Preliminary Drainage Report

TTRes at Commerce City Chambers Road

(JN: 23049)
10225 Chambers Rd
Commerce City, CO

August 27, 2024

Prepared for:

Thompson Thrift Residential
Steve Herron
111 Monument Circle, Suite 1600
Indianapolis, IN 46204
317.853.5425

Prepared by:

Proof Civil
Adrian Luce, PE
600 Grant Street, Ste. 210
Denver, CO 80203
303.325.5709

Certification

ENGINEER CERTIFICATION OF DRAINAGE REPORT

I hereby certify that this preliminary drainage study for the TTRes at Commerce City Chambers Road was prepared by me or under direct supervision in accordance with the provisions of the Commerce City Storm Drainage Design and Technical Criteria Manual for the owners thereof.

____
Date

____
Registered Professional Engineer
State of Colorado PE No. 0053564
For and on behalf of Proof Civil Co.

Table of Contents

I. Introduction

This preliminary drainage report for TTRes at Commerce City Chambers Road will address the on-site stormwater conveyance and treatment for the development in accordance with criteria set forth by applicable governing agencies as well as previously approved relevant drainage studies.

II. General Location and Description

A. Project Location

TTRes at Commerce City Chambers Road is located at 10225 Chambers Road at the northwest corner of the future intersection of 102^{nd} and Chambers Road. Specifically, within the south ½ of the NE ¼ of section 18, township 2 south, range 66 west of the 6^{th} principal meridian City of Commerce City, County of Adams, State of Colorado. The project is tributary to Second Creek which is approximately 0.5 miles east of the proposed development. There are no major drainage ways on the site, however near the southeast corner of the property there is an existing water quality and detention facility that was installed as part of the High Pointe subdivision project. The proposed development is bordered by a Colorado Public Service parcel to the north, Chambers Road to the east, E. 102^{nd} Ave to the south, and a single-family residential property to the west.

Refer to the vicinity map within the Appendix for additional information on site location.

B. Project Description

The pre-dedicated area of the property is approximately 13.3 acres, of which all will be disturbed as part of this project. The site is currently covered by native vegetation, homes, and farmland. The site is tributary to Second Creek and was analyzed as part of the 2007 JR Report titled "Final Drainage Study For 104^{th} Avenue Corridor Improvements Phase 2", prepared by JR Engineering, LLC, dated April 2007, hereafter referred to as the 2007 JR Report. Per the 2007 JR Report, flow from this property is routed in a northern direction towards 104^{th} Avenue via sheet flow within the vacant property north of the development. From the vacant property to the north, it is routed to Chambers where it is then conveyed via curb and gutter to existing storm sewer. Runoff produced from this development will ultimately be routed to the 104^{th} Avenue outfall and discharged into Second Creek.

The existing structures, pastures and drives will be cleared from the site to make way for the proposed multi-family residential development. The improvements associated with this project include parking lot paving, drive lanes, sidewalks, landscape area and 19 proposed buildings. The proposed buildings will consist of apartment units, leasing facilities, community areas and garages.

The geotechnical study encountered no groundwater during the drilled borings; therefore, groundwater will not impact the site. Based on the United States Department of Agriculture Natural Resources Conservation Service (NRCS) National Cooperative Soil Survey, the majority of onsite soils are identified as truckton loamy sand, and are classified as Hydrologic Soil Group A. Group A is sand, loamy sand or sandy loam types of soils. It has low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels and have a high rate of water transmission. Additional soil information will be provided as part of the final drainage report for this project, to include soil boring data.

There are no known major irrigation facilities onsite or immediately adjacent.

There is no known history of flooding within this property.

According to FEMA Flood Insurance Rate Map Panel #08001C0343H, the subject site is located within flood hazard area Zone X. Zone X is defined as an area outside the 0.2-percent-chance (or 500-year) flood. Refer to Appendix A for the applicable FEMA flood map.

Refer to attached drainage map for proposed and existing easements associated with this property.

Based on the maps available on the Colorado Department of Public Health and Environment (CDPHE) database there are no known points of contamination onsite, however there are areas of concern north of the project near 104th and Chambers. Onsite soil contamination will be further examined as part of the Geotechnical Report.

III. Drainage Basins and Sub-Basins

A. Major Basin Descriptions

The project is located within the Second Creek basin and has been part of DFA 0053 Outfall Systems Planning Drainage Study (OSP) and the aforementioned 2007 JR Report. The Second Creek basin is approximately 11.7 square miles, with an imperviousness range of 15% to 90% based on the commercial and residential land usages. The development site is located within sub basin 46 of the OSP, with a future imperviousness of 50% based on residential land usage. The 2007 JR Report used an assumed imperviousness of 2% and a Soil Group of B. The historic drainage pattern is in the northern direction towards 104th via sheet flows through the northern properties where they will be directed towards Chambers and ultimately Second Creek. Based on the 2007 JR report, the project would need to provide onsite detention, and restrict release rates to historic flows.

B. Sub-basin Descriptions

The majority of the existing site is currently undeveloped with approximately 30% native vegetation cover, and general slopes of 5% in a northern direction. Flows are conveyed via overland flows to the adjacent properties to the north where they sheet flow to Chambers Road north of the proposed development

The proposed development is located within Basin M of the 2007 JR Report and will outfall to the adjacent 36" storm line within Chambers. The storm line within Chambers will convey the flows north to the outfall system located in 104th Avenue. The 2007 JR Report anticipated that any future development would need to provide detention to reduce development runoff rates back to historic runoff rates, such that future developed basins were analyzed as 2% imperviousness. The resulting flows utilized in the 2007 JR report were 2.8 cfs and 18.3 cfs for the 5-year and 100-year event, respectively. These rates were utilized in the sizing of the 36" storm line within Chambers Road and the 104th Outfall. The 104th storm sewer outfalls into Second Creek per the 2007 JR Report, and OSP.

Refer to Appendix B for applicable information relating to the historic basin, Basin M, as identified within the previously approved 2007 JR Report.

Per section 2.3.2 of the Commerce City Drainage Criteria, (CCDC) and as outlined in the 2007 JR Report, the proposed development will need to provide onsite water quality and detention. Per section 2.3.2 of the CCDC, the project is not tributary to a regional water quality facility, and therefore the 20/10 requirements are not applicable to the development site.

Due to the development of the High Pointe Subdivision to the south there are no anticipated offsite flows that impact this site.

C. Historic Basins

The existing site is divided into drainage basins described as follows.

a. Basin H-OS1

Basin H-OS1 consists of 0.17 acres of landscape area and a small portion of Chambers Road that enters the subject property. Runoff generated from this basin is conveyed via sheet flow to the southeast corner of the subject property boundary.

b. Basin H-OS2

Basin H-OS2 consists of 0.28 acres of single-family residential lots that are a part of the High Pointe Subdivision. Runoff generated from this basin is conveyed via sheet flow to the south side of the subject property boundary.

c. Basin H-A

Basin H-A consists of 13.46 acres of onsite area that includes mostly undeveloped area and has some miscellaneous buildings and structures. In general, runoff from this basin is conveyed to the north and to the northeast and flow across the adjacent PSCo Utility Tract as surface flow.

d. Basin H-B

Basin H-B consists of 0.06 acres of landscape area from the subject site that drains into the existing High Pointe Subdivision water quality pond and is a portion of the existing water quality pond for High point Subdivision.

e. Basin H-C

Basin H-C consists of 0.07 acres of undeveloped area within the subject site. Runoff generated from this basin is conveyed to the west and into a small swale that is located on the western property line.

IV. Drainage Criteria

A. Regulation

Methods described in the MHFD Urban Storm Drainage Criteria Manual and in the Commerce City Storm Drainage Design and Technical Criteria Manual were used for the drainage design of the Site.

B. Drainage Studies, Outfall Systems Plans and Site Constraints

This preliminary drainage design has been prepared in compliance with the Final Drainage Study For 104th Avenue Corridor improvements Phase 2 and Second Creek (downstream of DIA) and DFA 0053 Watersheds Outfall System Planning Study Update (OSP). Per the 2007 JR Report, the site will provide an onsite full-spectrum pond, and release at a rate less than the historic 5 and 100-year release rates from the site.

The 2007 JR Report was used as a baseline for the storm improvements within Chambers and 104th Avenue. These improvements were completed under the High Pointe Phase III Drainage Report, prepared by Calibre Engineering, revised January 2005 (2005 Calibre Report), and the North Range Town Center Phase III Drainage Report, prepared by Calibre Engineering, revised February 2007 (2007 Calibre Report). The 2005 Calibre report outlines the installation of a 36" storm line within Chambers, which outfalls to Second Creek through a temporary system that was proposed to be abandoned after the final 104th Avenue outfall was completed. The 2007 Calibre Report outlines the extension of the storm line within Chambers and upsizes the storm sewer to a 48" RCP line at the connection of the storm installed under the High Pointe Subdivision, near the intersection of 103rd Avenue and Chambers. The storm line within Chambers was sized based on a flow of 88.6 cfs as outlined in both reports. It was unclear if the flow presented within the previous drainage studies included the release rates of the detention pond of the proposed development and therefore an analysis of the existing outfall within Chambers has been completed as part of this report.

The storm has been reevaluated within this report based on the Calibre flows of 88.6 cfs, which includes the areas south of the proposed development tributary to the storm line as well as the additional pond releases from the proposed development to ensure the total flow would not increase the hydraulic grade lines within the system to a point that would violate the Commerce City Storm Drainage criteria. The total flow analyzed within this report is 91.40 cfs that is routed to the 36" RCP storm line immediately adjacent to the proposed development.

Based on updated hydraulic modeling within the Appendix of this report the existing 36" and 48" storm lines within Chambers have adequate capacity to accommodate the proposed developments pond release rates.

There are two basins that will be tributary to the proposed development, denoted as H-OS1 & H-OS2 and described in section III.C of this report. The existing basins will be allowed to drain through the proposed development as they have in the historic condition, however they will be routed to the proposed onsite detention pond and will be treated and detained prior to being released to the existing storm line within Chambers Road.

As part of this project, 102nd Avenue will be extended along the southern property boundary. The drainage design of the development has been influenced by the increased imperviousness and vertical/horizontal alignment of the 102nd Avenue extension. The areas associated with the roadway extension were denoted as offsite drainage basins H-OS1 and H-OS2 on the historic drainage map.

The site grading is constrained by existing grades of the surrounding properties and Chambers Road adjacent to the site. On the northern portion of the property there is an existing gas main that will need to remain in place.

C. Hydrology

The Rational Method analysis, utilizing the Intensity-Duration-Frequency curves established for Commerce City, was used to determine the on-site runoff generated for the 5-year (minor), and 100-year (major) storm events. Runoff coefficients were based on the type of proposed development outlined in the MHFD manual and Soil Group A as outlined previously. Runoff coefficients used in the analysis were weighted according to the proposed land uses in each basin or sub-basin and the time of concentration values have been calculated for each of the basins or sub-basins per Commerce City criteria.

See the Proposed Drainage Basin Section and Appendix of this report for additional information relating to imperviousness and runoff values.

Detention storage and release rates have been calculated using the MHFD full-spectrum design criteria. The proposed pond will discharge at a rate of 2.1 cfs and 2.8 cfs during the 5-year and 100-year event, respectively. Hydrology calculations can be found in Appendix C. Refer to the Storage and Water Quality Treatment Section of this report for additional information.

D. Hydraulics

Conveyance of on-site generated and tributary off-site flows have been calculated using Manning's equation in accordance with the MHFD Urban Storm Drainage Criteria Manual and the Commerce City Storm Drainage Design and Technical Criteria Manual.

E. Stormwater Quality and Detention

Per City of CCDC Chapter 14, the proposed development will be required to provide water quality onsite. The proposed development will include a full-spectrum pond which is designed for the full Water Quality Capture Volume and will also minimize directly connected impervious areas (MDCIA) to the greatest extent practical as recommended by CCDC.

Since the project is not tributary to a downstream regional or sub-regional facility the proposed development will not be required to meet the 20/10 rule.

Although MDCIA is not required to meet the 20/10 threshold, CCDC MDCIA is required to be provided as practicable with the development and is met by sending rooftop areas to landscape buffers located along the landscape courtyard side of several of the buildings. A map and calculations for runoff reduction are included within the Appendix of this report that illustrates how MDCIA is provided.

Additionally, MDCIA will be implementing to the greatest extent practicable by routing rooftops and hardscape areas to grass buffers and grass swales prior to runoff entering the storm sewer system. It is important to note the full extent of MDCIA was not calculated as part of the Preliminary Drainage Report and will be supplemented as part of the Final Drainage Report.

MDCIA has been provided to the fullest extent practicable meeting the intent of Chapter 14 of City's Drainage Criteria. The proposed on-site full spectrum pond will meet all MS4 requirements by providing water quality for the entire development.

V. Drainage Design

A. General Concept

Runoff from the maximum practicable extents of the proposed development will be directed to the proposed onsite full spectrum pond via sheet flow, channelized gutter flow, roof drains, and storm sewer. As outlined within the 2007 JR Report, the proposed pond will discharge to the 36" storm line within Chambers, adjacent to the site, at a rate below or equal to the historic runoff rates.

Due to the increased impervious area in the proposed condition, a proposed full-spectrum detention and water quality pond will be constructed on site per MHFD criteria.

B. Proposed Drainage Basins

The improved site is divided into drainage basins described as follows:

a. Basin A1

Basin A1 is comprised of 0.59 acres of proposed parking lot, drive, building and landscape area. Runoff generated by this basin will be conveyed by a grass line swale along the western property boundary to Design Point 1. Design Point 1 represents a curb opening that will allow the runoff from Basin A1 to drain through Basin A3 where it will be captured by the proposed inlet at Design Point 3. The 100-year peak runoff of Basin A1 is 2.1 cfs.

b. Basin A2

Basin A2 is made up of building and landscape areas and has an area of 0.21 acres. Runoff generated from this basin will be routed via roof drains to landscape areas along the face of the building, where it will be captured by area inlets and conveyed to the storm sewer system at Design Point 2. The 100-year peak runoff from Basin A2 is 1.4 cfs.

c. Basin A3

Basin A3 is comprised of 0.57 acres of parking lot, drive, and garages. Runoff from this basin will be conveyed to an inlet located at Design point 3 via pans and curb and gutter. The runoff will be combined with the runoff from Basin A1, the inlet has been sized to capture the peak runoff from Basins A1 and A3. The peak runoff in the 100-year event is 3.7 cfs for Basin A3 and the combined peak runoff to the inlet at DP3 is 5.0 cfs.

d. Basin A4

Basin A4 is made up of building and landscape areas and has an area of 0.18 acres. Runoff generated from this basin will be routed via roof drains to landscape areas along the face of the building, where it will be captured by area inlets and conveyed to the storm sewer system at Design Point 4. The 100-year peak runoff from Basin A4 is 1.2 cfs.

e. Basin A5

Basin A5 is comprised of 0.91 acres of proposed building and landscape area. Runoff generated by this basin will be conveyed by a grass line swale located between the buildings to a proposed area inlet located at Design Point 5. The area inlet has been designed to capture 100% of the runoff generated within this basin. The 100-year peak runoff of Basin A5 is 4.2 cfs.

f. Basin A6

Basin A6 is made up of building and landscape areas and has an area of 0.21 acres. Runoff generated from this basin will be routed via roof drains to landscape areas along the face of the building, where it will be captured by area inlets and conveyed to the storm sewer system at Design Point 6. The 100-year peak runoff from Basin A4 is 1.4 cfs.

g. Basin A7

Basin A7 is made up of building and landscape areas and has an area of 0.17 acres. Runoff generated from this basin will be routed via roof drains to landscape areas along the face of the building, where it will be captured by area inlets and conveyed to the storm sewer system at Design Point 7. The 100-year peak runoff from Basin A4 is 1.0 cfs.

h. Basin A8

Basin A8 is comprised of 2.36 acres of parking lot, drive, and garages. Runoff from this basin will be conveyed to an inlet located at Design point 8 via pans and curb and gutter. The inlet has been sized to capture the peak runoff from Basins A8. The peak runoff in the 100-year event is 14.3 cfs for Basin A8.

i. Basin A9

Basin A9 is made up of building and landscape areas and has an area of 0.21 acres. Runoff generated from this basin will be routed via roof drains to landscape areas along the face of the building, where it will be captured by area inlets and conveyed to the storm sewer system at Design Point 9. The 100-year peak runoff from Basin A9 is 1.4 cfs.

j. Basin A10

Basin A10 is comprised of 0.63 acres of proposed building and landscape area. Runoff generated by this basin will be conveyed by a grass line swale located between the buildings to a proposed area inlet located at Design Point 10. The area inlet has been designed to capture 100% of the runoff generated within this basin. The 100-year peak runoff of Basin A10 is 3.0 cfs.

k. Basin A11

Basin A11 is made up of building and landscape areas and has an area of 0.18 acres. Runoff generated from this basin will be routed via roof drains to landscape areas along the face of the building, where it will be captured by area inlets and conveyed to the storm sewer system at Design Point 11. The 100-year peak runoff from Basin A11 is 1.1 cfs.

l. Basin A12

Basin A12 is comprised of 0.20 acres of proposed building and landscape area. Runoff generated by this basin will be conveyed by a concrete drain pan along the southern property boundary to Design Point 15. Design Point 13 represents a curb opening that will allow the runoff from Basin A13 to drain through Basin A15 where it will be captured by the proposed inlet at Design Point 16. The 100-year peak runoff of Basin A12 is 0.5 cfs.

m. Basin A13

Basin A13 is comprised of 1.43 acres of parking lot, drive, and buildings. Runoff from this basin will be conveyed to an inlet located at Design point 13 via pans and curb and gutter. The runoff will be combined with the runoff from Basin A12, the inlet has been sized to capture the peak runoff from Basins A12, A13 and A14. The peak runoff in the 100-year event is 6.7 cfs for Basin A13.

n. Basin A14

Basin A14 is comprised of 1.31 acres of parking lot, drive, and buildings. Runoff from this basin will be conveyed to an inlet located at Design point 13 via pans and curb and gutter. The inlet has been sized to capture the peak runoff from Basins A12, A13 and A14. The peak runoff in the 100-year event is 8.1 cfs for Basin A14 and the combined peak runoff to the inlet at DP13 is 13.8 cfs.

o. Basin A15

Basin A15 represents the area of the proposed detention pond and has a total area of 0.46 acres. Runoff generated within this basin will be routed directly to the pond via surface flow. The 100-year peak runoff from Basin A15 is 0.6 cfs.

p. Basin B1

Basin B1 is made up of building and landscape areas and has an area of 0.18 acres. Runoff generated from this basin will be routed via roof drains to landscape areas along the face of the building, where it will be captured by area inlets and conveyed to the storm sewer system at Design Point 14. The 100-year peak runoff from Basin B1 is 1.1 cfs.

q. Basin B2

Basin B2 is made up of building and landscape areas and has an area of 0.18 acres. Runoff generated from this basin will be routed via roof drains to landscape areas along the face of the building, where it will be captured by area inlets and conveyed to the storm sewer system at Design Point 15. The 100-year peak runoff from Basin B2 is 1.1 cfs.

r. Basin B3

Basin B3 is made up of buildings, courtyards and landscape areas and has an area of 1.00 acres. Runoff generated from this basin will be routed overland to a proposed area inlet at Design point 16. The 100-year peak runoff from Basin B3 is 4.2 cfs.

s. Basin B4

Basin B4 is made up of building and landscape areas and has an area of 0.15 acres. Runoff generated from this basin will be routed via roof drains to landscape areas along the face of the building, where it will be captured by area inlets and conveyed to the storm sewer system at Design Point 17. The 100-year peak runoff from Basin B3 is 0.9 cfs.

t. Basin C1

Basin C1 represents the southern half of 102nd Avenue that is historically tributary to the development with a total area of 0.77 acres. The basin is comprised of roadway pavement, sidewalk and landscape area. Runoff generated within this basin will be conveyed east to proposed inlets near the intersection of 102nd and Chambers at Design Point 18. The inlet has been sized to capture the 100-year peak runoff and route the runoff to the proposed pond via storm sewer. The 100-year peak runoff from Basin C1 is 3.5 cfs.

u. Basin C2

Basin C2 represents the northern half of 102nd Avenue that is historically tributary to the development with a total area of 0.93 acres. The basin is comprised of roadway pavement, sidewalk and landscape area. Runoff generated within this basin will be conveyed east to proposed inlets near the intersection of 102nd and Chambers at Design Point 19. The inlet has been sized to capture the 100-year peak runoff and route the runoff to the proposed pond via storm sewer. The 100-year peak runoff from Basin C1 is 4.8 cfs.

v. Basin C3

Basin C3 is made up of building and landscape areas and has an area of 0.19 acres. Runoff generated from this basin will be routed via roof drains to landscape areas along the face of the building, where it will be captured by area inlets and conveyed to the storm sewer system at Design Point 20. The 100-year peak runoff from Basin C3 is 1.1 cfs.

w. Basin C4

Basin C4 is made up of building and landscape areas and has an area of 0.27 acres. Runoff generated from this basin will be routed via roof drains to landscape areas along the face of the building, where it will be captured by area inlets and conveyed to the storm sewer system at Design Point 21. The 100-year peak runoff from Basin C4 is 1.1 cfs.

x. Basin OS-1

Basin OS-1 represents the southwest portion of 102nd Avenue, originally accounted for within the High Pointe Final Drainage Report. Runoff will be directed south as outlined within the approved report for the High Point Subdivision. The 100-year peak runoff from Basin OS-1 is 0.9 cfs.

y. Basin OS-2

Basin OS-2 is comprised of landscape area along the western perimeter of the site that was deemed unfeasible to capture. This basin will discharge to the neighboring property on the West as it does historically. The 100-year peak runoff from Basin OS-2 is less than 0.1 cfs.

z. Basin OS-3

Basin OS-3 is comprised of landscape area along the northern perimeter of the site that was deemed unfeasible to capture. This basin will discharge to the neighboring property on the North as it does historically. The 100-year peak runoff from Basin OS-2 is 0.2 cfs.

Refer to Appendix C for minor and major peak runoff of all drainage basins.

C. Site Specific Hydraulic Design

Onsite generated runoff will be conveyed to the proposed onsite Water Quality and Detention Pond via sheet flow, channelized swale flow, channelized gutter flow, curb chases, roof drains and storm sewer. Runoff at rooftops will discharge to the landscape areas via building downspouts to provide MDCIA to the extent practicable. The receiving landscape areas have been designed to convey the full peak runoff of the adjacent buildings. The proposed hardscape, remaining rooftops and landscape have been designed to sheet flow to curb and gutter or inlets. Curb inlets have been designed at designated low points within drive lanes and parking areas to convey flows to the proposed storm sewer system. The storm sewer system will discharge into the proposed detention and water quality pond for flow attenuation. Hydraulic calculations can be found in Appendix D.

D. Storage and Water Quality Treatment

A MHFD full-spectrum water quality and detention pond has been designed for the site to attenuate and treat flows within a 72-hour drain time, as identified within local and state requirements. The pond features a concrete trickle channel, micropool, overflow weir (emergency spillway), concrete forebay and maintenance access path. The top of the pond is set a minimum of 12" above the 100-Year ponding WSEL, therefore providing a minimum of 12" of freeboard within the pond. The total volume associated with the proposed pond is 1.61 ac-ft and will have a release rate of 2.1 cfs and 2.8 cfs during the 5-year and 100-year event, respectively.

The water quality forebay will remove larger particle sediment in an easily maintainable area at the upstream end of the pond. The water quality forebay will be designed as part of the final drainage report.

As part of the final drainage report a "V" shaped concrete trickle channel sloped at 0.4% will be designed to encourage complete draining of the pond and facilitate pond maintenance. The softscape pond bottom will be designed to provide a minimum 2% slope towards the proposed trickle channel.

As part of the final drainage report a 55 cubic foot volume, 2.5-foot depth permanent micropool will be designed to promote sediment separation and containment. The proposed micropool will be integrated into the proposed outlet structure.

An emergency spillway has been included in the drainage design. The emergency spillway has been designed to provide a safe overflow path to the public Right-of-Way for peak runoff in the unlikely situation that the outlet structure or downstream storm becomes overwhelmed or clogged. The spillway will discharge directly to Chambers Road in the event of an emergency. The bottom of the spillway is set at an elevation at the 100-Year Water Surface Elevation (WSEL). The emergency spillway has been sized to convey the undetained peak flow of the 100-year event runoff.

The full-spectrum water quality and detention pond will be privately owned and operated. A proposed access path is included as part of the design of the pond which will allow the ownership group to provide periodic maintenance in accordance with Commerce City requirements. As part of the maintenance plan for the pond, annual inspection and inspection reports will be completed by the ownership group, the reports will be kept on file for a minimum of 3 years as outlined within the CCDC. Should it become necessary the ownership group understands that the City reserves the right to access and conduct inspection of the stormwater facilities onsite. Prior to the final drainage report all necessary drainage easements will be put in place with the City.

The project includes a full spectrum pond, grass swales and landscape buffers as part of its permanent stormwater control measures. It's important to note that while the project is providing disconnected imperviousness areas, rooftops and hardscape areas routed to proposed landscape areas, it is not taking any pond volume reductions for this, and the full spectrum pond has been designed to treat full water quality.

Storage and Water Quality calculations can be found in Appendix E.

E. Variances from Criteria

No variances from applicable criteria are being requested as a part of this drainage design.

VI. Conclusion

A. Compliance with Standards

This report presents the description and calculations for the drainage analysis and design of TTRes at Commerce City Chambers Road. The drainage system was designed in accordance with the Commerce City

Storm Drainage Design Technical Criteria Manual, the MHFD Urban Storm Drainage Criteria Manual, and the previously discussed 2005 Calibre Report, 2007 Calibre Report, 2007 JR Report and the 2004 OSP.

Since the project is not located within a Floodplain or Floodway, there are no requirements, LOMOR or CLOMOR, from the Federal Emergency Management Agency (FEMA) associated with the project.

B. Drainage Concept

The 2004 OSP anticipated that the subject site would be developed as medium-density residential, school and have an imperviousness of 50% in the developed condition. The proposed apartment development has an imperviousness value of 75% which is greater than what was anticipated in the 2004 OSP. In response to this increase, we are mitigating any negative downstream impacts by installing a full-spectrum detention pond for the proposed development. Additionally, the more detailed 2007 JR Report was completed after the 2004 OSP and included the design of the downstream storm and outfall infrastructure for the basin that the subject site is within. For this reason, the 2007 JR Report has been used as the basis of the proposed site design to show conformance with the regional drainage infrastructure.

As outlined in the 2007 JR Report, the subject site will need to provide an on-site water quality and detention pond and ensure that the discharge from the development is less than the historic runoff from the site. The 2007 JR Report designed the downstream stormwater infrastructure based on peak discharge rates from the site of 2.8 cfs and 18.3 cfs from the subject site (Basin M) in the minor and major storms, respectively. The proposed full spectrum detention pond will release peak rates of 2.2 cfs (5-yr) and 2.8 cfs (100-yr) to the existing adjacent 36" storm sewer. Even though there is a decreased release compared to what was originally assumed within the JR 2007 Report the existing downstream storm sewer system was modeled to ensure the additional flow added would not increase the hydraulic grade lines within the system to a point that would violate the Commerce City Storm Drainage criteria. Based on the modeling and the lowered release rates, the proposed improvements cause no adverse impact on the existing downstream infrastructure that will convey the runoff to the Second Creek outfall per the OSP.

The development will increase the imperviousness of the site, therefore generating a higher amount of runoff. To mitigate negative impacts downstream of the development a water quality and detention pond has been included as part of the site improvements which will have a release rate less than the historic values.

C. Water Quality

The City and State construction MS4 requirements for construction activities will be met by a separate Stormwater Management Plan and Report. The City's post construction MS4 requirements are being met by the proposed onsite full-spectrum pond.

VII. References

(2023, May). *Storm Drainage Design and Technical Criterial Manual*. Commerce CIty, Colorado, USA.

(2016, June). *Urban Storm Drainage Criteria Manual Volumes 1, 2, and 3.* Mile High Floodl District.

(2007, April). *Final Drainage Study for 104th Avenue Corridor Improvements Phase 2.* JR Engineering, LLC.

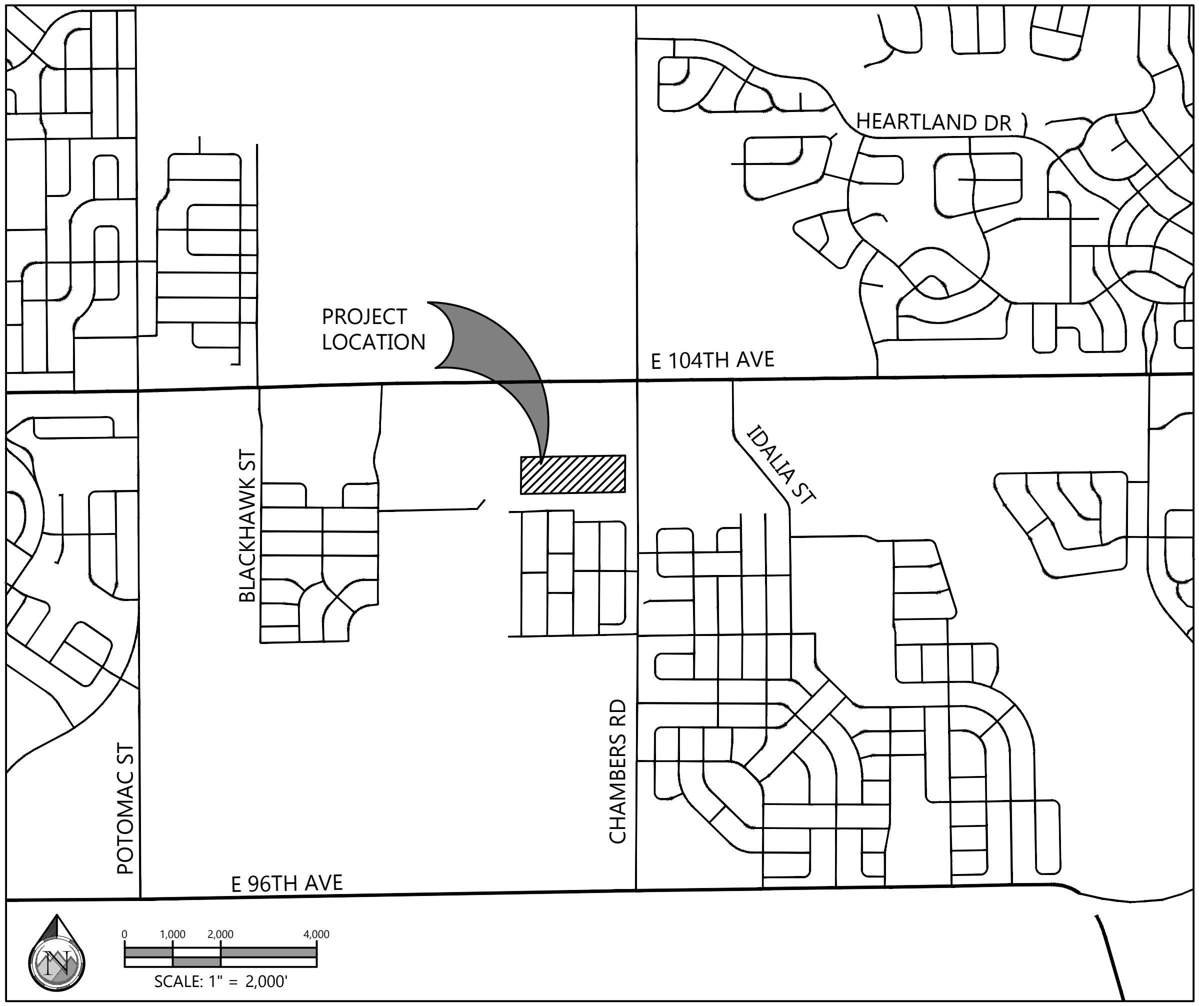
(2004, August). *Second Creek (Downstream of DIA) and DFA 0053 Watersheds Outfall System Planning Study Updated*. Kiowa Engineering Corporation.

(2006, December). *North Range Town Center Phase III Drainage Report.* Calbre Engineering.

(2004, September). *High Pointe Phase III Drainage Report.* JR Engineering.

APPENDIX A

- FEMA FIRM MAPS
- WEB SOIL SURVEY RESULTS

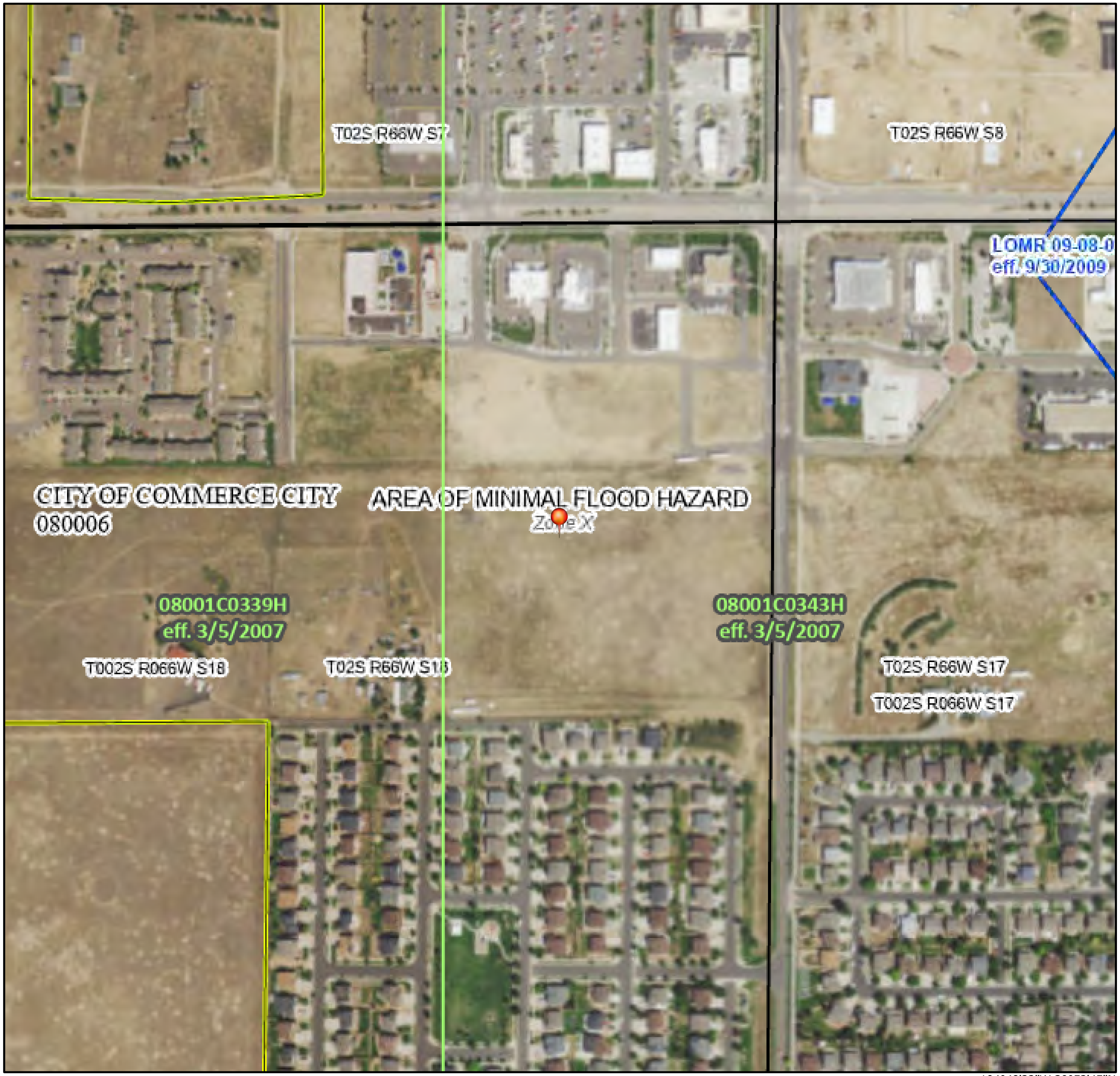


VICINITY MAP

National Flood Hazard Layer FIRMette

FEMA

104°49'W 39°53'13"N



104°48'22"W 39°52'45"N

Feet 0 250 500 1,000 1,500 2,000

1:6,000

Basemap Imagery Source: USGS National Map 2023

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 3/8/2024 at 11:48 AM 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.

Map Scale: 1:2,210 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 30, 60, 120, 180

Feet: 0, 100, 200, 400, 600

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 1:20,000.

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: Adams County Area, Parts of Adams and Denver Counties, Colorado
Survey Area Data: Version 20, Aug 24, 2023

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

Date(s) aerial images were photographed: Mar 1, 2023—Sep 1, 2023

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
AsB	Ascalon sandy loam, 0 to 3 percent slopes	B	1.0	6.8%
TtD	Truckton loamy sand, 3 to 9 percent slopes	A	13.5	93.2%
Totals for Area of Interest			**14.5**	**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

APPENDIX B

- REFERENCE MATERIAL

FINAL DRAINAGE STUDY
for
104^{TH} AVENUE CORRIDOR IMPROVEMENTS PHASE 2

Prepared for:

City of Commerce City
8602 Rosemary Street
Commerce City, Colorado 80022
Attn: Glenn Ellis

City of Commerce City Engineering
APPROVED
AUG 1_ 2007

Prepared By:

JR ENGINEERING, L.L.C.
6020 Greenwood Plaza Boulevard
Englewood, Colorado 80111
(303) 740-9393
Contact: Aaron Clutter

Project Number 15280.00
Revised June 15, 2007
April 20, 2007

portion of Basin A that outfalls into Potomac Farms will be handled at the Potomac Farms Retention Pond, which will be converted into a detention pond in the future by others.

Basin B consists of approximately 10.8 acres divided into 17 sub-basins (B1a through B10) and includes 104[th] Ave. from Blackhawk Street to Sable Boulevard. Basin G consists of approximately 29.2 acres, and outfalls east into the 104[th] Ave. storm drain system through a detention facility (to be provided at the time of development). Basin H is partially developed (Foxton Village Filing 1, existing single-family residential, and Foxton Village Filing 2, future multi-family residential) and consists of approximately 73.8 acres, and outfalls into the 104[th] Ave. storm drain system. Basin I is the South Adams County Water and Sanitation District's (SACWSD) Sable Pump Station. Basin I consists of approximately 4.1 acres. Currently some of the runoff from Basin I flows onto 104[th] Ave., some into Foxton Filing No. 2 via a culvert under Sable Blvd. and the remainder enters the existing retention pond. With the proposed expansion of 104[th] Ave. the existing pond will be converted to a detention pond by installing an outlet structure. In the future, another water tank will be added to the site and the runoff flows from the tank are assumed to be directed into the existing pond via a roof drain system and will be included in the design calculations for the detention pond size and outlet structure. Basin T is currently farmland with future mixed-use designation. Basin T consists of approximately 148.0 acres and will in the future outfall into the Sable storm drain system. Basin U is currently farmland with no future designation. Basin U consists of approximately 20.0 acres and will in the future outfall into the Sable storm drain system. The runoff from Basins B, G, H, and I will be collected in the 104[th] Ave. storm drain system where it will outfall into the temporary channel at Sable Blvd. The temporary channel will collect runoff from Basins T and U and will outfall into the Sable Water Quality Pond. The 112th Avenue Regional Detention Pond will provide detention for Foxton Village Filing 2 and Basins B, T and U.

Basin C consists of approximately 24.7 acres divided into 27 sub-basins (C1a through C22), which includes 104[th] Ave. from Sable Blvd. to Chambers Road. It also includes Chambers Rd. from the High Pointe site on the south side of 104[th] Ave. to Second Creek on the north side of 104[th] Ave. Basin J, Aspen Hills Residential, is currently developed as multifamily residential. Basin J consists of approximately 11.9 acres, and outfalls into the 104[th] Ave. storm drain system, through an existing detention pond. Basin K is currently undeveloped with no futur[...] ...sists of approximately 125.0 acres, and will outfall northeast inte[...] ...re detention facility (to be provided at the time of development) [...] ...4[th] Ave. storm drain system in the future. Basin L, Aspen Hills Commercial, is currently undeveloped with plans for future commercial development. Basin L consists of approximately 21.6 acres, and outfalls north into the 104[th] Ave. storm drain system. Basin M is currently undeveloped with no future designation. Basin M consists of 12.6 acres, and will outfall into Chambers Rd. through a future detention facility (to be provided at the time of development) which ties into the 104[th] Ave. storm drain system in the future. Basin R is currently undeveloped with a future designation for mixed-use development. Basin R consists of approximately 19.9 acres, and outfalls to the east into the 104[th] Ave. storm drain system in Chambers Rd. The runoff from Basins C, J, K, L, M, and R will be collected in the 104[th] Ave. storm drain system where it will outfall into the Chambers Road Water Quality Pond. Basin V is currently undeveloped with no future designation. Basin V consists of approximately 13.2 acres, and outfalls to the north directly into the Chambers Road Water Quality Pond forebay. The sub-basins that flow to future low

Information used as part of the Drainage Report associated with TTres Chambers Development

Storm drainage analysis and design criteria used for this project was taken from the "Storm Drainage Design and Technical Criteria Manual" by the City of Commerce City and the "Urban Storm Drainage Criteria Manual (USDCM)" by Urban Drainage and Flood Control District.

Development Criteria Reference and Constraints

The project area is part of the Second Creek and DFA 0053 Outfall Systems Planning drainage studies mentioned previously. The proposed plan takes into account the OSP planned facilities, the Potomac Farms Subdivision existing drainage facilities and planned future detention pond (currently a retention pond), the Foxton Village (Filings 1 and 2) development and planned detention pond release rates (Filing 1 currently utilizes a retention pond on the Filing 2 site), the Aspen Hills Residential Subdivision development and existing detention pond release rates, the North Range Town Center Subdivision development and planned relea[illegible]h Pointe and Hogan Residential Subdivisions storm drainage rele[illegible] developed portion of 104th Avenue east of Basin E existing relea[illegible]union Phase 1 Subdivision development Filings 1, 2 and 3 storm drainage releases piped into the 104th Avenue drainage system, and the Buffalo Mesa Subdivision development existing releases onto 104th Avenue.

Information used as part of the Drainage Report associated with TTres Chambers Development

Basins G, K, L M, T, U, and V do not have any preliminary designs at this time. Therefore, the discharge rates from these basins will be based on the 100-year historical (undeveloped) condition (Basin G), the 100-year developed condition (Basin L), or the 5-year developed condition (Basins K and M), which is approximately equivalent to the 100-year historical rate for these hydrological class B soils. The discharge rate for Basin O was determined (100-year historical) and accounted for in the storm drain system design for the High Pointe Subdivision. The discharge rate for Basins T and U were determined (100-year developed residential) and accounted for in the Sable Water Quality Pond design. The discharge rate for Basin V was determined (100-year developed commercial) and accounted for in the Chambers Road Water Quality Pond design. Therefore, Basins G, K, M and O will be detained releases into the storm drain system, and Basins L, T, U, and V will be undetained releases into the 104th Ave. storm drain system (see Water Quality Exhibits).

Hydrologic Criteria

The Rational Method was used for the site hydrology. Rainfall data and runoff coefficients were obtained from the Commerce City Criteria Manual. The 5-year runoff was analyzed as the minor storm and the 100-year runoff was analyzed as the major storm. Peak flow rates, times of concentration for runoff and detention pond release rates were used per their respective drainage reports for Foxton Village (Filings 1 and 2), Aspen Hills Residential Subdivision, the North Range Town Center Subdivision which includes the High Pointe and Hogan Residential Subdivisions storm drainage releases piped into this site, the developed portion of 104th Avenue east of Basin E existing release rates which includes the Reunion Phase 1 Subdivision development Filings 1, 2 and 3 storm drainage releases piped into the 104th Avenue drainage system, and the Buffalo Mesa Subdivision development existing releases onto 104th Avenue.

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision	East 104th Avenue	Project Name:	104th Ave. Corridor Phase 2 Improvements
Location	Commerce City	Project No.	15280.00
		Calculated By:	SMB
		Checked By:	FGF
		Date:	9/6/2006

SUB-BASIN DATA				INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)				Tc CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (AC)	C_{100}	C_5	L (FT)	S (%)	T_i (MIN)	L (FT)	S (%)	VEL. (FPS)	T_t (MIN)	COMP. T_c (MIN)	TOTAL LENGTH(FT)	MIN. T_c (MIN)	T_c (MIN)
E6	0.61	0.93	0.88	65	2.0	2.6	335	3.8	3.9	1.4	4.0	400.0	12.2	5.0
E7	0.57	0.93	0.88	239	3.0	4.3	44	1.6	2.5	0.3	4.6	283.0	11.6	5.0
E8	0.24	0.93	0.88	61	2.0	2.5	133	1.9	2.7	0.8	3.3	194.0	11.1	5.0
E9	1.04	0.93	0.88	27	2.0	1.7	602	1.2	2.2	4.6	6.2	629.0	13.5	6.2
E10	0.73	0.93	0.88	37	2.0	1.9	335	1.9	2.7	2.0	4.0	372.0	12.1	5.0
E11	1.18	0.93	0.88	40	2.0	2.0	604	1.2	2.2	4.6	6.6	644.0	13.6	6.6
E12	2.53	0.26	0.08	300	2.0	25.7	160	2.0	1.0	2.7	28.4	460.0	12.6	12.6
E12-D	2.53	0.89	0.87	300	2.0	5.8	160	2.0	1.0	2.7	8.5	460.0	12.6	8.5
E13	4.21	0.28	0.11	300	3.1	21.5	420	3.1	1.2	5.7	27.2	720.0	14.0	14.0
E13-D	4.21	0.89	0.87	300	3.1	5.0	420	3.1	1.2	5.7	10.7	720.0	14.0	10.7
E14	1.38	0.38	0.23	300	5.6	15.5	40	5.6	1.7	0.4	15.9	340.0	11.9	11.9
E14-D	1.38	0.89	0.87	300	5.6	4.1	40	5.6	1.7	0.4	4.5	340.0	11.9	5.0
E15	[illegible]	[illegible]	[illegible]	[illegible]	7.0	10.4	85	1.2	2.2	0.6	11.0	255.0	11.4	11.0
G	[illegible]	[illegible]	[illegible]	[illegible]	1.0	43.0	960	1.0	0.7	23.5	66.4			66.4
I1	[illegible]	[illegible]	[illegible]	[illegible]	4.5	8.8					8.8	150.0	10.8	8.8
I2	[illegible]	[illegible]	[illegible]	[illegible]	0.5	4.6	200	0.5	1.4	2.4	7.0	300.0	11.7	7.0
I3	[illegible]	[illegible]	[illegible]	[illegible]	3.5	19.9	540	1.0	0.7	12.9	32.8	770.0	14.3	14.3
K	125.00	0.60	0.45	100	2.0	9.4	2190	1.0	2.0	18.3	27.7	2290.0	22.7	22.7
L	21.60	0.74	0.66	100	2.0	6.4	700	2.5	3.2	3.7	11.2	995.0	14.4	11.2
							195	1.0	3.0	1.1				
M	12.60	0.60	0.45	100	2.0	9.4	735	1.3	2.3	5.4	14.8	835.0	14.6	14.6
R	19.00	0.89	0.87	100	1.0	4.2	1100	1.0	2.0	9.2	13.4	1200.0	16.7	13.4
R-ex	5.50	0.20	0.01	300	1.8	28.4	998	0.5	0.5	33.6	62.0	1298.0	17.2	17.2
S-1	20.20	0.89	0.87	100	2.0	3.3	1000	1.0	2.0	8.3	11.7	1100.0	16.1	11.7
S-2	10.20	0.89	0.87	100	2.0	3.3	700	1.0	2.0	5.8	9.2	800.0	14.4	9.2
V	13.20	0.89	0.87	100	2.0	3.3	800	1.0	2.0	6.7	10.0	900.0	15.0	10.0

Information used as part of the Drainage Report associated with TTres Chambers Development. Basin M.

NOTES:

$T_i = (0.395*(1.1 - C_5)*(L)^{0.5})/((S)^{0.33})$, S in ft/ft

$T_t = L/60V$ (Velocity From Fig. 501)

Tc Check = 10+L/180

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision East 104th Avenue
Location Commerce City
Design Storm Off-Site Minor Storm (5-year)

Project Name: 104th Ave. Corridor Phase 2 Improvements
Project No. 15280.00
Calculated By: SMB
Checked By: FGF
Date: 3/27/2007

STREET	Drainage Basin	DIRECT RUNOFF Area Design	Area (Ac)	Runoff Coeff	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	TOTAL RUNOFF Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	STREET Slope (%)	Street Flow (cfs)	PIPE Design Flow (cfs)	Slope (%)	Pipe Size (inches)	TRAVEL TIME Length (ft)	Velocity (fps)	Tt (min)	REMARKS
Future Off-site Development	G		29.20	0.06	66.4	1.75	1.52	2.7							2.7						Detained Flow Release Rate Q5 = Q100
Foxton Village Filing No. 1 Detention Pond	H		82.10									10.7									Pond Release Rate per approved Foxton Village Filing No. 1 drainage report
Public Service Easement	H	OS1	3.80	0.10	10.9	0.38	3.50	1.3													
Public Service Easement	H	OS2	0.93	0.10	11.2	0.09	3.50	0.3													
Foxton Village Filing No. 2	H		20.20	0.65	13.2	13.13	3.30	43.3													
Foxton Village Outfall	H		Add Foxton Village Filing No. 1 Detention Pond Release						13.2	13.60											Total Design Flow at Foxton Village Outfall at Sable Blvd
Future Off-site Development	K		125.0									[illegible]			21.5						Detained Flow -- Release Rate based on major storm release rate reduced to minor storm rate
Aspen Hills Commercial Site Future Off-site Development	L		21.60	0.66	11.2	14.26	3.57	50.9							51.0						Undetained Flow Release Rate Q5
Future Off-site Development	M		12.60									2.8			2.8						Detained Flow -- Release Rate based on major storm release rate reduced to minor storm rate
Future Off-site Development	R		19.90	0.89	13.4	17.71	3.32	58.0							58.0						Undetained Flow Release Rate Q5
Future Off-site Development	T		148.00	0.40	23.4	59.20	2.48	146.0													
Future Off-site Development	U		20.00	0.65	23.4	13.60	2.48	33.0							179.0						Undetained Flow Released From Basins T & U
Future Off-site Development	V		13.20	0.87	10.9	11.48	3.70	43.0							43.0						Undetained Flow Release Rate Q5

Information used as part of the Drainage Report associated with TTres Chambers Development. Basin M.

Q5 = 2.8 cfs

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision East 104th Avenue
Location Commerce City
Design Storm Off-Site Major Storm (100-year)

Project Name: 104th Ave. Corridor Phase 2 Improvements
Project No. 15280.00
Calculated By: SMB
Checked By: FGF
Date: 3/27/2007

STREET	Drainage Basin	DIRECT RUNOFF: Area Design	Area (Ac)	Runoff Coeff	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	TOTAL RUNOFF: Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	STREET: Slope (%)	Street Flow (cfs)	PIPE: Design Flow (cfs)	Slope (%)	Pipe Size (inches)	TRAVEL TIME: Length (ft)	Velocity (fps)	Tt (min)	REMARKS
Future Off-site Development	G		29.20	0.30	66.4	8.76	2.47	21.6							21.6						Detained Flow Release Rate Q[illegible]= Q[illegible]
Foxton Village Filing No. 1 Detention Pond	H		82.10	0.80								69.8									Pond Release Rate per approved Foxton Village Filing No. 1 drainage report
Public Service Easement	H	OS1	3.80	0.40	10.9	1.52	6.80	10.3													
Public Service Easement	H	OS2	0.93	0.40	11.2	0.37	6.80	2.5													
Foxton Village Filing No. 2	H		20.20	0.80	13.2	16.16	6.20	100.2													
Foxton Village Outfall	H		Add Foxton Village Filing No. 1 Detention Pond Release						13.2	18.05	[illegible]	[illegible]									Total Design Flow at Foxton Village Outfall at Sable Blvd.
Future Off-site Development	K		125.0	0.45	22.7	56.25	2.50	140.6	Less 17 cfs to Foxton Village						123.6						Detained Flow Q[illegible]=Q[illegible] Which approximately Q[illegible]
Aspen Hills Commercial Site Future Off-site Development	L		21.60	0.74	11.2	15.98	6.75	107.9							108.0						Undetained Flow Release Rate Q[illegible]
Future Off-site Development	M		12.60	0.45	14.5	5.67	3.22	18.3							18.3						Detained Flow Release Rate Q[illegible]=Q[illegible] Which approximately Q[illegible]
Future Off-site Development	N		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							111.0						Undetained Flow Release Rate Q[illegible]
Future Off-site Development	T		148.00	0.60	23.4	88.80	4.75	421.8													
Future Off-site Development	U		20.00	0.78	23.4	15.60	4.75	74.1							496.0						Undetained Flow Released From Basins T & U
Future Off-site Development	V		13.20	0.89	10.0	11.75	6.95	82.0							82.0						Undetained Flow Release Rate Q[illegible]

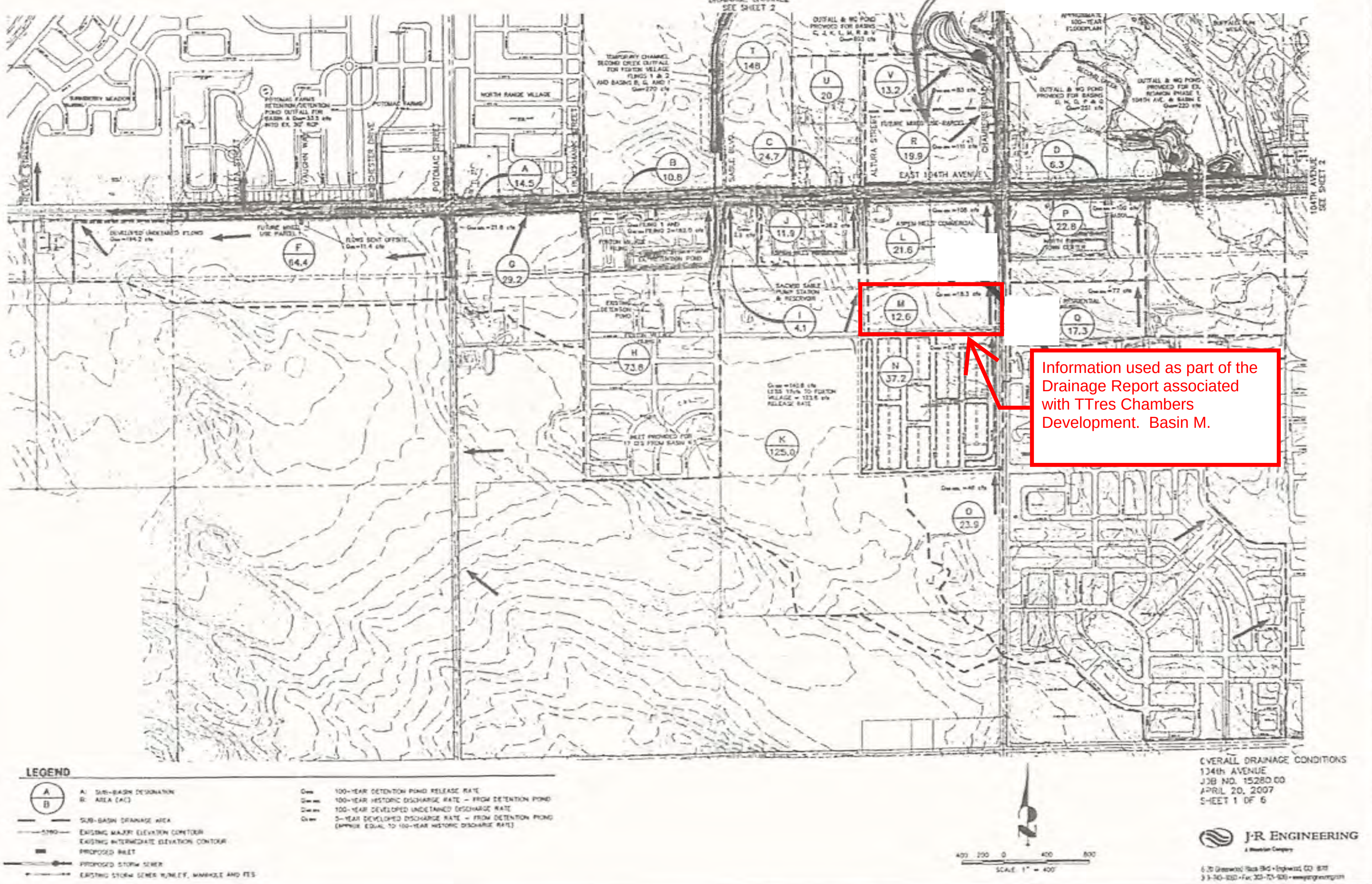
Information used as part of the Drainage Report associated with TTres Chambers Development. Basin M.

Q100 = 18.3 cfs

DRAINAGE MAP

PROPOSED DRAINAGE CONDITIONS

104th AVENUE



Calibre
ENGINEERING

HIGH POINTE

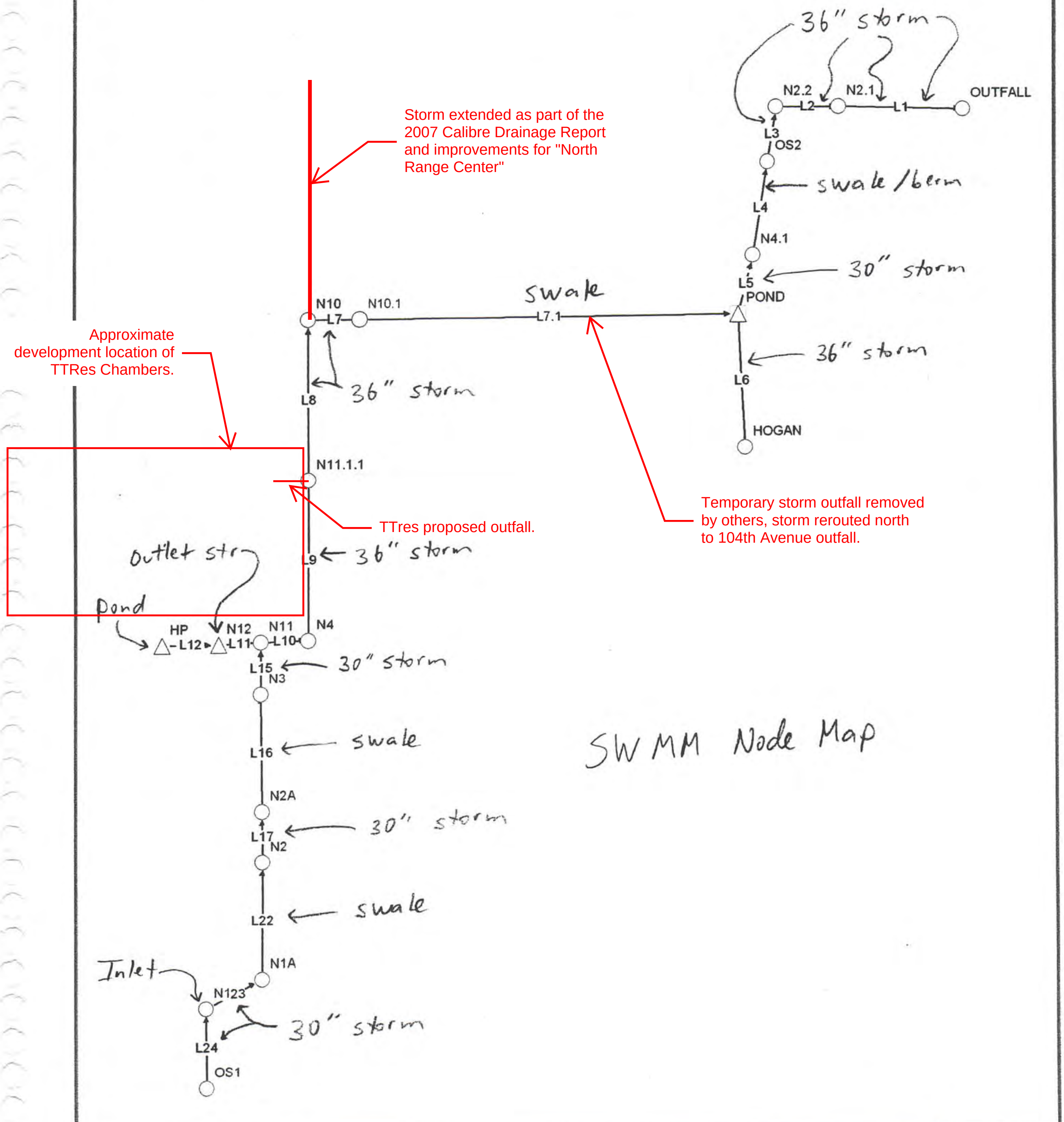
PHASE III DRAINAGE REPORT

September 9, 2004
Revised November 1, 2004
Revised January 10, 2005

For:
SW Begold LLC
333 West Hampden Avenue
Suite 810
Englewood, CO 80110

City of [illegible] City Engineering
APPROVED
JAN 15 2005

Calibre Engineering, Inc.
8000 South Lincoln Street, Unit 206, Littleton, CO
303-730-0434 fax 303-730-1139
Municipal Engineering Development Master Planning



XP-Storm Version 9.13 	**High Pointe** Licenced To: Civil Design Services [66-910-0450]	11/01/04 Page 1/1

L3	28.0000	382.0000	5.0000	0.0000	0.0000	0.0000	245.0000	0.0000	None
L6	0.0000	0.0000	660.0000	0.0000	0.0000	0.0000	0.0000	0.0000	None
L7	546.0000	0.0000	10.0000	0.0000	0.0000	0.0000	104.0000	0.0000	None
L10	0.0000	0.0000	548.0000	10.0000	0.0000	14.0000	88.0000	0.0000	None
L16	0.0000	0.0000	660.0000	0.0000	0.0000	0.0000	0.0000	0.0000	None
L1	33.0000	402.0000	75.0000	0.0000	0.0000	0.0000	150.0000	0.0000	None
L4	0.0000	654.0000	6.0000	0.0000	0.0000	0.0000	0.0000	0.0000	None
L9	36.0000	614.0000	5.0000	0.0000	0.0000	0.0000	5.0000	0.0000	None
L15	0.0000	0.0000	554.0000	0.0000	0.0000	0.0000	106.0000	0.0000	None
L8	30.0000	0.0000	630.0000	0.0000	0.0000	0.0000	0.0000	0.0000	None
L17	54.0000	339.0000	242.0000	0.0000	0.0000	0.0000	25.0000	0.0000	None
L22	184.0000	471.0000	5.0000	0.0000	0.0000	0.0000	0.0000	0.0000	None
L23	27.0000	44.0000	493.0000	0.0000	0.0000	0.0000	96.0000	0.0000	None
L24	2.0000	47.0000	509.0000	35.0000	0.0000	0.0000	67.0000	0.0000	None
L11	0.0000	0.0000	545.0000	36.0000	0.0000	15.0000	64.0000	0.0000	None
L7.1	69.0000	581.0000	10.0000	0.0000	0.0000	0.0000	0.0000	0.0000	None
pipe	177.0000	478.0000	5.0000	0.0000	0.0000	0.0000	0.0000	0.0000	None
WQorifice	4.0000	0.0000	5.0000	0.0000	0.0000	135.0000	516.0000	0.0000	None

```
*======================================*
|   Kinematic Wave Approximations      |
|  Time in Minutes for Each Condition  |
*======================================*
```

5-Year Flow.

Conduit Name	Duration of Normal Flow	Slope Criteria	Super-Critical	Roll Waves
L2	0.0000	636.9167	6.0833	0.0000
L3	0.0000	0.0000	0.1667	0.0000
L6	0.7611	0.7611	654.5000	0.0000
L7	0.0000	0.0000	184.3750	0.0000
L10	0.0000	122.3778	6.5000	0.0000
L16	450.0000	654.1667	0.1667	0.0000
L1	0.0000	0.0000	3.2500	0.0000
L4	321.3889	620.8274	0.1667	0.0000
L9	0.0000	0.0000	1.3333	0.0000
L15	0.0000	0.0000	654.5000	0.0000
L8	410.3250	520.5667	17.7611	0.0000
L17	0.0000	0.0000	126.4333	0.0000
L22	119.9333	122.0167	0.5000	0.0000
L23	526.0000	539.1000	2.1667	0.0000
L24	530.2000	558.8778	16.8333	0.0000
L11	3.1667	89.6357	1.5833	0.0000
L7.1	63.1000	63.1000	1.6528	0.0000
pipe	0.0000	8.5714	7.2778	0.0000
WQorifice	0.0000	0.0000	3.0000	0.0000

Anticipated flow within 36" at proposed outfall locations.

```
*=========================================================*
|     Table E15 - SPREADSHEET INFO LIST                   |
| Conduit Flow and Junction Depth Information for use in  |
| spreadsheets.  The maximum values in this table are the |
| true maximum values because they sample every time step.|
| The values in the review results may only be the        |
| maximum of a subset of all the time steps in the run.   |
| Note: These flows are only the flows in a single barrel.|
*=========================================================*
```

Conduit Name	Maximum Flow (cfs)	Total Flow (ft^3)	Maximum Velocity (ft/s)	Maximum Volume (ft^3)	##	Junction Name	Invert Elevation (ft)	Maximum Elevation (ft)
L2	41.1468	380539.0065	6.4181	2239.8279	##	OUTFALL	5131.0000	5133.0878
L3	41.1495	379893.1836	6.1529	188.0158	##	N2.2	5133.2200	5135.7765
L6	29.6241	60311.2596	9.1594	454.8054	##	OS2	5135.1800	5138.0206
L7	56.6689	168831.5387	12.0687	132.9528	##	POND	5136.1200	5138.5139
L10	52.8333	160371.1253	7.4435	670.3960	##	HOGAN	5142.3000	5143.7220
L16	28.4546	77389.8312	4.7496	844.0213	##	N10	5140.6300	5142.5807
L1	41.1457	380601.6040	6.5609	842.1916	##	N11	5156.4100	5161.4121
L4	25.1075	244596.8239	2.0579	6625.8787	##	N2A	5176.1000	5176.9907
L9	56.7218	168812.0173	8.1049	2381.8051	##	HP	5157.0000	5162.7965
L15	30.0974	84438.2605	8.1114	100.8482	##	N2.1	5131.6400	5134.1824
L8	56.7501	168841.8545	7.9435	2037.8699	##	N4.1	5136.0000	5138.0440
L17	28.4973	77234.0429	6.3991	302.6106	##	N4	5155.6000	5160.2023
L22	29.9375	70937.8171	3.1123	6808.9103	##	N3	5164.4000	5166.2054
L23	30.6942	70326.2424	6.6768	205.3446	##	N11.1.1	5142.5100	5145.8853

L24	30.2123	67251.8539	5.9176	233.1636	##	N2	5176.6000	5178.9418
L11	23.9211	75949.4620	4.4269	488.9685	##	N1A	5179.5000	5180.9865
L7.1	54.6384	163854.4589	3.3497	4996.6735	##	N1	5179.7600	5182.1095
pipe	24.8994	244632.7950	5.3009	157.2297	##	OS1	5180.0000	5182.8236
WQorifice	0.4882	17669.5837	10.8446	13.4660	##	N12	5156.9900	5161.5464
WEIR	23.4978	57565.6643	0.0000	0.0000	##	N10.1	5140.4900	5142.1554
FREE # 1	41.1457	380639.0832	0.0000	0.0000	##			

```
*=====================================================*
|     Table E15a - SPREADSHEET REACH LIST             |
| Peak flow and Total Flow listed by Reach or those   |
|      conduits or diversions having the same         |
|      upstream and downstream nodes.                 |
*=====================================================*
```

Upstream Node	Downstream Node	Maximum Flow (cfs)	Total Flow (ft^3)
N2.2	N2.1	41.1468	380539.006
OS2	N2.2	41.1495	379893.184
HOGAN	POND	29.6241	60311.2596
N10	N10.1	56.6689	168831.539
N11	N4	52.8333	160371.125
N2A	N3	28.4546	77389.8312
N2.1	OUTFALL	41.1457	380601.604
N4.1	OS2	25.1075	244596.824
N4	N11.1.1	56.7218	168812.017
N3	N11	30.0974	84438.2605
N11.1.1	N10	56.7501	168841.854
N2	N2A	28.4973	77234.0429
N1A	N2	29.9375	70937.8171
N1	N1A	30.6942	70326.2424
OS1	N1	30.2123	67251.8539
N12	N11	23.9211	75949.4620
N10.1	POND	54.6384	163854.459
POND	N4.1	24.8994	244632.795
HP	N12	23.7514	75235.2480

```
#########################################################
# Table E16. New Conduit Information Section            #
#           Conduit Invert (IE) Elevation and Conduit   #
#           Maximum Water Surface (WS) Elevations       #
#########################################################
```

Conduit Name	Upstream Node	Downstream Node	IE Up	IE Dn	WS Up	WS Dn	Conduit Type
L2	N2.2	N2.1	5133.2200	5131.6400	5135.7765	5134.1824	Circular
L3	OS2	N2.2	5135.1800	5135.0400	5138.0206	5137.1279	Circular
L6	HOGAN	POND	5142.3000	5139.3000	5143.7219	5140.7001	Circular
L7	N10	N10.1	5140.6300	5140.4900	5142.5807	5142.1554	Circular
L10	N11	N4	5156.4100	5155.7000	5161.4121	5160.2023	Circular
L16	N2A	N3	5176.1000	5164.4000	5176.9907	5166.2054	Trapezoid
L1	N2.1	OUTFALL	5131.6400	5131.0000	5134.1824	5133.0878	Circular
L4	N4.1	OS2	5136.0000	5135.1800	5138.0440	5138.0206	Trapezoid
L9	N4	N11.1.1	5155.6000	5154.7000	5160.2023	5157.1386	Circular
L15	N3	N11	5164.4000	5164.0000	5166.2054	5165.4475	Circular
L8	N11.1.1	N10	5142.5100	5140.6300	5145.8853	5142.5807	Circular
L17	N2	N2A	5176.6000	5176.1000	5178.9418	5176.9907	Circular
L22	N1A	N2	5179.5000	5176.6000	5180.9865	5178.9418	Trapezoid
L23	N1	N1A	5179.7600	5179.5000	5182.1092	5180.9865	Circular
L24	OS1	N1	5180.0000	5179.7600	5182.8236	5182.1095	Circular
L11	N12	N11	5157.0000	5156.6100	5161.5464	5161.4121	Circular
L7.1	N10.1	POND	5140.4900	5137.7700	5142.1554	5138.9892	Trapezoid
pipe	POND	N4.1	5136.1200	5136.0000	5138.5139	5138.0440	Circular
WQorifice	HP	N12	5157.0000	5156.9900	5162.7965	5161.5464	Circ Orif

```
*==========================================*
| Table E12. Mean Conduit Flow Information |
*==========================================*
```

Conduit Name	Mean Flow (cfs)	Total Flow (ft^3)	Mean Percent Change	Low Flow Weightng	Mean Froude Number	Mean Hydraulic Radius	Mean Cross Area	Mean Conduit Roughness
L2	20.2049	800114.16	0.0118	0.9978	0.7659	0.6815	4.5491	0.0130
L3	20.1990	799879.76	0.0287	0.9979	0.7233	0.6980	4.8453	0.0130
L6	3.5559	140815.05	0.0160	0.5191	1.4196	0.1623	0.6698	0.0130
L7	11.5856	458789.31	0.0149	0.9971	1.2524	0.3521	1.6909	0.0130
L10	10.9934	435336.92	0.0140	0.9978	0.8885	0.3104	2.0736	0.0130
L16	4.1588	164688.02	0.0030	0.9978	0.5436	0.1584	2.0079	0.0250
L1	20.2080	800236.09	0.0133	0.9978	0.8221	0.7152	4.4493	0.0130
L4	17.1308	678377.81	0.0180	0.9977	0.2496	0.8704	15.5850	0.0250
L9	11.5856	458791.37	0.0152	0.9979	0.7532	0.3495	2.1782	0.0130
L15	4.6612	184583.11	0.0098	0.9979	3.9016	0.1721	1.0193	0.0130
L8	11.5848	458757.00	0.0162	0.9979	0.9814	0.3216	2.0421	0.0130
L17	4.1509	164375.24	0.0081	0.8678	2.4368	0.1633	0.9831	0.0130
L22	3.7186	147258.36	0.0099	0.9978	0.2937	0.2010	3.0079	0.0250
L23	3.6804	145744.49	0.0102	0.3622	0.2604	0.1605	0.9282	0.0130
L24	3.4087	134984.55	0.0107	0.3285	0.2601	0.1523	0.9558	0.0130
L11	6.3338	250819.78	0.0133	0.9971	0.7331	0.3092	2.0509	0.0130
L7.1	11.3803	450660.53	0.0712	0.9965	0.3941	0.4176	6.6076	0.0250
pipe	17.1253	678160.04	0.0133	0.9978	0.7611	0.5822	3.7226	0.0130
WQorifice	0.3993	15813.548	0.0002	0.9979	2.8452	0.0567	0.0459	0.0026
WEIR	5.9289	234783.82						
FREE # 1	20.2092	800282.86						

```
*===================================================================*
| Table E13. Channel losses(H), headwater depth (HW), tailwater     |
| depth (TW), critical and normal depth (Yc and Yn).                |
| Use this section for culvert comparisons                          |
*===================================================================*
```

100-Year Flow.

Conduit Name	Maximum Flow	Head Loss	Friction Loss	Critical Depth	Normal Depth	HW Elevat	TW Elevat	
L2	47.1412	0.3081	1.6119	2.2349	2.6318	5136.4716	5134.4740	Max Flow
L3	47.1382	0.5852	0.1515	2.2348	2.6308	5138.3000	5137.2748	Max Flow
L6	70.1212	0.0000	2.9994	2.6565	2.6296	5144.9319	5141.9296	Max Flow
L7	85.2140	0.0000	0.5161	2.8032	3.0000	5143.0766	5142.5094	Max Flow
L10	82.0612	1.5178	1.3275	2.7815	3.0000	5167.0948	5164.2294	Max Flow
L16	42.6337	0.0000	2.8454	1.2505	1.0638	5177.1674	5168.0238	Max Flow
L1	47.1501	0.3893	0.6494	2.2351	2.7006	5134.4740	5133.2351	Max Flow
L4	44.3118	0.0000	0.1743	1.3814	1.7440	5138.2954	5138.1719	Max Flow
L9	85.2146	1.0867	5.6605	2.8032	3.0000	5164.3271	5157.5032	Max Flow
L15	46.2216	0.7300	0.3757	2.2410	1.9968	5168.0057	5166.9480	Max Flow
L8	85.2148	1.2138	5.3630	2.8032	3.0000	5149.7945	5143.0766	Max Flow
L17	42.6444	0.8635	1.2269	2.1811	2.5000	5180.9911	5177.1674	Max Flow
L22	47.4400	0.0000	1.6073	1.5413	1.7662	5181.2668	5179.9859	Max Flow
L23	47.7326	1.0800	0.7320	2.2644	2.5000	5183.4636	5181.2621	Max Flow
L24	46.5219	1.0971	0.5969	2.2457	2.5000	5185.1700	5183.4627	Max Flow
L11	62.6684	0.3469	0.5711	2.5453	3.0000	5164.8065	5163.8895	Max Flow
L7.1	85.6286	0.0000	2.4442	1.5280	1.9251	5142.5033	5139.3564	Max Flow
pipe	44.3159	1.2255	0.3996	2.2116	2.5000	5139.9848	5138.2953	Max Flow
WQorifice	0.4883	0.0000	4.8680	5.1956	0.2257	5162.1957	5157.2115	Max Flow

Anticipated flow within 36" at proposed outfall locations.

```
*=========================================================*
| Table E13a. CULVERT ANALYSIS CLASSIFICATION,            |
| and the time the culvert was in a particular            |
| classification during the simulation.  The time is     |
| in minutes.  The Dynamic Wave Equation is used for      |
| all conduit analysis but the culvert flow classification |
| condition is based on the HW and TW depths.             |
*=========================================================*
```

Conduit Name	Mild Slope Critical D Outlet Control	Mild Slope TW Control Outlet Control	Steep Slope TW Insignf Entrance Control	Slug Flow Outlet/ Entrance Control	Mild Slope TW > D Outlet Control	Mild Slope TW <= D Outlet Control	Outlet Control	Inlet Control	Inlet Configuration
L2	16.0000	387.0000	207.0000	0.0000	0.0000	0.0000	50.0000	0.0000	None
L3	60.0000	342.0000	5.0000	0.0000	0.0000	0.0000	253.0000	0.0000	None
L6	0.0000	0.0000	660.0000	0.0000	0.0000	0.0000	0.0000	0.0000	None

Calibre ENGINEERING

Calibre Engineering, Inc.
8000 South Lincoln Street, Unit 5
Littleton, CO. 80122 (303) 730-0434
Municipal Engineering Development Master Planning
Prepared for: SW BEGOLD LLC

HIGH POINTE
DEVELOPED BASIN MAP

JANUARY 10, 2005

Sheet 1 of 1 Sheets

Designer: CCF Drafter: CCF Checked: CCF
Drawing Name: Drainage-Dev.dwg
Path: D:\Land Projects 2004\High Point\dwg\

Calibre
ENGINEERING

North Range Town Center
PHASE III DRAINAGE REPORT

DECEMBER 2006
Revised February 21, 2007

For:

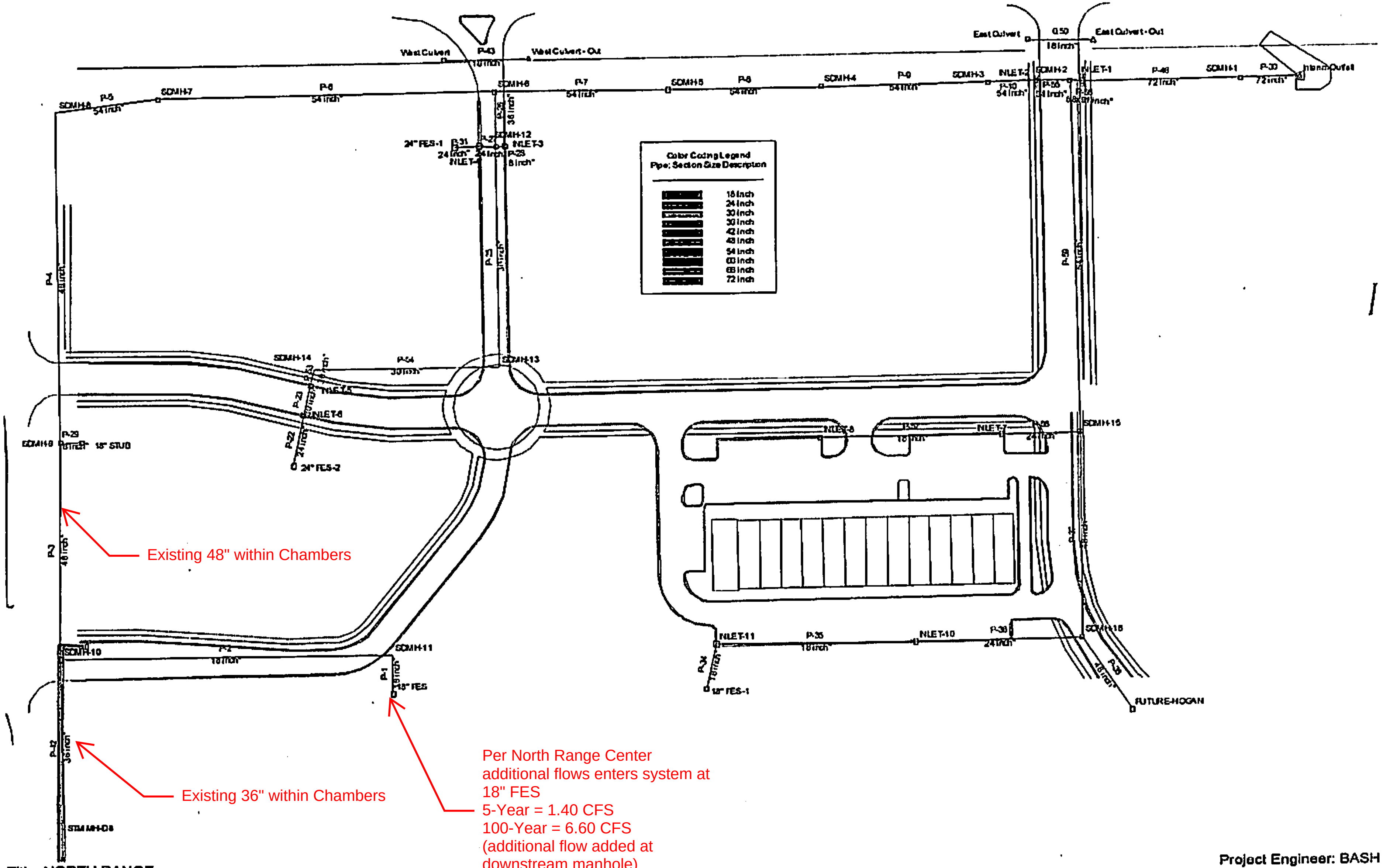
SW North Range, LLC
333 W. Hampden Ave., Suite 810
Englewood, CO 80110

COLORADO REGISTERED
TODD A. JOHNSON
37660
2.21.07
PROFESSIONAL ENGINEER

City of Commerce City Engineering
APPROVED
FEB 20 2007

Calibre Engineering, Inc.
8201 Southpark Lane, Suite 200
Littleton, CO 80120
303-730-0434 fax 303-730-1139
Land Development Civil Engineering Master Planning

Scenario: 5YR



Title: NORTH RANGE
p:\sout hogcom1\drainage\stormcad\20psc.stm
12/05/06 08:33:26 AM

Calibre Engineering
© Haestad Methods, Inc. 37 Brookside Road Waterbury, CT 06708 USA +1-203-755-1666

Project Engineer: BASH
StormCAD v4.1.1 [4.2014a]
Page 1 of 1

Scenario: 5YR

Report Output

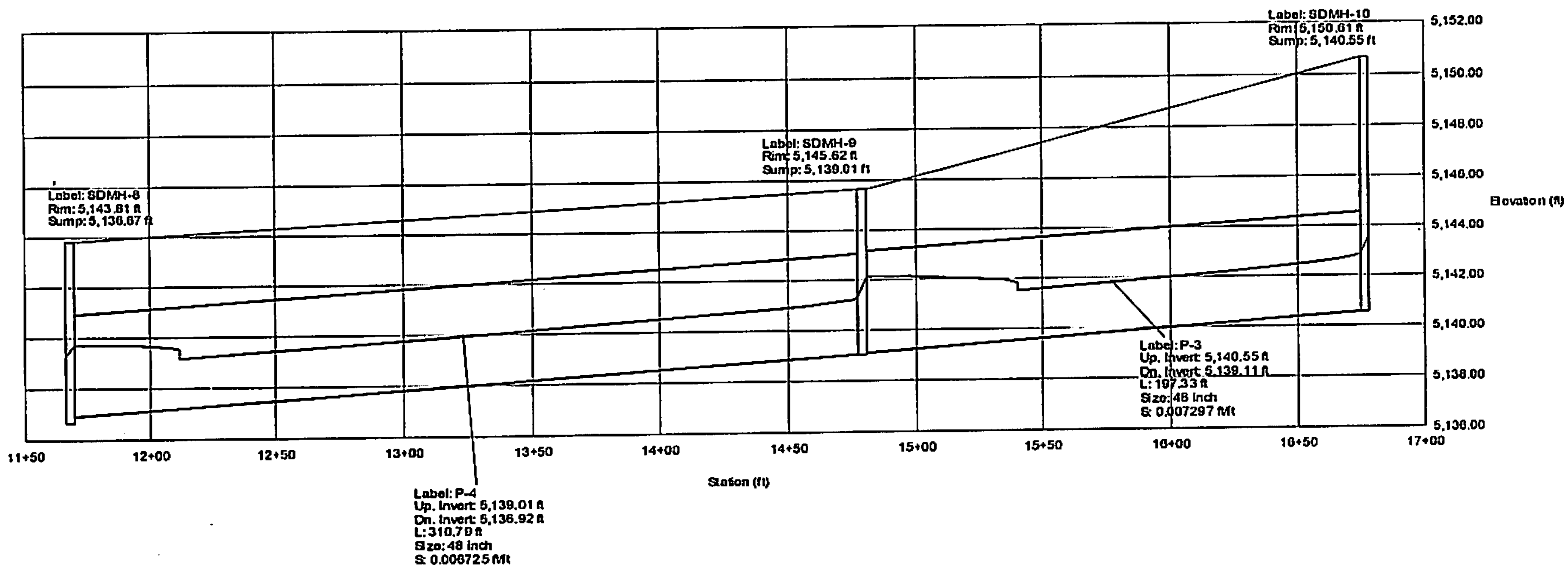
Label	Upstream Node	Downstream Node	Length (ft)	Section Size	Total System Flow (cfs)	Full Capacity (cfs)	Average Velocity (ft/s)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Upstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Invert Elevation (ft)	Downstream Ground Elevation (ft)	Constructed Slope (ft/ft)
0.50	East Culvert	East Culvert - Out	75.00	18 inch	5.90	4.92	4.26	5,137.46	5,136.44	5,136.06	5,137.56	5,135.50	5,137.00	0.007467
P-1	18" FES	SDMH-11	45.00	18 inch	1.40	7.51	3.23	5,145.51	5,145.28	5,145.07	5,145.07	5,144.84	5,148.49	0.005111
P-2	SDMH-11	SDMH-10	318.76	18 inch	1.40	7.42	3.13	5,145.08	5,143.51	5,144.64	5,148.49	5,143.05	5,150.61	0.004988
P-3	SDMH-10	SDMH-9	197.33	48 inch	57.40	122.70	6.72	5,142.83	5,142.11	5,140.55	5,150.61	5,139.11	5,145.62	0.007297
P-4	SDMH-9	SDMH-8	310.79	48 inch	57.70	117.79	6.94	5,141.30	5,139.73	5,139.01	5,145.62	5,136.92	5,143.81	0.006725
P-5	SDMH-8	SDMH-7	97.76	54 inch	57.70	125.78	5.86	5,139.23	5,139.22	5,136.73	5,143.81	5,136.33	5,144.88	0.004092
P-6	SDMH-7	SDMH-6	316.10	54 inch	59.30	124.15	6.34	5,138.46	5,138.01	5,136.22	5,144.88	5,134.96	5,143.12	0.003986
P-7	SDMH-6	SDMH-5	127.43	54 inch	64.50	139.35	6.58	5,137.19	5,137.36	5,134.85	5,143.12	5,134.21	5,142.05	0.005022
P-8	SDMH-5	SDMH-4	177.42	54 inch	65.20	123.51	5.81	5,136.82	5,136.75	5,134.10	5,142.05	5,133.40	5,141.04	0.003945
P-9	SDMH-4	SDMH-3	157.99	54 inch	66.40	125.15	5.37	5,136.32	5,136.25	5,133.30	5,141.04	5,132.66	5,140.69	0.004051
P-10	SDMH-3	INLET-2	43.49	54 inch	68.20	122.94	5.29	5,135.89	5,135.86	5,132.56	5,140.69	[illegible]	[illegible]	[illegible]
P-22	24" FES-2	INLET-6	30.72	24 inch	5.50	18.70	4.81	5,140.83	5,140.54	5,140.00	5,140.00	[illegible]	[illegible]	[illegible]
P-23	INLET-6	INLET-5	31.00	30 inch	7.60	32.94	3.99	5,140.51	5,140.57	5,139.59	5,143.87	[illegible]	[illegible]	[illegible]
P-25	SDMH-13	SDMH-12	209.07	30 inch	10.10	35.32	3.63	5,138.43	5,138.06	5,137.37	5,146.12	[illegible]	[illegible]	[illegible]
P-26	SDMH-12	SDMH-6	51.02	36 inch	12.30	48.52	1.79	5,138.02	5,138.01	5,135.32	5,142.15	[illegible]	[illegible]	[illegible]
P-27	INLET-4	SDMH-12	13.88	24 inch	3.30	22.72	1.08	5,138.06	5,138.06	5,136.24	[illegible]	[illegible]	[illegible]	0.010086
P-28	INLET-3	SDMH-12	6.10	18 inch	1.00	10.42	0.65	5,138.06	5,138.06	5,136.86	[illegible]	[illegible]	[illegible]	0.009836
P-29	18" STUB	SDMH-9	24.00	18 inch	0.80	9.10	0.45	5,142.11	5,142.11	5,139.39	[illegible]	[illegible]	[illegible]	0.007500
P-30	INLET-1	Interim Outfall	205.00	58x91 inc	109.90	313.75	4.16	5,135.59	5,135.57	5,131.93	[illegible]	[illegible]	[illegible]	0.004537
P-31	24" FES-1	INLET-4	26.51	24 inch	2.90	21.52	1.14	5,138.08	5,138.08	5,136.68	5,136.68	[illegible]	[illegible]	[illegible]
P-34	18" FES-1	INLET-11	32.10	18 inch	3.00	11.12	3.64	5,141.59	5,141.34	5,140.93	5,140.93	[illegible]	[illegible]	[illegible]
P-35	INLET-11	INLET-10	180.99	18 inch	3.40	9.00	4.46	5,141.07	5,139.68	5,140.37	5,144.15	[illegible]	[illegible]	[illegible]
P-36	INLET-10	SDMH-16	160.54	24 inch	4.60	19.56	4.66	5,139.29	5,138.00	5,138.54	5,144.13	[illegible]	[illegible]	[illegible]
P-37	SDMH-16	SDMH-15	180.76	48 inch	39.30	101.35	6.07	5,137.21	5,136.71	5,135.34	5,146.50	[illegible]	[illegible]	[illegible]
P-38	FUTURE-HOGA	SDMH-16	62.16	48 inch	35.40	101.43	5.32	5,137.77	5,137.85	5,135.85	5,147.00	[illegible]	[illegible]	[illegible]
P-40	STM MH-D10	STM MH-D9	92.13	36 inch	56.70	58.14	8.02	5,166.62	5,165.95	5,156.41	5,168.69	5,155.71	5,167.13	0.007598
P-41	STM MH-D9	STM MH-D8	365.32	36 inch	56.70	106.53	8.61	5,164.57	5,157.49	5,162.13	5,167.13	5,152.81	5,159.98	0.025512
P-42	STM MH-D8	SDMH-10	376.75	36 inch	56.70	130.16	8.67	5,157.42	5,143.51	5,154.98	5,159.98	5,140.63	5,150.61	0.038089
P-43	West Culvert	West Culvert - Out	90.00	18 inch	4.90	4.95	4.00	5,141.37	5,140.35	5,140.18	5,141.68	5,139.50	5,141.00	0.007556
P-53	INLET-5	SDMH-14	15.16	30 inch	10.10	36.49	5.52	5,140.25	5,140.01	5,139.19	5,143.47	5,139.07	5,144.19	0.007916
P-54	SDMH-14	SDMH-13	172.89	30 inch	10.10	35.57	4.53	5,139.93	5,138.85	5,138.87	5,144.19	5,137.57	5,146.12	0.007519
P-55	INLET-2	SDMH-2	30.09	54 inch	69.90	124.18	5.12	5,135.84	5,135.83	5,132.29	5,139.23	5,132.17	5,138.96	0.003988
P-56	SDMH-2	INLET-1	10.00	58x91 inc	109.10	551.17	4.58	5,135.58	5,135.61	5,132.07	5,138.96	5,131.93	5,138.87	0.014000
P-57	INLET-8	INLET-7	170.00	18 inch	2.50	11.31	4.47	5,140.55	5,138.46	5,139.95	5,144.57	5,137.98	5,144.20	0.011588
P-58	INLET-7	SDMH-15	69.51	24 inch	4.60	27.67	5.38	5,138.53	5,137.29	5,137.78	5,144.20	5,136.74	5,143.38	0.014962
P-59	SDMH-15	SDMH-2	333.69	54 inch	42.40	151.09	4.95	5,136.12	5,135.83	5,134.24	5,143.38	5,132.27	5,138.96	0.005904

Due to conflicts between survey data HGL has been adjusted per delta, HGL has been set 2.81' above adjusted invert.

Starting flow rate originally from High Pointe Drainage Report. Flow rate used as starting flow of analyzed system.

Per North Range Town Center information, flows remain unchanged downstream, therefore no additional flows added within sections of 48" storm that as been analyzed.

Profile
Scenario: 5YR



Scenario: 100YR

Report Output

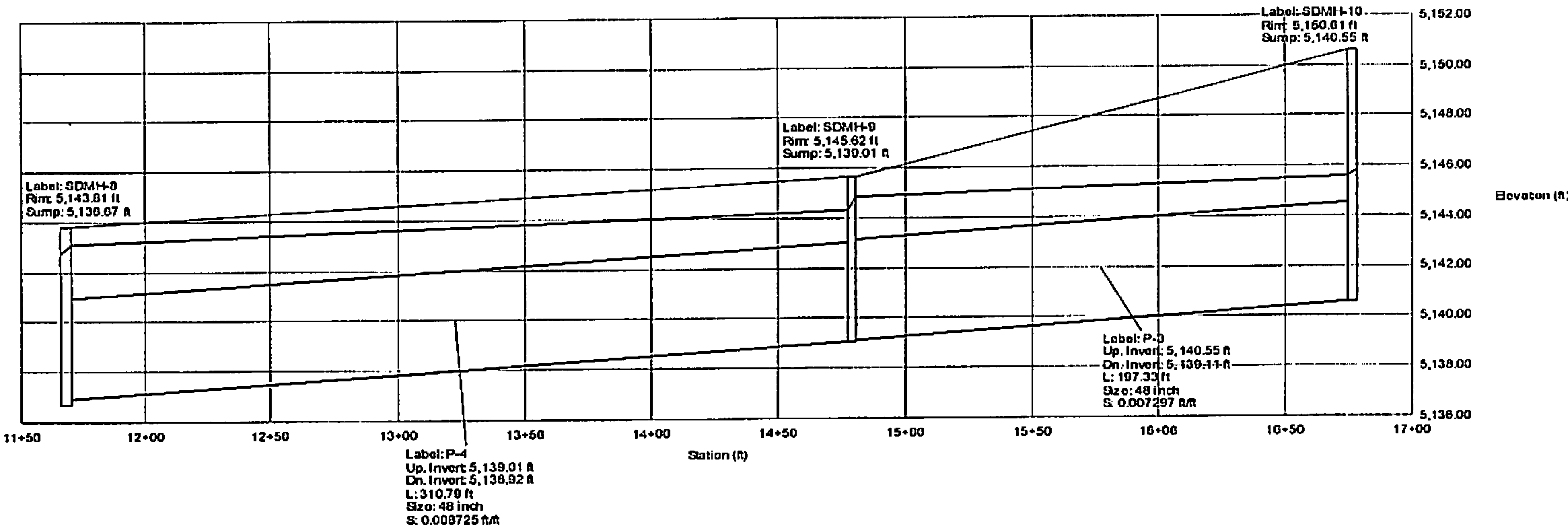
Label	Upstream Node	Downstream Node	Length (ft)	Section Size	Total System Flow (cfs)	Full Capacity (cfs)	Average Velocity (ft/s)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Upstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Invert Elevation (ft)	Downstream Ground Elevation (ft)	Constructed Slope (ft/ft)
0.50	East Culvert	East Culvert - Out	75.00	18 inch	10.70	4.92	6.41	5,139.54	5,136.76	5,136.06	5,137.56	5,135.50	5,137.00	0.007467
P-1	18" FES	SDMH-11	45.00	18 inch	6.60	7.51	4.28	5,146.25	5,146.11	5,145.07	5,145.07	5,144.84	5,148.49	0.005111
P-2	SDMH-11	SDMH-10	318.76	18 inch	6.60	7.42	4.30	5,145.74	5,144.45	5,144.64	5,148.49	5,143.05	5,150.61	0.004988
P-3	SDMH-10	SDMH-9	197.33	48 inch	88.10	122.70	7.19	5,144.17	5,143.53	5,140.55	5,150.61	5,139.11	5,145.62	0.007297
P-4	SDMH-9	SDMH-8	310.79	48 inch	88.60	117.79	7.06	5,142.95	5,141.77	5,139.01	5,145.62	5,136.92	5,143.81	0.006725
P-5	SDMH-8	SDMH-7	97.76	54 inch	88.60	125.78	5.57	5,141.39	5,141.19	5,136.73	5,143.81	5,136.33	5,144.88	0.004092
P-6	SDMH-7	SDMH-6	316.10	54 inch	91.70	124.15	5.77	5,140.79	5,140.11	5,136.22	5,144.88	5,134.96	5,143.12	0.003986
P-7	SDMH-6	SDMH-5	127.43	54 inch	101.20	139.35	6.36	5,139.61	5,139.27	5,134.85	5,143.12	5,134.21	5,142.05	0.005022
P-8	SDMH-5	SDMH-4	177.42	54 inch	102.60	123.51	6.45	5,138.78	5,138.30	5,134.10	5,142.05	5,133.40	5,141.04	0.003945
P-9	SDMH-4	SDMH-3	157.99	54 inch	104.90	125.15	6.60	5,137.78	5,137.33	5,133.30	5,141.04	5,132.66	5,140.69	0.004051
P-10	SDMH-3	INLET-2	43.49	54 inch	108.30	122.94	7.00	5,136.73	5,136.63	5,132.56	5,140.69	[illegible]	[illegible]	[illegible]
P-22	24" FES-2	INLET-6	30.72	24 inch	10.70	18.70	3.59	5,141.73	5,141.69	5,140.00	5,140.00	[illegible]	[illegible]	[illegible]
P-23	INLET-6	INLET-5	31.00	30 inch	14.70	32.94	3.24	5,141.68	5,141.67	5,139.59	5,143.87	[illegible]	[illegible]	[illegible]
P-25	SDMH-13	SDMH-12	209.07	30 inch	19.50	35.32	3.97	5,140.79	5,140.32	5,137.37	5,146.12	[illegible]	[illegible]	[illegible]
P-26	SDMH-12	SDMH-6	51.02	36 inch	25.30	48.52	3.58	5,140.18	5,140.11	5,135.32	5,142.15	[illegible]	[illegible]	[illegible]
P-27	INLET-4	SDMH-12	13.88	24 inch	6.40	22.72	2.04	5,140.33	5,140.32	5,136.24	[illegible]	[illegible]	[illegible]	0.010086
P-28	INLET-3	SDMH-12	6.10	18 inch	1.90	10.42	1.08	5,140.32	5,140.32	5,136.86	[illegible]	[illegible]	[illegible]	0.009836
P-29	18" STUB	SDMH-9	24.00	18 inch	1.60	9.10	0.91	5,143.54	5,143.53	5,139.39	[illegible]	[illegible]	[illegible]	0.007500
P-30	INLET-1	Interim Outfall	205.00	58x91 inc	199.60	313.75	7.47	5,135.67	5,135.57	5,131.93	[illegible]	[illegible]	[illegible]	0.004537
P-31	24" FES-1	INLET-4	26.51	24 inch	5.60	21.52	1.78	5,140.42	5,140.41	5,136.68	5,136.68	[illegible]	[illegible]	[illegible]
P-34	18" FES-1	INLET-11	32.10	18 inch	10.10	11.12	5.72	5,143.29	5,142.99	5,140.93	5,140.93	[illegible]	[illegible]	[illegible]
P-35	INLET-11	INLET-10	180.99	18 inch	11.00	9.00	6.56	5,142.39	5,140.31	5,140.37	5,144.15	[illegible]	[illegible]	[illegible]
P-36	INLET-10	SDMH-16	160.54	24 inch	13.40	19.56	5.18	5,139.86	5,139.44	5,138.54	5,144.13	[illegible]	[illegible]	[illegible]
P-37	SDMH-16	SDMH-15	180.76	48 inch	88.50	101.35	7.76	5,138.55	5,138.11	5,135.34	5,146.50	[illegible]	[illegible]	[illegible]
P-38	FUTURE-HOGA	SDMH-16	62.16	48 inch	77.20	101.43	6.26	5,139.57	5,139.44	5,135.85	5,147.00	[illegible]	[illegible]	[illegible]
P-40	STM MH-D10	STM MH-D9	92.13	36 inch	85.20	58.14	12.05	5,168.63	5,167.13	5,156.41	5,168.69	5,155.71	5,167.13	0.007598
P-41	STM MH-D9	STM MH-D8	365.32	36 inch	85.20	106.53	12.21	5,164.94	5,157.91	5,162.13	5,167.13	5,152.81	5,159.98	0.025512
P-42	STM MH-D8	SDMH-10	376.75	36 inch	85.20	130.16	12.21	5,157.79	5,144.45	5,154.98	5,159.98	5,140.63	5,150.61	0.038089
P-43	West Culvert	West Culvert - Out	90.00	18 inch	9.40	4.95	5.80	5,143.29	5,140.68	5,140.18	5,141.68	5,139.50	5,141.00	0.007556
P-53	INLET-5	SDMH-14	15.16	30 inch	19.50	36.49	4.12	5,141.45	5,141.44	5,139.19	5,143.47	5,139.07	5,144.19	0.007916
P-54	SDMH-14	SDMH-13	172.89	30 inch	19.50	35.57	3.97	5,141.44	5,141.05	5,138.87	5,144.19	5,137.57	5,146.12	0.007519
P-55	INLET-2	SDMH-2	30.09	54 inch	111.90	124.18	7.13	5,136.59	5,136.52	5,132.29	5,139.23	5,132.17	5,138.96	0.003988
P-56	SDMH-2	INLET-1	10.00	58x91 inc	198.10	551.17	8.19	5,135.60	5,135.72	5,132.07	5,138.96	5,131.93	5,138.87	0.014000
P-57	INLET-8	INLET-7	170.00	18 inch	4.80	11.31	4.58	5,140.79	5,138.86	5,139.95	5,144.57	5,137.98	5,144.20	0.011588
P-58	INLET-7	SDMH-15	69.51	24 inch	8.80	27.67	4.52	5,138.84	5,138.11	5,137.78	5,144.20	5,136.74	5,143.38	0.014962
P-59	SDMH-15	SDMH-2	333.69	54 inch	94.60	151.09	7.49	5,137.10	5,136.52	5,134.24	5,143.38	5,132.27	5,138.96	0.005904

Due to conflicts between survey data HGL has been adjusted per delta, HGL has been set 4.85' above adjusted invert.

Starting flow rate originally from High Pointe Drainage Report. Flow rate used as starting flow of analyzed system.

Per North Range Town Center information, flows remain unchanged downstream, therefore no additional flows added within sections of 48" storm that as been analyzed.

Profile
Scenario: 100YR



APPENDIX C

- HYDROLOGIC CALCULATIONS

Project : TTRes Chambers Road
Project No. : 23049

Date : 3/22/2024
By : ACL

Drainage Basin Imperviousness

Soil Type : **A**

	Roof	Concrete	Asphalt	Landscape	SF Residential	Gravel	Undeveloped	Total Area (ac.)	Total Area (sq.ft.)	Composite % Imp.	Runoff Coefficients			
Imperviousness :	90%	90%	100%	2%	45%	40%	2%							
Basin Name	Areas (sq.ft.)										C_2	C_5	C_{10}	C_{100}
H-OS1			992	6,519				0.17	7,511	15%	0.07	0.08	0.08	0.23
H-OS2					12,160			0.28	12,160	45%	0.30	0.31	0.33	0.46
H-A	8,650	1,204				3,931	572,600	13.46	586,385	4%	0.01	0.01	0.02	0.14
H-B							2,763	0.06	2,763	2%	0.01	0.01	0.01	0.13
H-C							3,249	0.07	3,249	2%	0.01	0.01	0.01	0.13

Project : TTRes Chambers Road
Project No. : 23049

Date : 3/22/2024
By : ACL

SF2 - Time of Concentration

				Initial/Overland Time			Travel Time					Time of Concentration		Final
Basin ID	Area (ac.)	Area (sq.ft.)	C_5	L_i (ft.)	S (%)	T_i (min.)	L_t (ft.)	S (%)	Conveyance Factor	Vel (fps)	T_t (min.)	Comp. T_C (min.)	Regional T_C (Min.)	T_C (Min.)
H-OS1	0.17	7,511	0.08	199	5.00	15.3	0	5.0	15	3.4	0.0	15.3	23.5	15.3
H-OS2	0.28	12,160	0.31	44	2.00	7.5	0	2.0	15	2.1	0.0	7.5	18.4	7.5
H-A	13.46	586,385	0.01	538	1.90	36.8	196	0.5	15	1.1	3.1	39.9	30.2	30.2
H-B	0.06	2,763	0.01	14	25.00	2.6	0	25.0	15	7.5	0.0	2.6	25.7	5.0
H-C	0.07	3,249	0.01	17	10.00	3.8	0	10.0	15	4.7	0.0	3.8	25.7	5.0

Project : TTRes Chambers Road
Project No. : 23049

Date : 3/22/2024
By : ACL

SF3 - Minor Storm

1-hr Point Rainfall **1.12** in. (5-year Event)

		Direct Runoff							Total Runoff				Street		Travel Time			
Description	Design Point	Area (ac.)	Area (sq.ft.)	C_5	Tc (min.)	CA (ac.)	I (in/hr)	Q (cfs)	Tc (min.)	CA (ac.)	I (in/hr)	Q (cfs)	Slope (%)	Flow (cfs)	Length (ft)	Vel. (fps)	tt (min.)	Comments
H-OS1	H1	0.17	7,511	0.08	15.3	0.01	2.52	0.0										
H-OS2	H2	0.28	12,160	0.31	7.5	0.09	3.36	0.3										
H-A	H3	13.46	586,385	0.01	30.2	0.17	1.75	0.3										
H-B	H4	0.06	2,763	0.01	5.0	0.00	3.80	0.0										
H-C	H5	0.07	3,249	0.01	5.0	0.00	3.80	0.0										

Project : TTRes Chambers Road
Project No. : 23049

Date : 3/22/2024
By : ACL

SF3 - Major Storm

1-hr Point Rainfall **2.43** in. (100-year Event)

		Direct Runoff							Total Runoff				Street		Travel Time			
Description	Design Point	Area (ac.)	Area (sq.ft.)	C_{100}	Tc (min.)	CA (ac.)	I (in/hr)	Q (cfs)	Tc (min.)	CA (ac.)	I (in/hr)	Q (cfs)	Slope (%)	Flow (cfs)	Length (ft)	Vel. (fps)	tt (min.)	Comments
H-OS1	H1	0.17	7,511	0.23	15.3	0.04	5.46	0.2										
H-OS2	H2	0.28	12,160	0.46	7.5	0.13	7.29	0.9										
H-A	H3	13.46	586,385	0.14	30.2	1.87	3.80	7.1										
H-B	H4	0.06	2,763	0.13	5.0	0.01	8.24	0.1										
H-C	H5	0.07	3,249	0.13	5.0	0.01	8.24	0.1										

Project : TTRes Chambers Road
Project No. : 23049

Date : 8/12/2024
By : ACL

Drainage Basin Imperviousness

Soil Type : **A**

Basin Name	Roof	Concrete	Asphalt	Landscape	Playground	Gravel	Undeveloped	Total Area (ac.)	Total Area (sq.ft.)	Composite % Imp.	Runoff Coefficients C_2	C_5	C_{10}	C_{100}
Imperviousness :	90%	90%	100%	2%	10%	40%	2%							
	Areas (sq.ft.)													
Development Site	167,925	42,419	186,241	118,005				11.81	514,590	73%	0.56	0.58	0.59	0.68
A1	9,851	2,570	4,030	9,265				0.59	25,716	60%	0.43	0.45	0.46	0.58
A2	7,942	927		398				0.21	9,266	86%	0.69	0.71	0.72	0.78
A3	5,377		17,193	2,223				0.57	24,793	89%	0.72	0.74	0.75	0.80
A4	6,852	773		112				0.18	7,737	89%	0.72	0.74	0.75	0.80
A5	20,772	3,974		15,001				0.91	39,747	57%	0.40	0.42	0.43	0.55
A6	7,901	900		201				0.21	9,002	88%	0.71	0.73	0.74	0.80
A7	6,019	727		524				0.17	7,270	84%	0.67	0.68	0.70	0.76
A8	13,959	10,276	74,355	4,172				2.36	102,762	94%	0.77	0.79	0.80	0.84
A9	8,191	917		67				0.21	9,175	89%	0.73	0.74	0.76	0.81
A10	15,196	2,732		9,393				0.63	27,321	60%	0.43	0.45	0.46	0.58
A11	7,006			732				0.18	7,737	82%	0.65	0.66	0.68	0.75
A12	1,919	850		5,732				0.20	8,500	31%	0.18	0.19	0.20	0.35
A13	4,634	6,218	42,679	8,649				1.43	62,180	85%	0.68	0.69	0.71	0.77
A14	600	5,712	47,984	2,731				1.31	57,028	94%	0.78	0.80	0.81	0.84
A15		644		18,218		1,114		0.46	19,976	7%	0.03	0.03	0.03	0.16
B1	7,006			732				0.18	7,737	82%	0.65	0.66	0.68	0.75
B2	7,006			732				0.18	7,737	82%	0.65	0.66	0.68	0.75
B3	19,639	4,363		19,631				1.00	43,633	50%	0.34	0.36	0.37	0.50
B4	6,019			618				0.15	6,637	82%	0.65	0.67	0.68	0.75
C1		3,334	23,344	6,668				0.77	33,346	79%	0.62	0.64	0.65	0.73
C2		4,063	28,223	8,126				0.93	40,412	79%	0.62	0.64	0.65	0.73
C3	6,019	836		1,508				0.19	8,363	74%	0.57	0.59	0.60	0.69
C4	6,019			5,929				0.27	11,948	46%	0.31	0.32	0.34	0.47
Total to Pond	159,484	64,818	204,167	135,432				12.95	563,901	72%	0.55	0.57	0.59	0.68
OS-1		737	5,164	1,474.0				0.17	7,375	79%	0.62	0.64	0.65	0.73
OS-2				1,691.0				0.04	1,691	2%	0.01	0.01	0.01	0.13
OS-3				9,748				0.22	9,748	2%	0.01	0.01	0.01	0.13

Project : TTRes Chambers Road
Project No. : 23049

Date : 8/12/2024
By : ACL

SF2 - Time of Concentration

				Initial/Overland Time			Travel Time					Time of Concentration		Final
Basin ID	Area (ac.)	Area (sq.ft.)	C_5	L_i (ft.)	S (%)	T_i (min.)	L_t (ft.)	S (%)	Conveyance Factor	Vel (fps)	T_t (min.)	Comp. T_C (min.)	Regional T_C (Min.)	T_C (Min.)
A1	0.59	25,716	0.45	100	2.00	9.4	300	2.0	20	2.8	1.8	11.1	17.9	11.1
A2	0.21	9,266	0.71	35	2.00	3.3	0	2.0	20	2.8	0.0	3.3	11.3	5.0
A3	0.57	24,793	0.74	40	1.50	3.6	350	2.0	20	2.8	2.1	5.6	12.8	5.6
A4	0.18	7,737	0.74	40	1.50	3.6	0	2.0	20	2.8	0.0	3.6	10.9	5.0
A5	0.91	39,747	0.42	10	10.00	1.8	200	2.0	20	2.8	1.2	3.0	17.7	5.0
A6	0.21	9,002	0.73	40	2.00	3.4	0	2.0	20	2.8	0.0	3.4	11.0	5.0
A7	0.17	7,270	0.68	40	2.00	3.8	0	2.0	20	2.8	0.0	3.8	11.8	5.0
A8	2.36	102,762	0.79	100	2.00	4.4	500	1.5	20	2.4	3.4	7.8	13.2	7.8
A9	0.21	9,175	0.74	40	2.00	3.2	0	2.0	20	2.8	0.0	3.2	10.8	5.0
A10	0.63	27,321	0.45	10	10.00	1.7	150	2.0	20	2.8	0.9	2.6	16.9	5.0
A11	0.18	7,737	0.66	40	2.00	4.0	0	2.0	20	2.8	0.0	4.0	12.1	5.0
A12	0.20	8,500	0.19	10	2.00	4.1	250	1.0	20	2.0	2.1	6.2	23.9	6.2
A13	1.43	62,180	0.69	60	1.50	5.0	850	1.0	20	2.0	7.1	12.0	18.4	12.0
A14	1.31	57,028	0.80	80	2.00	3.9	500	1.5	20	2.4	3.4	7.3	13.1	7.3
A15	0.46	19,976	0.03	10	33.33	1.9	0	2.0	20	2.8	0.0	1.9	24.8	5.0
B1	0.18	7,737	0.66	40	2.00	4.0	0	2.0	20	2.8	0.0	4.0	12.1	5.0
B2	0.18	7,737	0.66	40	2.00	4.0	0	2.0	20	2.8	0.0	4.0	12.1	5.0
B3	1.00	43,633	0.36	10	10.00	2.0	150	2.0	20	2.8	0.9	2.9	18.5	5.0
B4	0.15	6,637	0.67	40	2.00	3.9	0	2.0	20	2.8	0.0	3.9	12.1	5.0
C1	0.77	33,346	0.64	60	2.00	5.1	1,100	2.0	20	2.8	6.5	11.6	18.9	11.6
C2	0.93	40,412	0.64	60	2.00	5.1	500	2.0	20	2.8	2.9	8.1	15.5	8.1
C3	0.19	8,363	0.59	40	2.00	4.7	0	2.0	20	2.8	0.0	4.7	13.4	5.0
C4	0.27	11,948	0.32	10	10.00	2.1	100	2.0	20	2.8	0.6	2.7	18.9	5.0
OS-1	0.17	7,375	0.64	60	2.00	5.1	600	2.0	20	2.8	3.5	8.6	16.0	8.6
OS-2	0.04	1,691	0.01	10	33.33	2.0	0	2.0	20	2.8	0.0	2.0	25.7	5.0
OS-3	0.22	9,748	0.01	10	33.33	2.0	0	2.0	20	2.8	0.0	2.0	25.7	5.0

Project : TTRes Chambers Road
Project No. : 23049

Date : 8/12/2024
By : ACL

SF3 - Minor Storm

1-hr Point Rainfall **1.12** in. (5-year Event)

		Direct Runoff							Total Runoff				Street		Travel Time			
Description	Design Point	Area (ac.)	Area (sq.ft.)	C_5	Tc (min.)	CA (ac.)	I (in/hr)	Q (cfs)	Tc (min.)	CA (ac.)	I (in/hr)	Q (cfs)	Slope (%)	Flow (cfs)	Length (ft)	Vel. (fps)	tt (min.)	Comments
A1	1	0.59	25,716	0.45	11.1	0.26	2.90	0.8					2.0	0.8	24	2.8	0.1	Direct Runoff to 1, to 3 via Surface
A2	2	0.21	9,266	0.71	5.0	0.15	3.80	0.6					1.0	0.6	50	2.0	0.4	Direct Runoff to 2, to 8 via Storm Sewer
A3	3	0.57	24,793	0.74	5.6	0.42	3.68	1.6										Direct Runoff to 3, to 8 via Storm Sewer
	3								11.3	0.69	2.88	2.0	1.0	2.0	425	2.0	3.5	Peak Flow to 3, to 8 via Storm Sewer
A4	4	0.18	7,737	0.74	5.0	0.13	3.80	0.5					1.0	0.5	50	2.0	0.4	Direct Runoff to 4, to 8 via Storm Sewer
A5	5	0.91	39,747	0.42	5.0	0.38	3.80	1.4					1.0	1.4	50	2.0	0.4	Direct Runoff to 5, to 8 via Storm Sewer
A6	6	0.21	9,002	0.73	5.0	0.15	3.80	0.6					1.0	0.6	50	2.0	0.4	Direct Runoff to 6, to 8 via Storm Sewer
A7	7	0.17	7,270	0.68	5.0	0.11	3.80	0.4					1.0	0.4	50	2.0	0.4	Direct Runoff to 7, to 8 via Storm Sewer
A8	8	2.36	102,762	0.79	7.8	1.87	3.31	6.2										Direct Runoff to 8, to 13 via Storm Sewer
	8								14.8	3.33	2.56	8.5	1.0	8.5	505	2.0	4.2	Peak Flow to 8, to 13 via Storm Sewer
A9	9	0.21	9,175	0.74	5.0	0.16	3.80	0.6					1.0	0.6	50	2.0	0.4	Direct Runoff to 9, to 13 via Storm Sewer
A10	10	0.63	27,321	0.45	5.0	0.28	3.80	1.1					1.0	1.1	55	2.0	0.5	Direct Runoff to 10, to 13 via Storm Sewer
A11	11	0.18	7,737	0.66	5.0	0.12	3.80	0.4					1.0	0.4	50	2.0	0.4	Direct Runoff to 11, to 13 via Storm Sewer
A12	12	0.20	8,500	0.19	6.2	0.04	3.57	0.1					1.0	0.1	50	2.0	0.4	Direct Runoff to 12, via Surface flow Through Basin A13
A13	13	1.43	62,180	0.69	12.0	0.99	2.81	2.8										Direct Runoff to 13, via Surface
A14	13	1.31	57,028	0.80	7.3	1.04	3.40	3.5										Direct Runoff to 13, via Surface
	13								12.0	2.07	2.81	5.8						Total Peak to 13, to A via Storm Sewer
	A								19.0	6.64	2.26	15.0						Peak Runoff From A Basins to Pond
A15		0.46	19,976	0.03	5.0	0.01	3.80	0.0										Peak Runoff Direct to Pond
B1	14	0.18	7,737	0.66	5.0	0.12	3.80	0.4					1.0	0.4	50	2.0	0.4	Direct Runoff to 14, to B via Storm Sewer
B2	15	0.18	7,737	0.66	5.0	0.12	3.80	0.4					1.0	0.4	50	2.0	0.4	Direct Runoff to 15, to B via Storm Sewer
B3	16	1.00	43,633	0.36	5.0	0.36	3.80	1.4					1.0	1.4	50	2.0	0.4	Direct Runoff to 16, to B via Storm Sewer
B4	17	0.15	6,637	0.67	5.0	0.10	3.80	0.4					1.0	0.4	50	2.0	0.4	Direct Runoff to 17, to B via Storm Sewer
	B								5.4	0.70	3.72	2.6						Peak Runoff From B Basins to Pond
C1	18	0.77	33,346	0.64	11.6	0.49	2.85	1.4					1.0	1.4	50	2.0	0.4	Direct Runoff to 18, to B via Storm Sewer
C2	19	0.93	40,412	0.64	8.1	0.59	3.28	1.9					1.0	1.9	50	2.0	0.4	Direct Runoff to 19, to B via Storm Sewer
C3	20	0.19	8,363	0.59	5.0	0.11	3.80	0.4					1.0	0.4	50	2.0	0.4	Direct Runoff to 20, to B via Storm Sewer
C4	21	0.27	11,948	0.32	5.0	0.09	3.80	0.3					1.0	0.3	50	2.0	0.4	Direct Runoff to 21, to B via Storm Sewer
	C								12.0	1.28	2.81	3.6	1.0	3.6	70	2.0	0.6	Peak Runoff From C Basins to Pond
Total Runoff to Pond									19.0	8.64	2.26	19.5						Peak Runoff to Pond
OS-1		0.17	7,375	0.64	8.6	0.11	3.20	0.3										Direct Runoff routed offsite to South (102nd)
OS-2		0.04	1,691	0.01	5.0	0.00	3.80	0.0										Direct Runoff routed offsite to West
OS-3		0.22	9,748	0.01	5.0	0.00	3.80	0.0										Direct Runoff routed offsite to North

Project : TTRes Chambers Road | Date : 8/12/2024
Project No. : 23049 | By : ACL

SF3 - Major Storm

1-hr Point Rainfall **2.43** in. (100-year Event)

		Direct Runoff							Total Runoff				Street		Travel Time			
Description	**Design Point**	**Area (ac.)**	**Area (sq.ft.)**	**C_{100}**	**Tc (min.)**	**CA (ac.)**	**I (in/hr)**	**Q (cfs)**	**Tc (min.)**	**CA (ac.)**	**I (in/hr)**	**Q (cfs)**	**Slope (%)**	**Flow (cfs)**	**Length (ft)**	**Vel. (fps)**	**tt (min.)**	**Comments**
A1	1	0.59	25,716	0.58	11.1	0.34	6.29	2.1					2.0	2.1	24	2.8	0.1	Direct Runoff to 1, to 3 via Surface
A2	2	0.21	9,266	0.78	5.0	0.17	8.24	1.4					1.0	1.4	50	2.0	0.4	Direct Runoff to 2, to 8 via Storm Sewer
A3	3	0.57	24,793	0.80	5.6	0.46	7.98	3.7										Direct Runoff to 3, to 8 via Storm Sewer
	3								11.3	0.80	6.26	5.0	1.0	5.0	425	2.0	3.5	Peak Flow to 3, to 8 via Storm Sewer
A4	4	0.18	7,737	0.80	5.0	0.14	8.24	1.2					1.0	1.2	50	2.0	0.4	Direct Runoff to 4, to 8 via Storm Sewer
A5	5	0.91	39,747	0.55	5.0	0.50	8.24	4.2					1.0	4.2	50	2.0	0.4	Direct Runoff to 5, to 8 via Storm Sewer
A6	6	0.21	9,002	0.80	5.0	0.16	8.24	1.4					1.0	1.4	50	2.0	0.4	Direct Runoff to 6, to 8 via Storm Sewer
A7	7	0.17	7,270	0.76	5.0	0.13	8.24	1.0					1.0	1.0	50	2.0	0.4	Direct Runoff to 7, to 8 via Storm Sewer
A8	8	2.36	102,762	0.84	7.8	1.98	7.19	14.3										Direct Runoff to 8, to 13 via Storm Sewer
	8								14.8	3.72	5.55	20.6	1.0	20.6	505	2.0	4.2	Peak Flow to 8, to 13 via Storm Sewer
A9	9	0.21	9,175	0.81	5.0	0.17	8.24	1.4					1.0	1.4	50	2.0	0.4	Direct Runoff to 9, to 13 via Storm Sewer
A10	10	0.63	27,321	0.58	5.0	0.36	8.24	3.0					1.0	3.0	55	2.0	0.5	Direct Runoff to 10, to 13 via Storm Sewer
A11	11	0.18	7,737	0.75	5.0	0.13	8.24	1.1					1.0	1.1	50	2.0	0.4	Direct Runoff to 11, to 13 via Storm Sewer
A12	12	0.20	8,500	0.35	6.2	0.07	7.75	0.5					1.0	0.5	50	2.0	0.4	Direct Runoff to 12, via Surface flow Through Basin A13
A13	13	1.43	62,180	0.77	12.0	1.10	6.09	6.7										Direct Runoff to 13, via Surface
A14	13	1.31	57,028	0.84	7.3	1.11	7.37	8.1										Direct Runoff to 13, via Surface
	13								12.0	2.27	6.09	13.8						Total Peak to 13, to A via Storm Sewer
	A								19.0	7.46	4.90	36.6						Peak Runoff From A Basins to Pond
A15		0.46	19,976	0.16	5.0	0.08	8.24	0.6										Peak Runoff Direct to Pond
B1	14	0.18	7,737	0.75	5.0	0.13	8.24	1.1					1.0	1.1	50	2.0	0.4	Direct Runoff to 14, to B via Storm Sewer
B2	15	0.18	7,737	0.75	5.0	0.13	8.24	1.1					1.0	1.1	50	2.0	0.4	Direct Runoff to 15, to B via Storm Sewer
B3	16	1.00	43,633	0.50	5.0	0.50	8.24	4.2					1.0	4.2	50	2.0	0.4	Direct Runoff to 16, to B via Storm Sewer
B4	17	0.15	6,637	0.75	5.0	0.11	8.24	0.9					1.0	0.9	50	2.0	0.4	Direct Runoff to 17, to B via Storm Sewer
	B								5.4	0.88	8.07	7.1						Peak Runoff From B Basins to Pond
C1	18	0.77	33,346	0.73	11.6	0.56	6.19	3.5					1.0	3.5	50	2.0	0.4	Direct Runoff to 18, to B via Storm Sewer
C2	19	0.93	40,412	0.73	8.1	0.68	7.12	4.8					1.0	4.8	50	2.0	0.4	Direct Runoff to 19, to B via Storm Sewer
C3	20	0.19	8,363	0.69	5.0	0.13	8.24	1.1					1.0	1.1	50	2.0	0.4	Direct Runoff to 20, to B via Storm Sewer
C4	21	0.27	11,948	0.47	5.0	0.13	8.24	1.1					1.0	1.1	50	2.0	0.4	Direct Runoff to 21, to B via Storm Sewer
	C								12.0	1.50	6.10	9.1	1.0	9.1	70	2.0	0.6	Peak Runoff From C Basins to Pond
Total Runoff to Pond									19.0	9.91	4.90	48.6						Peak Runoff to Pond
OS-1		0.17	7,375	0.73	8.6	0.12	6.95	0.9										Direct Runoff routed offsite to South (102nd)
OS-2		0.04	1,691	0.13	5.0	0.00	8.24	0.0										Direct Runoff routed offsite to West
OS-3		0.22	9,748	0.13	5.0	0.03	8.24	0.2										Direct Runoff routed offsite to North

Table 6-3. Recommended percentage imperviousness values

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

APPENDIX D

- HYDRAULIC CALCULATIONS

Channel Report

Private Roadway Capacity - V-Pan Section (@ Max Basin Peak Flow - 14.3 cfs)

User-defined

Invert Elev (ft)	= 2.66
Slope (%)	= 1.00
N-Value	= 0.013

Calculations

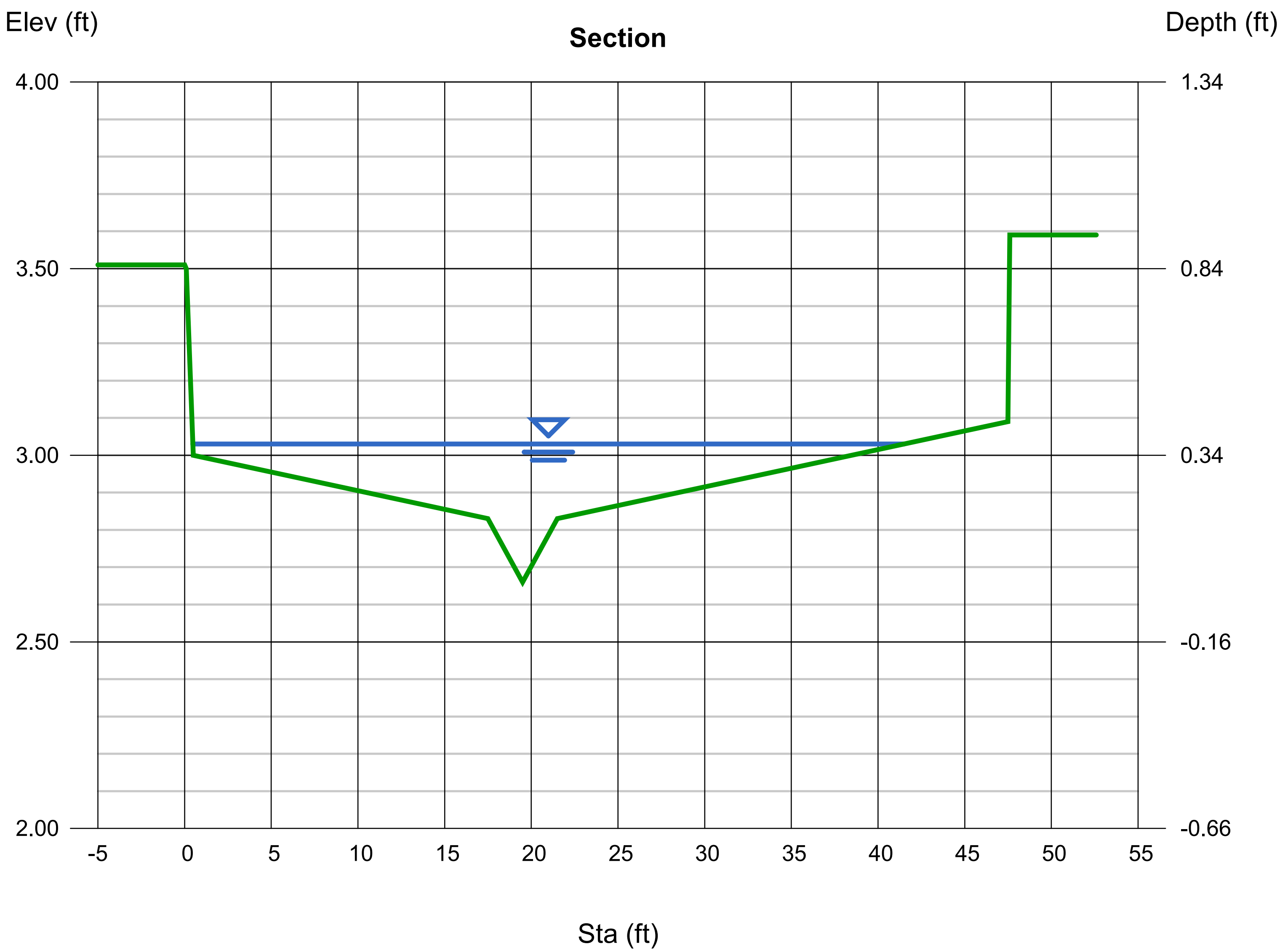
Compute by:	Known Q
Known Q (cfs)	= 14.30

Highlighted

Depth (ft)	= 0.37
Q (cfs)	= 14.30
Area (sqft)	= 5.10
Velocity (ft/s)	= 2.81
Wetted Perim (ft)	= 41.05
Crit Depth, Yc (ft)	= 0.41
Top Width (ft)	= 41.02
EGL (ft)	= 0.49

(Sta, El, n)-(Sta, El, n)...

(0.00, 3.51)-(0.10, 3.50, 0.013)-(0.50, 3.00, 0.013)-(17.50, 2.83, 0.013)-(19.50, 2.66, 0.013)-(21.50, 2.83, 0.013)-(47.50, 3.09, 0.013)
-(47.60, 3.59, 0.013)



Channel Report

Private Roadway Capacity - Curb Only Section (@ DP 15 - Max Peak)

Gutter

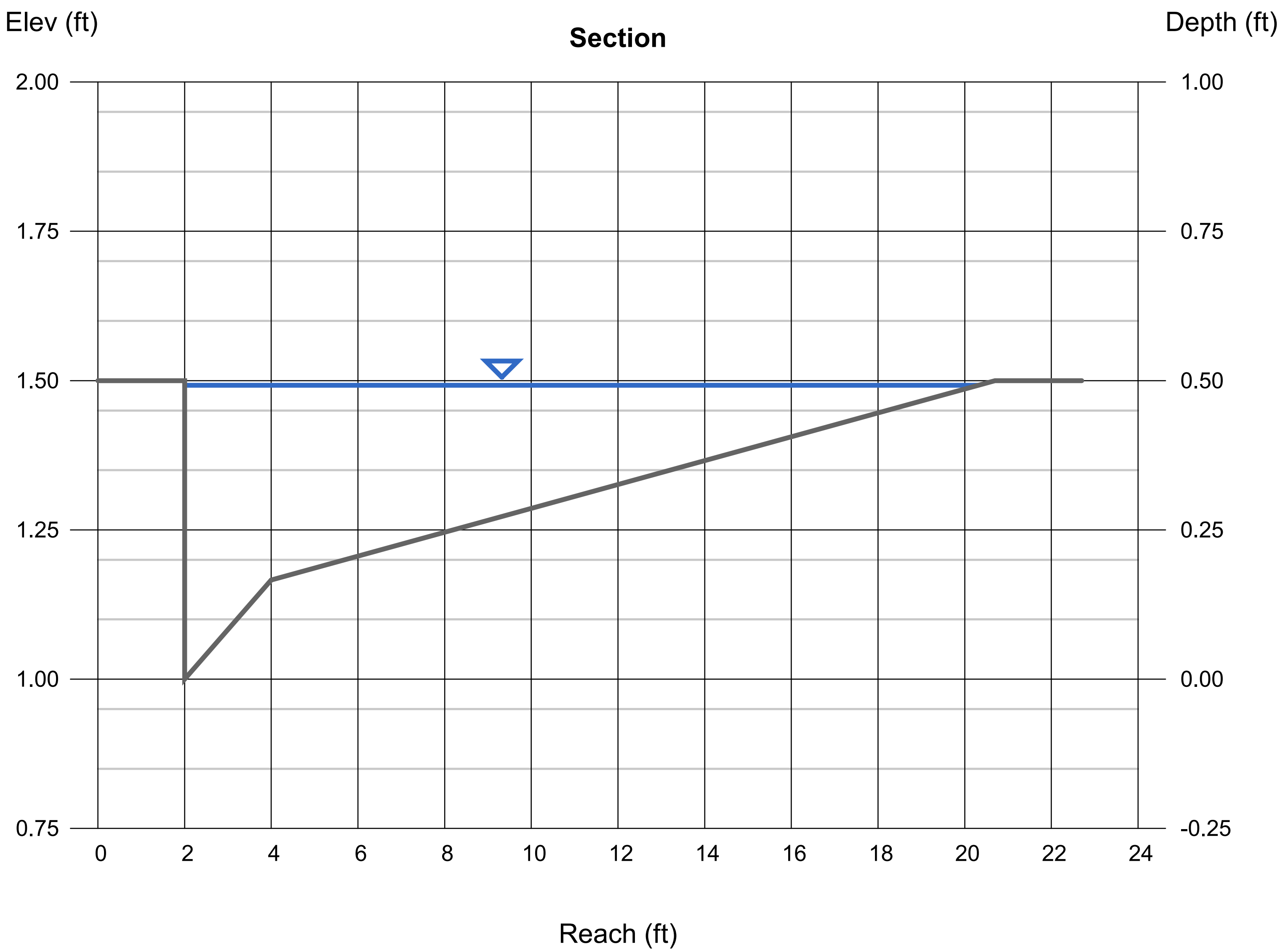
Cross Sl, Sx (ft/ft)	= 0.020
Cross Sl, Sw (ft/ft)	= 0.083
Gutter Width (ft)	= 2.00
Invert Elev (ft)	= 1.00
Slope (%)	= 0.75
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 13.80

Highlighted

Depth (ft)	= 0.49
Q (cfs)	= 13.80
Area (sqft)	= 3.47
Velocity (ft/s)	= 3.97
Wetted Perim (ft)	= 18.80
Crit Depth, Yc (ft)	= 0.58
Spread Width (ft)	= 18.30
EGL (ft)	= 0.74



Channel Report

102nd Roadway Section - Peak Flow 3.4 CFS (5-Year)

Gutter

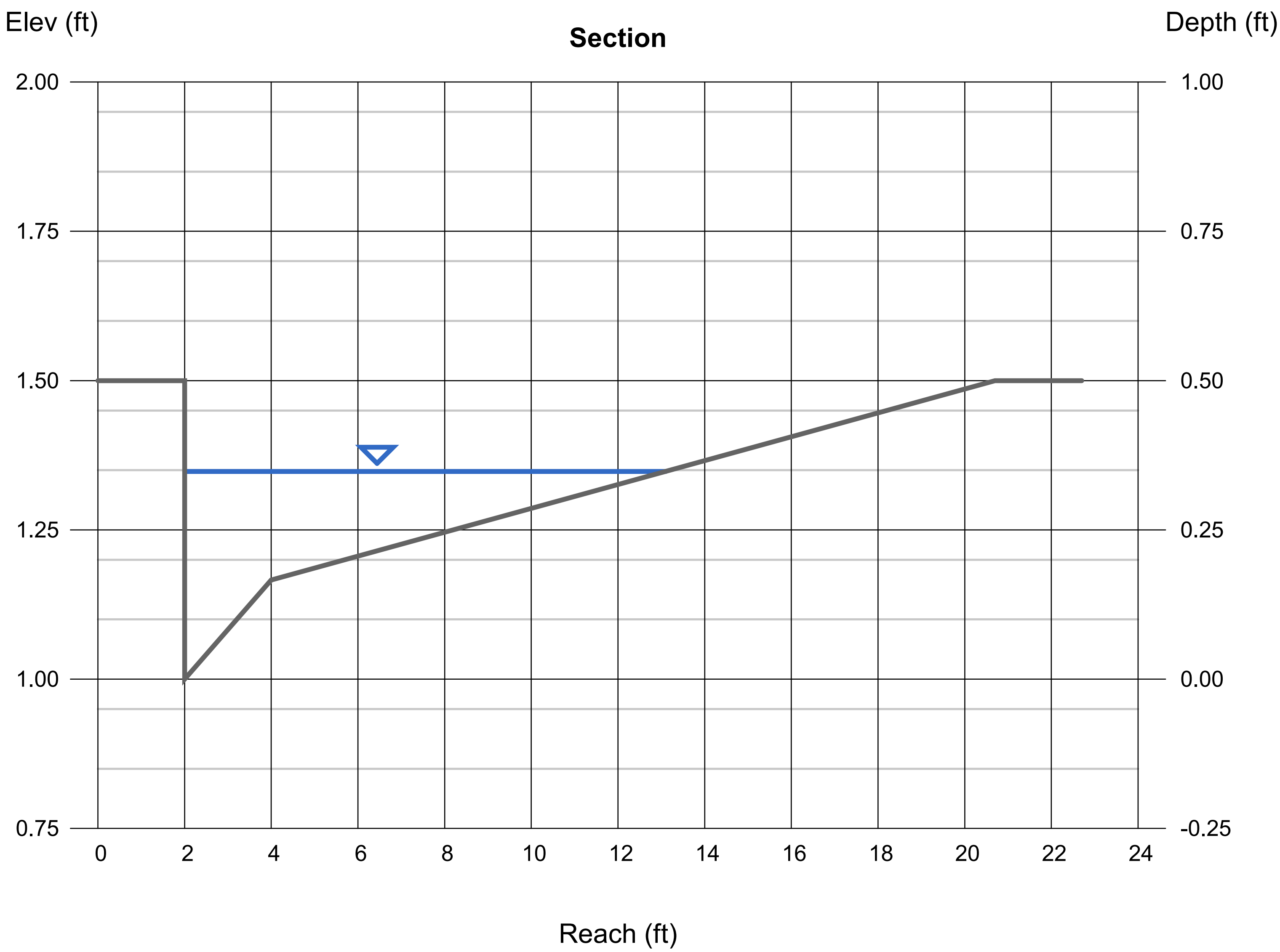
Cross Sl, Sx (ft/ft)	=	0.020
Cross Sl, Sw (ft/ft)	=	0.083
Gutter Width (ft)	=	2.00
Invert Elev (ft)	=	1.00
Slope (%)	=	0.50
N-Value	=	0.013

Calculations

Compute by:		Known Q
Known Q (cfs)	=	3.40

Highlighted

Depth (ft)	=	0.35
Q (cfs)	=	3.400
Area (sqft)	=	1.36
Velocity (ft/s)	=	2.50
Wetted Perim (ft)	=	11.46
Crit Depth, Yc (ft)	=	0.38
Spread Width (ft)	=	11.10
EGL (ft)	=	0.45



Channel Report

102nd Roadway Section - Peak Flow 8.4 CFS (100-Year)

Gutter

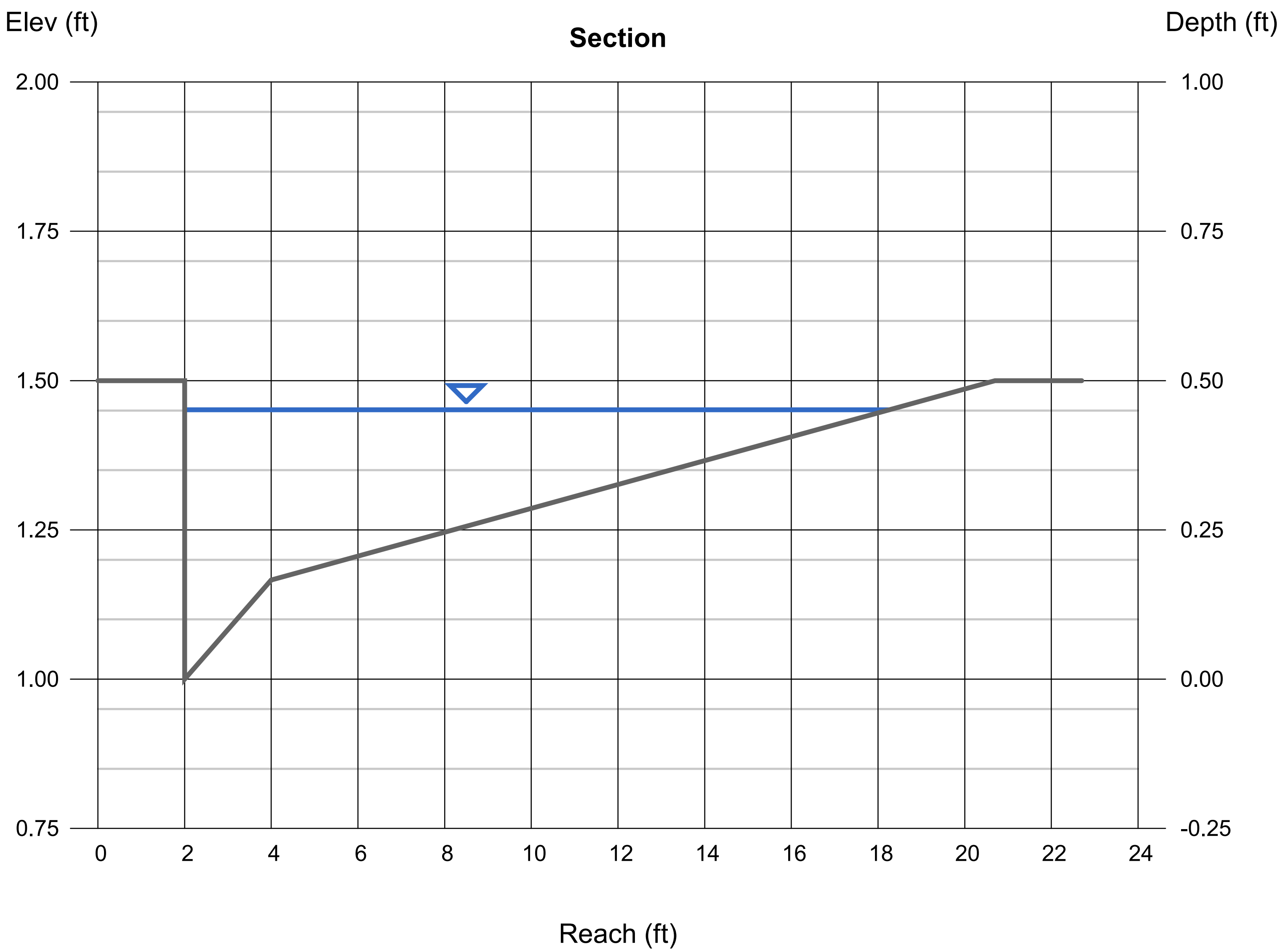
Cross Sl, Sx (ft/ft)	=	0.020
Cross Sl, Sw (ft/ft)	=	0.083
Gutter Width (ft)	=	2.00
Invert Elev (ft)	=	1.00
Slope (%)	=	0.50
N-Value	=	0.013

Calculations

Compute by:		Known Q
Known Q (cfs)	=	8.40

Highlighted

Depth (ft)	=	0.45
Q (cfs)	=	8.400
Area (sqft)	=	2.77
Velocity (ft/s)	=	3.04
Wetted Perim (ft)	=	16.71
Crit Depth, Yc (ft)	=	0.49
Spread Width (ft)	=	16.25
EGL (ft)	=	0.59



Inlet at Design Point 3

Figure 8-1. Allowable Inlet Capacity – Type R Inlet, Sump Conditions
(Note: See Section 8.3.2 for assumptions)

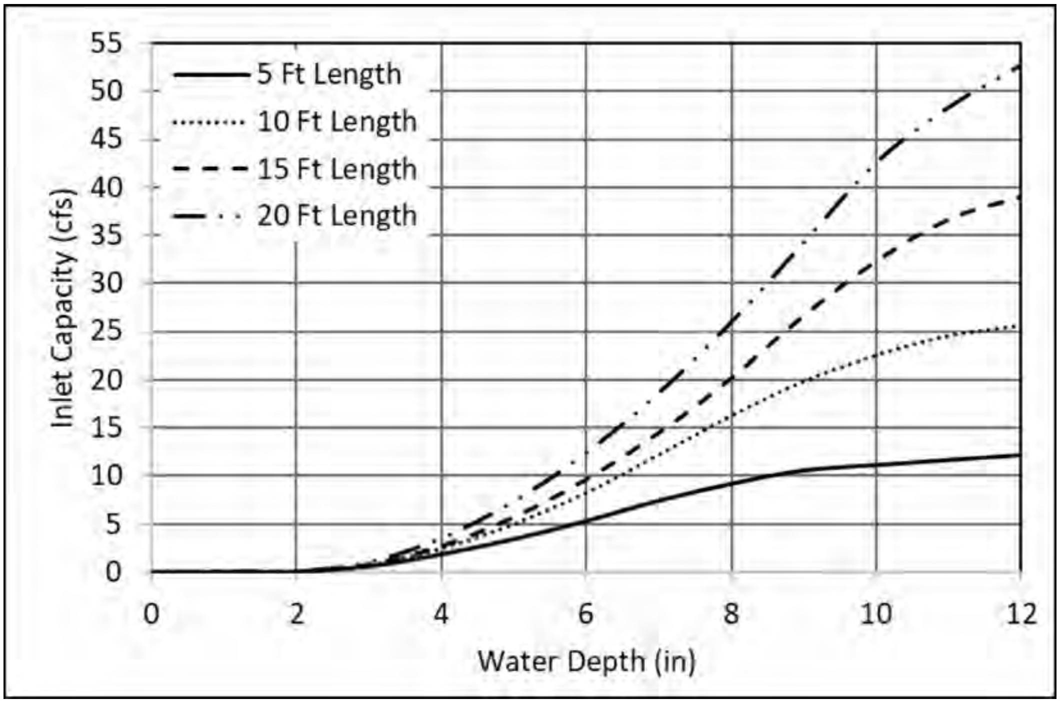
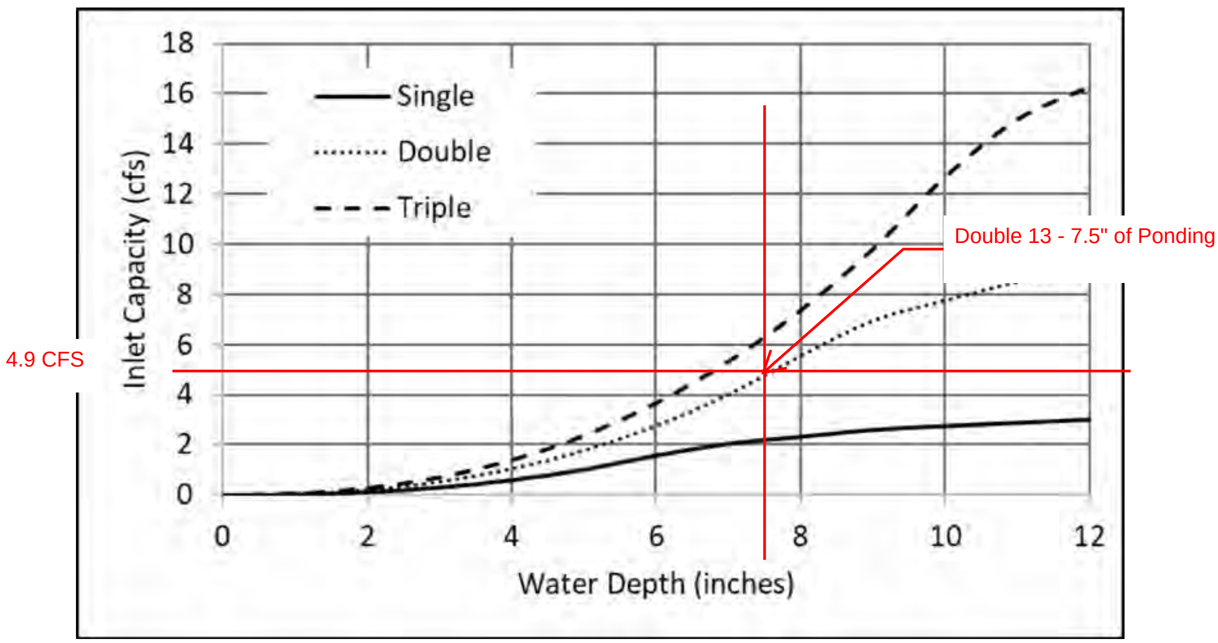


Figure 8-2. Allowable Inlet Capacity – Type 13 Grated Inlet, Sump Conditions
(Note: See Section 8.3.2 for assumptions)



Inlet at Design Point 8

Figure 8-1. Allowable Inlet Capacity – Type R Inlet, Sump Conditions
(Note: See Section 8.3.2 for assumptions)

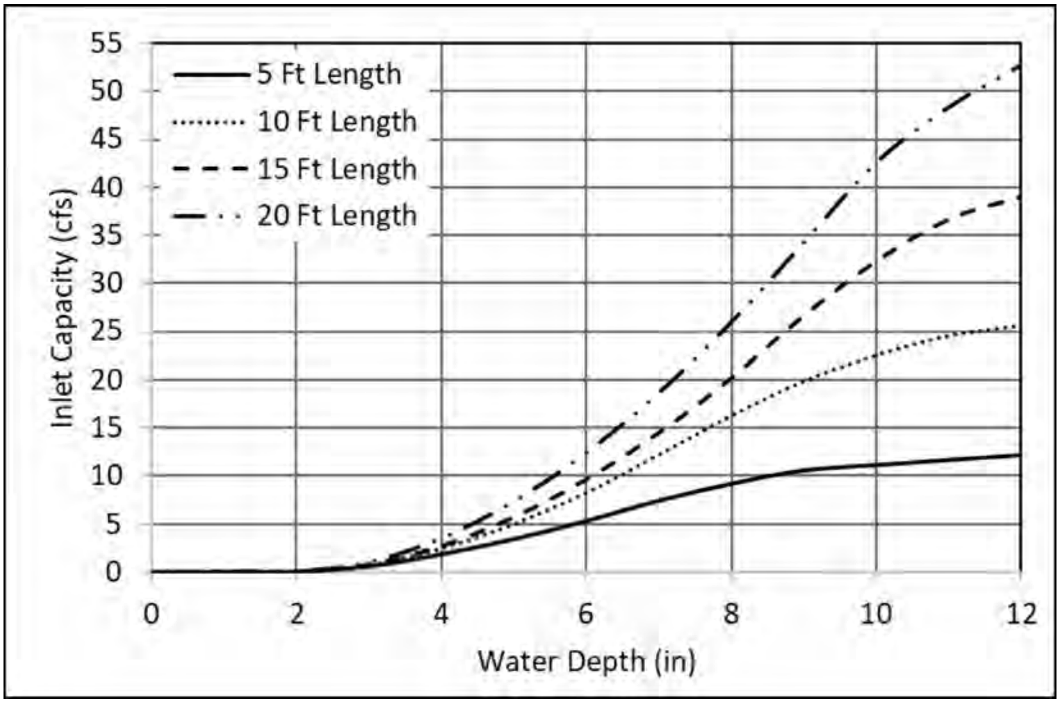
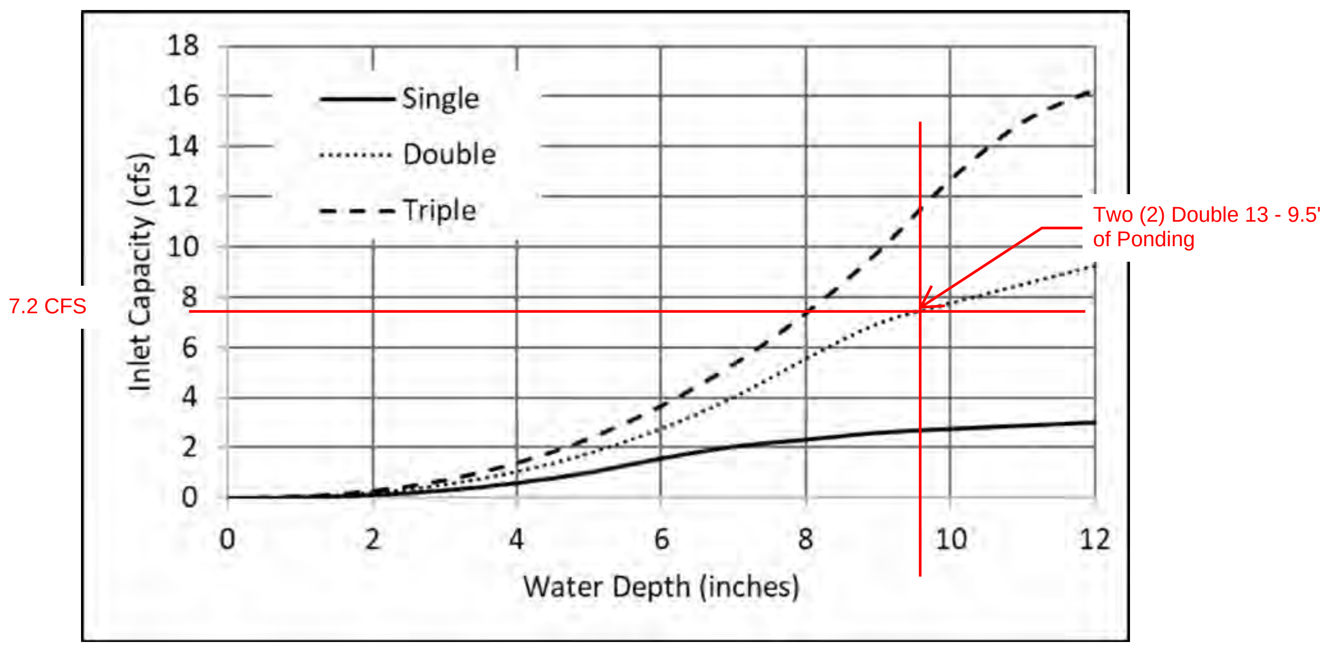


Figure 8-2. Allowable Inlet Capacity – Type 13 Grated Inlet, Sump Conditions
(Note: See Section 8.3.2 for assumptions)



Two (2) double Type 13s to be used in series, it is assumed each inlet will receive half of the direction runoff. Total direct runoff = 14.3, each inlet will receive 7.2 cfs.

Figure 8-1. Allowable Inlet Capacity – Type R Inlet, Sump Conditions
(Note: See Section 8.3.2 for assumptions)

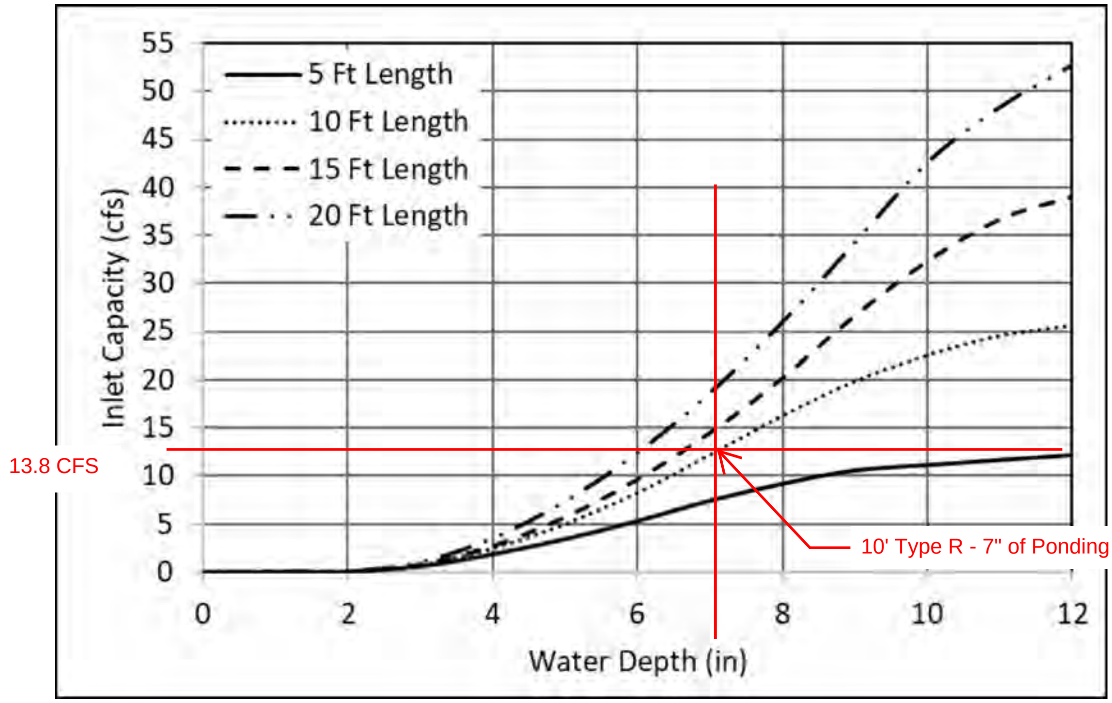


Figure 8-2. Allowable Inlet Capacity – Type 13 Grated Inlet, Sump Conditions
(Note: See Section 8.3.2 for assumptions)

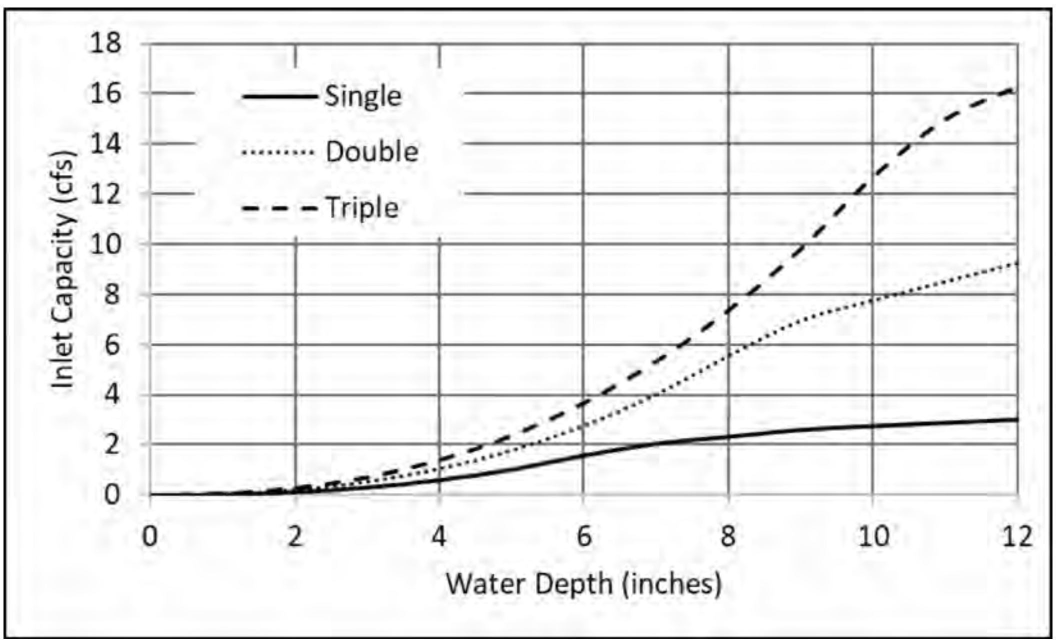


Figure 8-1. Allowable Inlet Capacity – Type R Inlet, Sump Conditions
(Note: See Section 8.3.2 for assumptions)

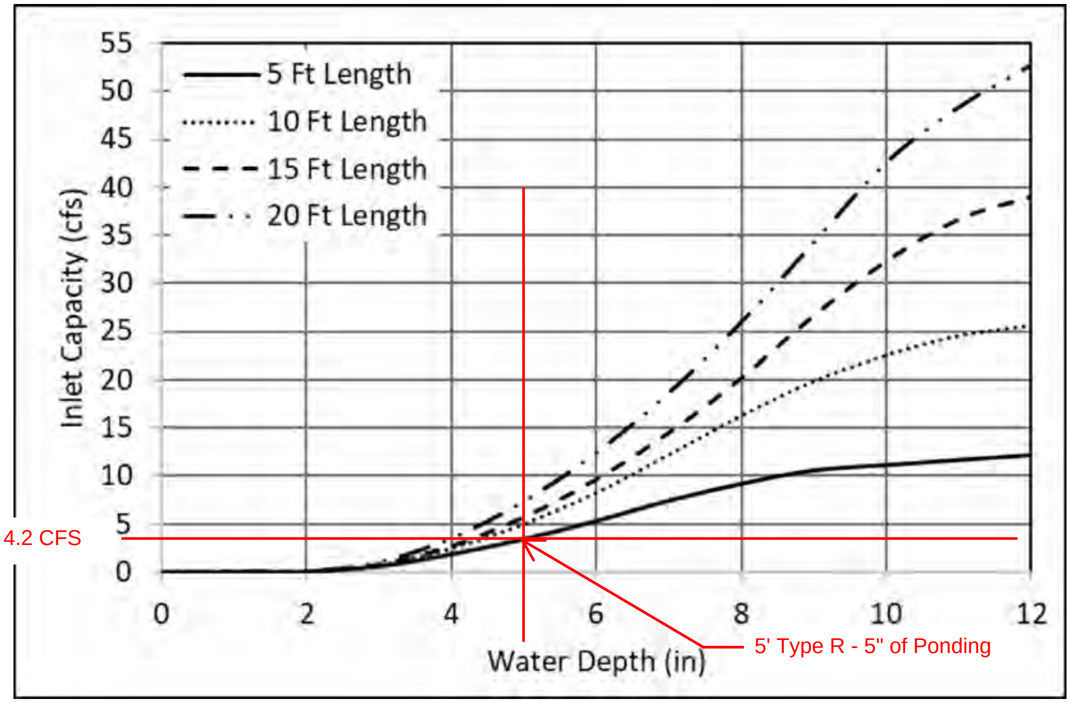
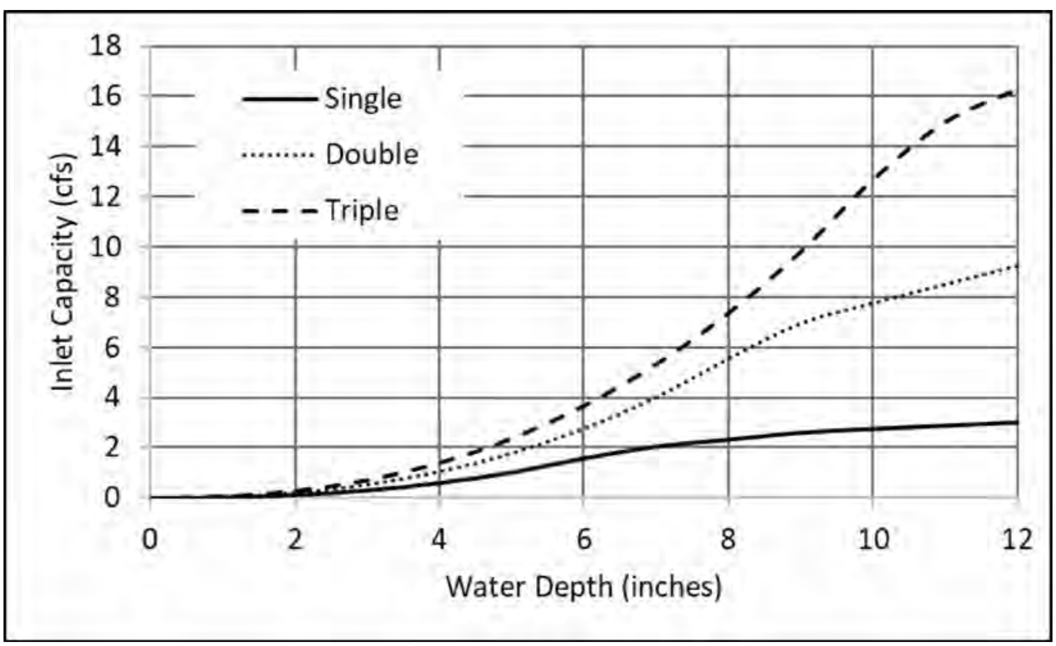


Figure 8-2. Allowable Inlet Capacity – Type 13 Grated Inlet, Sump Conditions
(Note: See Section 8.3.2 for assumptions)



Inlet at Design Point 17

Figure 8-1. Allowable Inlet Capacity – Type R Inlet, Sump Conditions
(Note: See Section 8.3.2 for assumptions)

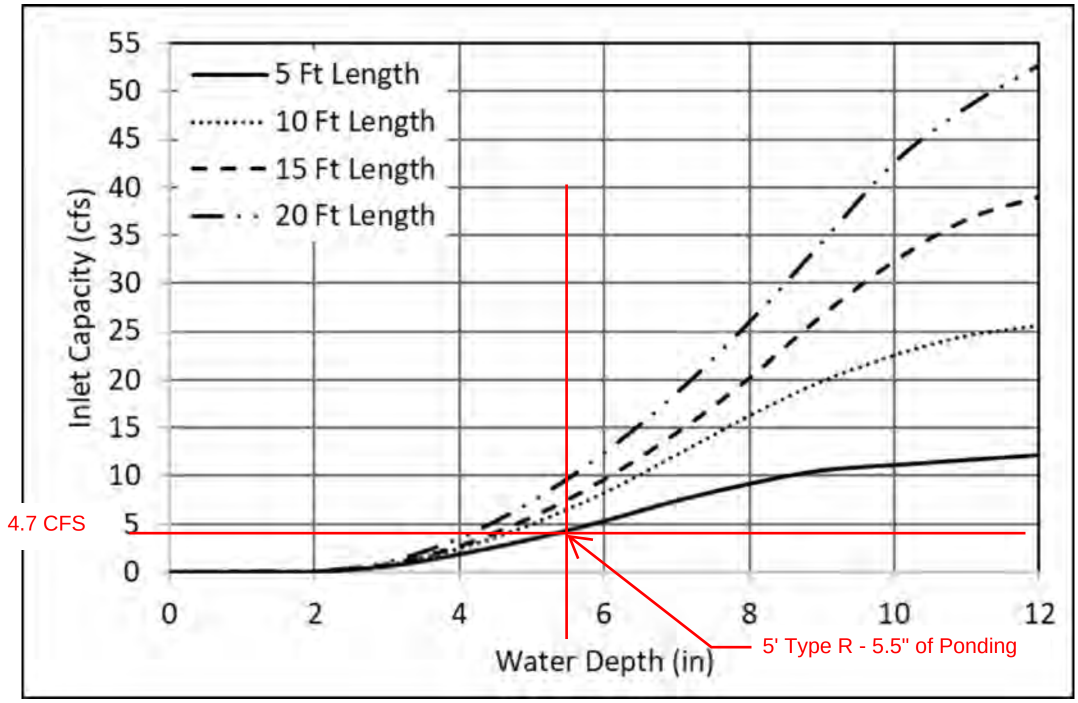
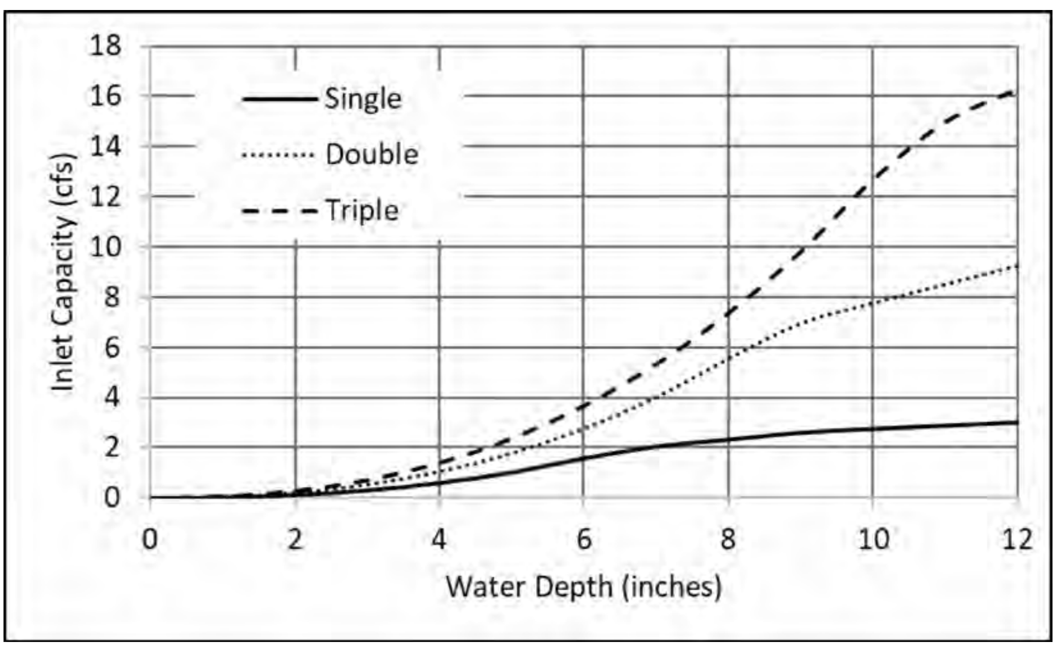


Figure 8-2. Allowable Inlet Capacity – Type 13 Grated Inlet, Sump Conditions
(Note: See Section 8.3.2 for assumptions)



Channel Report

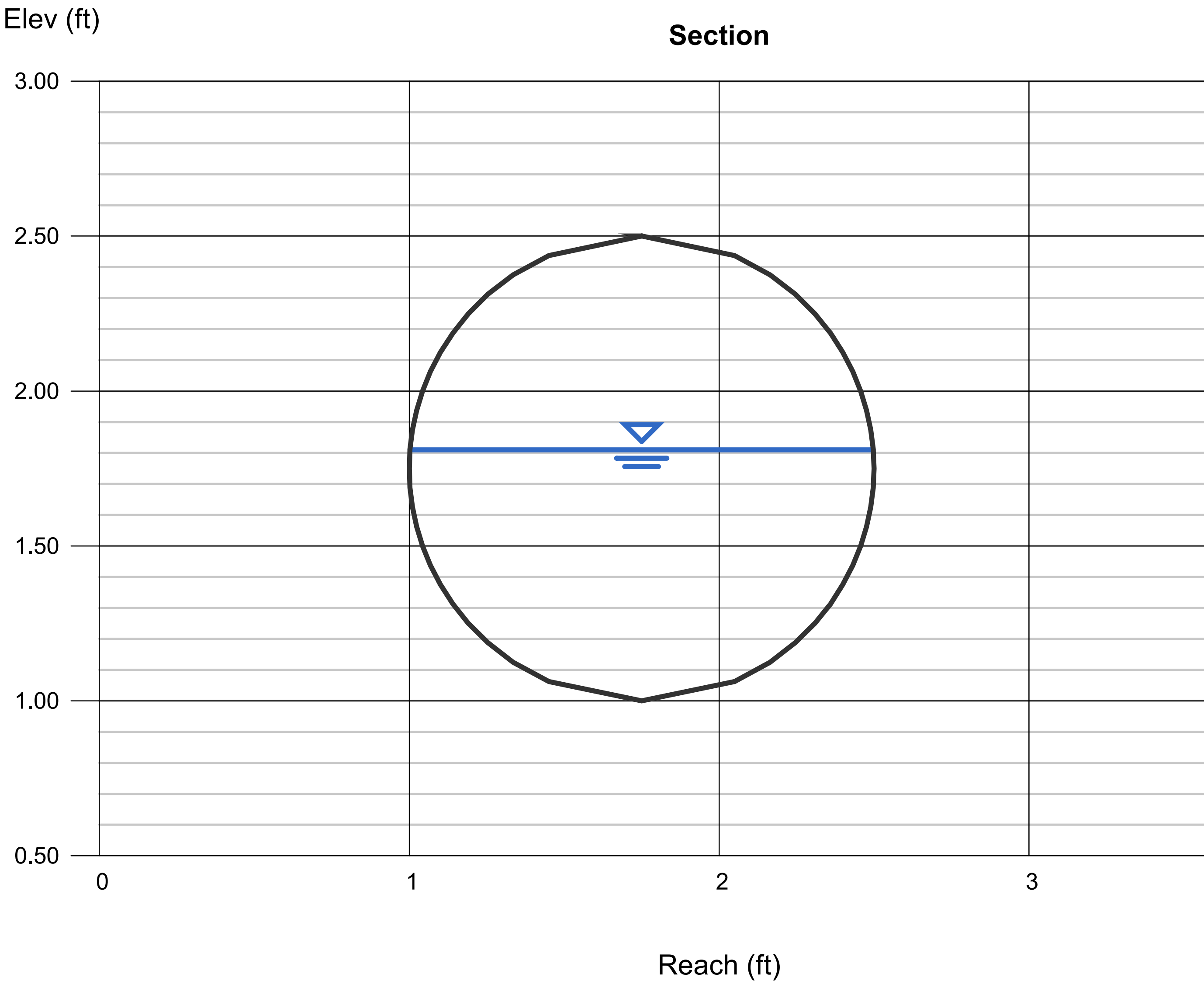
18 Inch RCP Capacity (DP 3)

Circular
Diameter (ft) = 1.50

Invert Elev (ft) = 1.00
Slope (%) = 1.00
N-Value = 0.013

Calculations
Compute by: Known Q
Known Q (cfs) = 5.90

Highlighted
Depth (ft) = 0.81
Q (cfs) = 5.900
Area (sqft) = 0.98
Velocity (ft/s) = 6.03
Wetted Perim (ft) = 2.48
Crit Depth, Yc (ft) = 0.94
Top Width (ft) = 1.49
EGL (ft) = 1.38



Channel Report

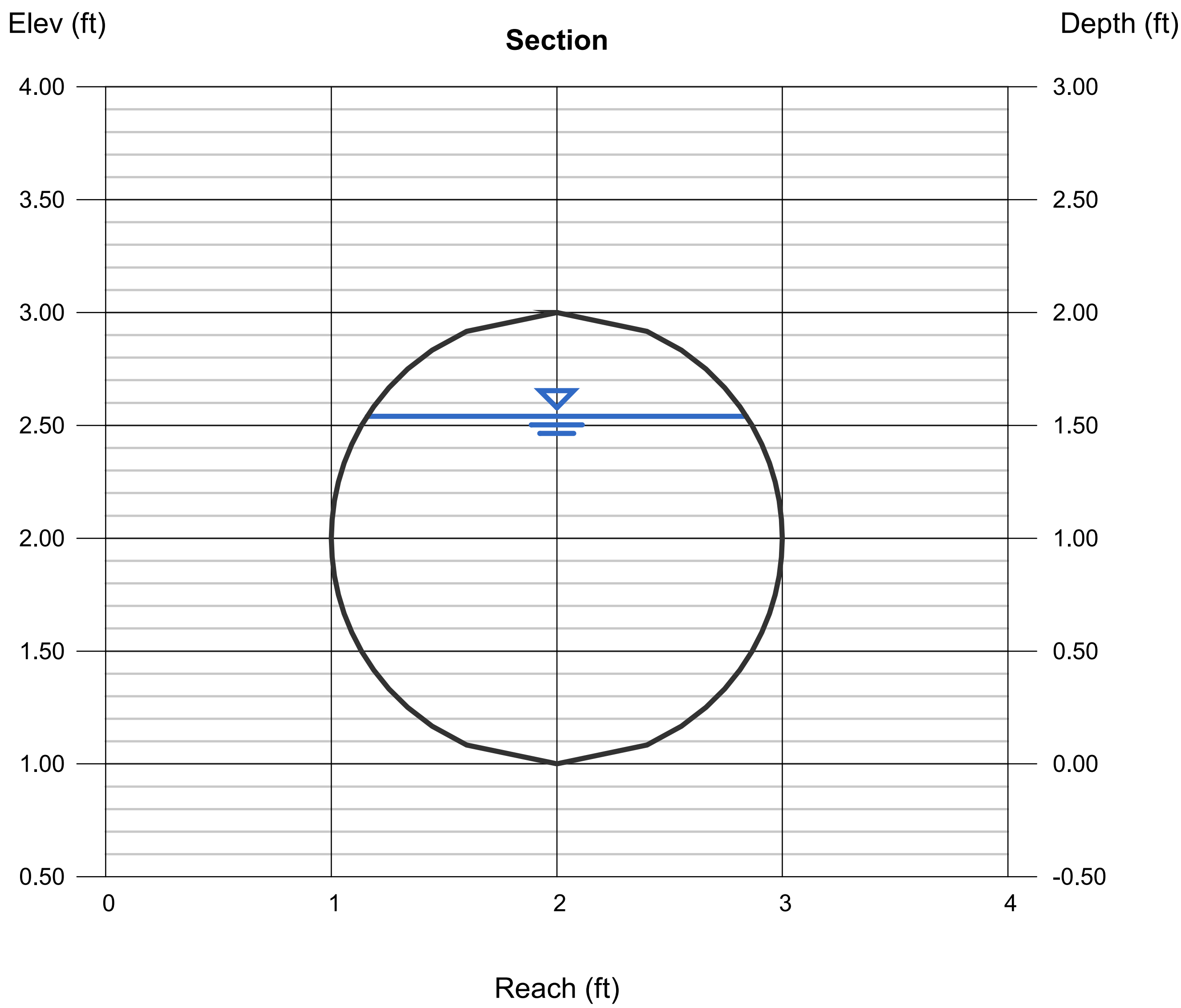
24 Inch RCP Capacity DP 8

Circular
Diameter (ft) = 2.00

Invert Elev (ft) = 1.00
Slope (%) = 1.00
N-Value = 0.013

Calculations
Compute by: Known Q
Known Q (cfs) = 21.20

Highlighted
Depth (ft) = 1.54
Q (cfs) = 21.20
Area (sqft) = 2.60
Velocity (ft/s) = 8.15
Wetted Perim (ft) = 4.29
Crit Depth, Yc (ft) = 1.65
Top Width (ft) = 1.68
EGL (ft) = 2.57



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Mar 28 2024

30 Inch RCP - DP A

Circular

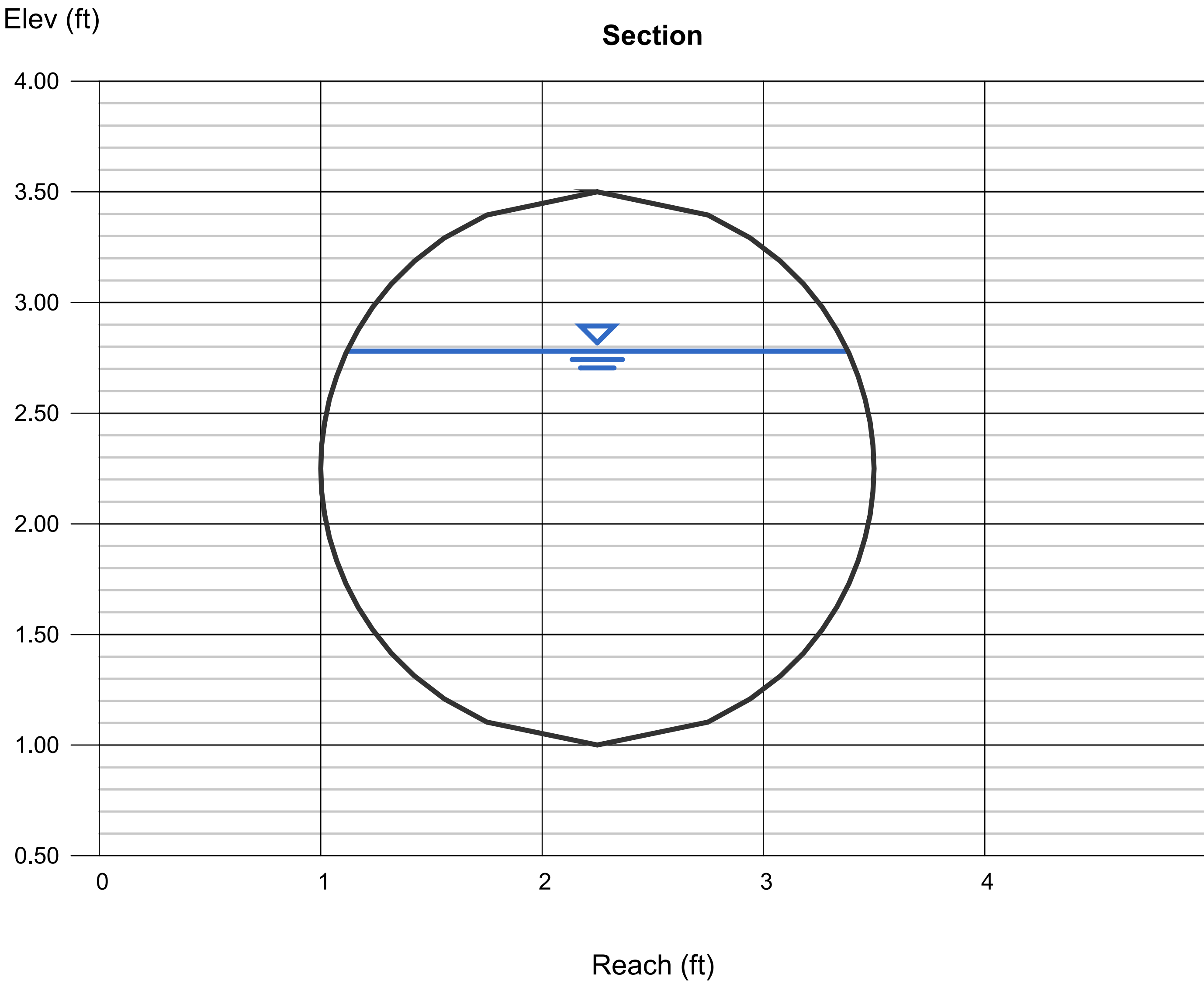
Diameter (ft)	=	2.50
Invert Elev (ft)	=	1.00
Slope (%)	=	1.00
N-Value	=	0.013

Calculations

Compute by:		Known Q
Known Q (cfs)	=	34.90

Highlighted

Depth (ft)	=	1.78
Q (cfs)	=	34.90
Area (sqft)	=	3.74
Velocity (ft/s)	=	9.33
Wetted Perim (ft)	=	5.02
Crit Depth, Yc (ft)	=	2.01
Top Width (ft)	=	2.26
EGL (ft)	=	3.13



Channel Report

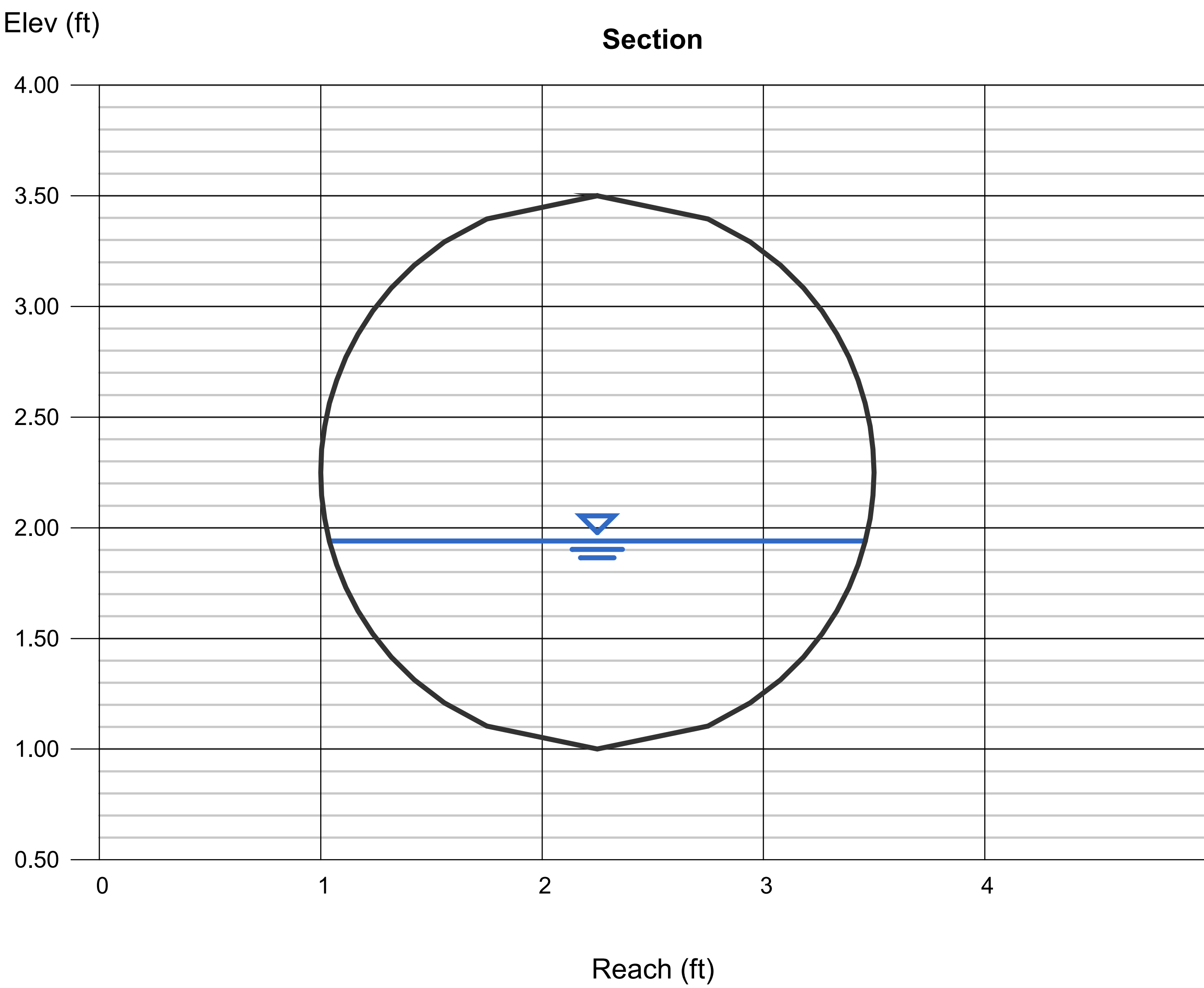
18 Inch RCP - DP B

Circular
Diameter (ft) = 2.50

Invert Elev (ft) = 1.00
Slope (%) = 1.00
N-Value = 0.013

Calculations
Compute by: Known Q
Known Q (cfs) = 12.30

Highlighted
Depth (ft) = 0.94
Q (cfs) = 12.30
Area (sqft) = 1.70
Velocity (ft/s) = 7.23
Wetted Perim (ft) = 3.31
Crit Depth, Yc (ft) = 1.18
Top Width (ft) = 2.42
EGL (ft) = 1.75



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Mar 28 2024

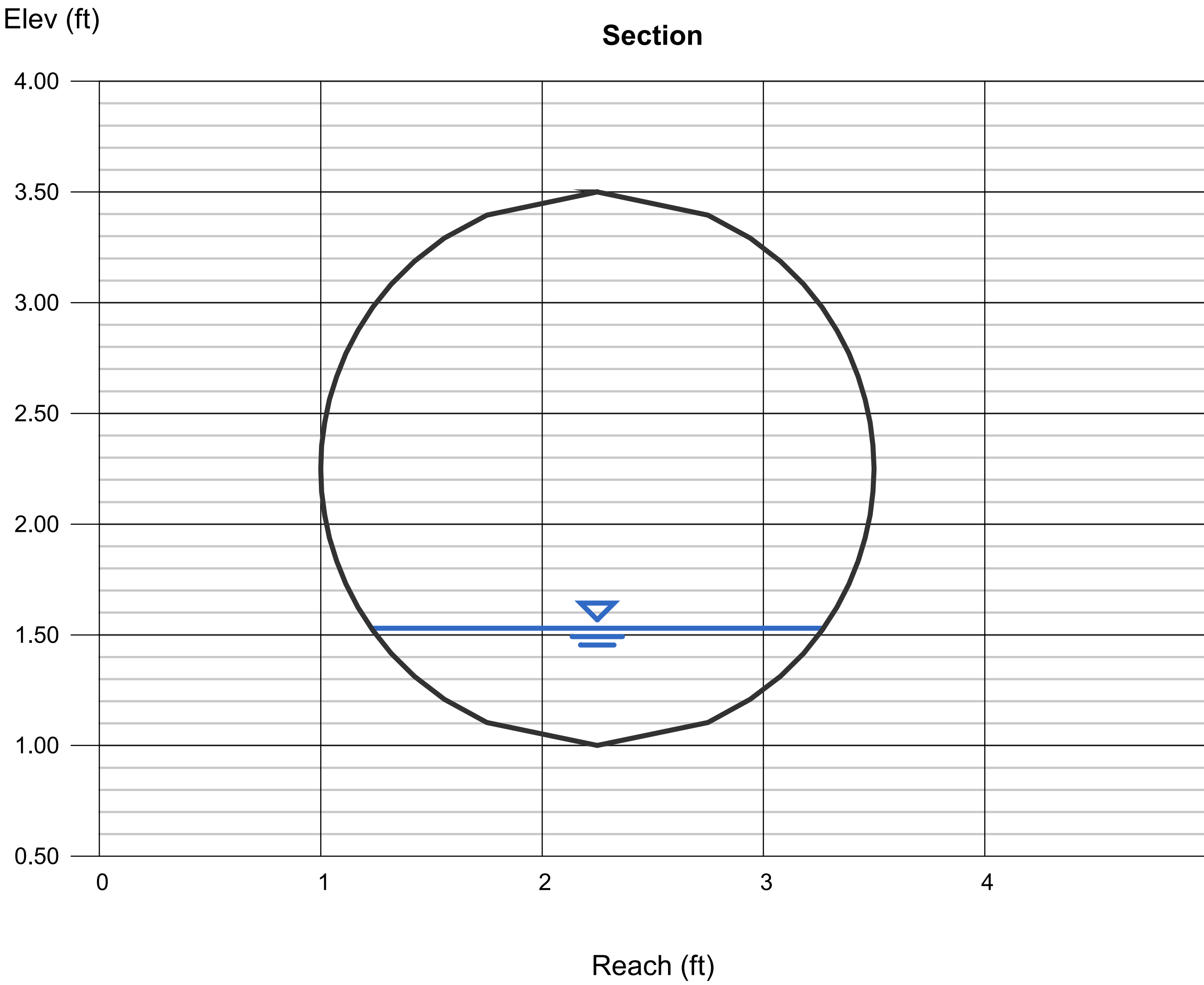
18 Inch RCP - Outfall

Circular
Diameter (ft) = 2.50

Invert Elev (ft) = 1.00
Slope (%) = 0.50
N-Value = 0.013

Calculations
Compute by: Known Q
Known Q (cfs) = 2.80

Highlighted
Depth (ft) = 0.53
Q (cfs) = 2.800
Area (sqft) = 0.77
Velocity (ft/s) = 3.66
Wetted Perim (ft) = 2.40
Crit Depth, Yc (ft) = 0.55
Top Width (ft) = 2.05
EGL (ft) = 0.74



APPENDIX E

- DETENTION CALCULATIONS

Site Assessment

SCM Design, Version 4.00 (April 2024)

Designer: ACL
Company: Proof Civil
Date: July 25, 2024
Project: 53049 - TTRes
Location:

1. Physical Site Characteristics

A) Total Site Area — Area = 13.24 acres 576,546 ft^2

B) Describe any upstream offsite areas that drain onto site and downstream conveyance systems or overland flow paths.

C) Describe any floodplain/floodway mapping, fluvial hazard zones, or geomorphic/geotechnical instabilites that may impact the site.

D) Is the watershed anticipated to be in a phased development state for a number of years moving forward or are highly erosive soils present? Explain. — NO

E) List any vegetation assessments that have been conducted including wetland and aquatic resources delineations.

F) List any assessments of habitat for threatened or endangered species and other regulated species.

G) Describe any existing and/or proposed utility mapping for subsurface and/or above-ground utilities that may impact SCMs.

H) Are there receiving water quality concerns such as TMDLs, 303(d) listings, or other pollutant reduction targets? Explain. — NO

I) Describe how community values including context, scale, materials, and user experience will be incorporated on site. See Chapter 4 for additional gudance.

J) Will attenuation of the EURV and/or flood storage (e.g. FSD) be provided onsite? — YES

Site Assessment

SCM Design, Version 4.00 (April 2024)

Designer: ACL
Company: Proof Civil
Date: July 25, 2024
Project: 53049 - TTRes
Location:

2. Opportunities for Step 1: Runoff Reduction

A) Describe opportunities for runoff reduction measures that can be used on this site to potentially reduce WQCV requirements?

Imperviousness areas will be directed to landscape areas to greatest extent possible.

Conserve Existing Amenities: Identify portions of site that should be protected including mature trees, stream corridors, wetlands, and Type A/B soils with high infiltration potential.

Minimize Impacts: Creative site layout and constructing to minimum widths can reduce the extent of paved areas. Concentrate new impervious areas over Type C/D soils. Maintain natural drainage patterns and promote sheet flow.

Minimize Directly Connected Impervious Areas (MDCIA): Allow runoff from impervious areas to sheet flow through vegetation which slows runoff, promotes infiltration, reduces pollutant loads and helps mimic predevelopment hydrology.

3. Suitability for Infiltration-Based SCMs

A) What are the dominant Hydrologic Soil Groups (HSG) for the site? — Type A and B Soils — ***Soils suitable for full infiltration***

B) Provide a description of topsoil texture, agronomic properties, and geotechnical soil characterizations.

C) Identify Site Constraints

i) Is subgrade depth to bedrock < 3 feet?	NO
ii) Is subgrade depth to seasonal high groundwater table < 3 feet?	NO

D) Identify Site Risks

i) Are expansive/collapsible soils present?	NO
ii) Are highly concentrated pollutant sources present (hotspot)?	NO
iii) Is site located above contaminated soils or groundwater?	NO
iv) Are steep slopes present in proposed SCM locations? (> 3H:1V)	NO
v) Are there other concerns that indicate high risk for infiltration?	NO

E) Describe Exploratory Borings/Pits and Laboratory Tests (Sec. 4.2)

i) How many borings/pits were drilled/excavated? $N_{Borings/Pits}$ = 15

ii) Depth of borings/pits below SCM (or proposed grade) surface? $D_{Borings/Pits}$ = 25.00 ft

iii) Describe laboratory tests performed on soil samples:

F) Preliminary Infiltration System Recommendation — Full Infiltration — **Suitable Soils and Low Risk, must verify adequate subgrade infiltration rates.**

This is a preliminary recommendation. Consult with a qualified geotechnical engineer when planning an infiltration-based SCM.

Site Layout

SCM Design, Version 4.00 (April 2024)

Designer: **ACL**
Company: **Proof Civil**
Date: **July 25, 2024**
Project: **23049 - TTRes Chambers**
Location: **Commerce City**

SITE LAYOUT INFO (User Input in Blue Cells)

Water Quality Event (WQE) 0.60 inches

Outfall ID	EDB											
Total Tributary Area (ft^2)	576,546											
Imperviousness (%)	76.0%											
MS4 Design Standard	WQCV											
SCM Type	EDB											

Notes:

OUTFALL RESULTS

SCM Worksheet Name	EDB_EDB											
Untreated Area (ft^3)	0											
Default WQCV (ft^3)	14,650											
WQCV Reduction (ft^3)	1638											
Remaining WQCV (ft^3)	13,012											
WQCV Reduction (%)	11%											
Design WQCV of SCM (ft^3)	15,115											
Pollutant Removal (ft^3)	0											
Untreated WQCV (ft^3)	0											

TOTAL SITE RESULTS (Sums results from all Outfalls)

Total Site Area	576,546	ft^2	13.24	acres
Treated Area	576,546	ft^2	13.24	acres
Untreated Area	0	ft^2	0.00	acres
Total Site Imperviousness	76.0%	%		
Default WQCV	14,650	ft^3	0.336	acre-feet
Remaining WQCV	13,012	ft^3	0.299	acre-feet
WQCV Reduction	11%	%		
Design WQCV	15,115	ft^3	0.347	acre-feet
Untreated WQCV	0	ft^3	0.000	acre-feet

Extended Detention Basin (EDB)

SCM Design, Version 4.00 (April 2024)

Designer:	**ACL**
Company:	**Proof Civil**
Date:	**July 25, 2024**
Project:	**23049 - TTRes Chambers**
Location:	**Commerce City**
Outfall ID:	**EDB**

1. Inlet and Forebay

Define inflow points for all areas tributary to the SCM on the paired RPA worksheet.

A) Is RPA (GB/GS) used for Runoff Reduction upstream of SCM? YES

Paired Inflows Worksheet Name: **EDB_EDB_Inflows**

B) Inflow Points contributing to SCM (max 8)

Inflow Design Point ID	RPA1	RPA2	RPA3	RPA4	RPA5	RPA6	RPA7	emaining Site
Tributary Area to Inflow Point (ft^2)	13,229	12,538	10,497	8,263	13,988	10,308	14,596	493,127
Imperviousness above Inflow Point (%)	64.8%	51.7%	69.0%	67.2%	55.1%	68.4%	44.5%	100.0%
Default WQCV for Inflow Point (ft^3)	280	220	237	181	257	230	233	20,547
WQCV Reduction above Inflow Point (ft^3)	280	220	237	181	257	230	233	0
Remaining WQCV at Inflow Point (ft^3)	0	0	0	0	0	0	0	20,547
Will pretreatment be provided with a Sedimentation MTD (HDS)	NO	NO	NO	NO	NO	NO	NO	NO
Paired Pretreatment HDS Worksheet Name	--	--	--	--	--	--	--	--
Sheet or Concentrated Flow	Sheet	Sheet	Sheet	Sheet	Sheet	Sheet	Sheet	Conc

C) Sheet Flow

Select sheet flow inflow feature	Other	Other	Other	Other	Other	Other	Other	--
Is Concrete Edger used?	--	--	--	--	--	--	--	--
Spacing between slots, recommend ≤ 2 ft on center (ft)	--	--	--	--	--	--	--	--
Slot Opening Length, recommend 1.5 (in)	--	--	--	--	--	--	--	--
Select type of blind swale used to distribute flow	--	--	--	--	--	--	--	--
Select energy dissipation method for level spreader	--	--	--	--	--	--	--	--
Height of drop, recommend 2 to 3 (in)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--
Is concrete mowing strip provided to facilitate maintenance?	NO	NO	NO	NO	NO	NO	NO	--

D) Concentrated Flow

Select concentrated flow inflow feature	--	--	--	--	--	--	--	Pipe
Is downspout extension needed to bridge backfill zone?	--	--	--	--	--	--	--	--
Depth of gutter flow line depression for curb opening, recommend 3 (in)	--	--	--	--	--	--	--	--
Curb opening inlet width (ft)	--	--	--	--	--	--	--	--
Height of drop to sediment pad/forebay, recommend ≥ 1 (in)	--	--	--	--	--	--	--	--
Select energy dissipation method for downspouts and/or curb openings.	--	--	--	--	--	--	--	--
Select energy dissipation method for swales, channels, and piped outfalls	--	--	--	--	--	--	--	Riprap

v) Forebay

Impervious area tributary to concentrated inflow location (ft^2)	--	--	--	--	--	--	--	493,127
Forebay Type (Concrete Sediment Pad sufficient for Imp Area ≤ 2 acre)	--	--	--	--	--	--	--	Forebay
Minimum Forebay Volume (ft^3)	--	--	--	--	--	--	--	205
Design Forebay Volume (ft^3)	--	--	--	--	--	--	--	1,512
Maximum Forebay Depth (in)	--	--	--	--	--	--	--	24.00
Design Forebay Depth (in)	--	--	--	--	--	--	--	12.00
Rectangular Weir Notch Width to Empty Forebay in 5-minutes (in)	--	--	--	--	--	--	--	6.32
Design Notch Width (in)	--	--	--	--	--	--	--	2.00
Forebay Drain Time (minutes)	--	--	--	--	--	--	--	15.8

Extended Detention Basin (EDB)

SCM Design, Version 4.00 (April 2024)

Designer:	**ACL**
Company:	**Proof Civil**
Date:	**July 25, 2024**
Project:	**23049 - TTRes Chambers**
Location:	**Commerce City**
Outfall ID:	**EDB**

2. Design Storage Volume

Inflow Points above should be fully defined before proceeding below

A) Contributing Watershed Area (including EDB area)	Area = 576,546 ft^2 Area = 13.24 ac	**For area < 20 impervious acres, consider filtration/infiltration SCMs to avoid small orifices prone to clogging.**
B) Imperviousness of Tributary Area	i = 76.0%	
C) Default WQCV	$V_{WQCV\ Default}$ = 14,650 ft^3	
D) WQCV Reduction resulting from Upstream RPA (GB/GS)	WQCV Reduction = 1,638 ft^3	
E) Remaining WQCV	$V_{WQCV\ Remaining}$ = 13,012 ft^3	
F) Design WQCV (based on actual design geometry)	$V_{WQCV\ Design}$ = 15,115 ft^3	

G) Describe additional storage volume provided (e.g. EURV/100yr)

Describe why EDB was selected over other SCMs based on Table EDB-3 considerations related to contributing impervious area.

3. EDB Shape

A) Basin Length-to-Width Ratio (measured along the low flow channel from inlet to outlet)	$R_{L/W}$ = 1.5	**L/W Ratio > 2 increases residence time**

B) Discuss how the design considered community values

4. Side Slopes

When designing basin slopes, consider requirements for access and vegetation management.

A) Max. Side Slope (Z = 4:1 or flatter, horiz. dist per unit vertical) (Use "0" if EDB has vertical walls)	Z = 4.00 ft / ft

5. Low Flow Channels and Basin Bottom Grading

A) Type of low flow channel	Concrete Pan	
B) Depth of low flow channel (recommend 18")	D_{LFC} = 6.00 in	**Recommend > 18 inches**
C) Depth of concrete curb (recommend 6")	D_{Curb} = 6.00 in	
D) Side Slopes of low flow channel (Z = 2 min.)	Z_{LFC} = 2.00 ft / ft	
E) Bottom width of low flow channel (as needed for equipment)	Bottom Width $_{LFC}$ = 2.00 ft	
F) Longitudinal Slope (recommend 0.004 to 0.01 ft/ft for concrete)	Slope $_{LFC}$ = 0.004 ft / ft	
G) Typical Bottom Slope toward low flow channel (min. 0.02 ft/ft)	Slope $_{Basin\ Bottom}$ = 0.020 ft / ft	

H) Describe any non-typical low flow channel features (if applicable)

Extended Detention Basin (EDB)

SCM Design, Version 4.00 (April 2024)

Designer:	**ACL**
Company:	**Proof Civil**
Date:	**July 25, 2024**
Project:	**23049 - TTRes Chambers**
Location:	**Commerce City**
Outfall ID:	**EDB**

6. Initial Surcharge Volume	
A) Initial Surcharge Depth (recommend 4 inches minimum)	ISD = 4.00 in
7. Outlet Structure	
A) Micropool Type	External
B) Depth of Micropool (recommend 2.5 feet minimum)	D_{MP} = 2.50 ft
C) Surface Area of Micropool (recommend 15 square feet minimum)	A_{MP} = 15.0 ft^2
D) Describe Micropool configuration	
E) Minimum dimension of opening in water quality orifice plate based on 40-hour drain time and hydrograph routing in MHFD-Detention.	Orifice D_{Min} = 0.20 in **Well Screen necessary to protect small orifice opening**
F) Describe orifice plate configuration	
G) Trash Rack Type	Well Screen
H) Trash Rack Configuration	Vertical
I) Describe Outlet Structure(s) for events larger than WQCV. (EURV, full-spectrum detention, safety grating, etc.)	
8. Emergency Spillway and Overflow Embankment	
A) Describe spillway configuration, spillway capacity, and embankment protection.	
9. Vegetation	
A) Has a vegetation management plan been developed?	N/A **Explain why not below**
B) Has a landscape management plan been developed?	N/A **Explain why not below**
C) Describe vegetation/landscaping considerations: - Specify plants that support the water quality function of the EDB? (e.g. wetland, wetland fringe, riparian, upland, trees) - Include drought tolerant native plants? - Consider soil assessment, preparation, and erosion mitigation? - Include plants that enhance within context of the site? - Address alternative hydraulic regimes? - Consider required maintenance activities and intervals? - Consider short and long-term irrigation needs? - Consider irrigation head placement?	

Extended Detention Basin (EDB)

SCM Design, Version 4.00 (April 2024)

Designer:	**ACL**
Company:	**Proof Civil**
Date:	**July 25, 2024**
Project:	**23049 - TTRes Chambers**
Location:	**Commerce City**
Outfall ID:	**EDB**

10. Maintenance Access

A) Describe maintenance access into forebay(s) and area adjacent to and within outlet structure:
- minimum access path width of 10 feet
- maximum 10% grade for haul road surface
- maximum 20% grade for skid-loader and backhoe access
- cross-slope of 2% for access path
- stabilized access materials (concrete, block, grid, reinforced turf)
- access stairs inside outlet structure

Notes:

SCM Inflows from Upstream Receiving Pervious Areas (Including Grass Swales and Buffers)

SCM Design, Version 4.00 (April 2024)

Designer: ACL
Company: Proof Civil
Date: July 25, 2024
Project: 23049 - TTRes Chambers
Location: Commerce City
Outfall ID: EDB_EDB

DESIGN PROCEDURE AND CRITERIA FOR ALL RPAs (User Input in Blue Cells)

1. Apply Four-Cover Land Use Model to Site Layout

Design Point ID	EDB_EDB	UIA1	RPA1	UIA2	RPA2	UIA3	RPA3	UIA4	RPA4	UIA5	RPA5	UIA6	RPA6	UIA7	RPA7	Remaining Site	
Area Type	EDB	UIA	RPA_Buffer	UIA	RPA_Buffer	UIA	RPA_Buffer	UIA	RPA_Buffer	UIA	RPA_Buffer	UIA	RPA_Buffer	UIA	RPA_Buffer	DCIA	
Downstream Design Point ID	--	RPA1	EDB_EDB	RPA2	EDB_EDB	RPA3	EDB_EDB	RPA4	EDB_EDB	RPA5	EDB_EDB	RPA6	EDB_EDB	RPA7	EDB_EDB	EDB_EDB	
DCIA (ft^2)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	493,127	
UIA (ft^2)	--	8,579	--	6,485	--	7,243	--	5,556	--	7,712	--	7,048	--	6,495	--	--	
RPA (ft^2)	--	--	4,650	--	6,053	--	3,254	--	2,707	--	6,276	--	3,260	--	8,101	--	
SPA (ft^2)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	

2. Protect the RPA from Traffic

RPA Protection Type	--	--	None	--	None	--	None	--	None	--	None	--	None	--	None	--	

3. Characterize On-site Topsoil and Determine Suitability for the RPA

HSG A (%)	--	--	100.0%	--	100.0%	--	100.0%	--	100.0%	--	100.0%	--	100.0%	--	100.0%	--	
HSG B (%)	--	--	0.0%	--	0.0%	--	0.0%	--	0.0%	--	0.0%	--	0.0%	--	0.0%	--	
HSG C/D (%)	--	--	0.0%	--	0.0%	--	0.0%	--	0.0%	--	0.0%	--	0.0%	--	0.0%	--	

4. Select Appropriate Vegetation

RPA Vegetation Type	--	--	Sod	--	Sod	--	Sod	--	Sod	--	Sod	--	Sod	--	Sod	--	
Irrigation Type	--	--	Permanent	--	Permanent	--	Permanent	--	Permanent	--	Permanent	--	Permanent	--	Permanent	--	

Notes:

GRASS BUFFER ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Define the UIA:RPA pair, Ratio, and Interface Width

Sheet Flow Inflow Feature	--	--	Other	--	Other	--	Other	--	Other	--	Other	--	Other	--	Other	--	
Is Concrete Edger used?	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Spacing between slots (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Slot Opening Length (in)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Blind Swale Type	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Spreader Energy Dissipation	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Total Area of UIA:RPA (ft^2)	--	--	13,229	--	12,538	--	10,497	--	8,263	--	13,988	--	10,308	--	14,596	--	
UIA:RPA Ratio	--	--	1.8	--	1.1	--	2.2	--	2.1	--	1.2	--	2.2	--	0.8	--	
UIA:RPA Interface Width (ft)	--	--	275	--	209	--	235	--	183	--	235	--	235	--	209	--	
L / W Ratio of UIA:RPA	--	--	0.17	--	0.29	--	0.19	--	0.25	--	0.25	--	0.19	--	0.33	--	

2. Buffer Length

Average Buffer Length (ft)	--	--	17	--	29	--	14	--	15	--	27	--	14	--	39	--	

3. Buffer Slope

Average Buffer Slope (ft/ft)	--	--	0.250	--	0.250	--	0.250	--	0.250	--	0.250	--	0.250	--	0.250	--	
Effective Distance (ft)	--	--	17	--	17	--	17	--	17	--	17	--	17	--	17	--	
Number of Level Spreaders	--	--	1	--	2	--	1	--	1	--	2	--	1	--	3	--	

4. Provide a Vertical Drop

Vertical Drop (in)	--	--	0.00	--	0.00	--	0.00	--	0.00	--	0.00	--	0.00	--	0.00	--	
Mowing Strip Provided?	--	--	NO	--	NO	--	NO	--	NO	--	NO	--	NO	--	NO	--	

5. Calculate Runoff for UIA and RPA Pair

Imperviousness (%)	--	--	64.8%	--	51.7%	--	69.0%	--	67.2%	--	55.1%	--	68.4%	--	44.5%	--	
UIA:RPA Runoff (in)	--	--	0.00	--	0.00	--	0.00	--	0.00	--	0.00	--	0.00	--	0.00	--	
UIA:RPA Runoff (ft^3)	--	--	0	--	0	--	0	--	0	--	0	--	0	--	0	--	

6. Compare Runoff from UIA:RPA Pair to Runoff from UIA Only

UIA Runoff (ft^3)	--	--	357	--	270	--	302	--	232	--	321	--	294	--	271	--	
Runoff Reduction (ft^3)	--	--	357	--	270	--	302	--	232	--	321	--	294	--	271	--	
Runoff Reduction (%)	--	--	100.0%	--	100.0%	--	100.0%	--	100.0%	--	100.0%	--	100.0%	--	100.0%	--	

Notes:

GRASS SWALE ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Delineate Areas Tributary to Swale

Total Tributary Area (ft^2)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Imperviousness (%)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	

2. Swale Inflows

Concentrated Flow Type	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Blind Swale Type	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Spreader Energy Dissipation	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Vertical Drop (in)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Gutter Depression (in)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Curb Opening Length (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Concrete Sediment Pad	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Min. Forebay Volume (ft^3)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Design Forebay Volume (ft^3)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Max. Forebay Depth (in)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Design Forebay Depth (in)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Calculated Notch Width (in)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Design Notch Width (in)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Drain Time (minutes)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Energy Dissipation Type	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	

3. Swale Cross Section

Length of Swale (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Bottom Width (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Bottom Area (ft^2)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Side Slopes (horiz/vert)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	

4. Longitudinal Slope

Available Slope (ft/ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Design Slope (ft/ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Total Drop Height (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Underdrains Provided?	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	

5. Calculate Runoff from Tributary Area

Tributary Runoff (ft^3)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Reduced Trib. Runoff (ft^3)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	

6. Calculate Runoff Reduction through Swale Bottom

Volume Infiltrated (ft^3)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Swale Discharge (ft^3)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Runoff Reduction (%)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	

7. Design Discharge

2-year Discharge, Q2 (cfs)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	

8. Design Velocity

Vegetal Retardance Curve	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Velocity, V2 (fps)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	

9. Design Flow Depth

Flow Depth, D2 (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Flow Area, A (ft^2)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Wetted Perimeter, P (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Top Width, T (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Hydraulic Radius, Rh (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
VR Product (ft^2/sec)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Manning's n value	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Hydraulic Depth, Dh (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Froude Number	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	

10. Swale Outflows

Outflows Considered?	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	

Notes:

DESIGN POINT RESULT (Sums results for current column and all upstream design point columns.)

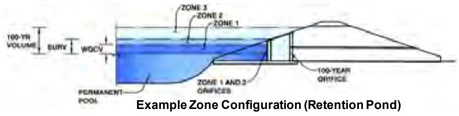
Design Point ID	EDB_EDB	UIA1	RPA1	UIA2	RPA2	UIA3	RPA3	UIA4	RPA4	UIA5	RPA5	UIA6	RPA6	UIA7	RPA7	Remaining Site	
Total Area (ft^2)	576,546	8,579	13,229	6,485	12,538	7,243	10,497	5,556	8,263	7,712	13,988	7,048	10,308	6,495	14,596	493,127	
Imperviousness (%)		100.0%	64.8%	100.0%	51.7%	100.0%	69.0%	100.0%	67.2%	100.0%	55.1%	100.0%	68.4%	100.0%	44.5%	100.0%	
Tributary Runoff (ft^3)	22,594	357	357	270	270	302	302	232	232	321	321	294	294	271	271	20,547	
Runoff Reduction (ft^3)	2,047	0	357	0	270	0	302	0	232	0	321	0	294	0	271	0	
Runoff Remaining (ft^3)	20,547	357	0	270	0	302	0	232	0	321	0	294	0	271	0	20,547	

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: TTRes Chambers

Basin ID: Proposed Site



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	13.27	acres
Watershed Length =	1,350	ft
Watershed Length to Centroid =	675	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	76.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	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.

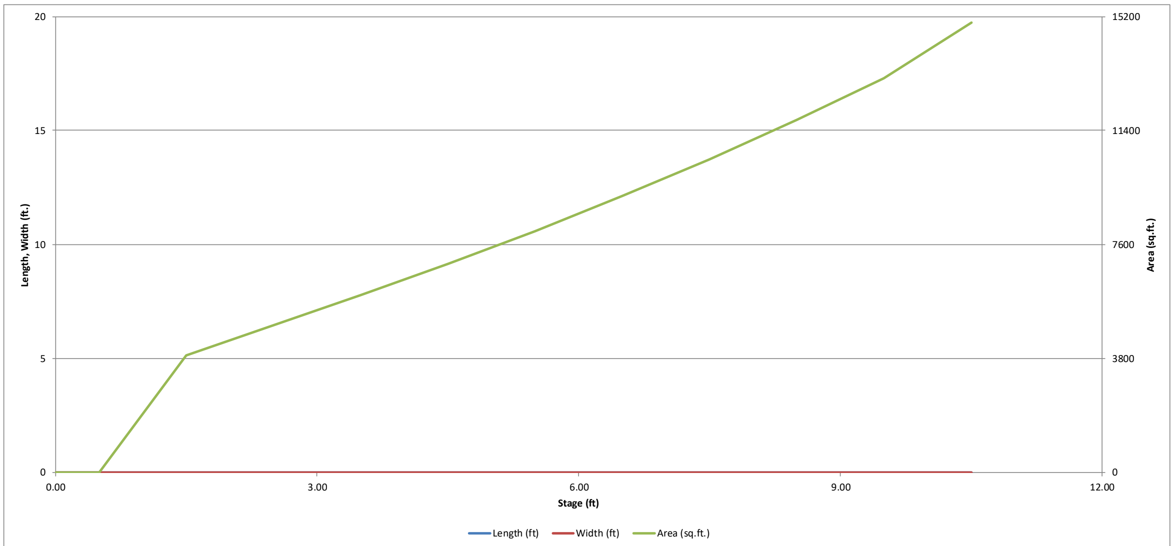
			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.337	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.307	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.84 in.) =	0.636	acre-feet	0.84	inches
5-yr Runoff Volume (P1 = 1.12 in.) =	0.873	acre-feet	1.12	inches
10-yr Runoff Volume (P1 = 1.37 in.) =	1.098	acre-feet	1.37	inches
25-yr Runoff Volume (P1 = 1.69 in.) =	1.403	acre-feet		inches
50-yr Runoff Volume (P1 = 2.08 in.) =	1.802	acre-feet	2.08	inches
100-yr Runoff Volume (P1 = 2.43 in.) =	2.197	acre-feet	2.43	inches
500-yr Runoff Volume (P1 = 3.35 in.) =	3.221	acre-feet	3.35	inches
Approximate 2-yr Detention Volume =	0.605	acre-feet		
Approximate 5-yr Detention Volume =	0.833	acre-feet		
Approximate 10-yr Detention Volume =	1.045	acre-feet		
Approximate 25-yr Detention Volume =	1.344	acre-feet		
Approximate 50-yr Detention Volume =	1.609	acre-feet		
Approximate 100-yr Detention Volume =	1.816	acre-feet		

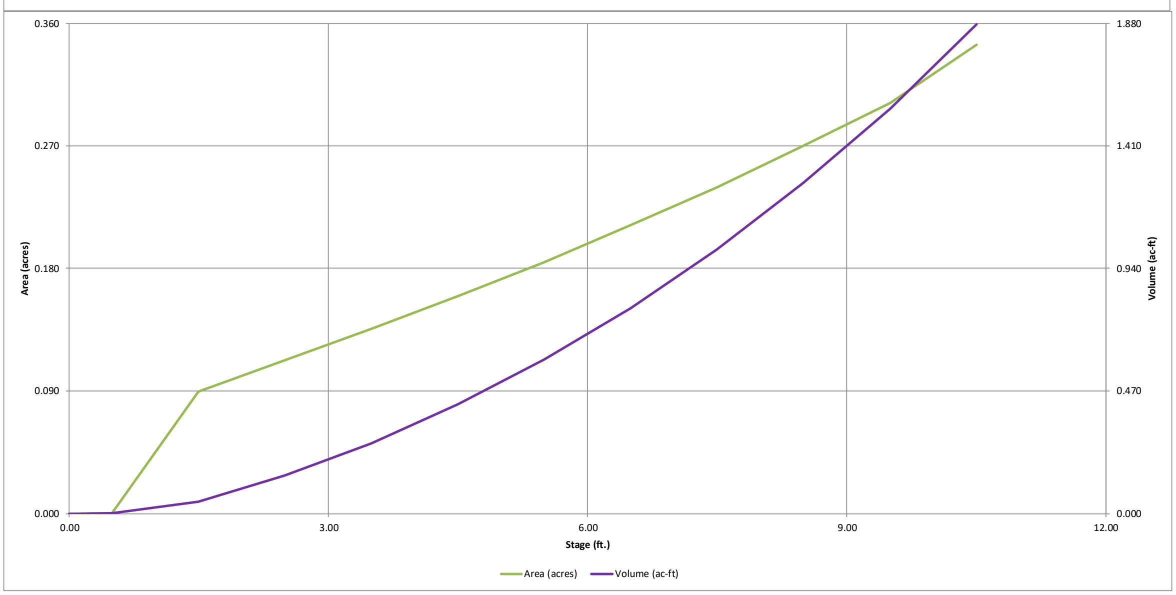
Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.337	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.970	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.509	acre-feet
Total Detention Basin Volume =	1.816	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	
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 = 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	--	--	--	0	0.000		
	--	0.50	--	--	--	3	0.000	1	0.000
	--	1.50	--	--	--	3,897	0.089	1,950	0.045
	--	2.50	--	--	--	4,902	0.113	6,349	0.146
	--	3.50	--	--	--	5,894	0.135	11,747	0.270
	--	4.50	--	--	--	6,940	0.159	18,164	0.417
	--	5.50	--	--	--	8,038	0.185	25,653	0.589
	--	6.50	--	--	--	9,212	0.211	34,278	0.787
	--	7.50	--	--	--	10,430	0.239	44,099	1.012
	--	8.50	--	--	--	11,755	0.270	55,192	1.267
	--	9.50	--	--	--	13,127	0.301	67,632	1.553
	--	10.50	--	--	--	15,007	0.345	81,699	1.876
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				

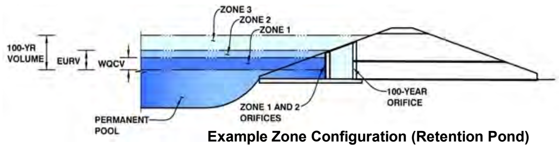

20
15
10
5
0
Length, Width (ft.)
15200
11400
7600
3800
0
Area (sq.ft.)
0.00
3.00
6.00
9.00
12.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)


0.360
0.270
0.180
0.090
0.000
Area (acres)
1.880
1.410
0.940
0.470
0.000
Volume (ac-ft)
0.00
3.00
6.00
9.00
12.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **TTRes Chambers**
Basin ID: **Proposed Site**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.98	0.337	Orifice Plate
Zone 2 (EURV)	8.65	0.970	Rectangular Orifice
Zone 3 (100-year)	10.33	0.509	Weir&Pipe (Restrict)
Total (all zones)		1.816	

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

Calculated Parameters for Underdrain

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)

Calculated Parameters for Plate

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	8.333E-03	ft^2
Depth at top of Zone using Orifice Plate =	4.21	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	16.80	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	1.20	sq. inches (diameter = 1-1/4 inches)	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	1.40	2.81					
Orifice Area (sq. inches)	1.20	1.20	1.20					

	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)

Calculated Parameters for Vertical Orifice

	Zone 2 Rectangular	Not Selected			Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	4.50	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.38	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	9.15	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.25	N/A	feet
Vertical Orifice Height =	6.00	N/A	inches				
Vertical Orifice Width =	9.00		inches				

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

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	9.15	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	9.15	N/A	feet
Overflow Weir Front Edge Length =	3.00	N/A	feet	Overflow Weir Slope Length =	3.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	35.75	N/A	
Horiz. Length of Weir Sides =	3.00	N/A	feet	Overflow Grate Open Area w/o Debris =	6.26	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	3.13	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

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

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	1.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.18	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.14	N/A	feet
Restrictor Plate Height Above Pipe Invert =	2.80		inches	Half-Central Angle of Restrictor Plate on Pipe =	0.81	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Calculated Parameters for Spillway

Spillway Invert Stage=		ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=		feet
Spillway Crest Length =		feet	Stage at Top of Freeboard =		feet
Spillway End Slopes =		H:V	Basin Area at Top of Freeboard =		acres
Freeboard above Max Water Surface =		feet	Basin Volume at Top of Freeboard =		acre-ft

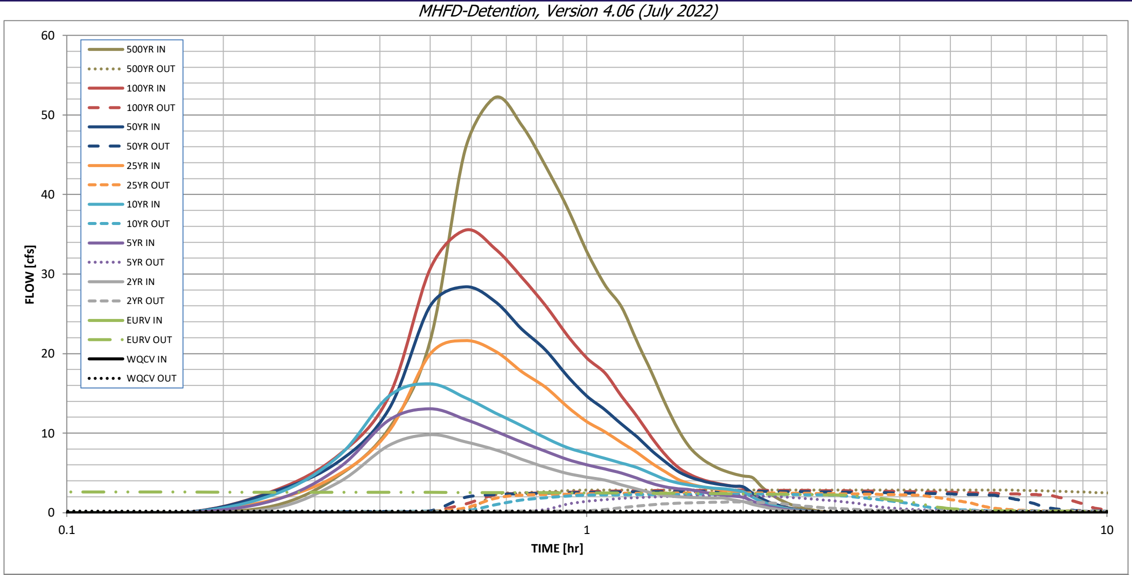
Routed Hydrograph Results

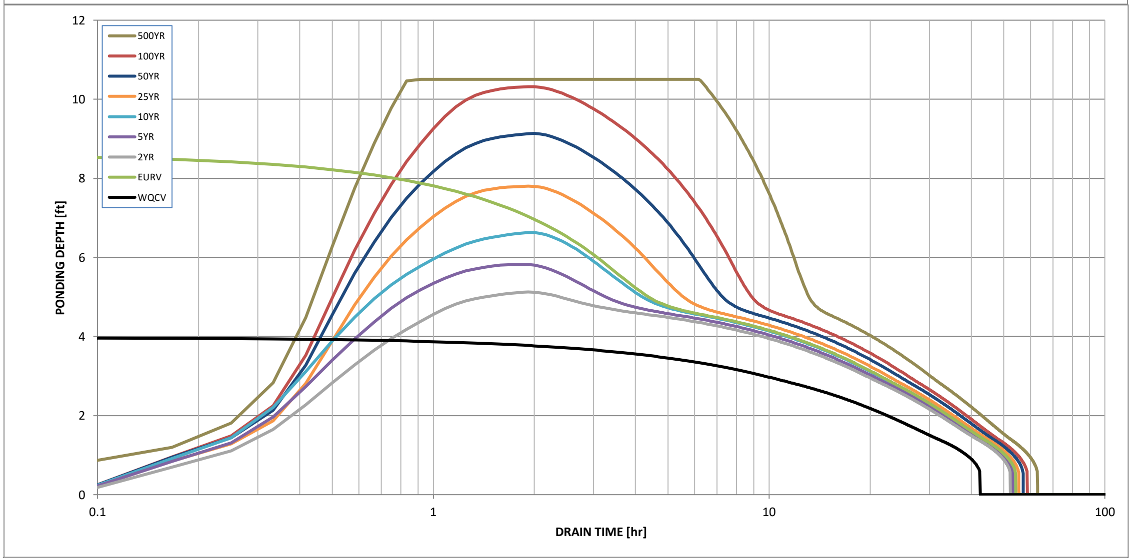
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

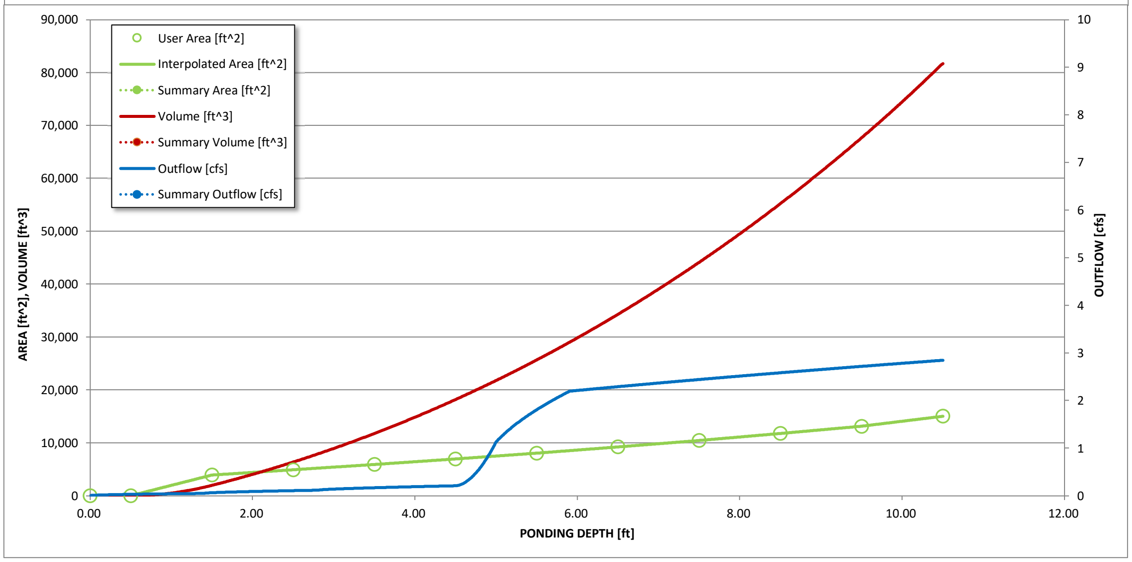
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.84	1.12	1.37	1.69	2.08	2.43	3.35
CUHP Runoff Volume (acre-ft) =	0.337	1.307	0.636	0.873	1.098	1.403	1.802	2.197	3.221
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.636	0.873	1.098	1.403	1.802	2.197	3.221
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.1	0.2	2.7	5.8	14.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.00	0.01	0.02	0.20	0.44	1.06
Peak Inflow Q (cfs) =	N/A	N/A	9.8	13.0	16.2	21.6	28.4	35.5	52.2
Peak Outflow Q (cfs) =	0.2	2.6	1.3	2.1	2.3	2.5	2.7	2.8	2.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	43.1	21.0	10.0	1.0	0.5	0.2
Structure Controlling Flow =	Plate	Outlet Plate 1	Vertical Orifice 1	Vertical Orifice 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-0.3	-0.3
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) =	39	43	46	45	44	44	43	43	42
Time to Drain 99% of Inflow Volume (hours) =	**41**	50	50	50	50	51	51	52	54
Maximum Ponding Depth (ft) =	3.98	8.65	5.13	5.82	6.63	7.80	9.13	10.32	10.50
Area at Maximum Ponding Depth (acres) =	0.15	0.27	0.17	0.19	0.21	0.25	0.29	0.34	0.34
Maximum Volume Stored (acre-ft) =	0.337	1.308	0.521	0.649	0.812	1.086	1.443	1.811	1.876

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86
	0:15:00	0.00	0.00	0.53	1.54	2.27	1.65	2.62	2.75	4.63
	0:20:00	0.00	0.00	3.82	5.61	7.09	4.80	6.41	7.24	10.62
	0:25:00	0.00	0.00	8.46	11.64	14.66	10.29	13.05	14.67	21.60
	0:30:00	0.00	0.00	9.79	13.04	16.18	19.95	25.95	30.66	45.56
	0:35:00	0.00	0.00	8.92	11.74	14.45	21.64	28.40	35.52	52.20
	0:40:00	0.00	0.00	7.91	10.24	12.55	20.31	26.54	33.18	48.70
	0:45:00	0.00	0.00	6.72	8.87	10.94	17.73	23.08	29.59	43.56
	0:50:00	0.00	0.00	5.70	7.73	9.39	15.76	20.44	26.02	38.37
	0:55:00	0.00	0.00	4.94	6.71	8.21	13.34	17.21	22.33	32.86
	1:00:00	0.00	0.00	4.46	6.02	7.45	11.45	14.66	19.45	28.62
	1:05:00	0.00	0.00	4.07	5.48	6.84	10.17	12.94	17.55	25.85
	1:10:00	0.00	0.00	3.49	4.97	6.24	8.78	11.12	14.64	21.45
	1:15:00	0.00	0.00	2.95	4.32	5.65	7.55	9.50	12.07	17.59
	1:20:00	0.00	0.00	2.49	3.68	4.90	6.21	7.78	9.44	13.66
	1:25:00	0.00	0.00	2.17	3.24	4.17	5.12	6.37	7.26	10.42
	1:30:00	0.00	0.00	2.01	3.01	3.73	4.18	5.17	5.68	8.11
	1:35:00	0.00	0.00	1.92	2.88	3.45	3.61	4.45	4.75	6.74
	1:40:00	0.00	0.00	1.87	2.59	3.24	3.24	3.99	4.18	5.89
	1:45:00	0.00	0.00	1.84	2.37	3.10	3.00	3.69	3.79	5.30
	1:50:00	0.00	0.00	1.82	2.20	3.00	2.83	3.48	3.52	4.89
	1:55:00	0.00	0.00	1.59	2.08	2.85	2.71	3.34	3.33	4.60
	2:00:00	0.00	0.00	1.40	1.93	2.59	2.63	3.24	3.19	4.41
	2:05:00	0.00	0.00	1.05	1.45	1.94	1.98	2.43	2.39	3.29
	2:10:00	0.00	0.00	0.77	1.05	1.41	1.44	1.77	1.74	2.39
	2:15:00	0.00	0.00	0.56	0.77	1.02	1.05	1.29	1.27	1.75
	2:20:00	0.00	0.00	0.40	0.55	0.74	0.76	0.93	0.93	1.27
	2:25:00	0.00	0.00	0.28	0.38	0.52	0.54	0.66	0.65	0.90
	2:30:00	0.00	0.00	0.19	0.26	0.36	0.38	0.46	0.46	0.63
	2:35:00	0.00	0.00	0.13	0.18	0.25	0.26	0.32	0.32	0.44
	2:40:00	0.00	0.00	0.08	0.11	0.16	0.17	0.21	0.21	0.28
	2:45:00	0.00	0.00	0.04	0.06	0.09	0.10	0.12	0.12	0.16
	2:50:00	0.00	0.00	0.02	0.03	0.04	0.04	0.05	0.05	0.07
	2:55:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft ^{2}]	Area [acres]	Volume [ft ^{3}]	Volume [ac-ft]	Total Outflow [cfs]

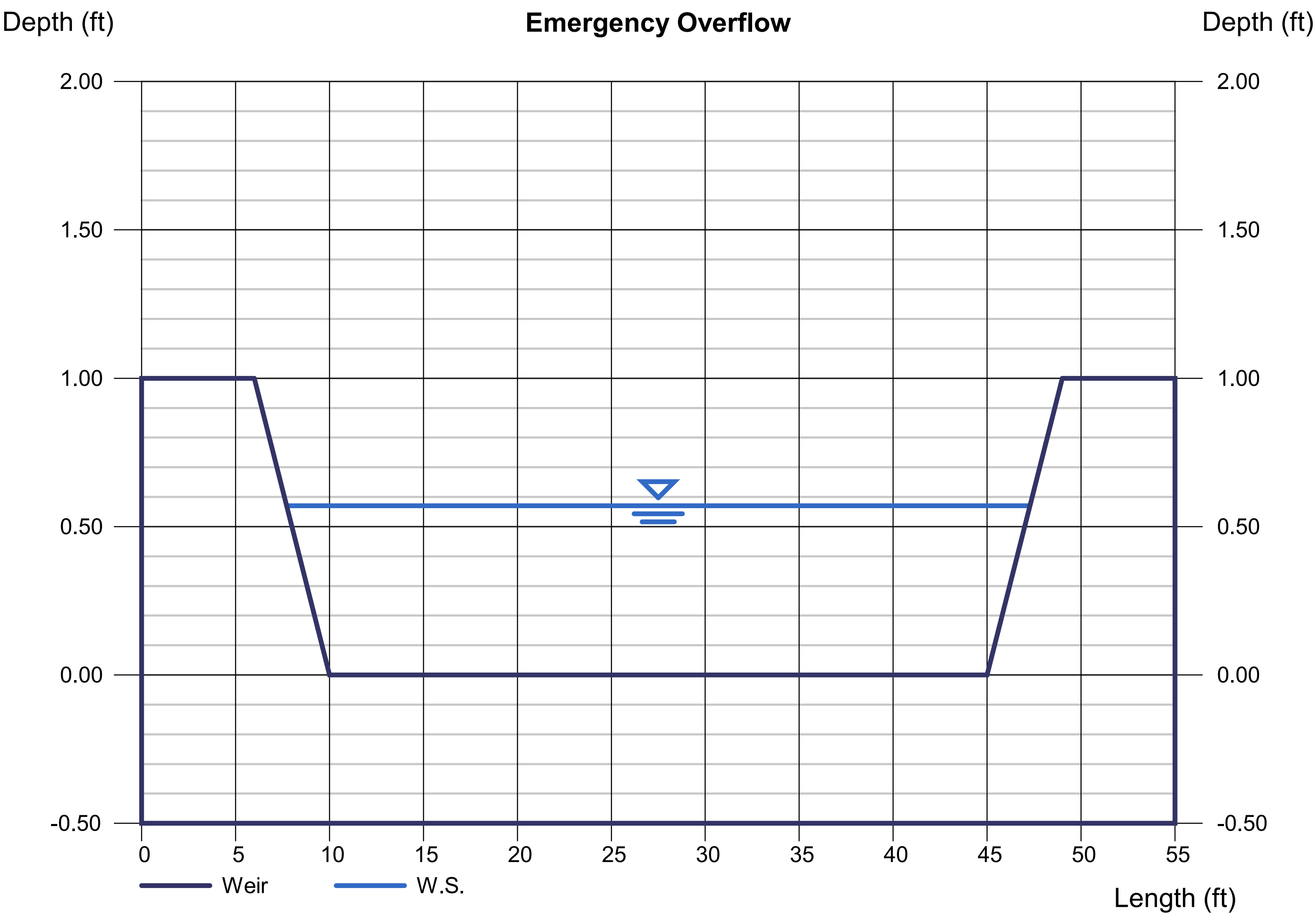
For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

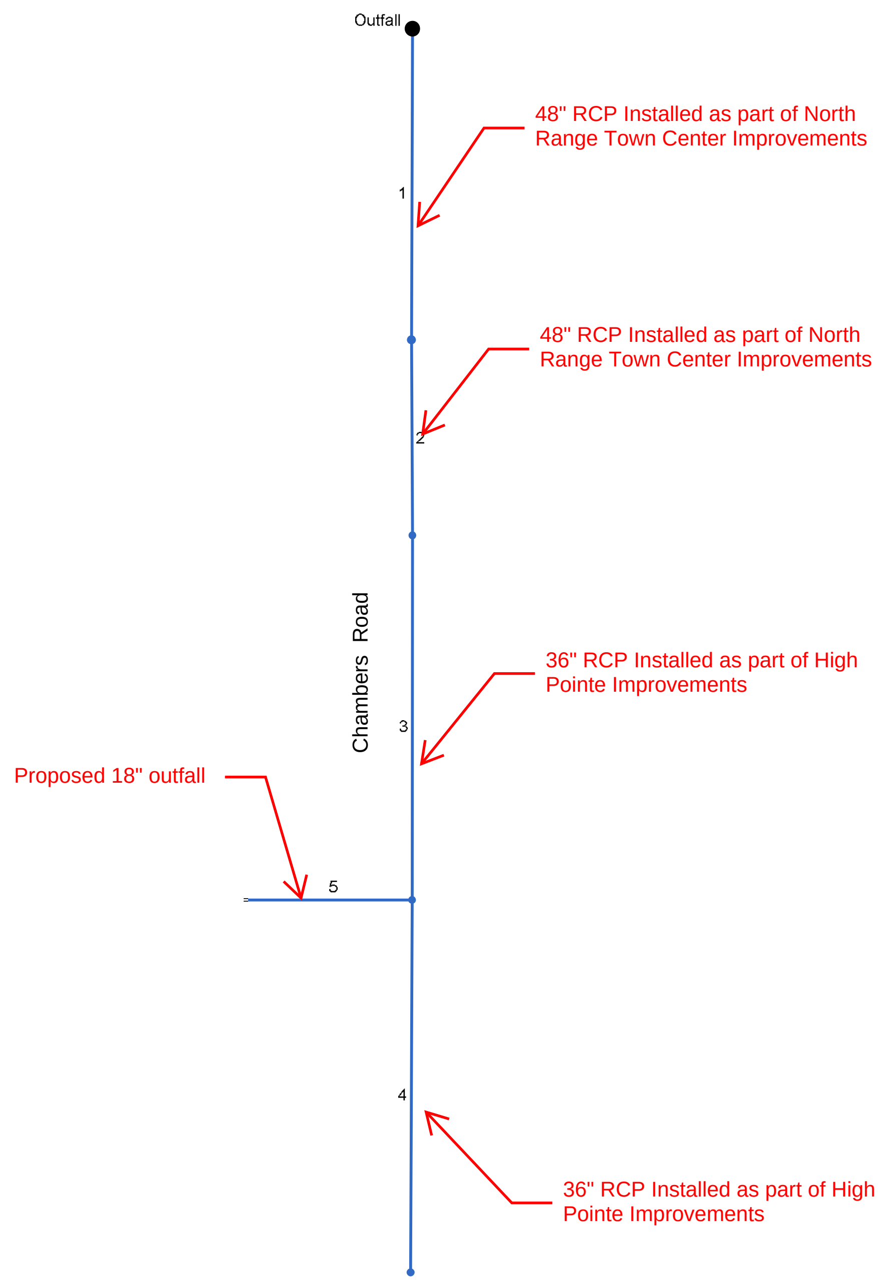
Weir Report

Emergency Overflow

Trapezoidal Weir		**Highlighted**	
Crest	= Sharp	Depth (ft)	= 0.57
Bottom Length (ft)	= 35.00	Q (cfs)	= 48.60
Total Depth (ft)	= 1.00	Area (sqft)	= 21.25
Side Slope (z:1)	= 4.00	Velocity (ft/s)	= 2.29
		Top Width (ft)	= 39.56
Calculations			
Weir Coeff. Cw	= 3.10		
Compute by:	Known Q		
Known Q (cfs)	= 48.60		



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: 23049 - 100-Year Storm Outfall.stm	Number of lines: 5	Date: 8/8/2024

Pipe Info

Line No.	Line ID	Line Length (ft)	Line Size (in)	Line Slope (%)	Line Type	n-val Pipe	Flow Rate (cfs)	Capac Full (cfs)
1	Pipe - (42)	312.222	48	0.59	Cir	0.013	60.90	110.27
2	Pipe - (41)	196.100	48	0.54	Cir	0.013	59.50	105.61
3	Pipe - (39)	365.707	36	0.70	Cir	0.013	59.50	55.91
4	Pipe - (38)	373.642	36	0.77	Cir	0.013	57.40	58.45
5	Pipe - (40)	134.941	18	2.00	Cir	0.013	2.10	14.85

Project File: 23049 - 100-Year Storm Outfall.stm | Number of lines: 5 | Date: 8/8/2024

NOTES: ** Critical depth

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
1	48	60.90	5136.60	5139.41	2.81	7.67	6.46	0.98	5140.39	0.000	312.22	5138.44	5140.79	2.35**	7.67	7.94	0.98	5141.77	0.000	0.000	n/a	0.15	0.15
2	48	59.50	5138.64	5140.79	2.15	6.88	8.65	0.96	5141.75	0.000	196.10	05139.70	5142.02	2.32**	7.56	7.87	0.96	5142.98	0.000	0.000	n/a	0.15	n/a
3	36	59.50	5139.85	5142.54	2.69*	6.68	8.90	1.23	5143.77	0.703	365.707	5142.42	5145.11	2.69	6.68	8.90	1.23	5146.34	0.703	0.703	2.570	1.00	1.23
4	36	57.40	5152.00	5154.41	2.41*	6.09	9.43	1.34	5155.75	0.000	373.64	5154.87	5157.32	2.45**	6.18	9.28	1.34	5158.66	0.000	0.000	n/a	1.00	1.34
5	18	2.10	5146.07	5146.45	0.38*	0.35	5.95	0.20	5146.65	0.000	134.94	5148.77	5149.32	0.55**	0.58	3.61	0.20	5149.52	0.000	0.000	n/a	1.00	n/a

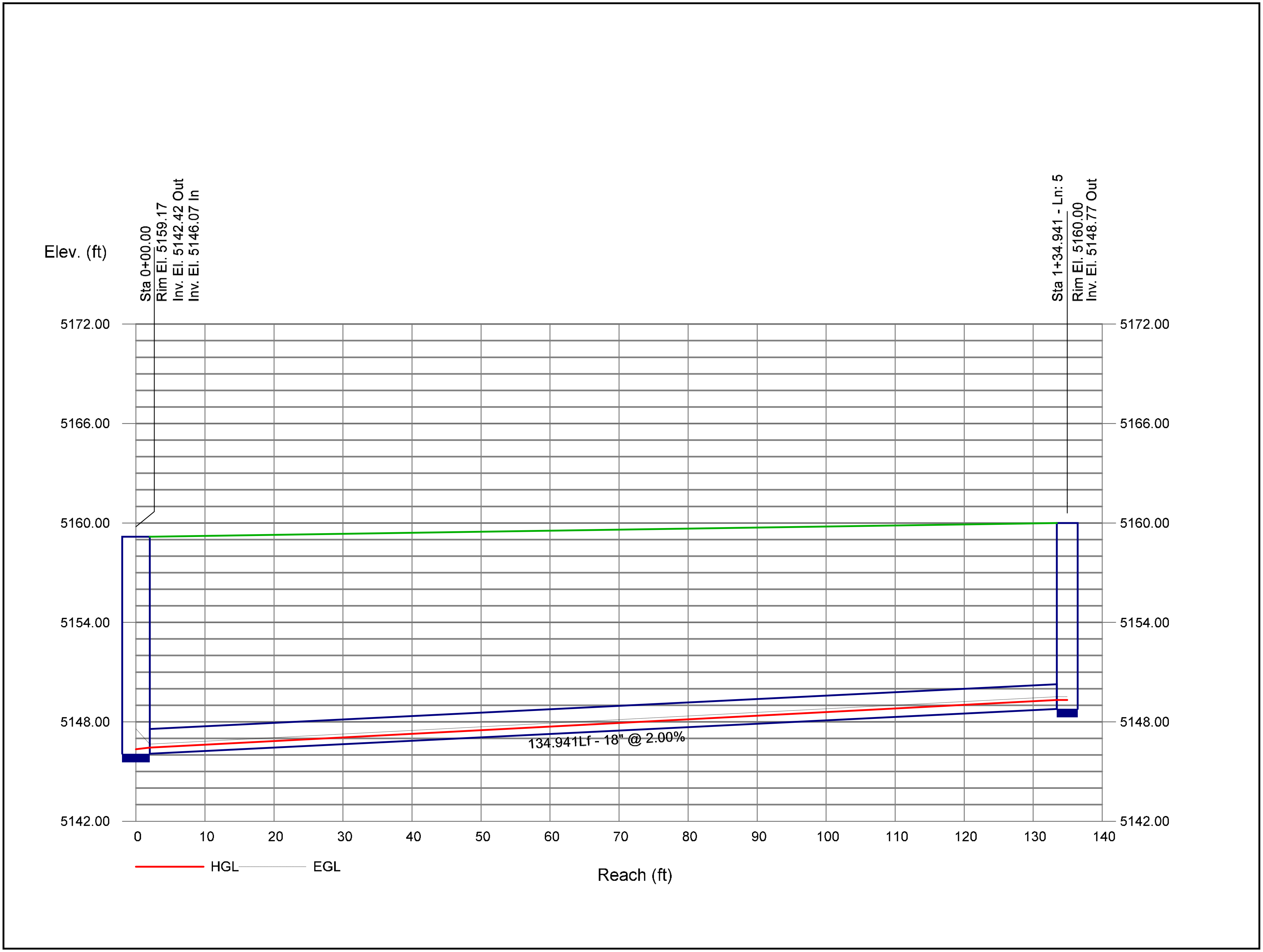
Project File: 23049 - 100-Year Storm Outfall.stm | Number of lines: 5 | Run Date: 8/8/2024

Notes: * depth assumed; ** Critical depth. ; c = cir e = ellip b = box

Storm Sewers v2022.00

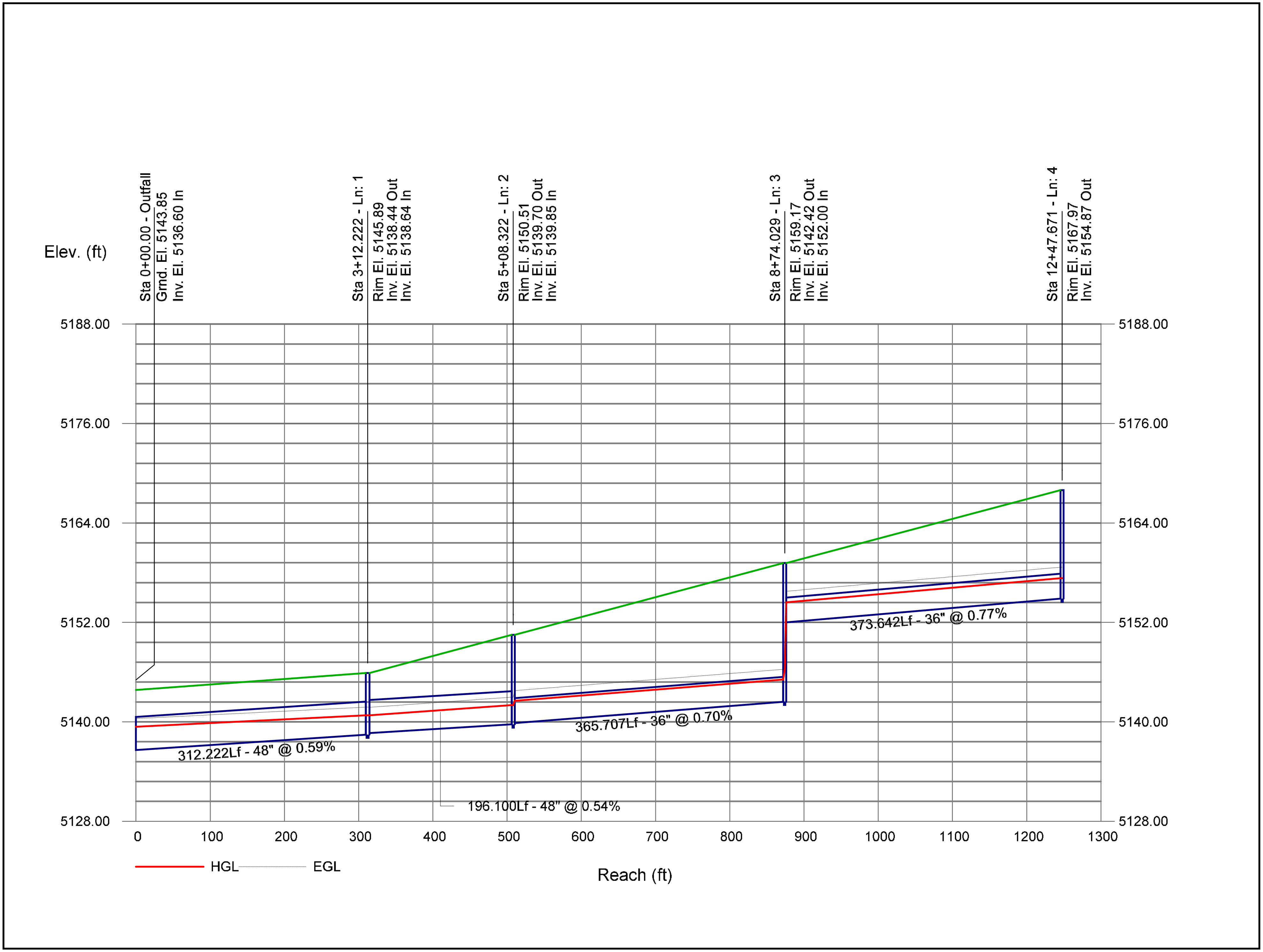
Storm Sewer Profile

Proj. file: 23049 - 100-Year Storm Outfall.stm



Storm Sewer Profile

Proj. file: 23049 - 100-Year Storm Outfall.stm



Pipe Info

Line No.	Line ID	Line Length (ft)	Line Size (in)	Line Slope (%)	Line Type	n-val Pipe	Flow Rate (cfs)	Capac Full (cfs)
1	Pipe - (42)	312.222	48	0.59	Cir	0.013	98.00	110.27
2	Pipe - (41)	196.100	48	0.54	Cir	0.013	91.40	105.61
3	Pipe - (39)	365.707	36	0.70	Cir	0.013	91.40	55.91
4	Pipe - (38)	373.642	36	0.77	Cir	0.013	88.60	58.45
5	Pipe - (40)	134.941	18	2.00	Cir	0.013	2.80	14.85

Project File: 23049 - 100-Year Storm Outfall.stm	Number of lines: 5	Date: 8/8/2024

NOTES: ** Critical depth

Hydraulic Grade Line Computations

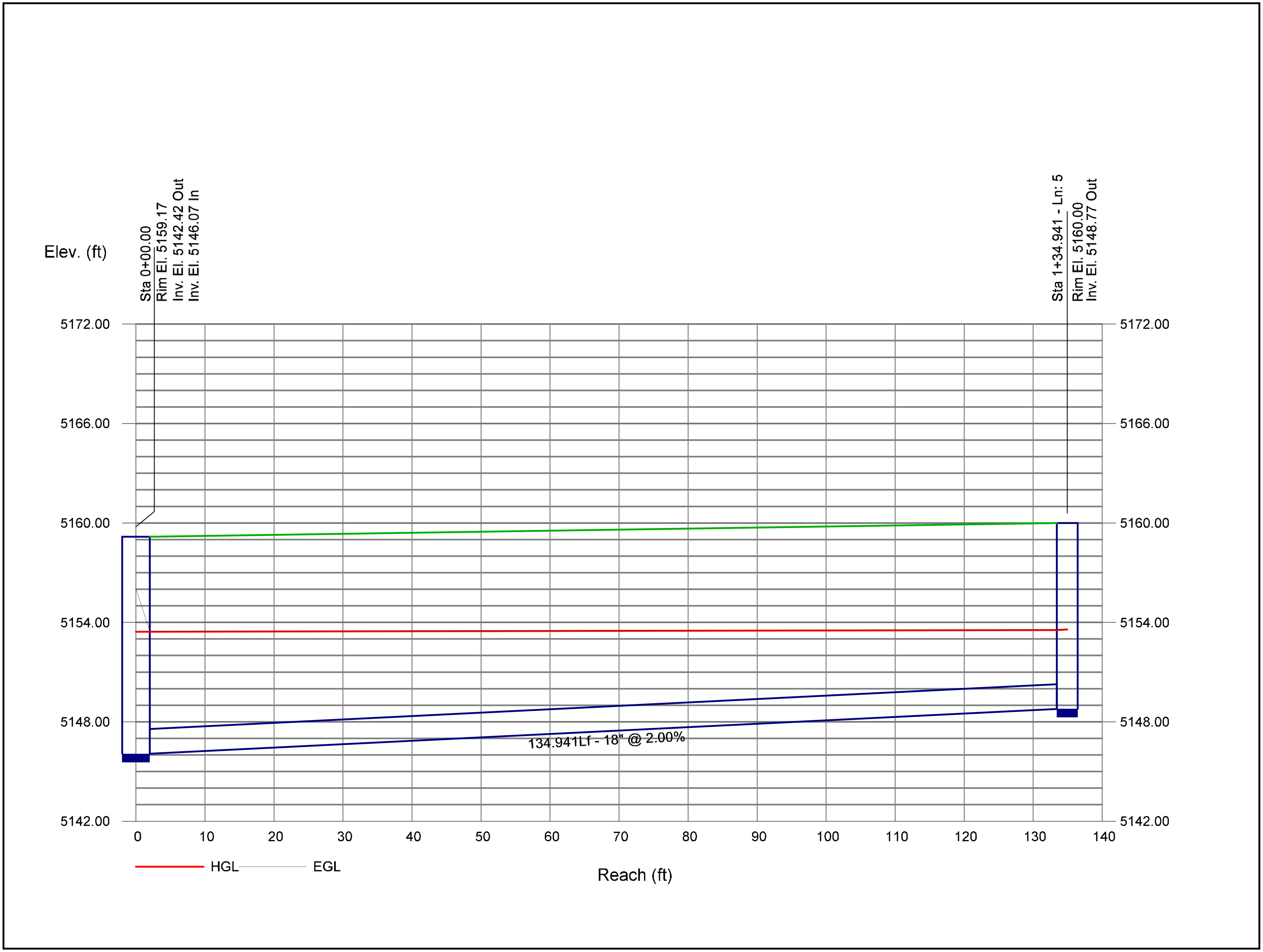
Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
1	48	98.00	5136.60	5141.45	4.00	12.56	7.80	0.95	5142.40	0.466	312.222	5138.44	5142.90	4.00	12.57	7.80	0.95	5143.85	0.465	0.466	1.454	0.15	0.14
2	48	91.40	5138.64	5143.05	4.00	12.56	7.27	0.82	5143.87	0.405	196.100	5139.70	5143.84	4.00	12.57	7.27	0.82	5144.66	0.405	0.405	0.794	0.15	0.12
3	36	91.40	5139.85	5143.96	3.00	7.07	12.93	2.60	5146.56	1.879	365.707	5142.42	5150.84	3.00	7.07	12.93	2.60	5153.44	1.878	1.879	6.870	1.00	2.60
4	36	88.60	5152.00	5155.00	3.00*	7.07	12.54	2.44	5157.44	1.766	373.642	5154.87	5161.60	3.00	7.07	12.53	2.44	5164.04	1.765	1.765	6.596	1.00	2.44
5	18	2.80	5146.07	5153.44	1.50	1.77	1.58	0.04	5153.47	0.071	134.941	5148.77	5153.53	1.50	1.77	1.58	0.04	5153.57	0.071	0.071	0.096	1.00	0.04

Project File: 23049 - 100-Year Storm Outfall.stm | Number of lines: 5 | Run Date: 8/8/2024

Notes: * depth assumed ; c = cir e = ellip b = box

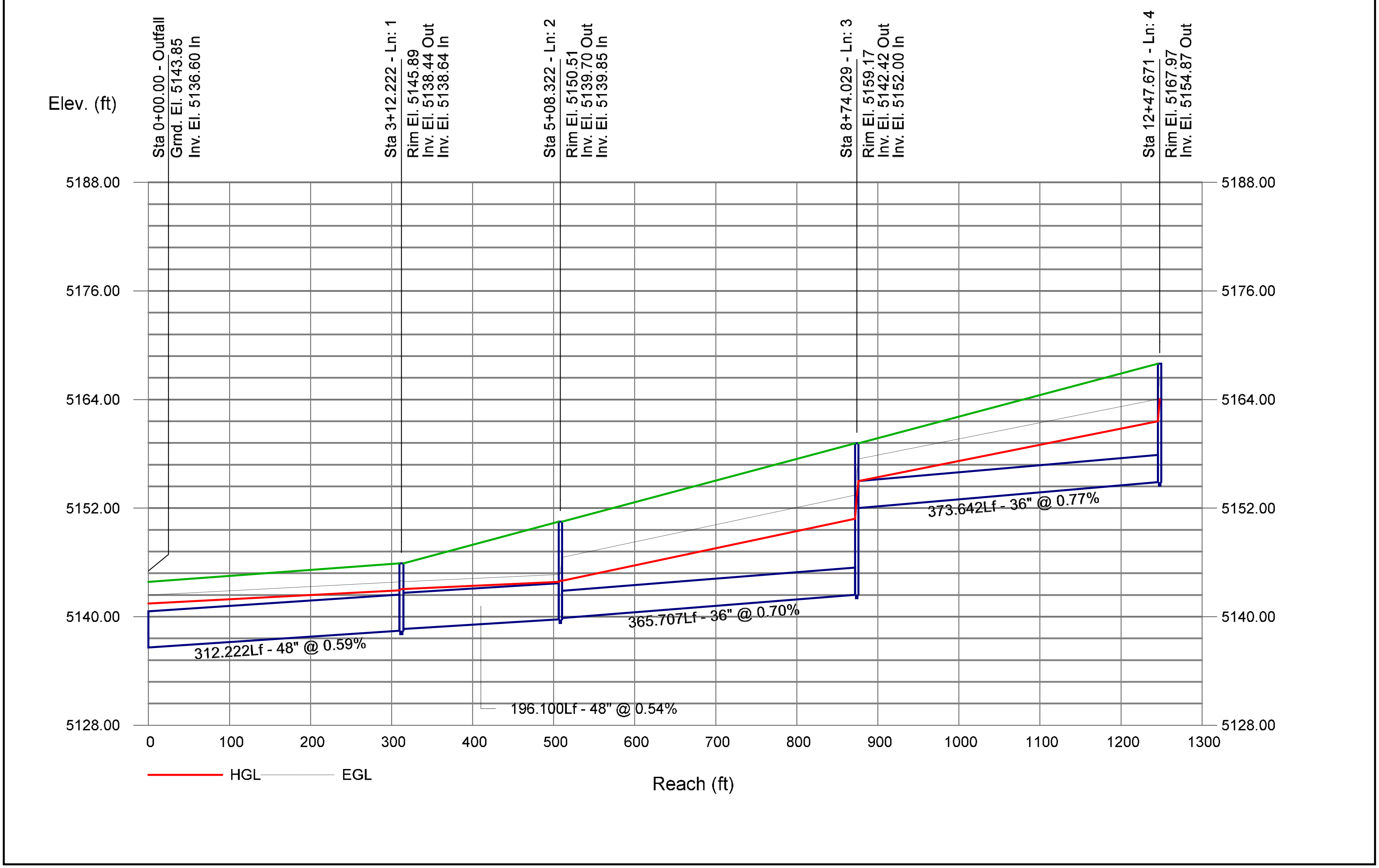
Storm Sewer Profile

Proj. file: 23049 - 100-Year Storm Outfall.stm



Storm Sewer Profile

Proj. file: 23049 - 100-Year Storm Outfall.stm

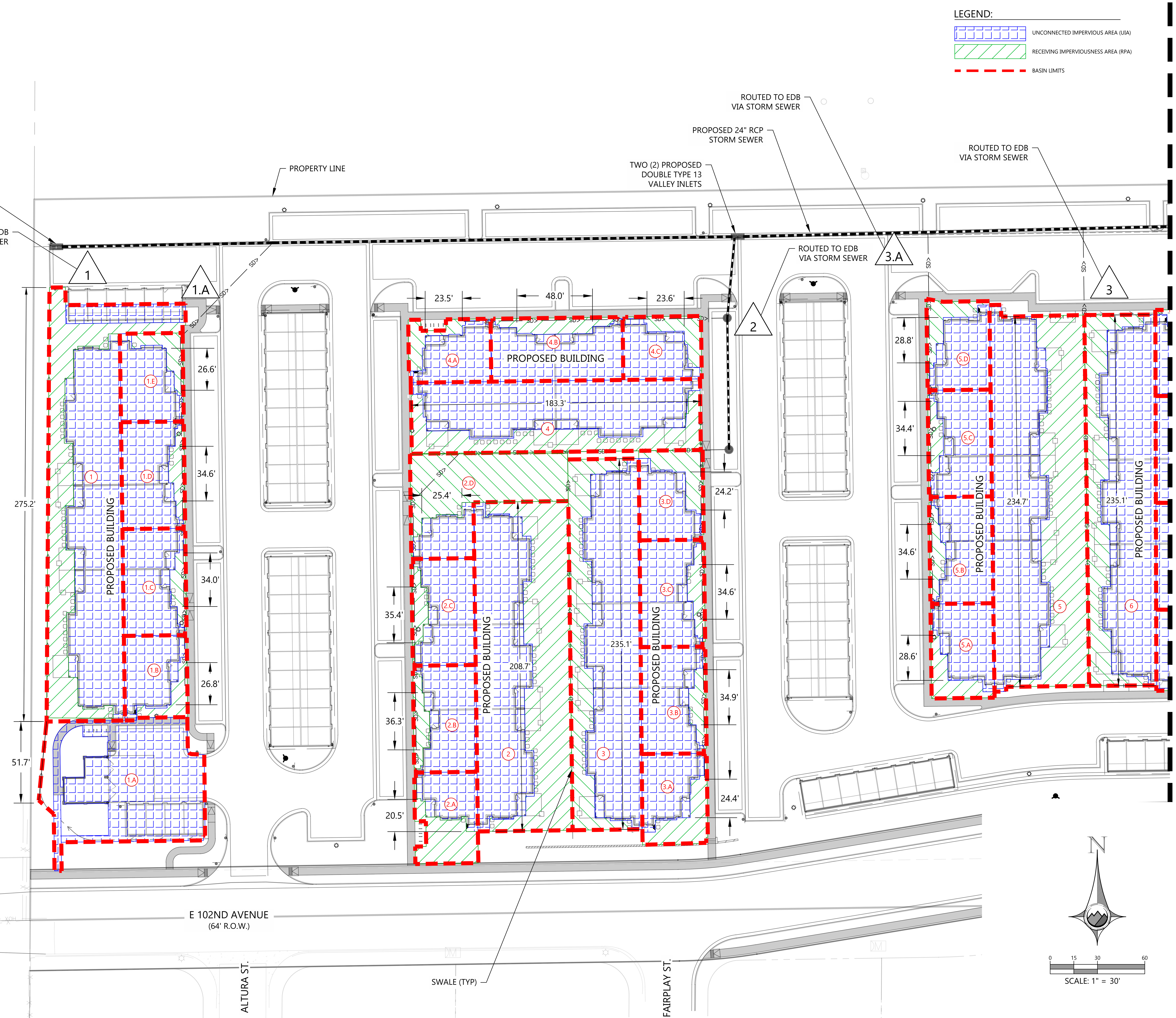


APPENDIX F

- Runoff Reduction Map
- Historic Drainage Map
- PROPOSED DRAINAGE MAP

RUNOFF REDUCTION SUMMARY

BASIN ID	UIA (SF)	RPA (SF)
1	8,579	4650
1.A	7,000	50
1.B	1,603	475
1.C	2,300	395
1.D	2.250	445
1.E	1,700	530
2	6,485	6,053
2.A	1,130	1,060
2.B	2,250	450
2.C	2,300	400
2.D	1,035	3,440
3	7,243	3,254
3.A	1,473	890
3.B	2,335	440
3.C	2,268	490
3.D	1,524	780
4	5,556	2,707
4.A	1,495	464
4.B	2,700	634
4.C	1,409	570
5	7,712	6,467
5.A	1,717	668
5.B	2,248	448
5.C	2,314	382
5.D	1,620	623
6	7,048	3,260



PROOFCIVIL
consulting engineers
600 Grant Street | Suite 210 | Denver, CO

SEAL:

FOR AND ON BEHALF OF PROOF CIVIL CO.

REVISIONS

NO.	DATE	DESCRIPTION

PROJ. NO.: 23049
DATE: 6/13/2024
DRAWN BY: ACL
CHECKED BY: TAL

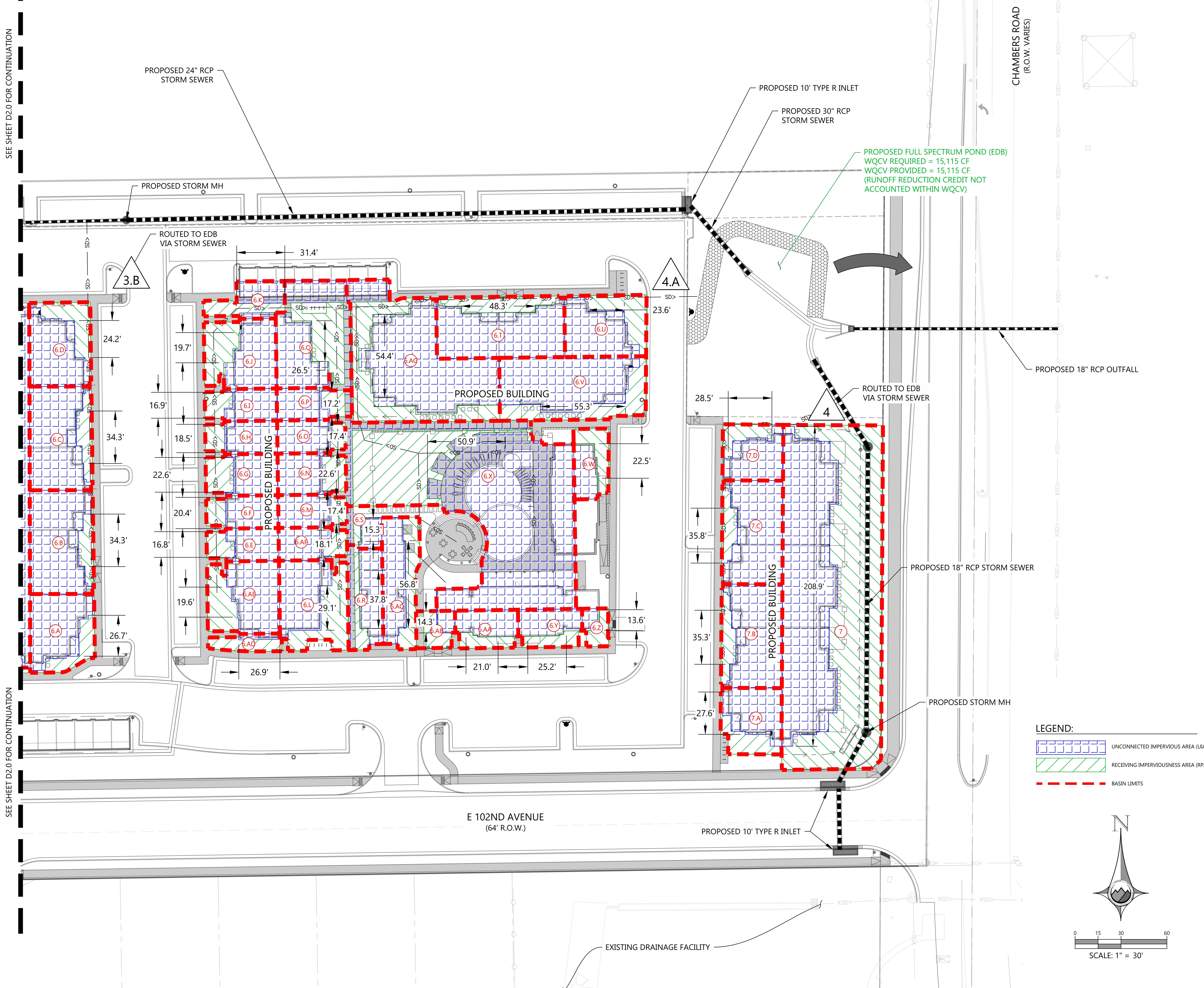
RUNOFF REDUCTION MAP

TTRES CHAMBERS ROAD
PRELIMINARY DRAINAGE REPORT
COMMERCE CITY
COLORADO

DRAWING NO.
D2.0

RUNOFF REDUCTION SUMMARY

BASIN ID	UIA (SF)	RPA (SF)
6.A	1,553	490
6.B	2,423	380
6.C	2,308	449
6.D	1,529	664
6.AD	101	379
6.AE	1456	695
6.E	677	275
6.F	738	275
6.G	807	419
6.H	743	219
6.I	666	235
6.J	1,313	738
6.K	642	414
6.L	1,388	1,058
6.AF	679	231
6.M	739	176
6.N	808	360
6.O	743	175
6.P	666	229
6.Q	1,861	977
6.R	888	277
6.S	285	75
6.AG	4,259	1,790
6.T	2,689	644
6.U	1,397	732
6.V	2,775	1,093
6.W	533	481
6.X	8,586	2,293
6.Y	686	301
6.Z	161	232
6.AA	677	294
6.AB	170	300
6.AC	1,173	755
7	6,495	8,101
7.A	1,143	512
7.B	2,256	430
7.C	2,293	386
7.D	1,043	397



PROOFCIVIL
consulting engineers
600 Grant Street | Suite 210 | Denver, CO

SEAL:

FOR AND ON BEHALF OF PROOF CIVIL CO.

REVISIONS

NO.	DATE	DESCRIPTION

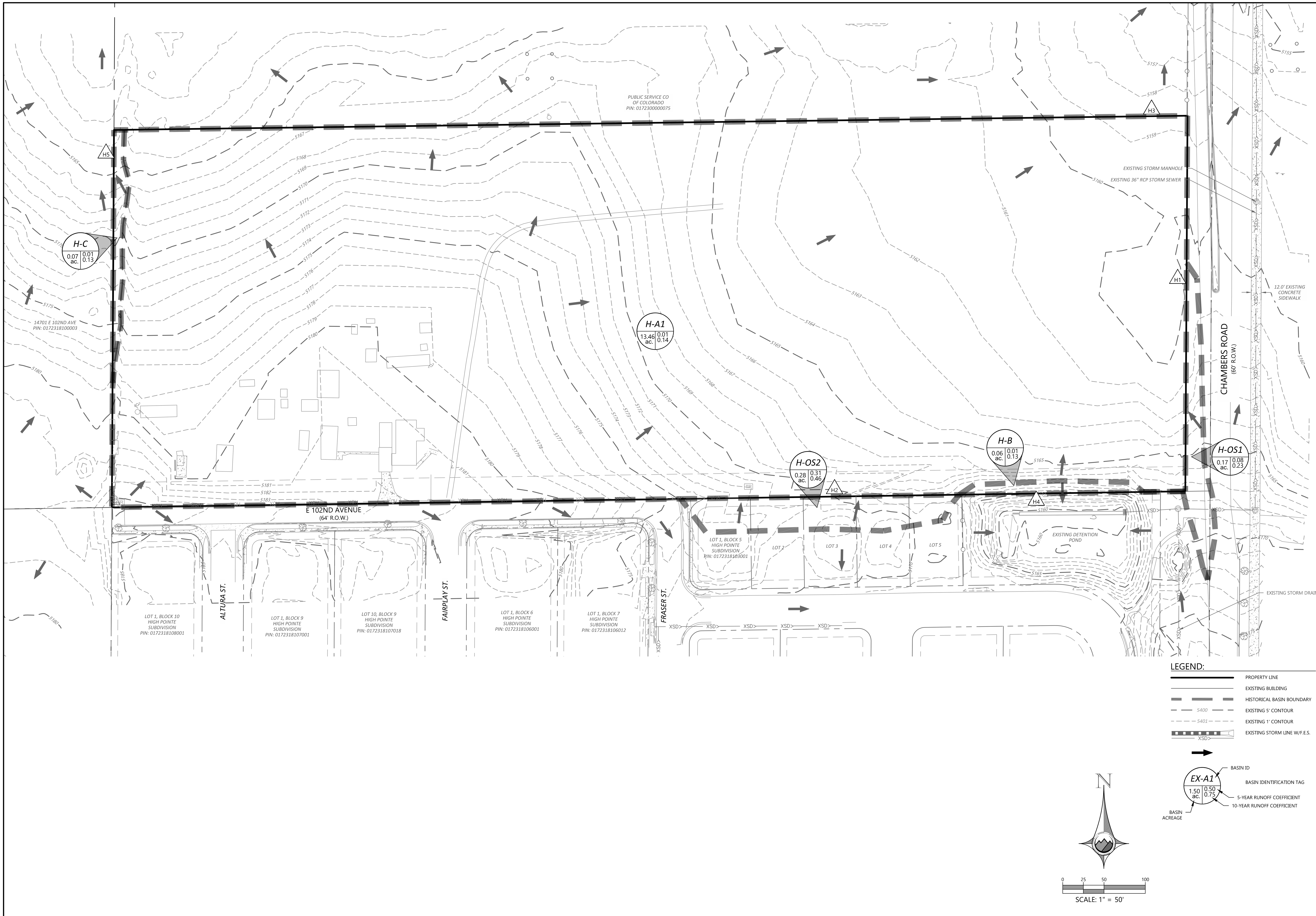
PROJ. NO.: 23049
DATE: 6/13/2024
DRAWN BY: ACL
CHECKED BY: TAL

RUNOFF REDUCTION MAP

TTRES CHAMBERS ROAD
PRELIMINARY DRAINAGE REPORT
COMMERCE CITY
COLORADO

DRAWING NO.

D2.1



PROOFCIVIL
consulting engineers
600 Grant Street | Suite 210 | Denver, CO

SEAL:

FOR AND ON BEHALF OF PROOF CIVIL CO.

REVISIONS

NO.	DATE	DESCRIPTION

PROJ. NO.:	23049
DATE:	6/13/2024
DRAWN BY:	LO
CHECKED BY:	TAL

HISTORIC DRAINAGE MAP

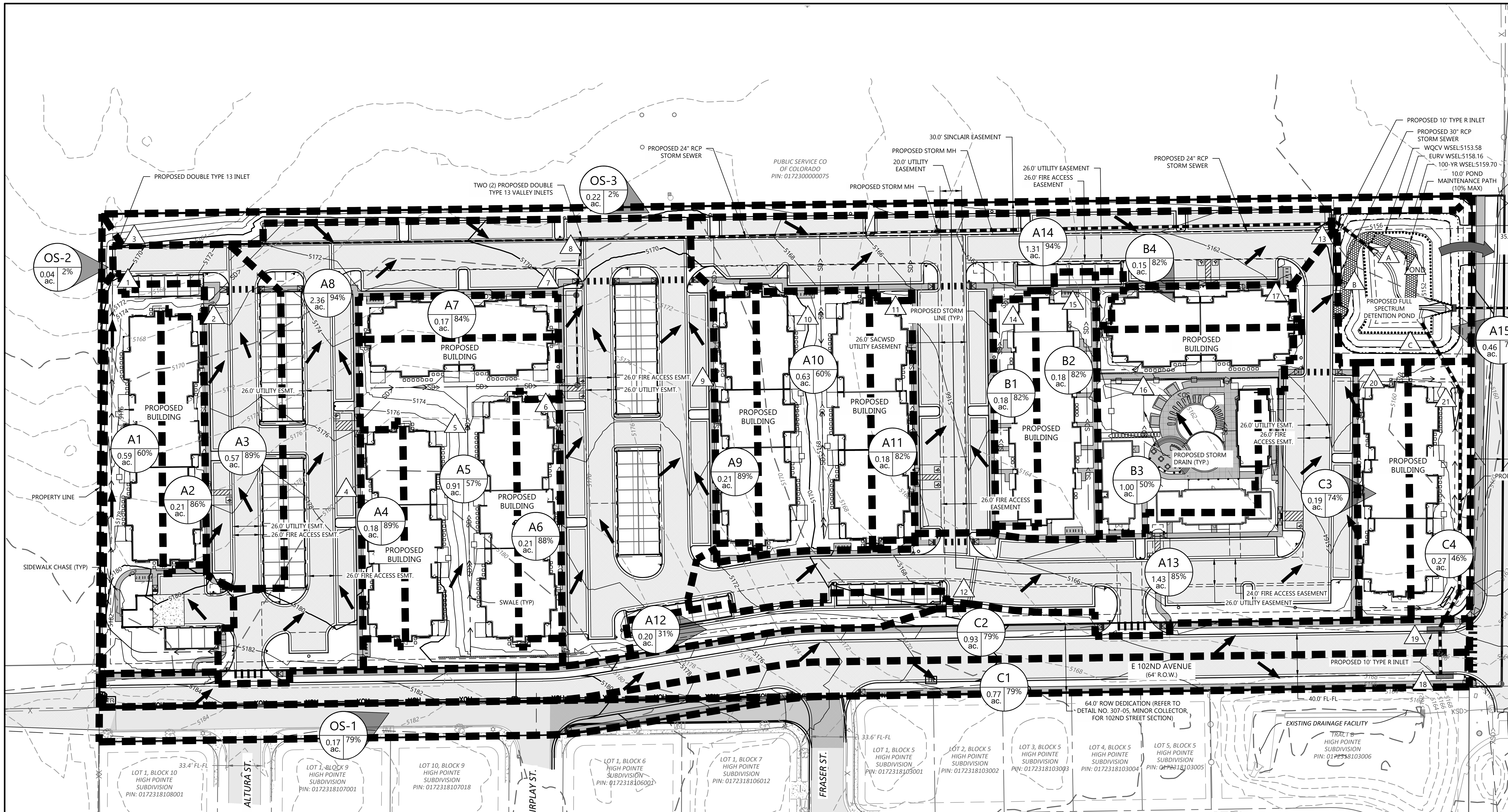
TTRES CHAMBERS ROAD

DRAINAGE PLAN MAPS

COMMERCE CITY COLORADO

DRAWING NO.

D0



SUMMARY RUNOFF

DESIGN POINT	CONTRIBUTING BASIN(S)	CONTRIBUTING AREA (ACRES)	5-YEAR RUNOFF (CFS)	100-YEAR RUNOFF (CFS)
1	A1	0.59	0.8	2.1
2	A2	0.21	0.6	1.4
3	A1, A2, A3	1.37	2.0	5.0
4	A4	0.18	0.5	1.2
5	A5	0.91	1.4	4.2
6	A6	0.21	0.6	1.4
7	A7	0.17	0.4	1.0
8	A4, A5, A6, A7, A8	3.83	8.5	20.6
9	A9	0.21	0.6	1.4
10	A10	0.63	1.1	3.0
11	A11	0.18	0.4	1.1
12	A12	0.18	0.1	0.5
13	A12, A13, A14	3.01	5.8	13.8
14	B1	0.18	0.4	1.1
15	B2	0.18	0.4	1.1
16	B3	1.00	1.4	4.2
17	B4	0.15	0.4	0.9
18	C1	0.77	1.4	3.5
19	C2	0.93	1.9	4.8
20	C3	0.19	0.4	1.1
21	C4	0.27	0.3	1.1
A	ALL A BASINS	9.62	15.0	36.6
B	ALL B BASIN	1.51	2.6	7.1
C	ALL C BASINS	2.16	3.6	9.1
	OS-1	0.17	0.3	0.9
	OS-2	0.04	0.0	0.0
	OS-3	0.22	0.0	0.2

N

SCALE: 1" = 50'

DETENTION BASIN SUMMARY

DESIGN VOLUME	WATER SURFACE ELEVATION (FT)	VOLUME (ACRE-FT)	MAXIMUM RELEASE RATE (CFS)	PROVIDED RELEASE RATE (CFS)
WATER QUALITY CAPTURE VOLUME	5153.58	0.307	40 HOURS PER DRAINAGE CRITERIA	0.2 CFS
EXCESS URBAN RUNOFF VOLUME	5158.16	1.191	2.8 CFS - PER PREVIOUSLY APPROVED DRAINAGE REPORT	2.6 CFS
100-YEAR STORAGE VOLUME	5159.70	1.673	18.3 CFS - PER PREVIOUSLY APPROVED DRAINAGE REPORT	2.8 CFS

LEGEND:

- PROPERTY LINE
- PROPOSED BUILDING
- EXISTING BUILDING
- PROPOSED EASEMENT
- EXISTING EASEMENT
- PROPOSED BASIN BOUNDARY
- HISTORICAL BASIN BOUNDARY
- 5400 PROPOSED 5' CONTOUR
- 5401 PROPOSED 1' CONTOUR
- 5400 EXISTING 5' CONTOUR
- 5401 EXISTING 1' CONTOUR
- SD> PROPOSED STORM LINE W/F.E.S.
- XSD> EXISTING STORM LINE W/F.E.S.
- PROPOSED SAWCUT
- PROPOSED STORM INLET
- EXISTING STORM INLET
- FLOW DIRECTION
- OVERFLOW PATH
- 25.25 PROPOSED SPOT GRADE
- 25.25 EXISTING SPOT GRADE
- 2.00% SLOPE AND DIRECTION
- HP HIGH POINT
- LP LOW POINT
- GB GRADE BREAK
- A1 — BASIN ID
- 1.50 ac. 80% — BASIN IDENTIFICATION TAG
- PERCENT IMPERVIOUSNESS
- BASIN ACREAGE

PROOFCIVIL consulting engineers
600 Grant Street | Suite 210 | Denver, CO

SEAL:

FOR AND ON BEHALF OF PROOF CIVIL CO.

REVISIONS

NO.	DATE	DESCRIPTION

PROJ. NO.: 23049
DATE: 6/13/2024
DRAWN BY: ACL
CHECKED BY: TAL

PROPOSED DRAINAGE MAP

TTRES CHAMBERS ROAD
PRELIMINARY DRAINAGE REPORT
COMMERCE CITY
COLORADO

DRAWING NO.
D1