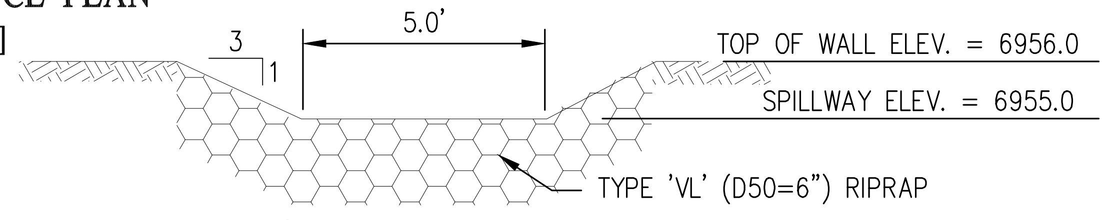
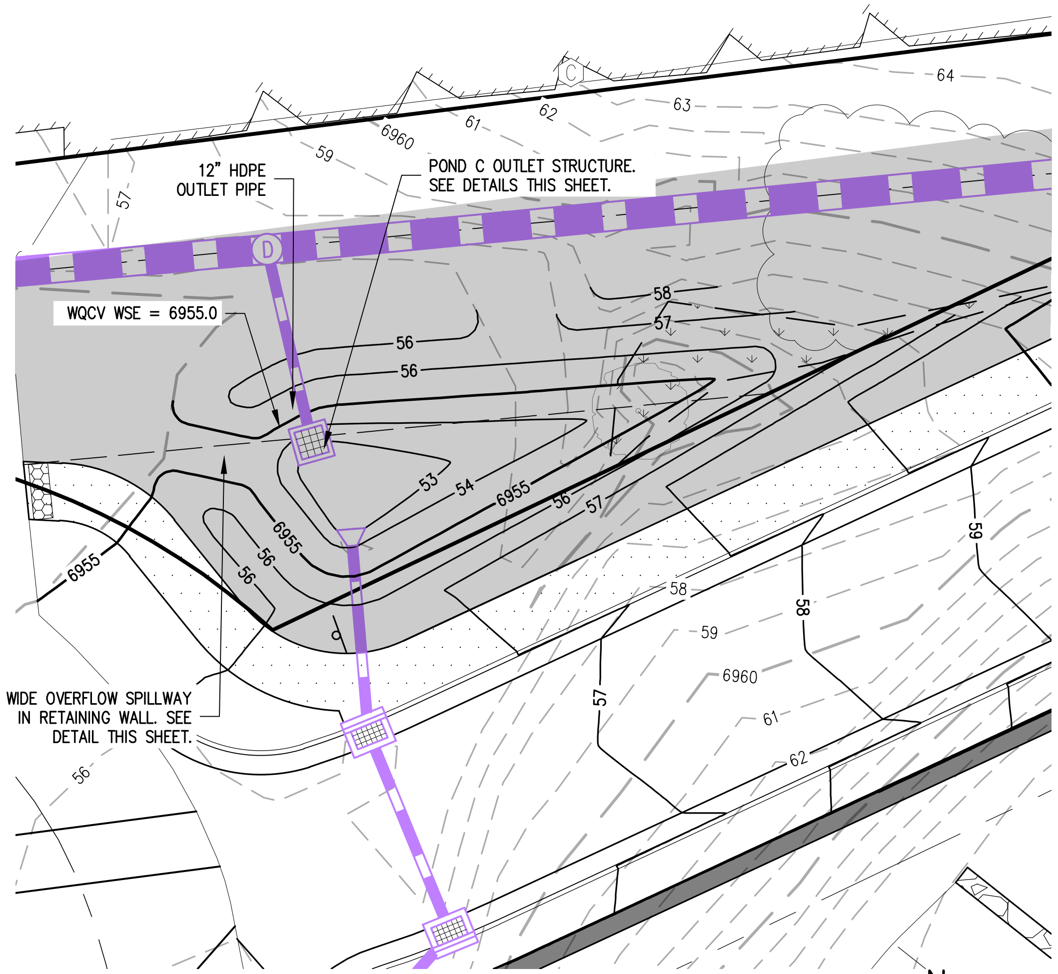
2. SEE DETAILED NOTES ON THE SECOND SHEET OF THIS PLAN FOR ALL MAINTENANCE REQUIREMENTS.

LEGEND

▨	AREA TO BE MOWED (SEE NOTE 4 NEXT SHEET)



2 OM3 OM3 EMERGENCY SPILLWAY DETAIL
NO SCALE



1 OM3 OM3 POND C WATER QUALITY BASIN PLAN

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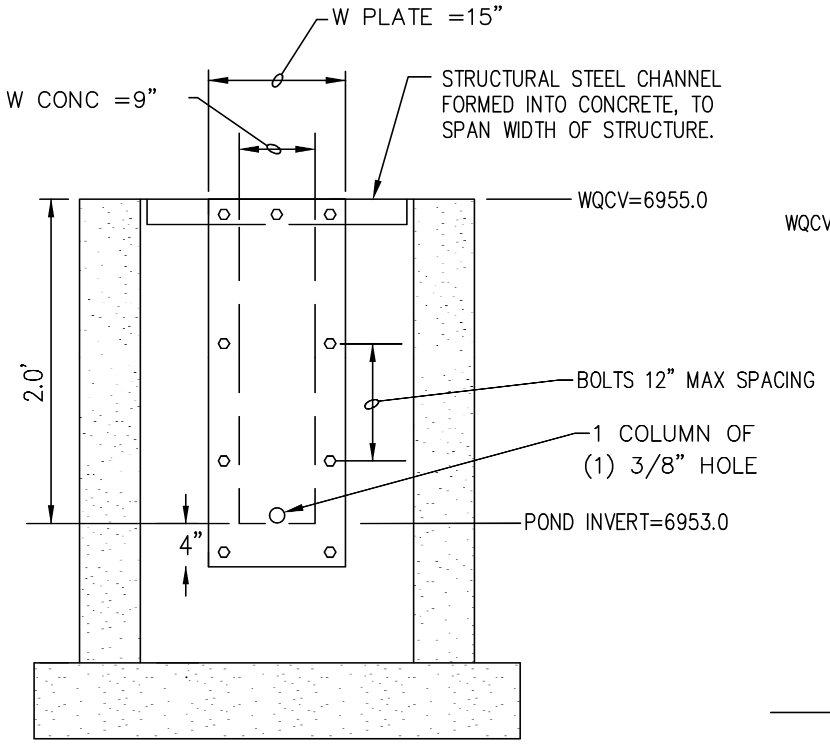
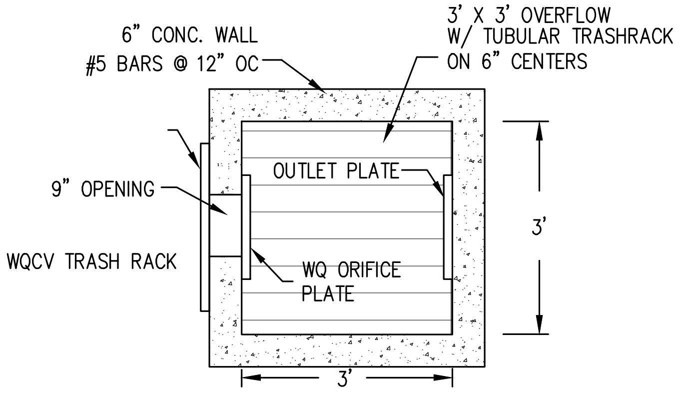
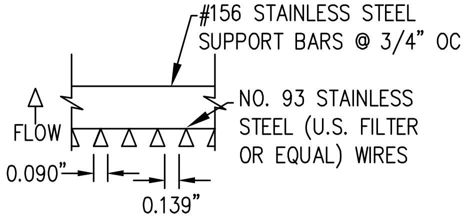
(IN FEET)
1 INCH = 20 FT



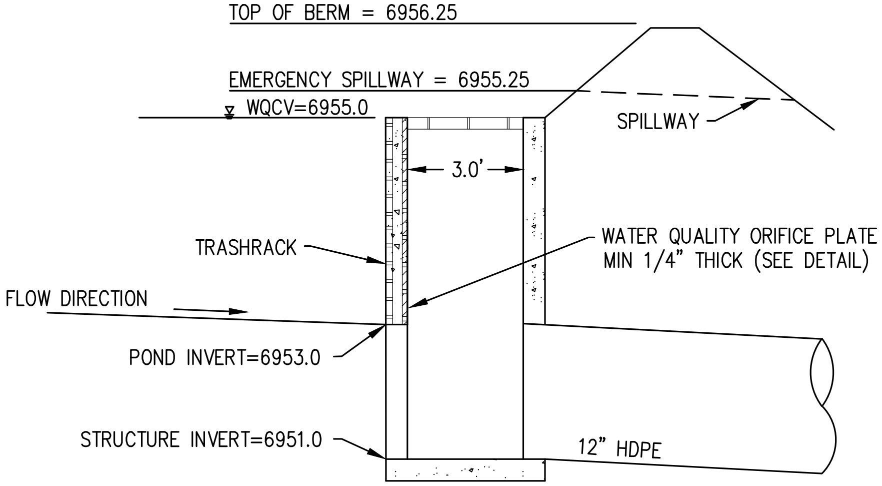
WATER QUALITY ORIFICE



PLAN VIEW



WQCV TRASH RACK DETAIL



3 OM3 OM3 WATER QUALITY POND OUTLET STRUCTURE
NO SCALE

DETAIL NOTES:
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DESIGNED BY	DRAWN BY	CHECKED BY
SMB	SMB	MB

REVISION DESCRIPTION	PREPARED BY	DATE
CONSTRUCTION DOCUMENT SUBMITTAL	SMB	2/29/2024

STEAMBOAT ESQUAIR LP

STEAMBOAT SPRINGS
ROUTT COUNTY

ASTRID SITE DEVELOPMENT PLAN
4210 SKI TRAIL LANE
OWNERSHIP & MAINTENANCE PLAN – POND C

INITIAL SUBMITTAL	12/22/22
DRAWING SIZE	11" X 17"
SURVEY FIRM LANDMARK CONS.	SURVEY DATE 06/03/22
JOB NO.	C020235
DRAWING NAME 20235 PRO DRAIN.dwg	
SHEET 3 OF 4	

OM3

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ASTRID SITE DEVELOPMENT PLAN
EXTENDED DETENTION BASIN
DRAFT OWNERSHIP AND MAINTENANCE PLAN
CONSTRUCTED IN (MONTH, YEAR)

1. <u>GENERAL PROJECTION INFORMATION</u>

A. LOCATED AT 2410 SKI TRAIL LANE. SUBDIVISION & LEGAL NAME =

PARCEL 1:

LOT 1, BEAR CLAW III SUBDIVISION, COUNTY OF ROUTT, STATE OF COLORADO; EXCEPTING THEREFROM THAT PORTION LYING WITHIN THE MAP OF EDGEMONT CONDOMINIUM – BUILDING A RECORDED DECEMBER 16, 2009 UNDER RECEPTION NO. 694320.

PARCEL 2:
THAT PORTION OF THE "OUT LOT" ABUTTING LOT 8, BLOCK 2, SKI TRAIL SUBDIVISION, FILING NO. 3 AND EXTENDING EASTERLY FROM THE WESTERLY LINE OF SAID LOT 8, EXTENDED SOUTHERLY TO THE NORTHERLY LINE OF SKI TRAIL LANE,

PARCEL 3:
OUTLOT, SKI TRAIL SUBDIVISION FILING NO. 3

CITY OF STEAMBOAT SPRINGS, COUNTY OF ROUTT, STATE OF COLORADO

B. RECEIVING WATER: BURGESS CREEK

C. PROPERTY OWNER(S) NAME = STEAMBOAT ESQUIAR LP; CONTACT NAME ADDRESS, PHONE NUMBER & EMAIL = W. BRODIE SHERMAN 4265 SAN FELIPE, STE #970, HOUSTON, TX 77027, BRODIE@FUSEFV.COM

D. AGENCY RESPONSIBLE FOR MAINTENANCE NAME, CONTACT NAME, ADDRESS, PHONE NUMBER, & EMAIL; STEAMBOAT ESQUIAR LP (SAME AS ABOVE)

E. DESIGN ENGINEER, CONTACT NAME, ADDRESS, PHONE NUMBER, EMAIL, & PE LICENCE NUMBER = BASELINE ENGINEERING, STEVE BATCHELDER, 1169 HILLTOP PKWY, SUITE 204, STEAMBOAT SPRINGS, 970–879–1825, STEVE@BASELINECORP.COM, PE # 37112

2. <u>GENERAL FACILITY DESCRIPTION</u>
THIS FACILITY IS AN EXTENDED DETENTION BASIN THAT WILL CAPTURE AND TREAT THE STORMWATER QUALITY CAPTURE VOLUME. THE FACILITY HAS BEEN ADOPTED AND APPROVED BY CITY OF STEAMBOAT SPRINGS AS PART OF THE ASTRID SITE DEVELOPMENT PLAN PROJECT. IT WILL RECEIVE RUNOFF FROM 3.18 ACRES AND WILL OCCUPY A PARCEL OF 0.10 ACRES THAT WILL BE USED TO CAPTURE AND TREAT THE STORMWATER QUALITY CAPTURE VOLUME AND PROVIDE FOR MAINTENANCE AND ACCESS OPERATIONAL ACTIVITIES.

3. <u>INSPECTION & MAINTENANCE FREQUENCY & PROCEDURE</u>

A. THE FOLLOWING ITEMS SHOULD BE INSPECTED: TWICE ANNUALLY = OUTLET STRUCTURE FOR DEBRIS AND DAMAGE TO OUTLET STRUCTURE AND EMBANKMENTS; ANNUALLY = REMOVE SEDIMENT FROM BOTTOM OF DETENTION BASIN AND AERATE VEGETATED AREAS; AS NEEDED = MOW TO MAINTAIN 6" GRASS HEIGHT AND CONTROL WEEDS; AS NEEDED = REPAIR IRRIGATION AND APPLY FERTILIZER, HERBICIDE, AND PESTICIDE. . ITEMS SHOULD BE MAINTAINED, REPAIRED, OR REPLACED AS NEEDED. AN INSPECTION FORM SHALL BE COMPLETED AFTER EACH INSPECTION.

B. REVISIONS TO MAINTENANCE FREQUENCY:

DATES / REASONS FOR CHANGES:

C. TRAFFIC CONTROL SHALL ONLY INCLUDE ENSURING VEHICLES ARE NOT PARKED IN THE STREET AT POINTS NEEDED TO ACCESS THE DETENTION BASIN. THE HOA WILL BE RESPONSIBLE.

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

E. DEWATERING AND WATER CONTROL

CLEANING THE OUTLET STRUCTURE AND BOTTOM OF DETENTION BASIN MAY REQUIRE DEWATERING. A TRASH PUMP WILL BE REQUIRED. WATER WILL NEED TO BE PUMPED INTO A WATER TRUCK AND DISPOSED OF AT A PROPER FACILITY TO ACCEPT THIS WATER SO THAT A PERMIT IS NOT REQUIRED. IF DEWATERING IS CONDUCTED IN ACCORDANCE WITH THE PROCEDURES SPECIFIED HEREIN, A DEWATERING PERMIT SHOULD NOT BE REQUIRED.

F. SEDIMENT, DEBRIS, & TRASH REMOVAL & DISPOSAL
REMOVAL SHALL BE CONDUCTED TWICE ANNUALLY AT A MINIMUM OR WHEN SEDIMENT REACHES 6 INCHES IN THE OUTLET STRUCTURE OF BOTTOM OF DETENTION BASIN. REMOVAL SHALL BE CONDUCTED AS NEEDED, BUT ESPECIALLY WHEN ANY DEBRIS BLOCKS FLOW AT THE OUTLET STRUCTURE. SEDIMENT AND DEBRIS SHALL BE REMOVED BY SHOVEL OR A VACUUM TRUCK AND DISPOSED OF AT A LANDFILL OR GRAVEL PIT THAT ACCEPT THESE WASTES OR IF SMALL VOLUMES IN REFUSE CONTAINER. THE LONGEST DISTANCE BETWEEN THE EDGE OF AN ACCESS ROAD AND THE FAR CORNER OF A STRUCTURE REQUIRING SEDIMENT REMOVAL IS 50 FEET.

G. VEGETATION MANAGEMENT
SEE SECTION 4 OF THE NOTES ON THIS SHEET.

H. WETLAND AREAS ARE NOT ANTICIPATED ON SITE. SEE SECTION 8.0 OF THE NOTES ON THIS SHEET.

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

J. TEMPORARY BEST MANAGEMENT PRACTICES SUCH AS INLET CONTROL AT THE OUTLET STRUCTURE SHALL BE REMOVED ONCE VEGETATION IS ESTABLISHED.

4. <u>EQUIPMENT, STAFFING, AND VEGETATION MANAGEMENT</u>

A. EQUIPMENT REQUIRED: VACUUM TRUCK, SHOVEL, AERATOR, MOWER.

B. STAFFING: THE HOA & LANDSCAPE CONTRACTOR WILL BE ABLE TO MAINTAIN TREATMENT FACILITY.

C. SEED: [TBD] SEED MIXES HAVE BEEN PLANTED AT THE SITE. THE [TBD.] SEED MIX HAS BEEN PLANTED WITHIN THE DETENTION BASIN. SEED MIXES ARE AS FOLLOWS:

BOTANICAL NAME	COMMON NAME	LBS PURE LIVE SEED/AC
[SEED MIX NAME]:		
Xxxxx xxxxxxxxxxxx	Xxxxxx Xxxxxx	X.X

[REPEAT AS NECESSARY TO INCLUDE ALL MIX SPECIES]

[REPEAT AS NECESSARY TO INCLUDE ALL MIXES IF NOT CITY STANDARD SPECIFICATION]

ANY AREAS THAT LACKING VEGETATION SHALL BE RESEEDED WITH THE ABOVE LISTED SEED MIX AND MULCHED.

D. MOWING: THE EXTENDED DETENTION BASIN SHALL BE MOWED TO A HEIGHT OF 6" AT COMPLETION OF CONSTRUCTION, REQUIRED MOW AREA WAS ESTIMATED TO BE X.X ACRES

E. WEEDS & UNDESIRABLE VEGETATION: WEEDS SHALL BE MOWED. NO WEED KILLER SHALL BE USED ON THE SITE. NOXIOUS WEEDS AND OTHER UNDESIRABLE VEGETATION SHALL BE REMOVED BY HAND TOOLS AND MOWING.

5. <u>SNOW AND ICE CONTROL</u>

FACILITY IS NOT LOCATED WITHIN A SNOW STORAGE AREA.

6. <u>RIGHT–OF–WAY, ADJACENT OWNERSHIP, & ACCESS</u>

A. RIGHT–OF–WAY DESCRIPTION: SKI TRAIL LANE AND THE ACCESS TO THE SITE IS CLOSEST RIGHT–OF–WAY TO THE MAINTENANCE ACCESS.

B. ADJACENT OWNERSHIP: THE ADJACENT PROPERTIES ARE SKI TRAIL CONDOS, ELKHORN CONDOS, THE STEAMBOAT RESORT, EDGEMONT CONDOS, BEAR CLAW II, BEAR CLAW ESTATES, NORWEGIAN CONDOS, AND THE SKI INN CONDOS.

C. ACCESS INFORMATION AND DETAILS: ACCESS IS FROM SKI TRAIL LANE TO THE PRIVATE PROJECT ACCESS..

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

7. <u>HYDRAULIC DESIGN</u>

A. FLOW RATES (CFS):

	POND A		POND B	
	INFLOW	OUTFLOW	INFLOW	OUTFLOW
WQ EVENT:	1.6 CFS	0.4 CFS	0.4 CFS	0.1 CFS
5–YEAR:	4.4 CFS	0.9 CFS	1.2 CFS	0.1 CFS
100–YEAR:	13.1 CFS	1.8 CFS	3.5 CFS	0.4 CFS

	POND C	
	INFLOW	OUTFLOW
WQ EVENT:	0.4 CFS	0.1 CFS
5–YEAR:	1.1 CFS	1.1 CFS
100–YEAR:	3.6 CFS	3.6 CFS

B. VOLUMES, DEPTHS, & WSELS:

ITEM	VOLUME	WSEL	DEPTH	INVERT
POND A	5085 CF	6987.5	3.5'	6984.0
EMERGENCY SPILLWAY	N/A	6988.5	1.0'	6987.1
WQCV DRAIN TIME = 40 HOURS				
POND B	1046 CF	6981.45	2.05'	6979.4
EMERGENCY SPILLWAY	N/A	6982.45	1.0'	6981.4
POND C	425 CF	6655.0	2.0'	6653.0
EMERGENCY SPILLWAY	N/A	6656.25	1.0'	6655.25

8. <u>SENSITIVE AREAS, WETLANDS, & PERMITS</u>

THE SITE HAS 0.1 ACRES OF WETLANDS LOCATED AT THE ENTRANCE TO THE SITE OFF OF SKI TRAIL LANE. NO PORTION OF THE SITE IS LOCATED IN THE BURGESS CREEK FLOODWAY AND FLOODPLAIN.

9. <u>MISCELLANEOUS INFORMATION</u>

A. PROJECT SURVEY:
EXISTING CONDITIONS TOPOGRAPHIC SURVEY WAS PREPARED BY LANDMARK CONSULTANTS BASED ON INFORMATION GATHERED JUNE 3, 2022. SITE BENCHMARK: A RECOVERED NO.5 REBAR WITH ALUMINUM CAP STAMPED "LS 29039", HAVING AN ELEVATION OF 6986.18' BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88) AT THE WESTERN MOST PROPERTY CORNER ADJACENT WITH THE SKI RESORT.

BASELINE
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DESIGNED BY	DRAWN BY	CHECKED BY
SMB	SMB	MB

REVISION DESCRIPTION	PREPARED BY	DATE
CONSTRUCTION DOCUMENT SUBMITTAL	SMB	2/29/2024

STEAMBOAT ESQUAIR LP
STEAMBOAT SPRINGS
ROUTT COUNTY
ASTRID SITE DEVELOPMENT PLAN
4210 SKI TRAIL LANE
OWNERSHIP AND MAINTENANCE PLAN NOTES

INITIAL SUBMITTAL 12/22/22
DRAWING SIZE 11" X 17"
SURVEY FIRM LANDMARK CONS.
SURVEY DATE 06/03/22
JOB NO. C020235
DRAWING NAME O&M NOTES.dwg
SHEET 4 OF 4
OM4

O:\C020235 Astrid–Edgemont Ph2\Drawings\Drainage Maps\O&M NOTES.dwg, 2/29/2024 3:37:59 PM, Steve Batchelder