



FDR AMENDMENT 1:  
07/30/24

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## **Bradley Heights Filing 3 & 4 Final Drainage Report Amendment #1**

STM-REV24-0697 (FDR Amendment #1 Pending)

STM-REV22-0521 (Approved FDR)

STM-MP-0167

August 2024

HR Green Project No: 211448

**Prepared For:**

Challenger Homes

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Colorado Springs, CO 80920

**Prepared By:**

HR Green Development, LLC

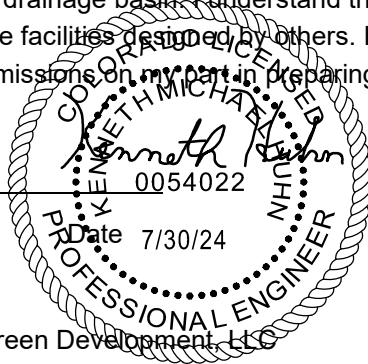
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## Engineer's Statement

This report and plan for the drainage design of the development, Bradley Heights Filing 3 and 4, was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the *City of Colorado Springs Drainage Criteria Manual* and is in conformity with the master plan of the drainage basin. I understand that the City of Colorado Springs does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.



Ken Huhn, PE

State of Colorado No.

For and on behalf of HR Green Development, LLC

## Developer's Statement

Challenger Homes hereby certifies that the drainage facilities for Bradley Heights Filing 3 & 4 shall be constructed according to the design presented in this report. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to the City of Colorado Springs pursuant to section 7.4.701 of the City Code: and cannot, on behalf of Bradley Heights Filing 3 & 4, guarantee that final drainage design review will absolve Challenger Homes and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

Challenger Communities, LLC.

*Erin Ganaway*

07/30/24

Name of Developer

Authorized Signature

Date

Erin Ganaway Community Development Project Manager 8605 Explorer Dr. #250, C/S CO 80920

Printed Name

Title

Address

## City of Colorado Springs Statement

Filed in accordance with 7.4.701 of the Code of the City of Colorado Springs, 2023, as amended.

*Emilia Wang*

8/13/2024

For City Engineer

Date

Conditions: Building Permits will not be released until assurances for channel improvements have been posted or channel improvements have been installed and accepted.



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## I. General Purpose, Location and Description

### a. Purpose

The purpose of this Final Drainage Report (FDR) is to describe the onsite and offsite drainage patterns, existing and proposed storm infrastructure, and the planned stormwater management for Bradley Heights Filing 3 & 4. This report will support the development plan that is currently in review the City of Colorado Springs.

### b. Location

Bradley Heights Filing 3 & 4, referred to as 'the site' herein, is in a portion of the east half of Section 9, Township 15 South, Range 65 West of the 6<sup>th</sup> P.M., Colorado Springs, El Paso County, Colorado. The site is bound by Bradley Road to the north, Bradley Landing Boulevard to the east, the Trails at Aspen Ridge Filing 1 and Filing 2 to the west, and Legacy Hill Drive to the south. Surrounding platted developments include Trails at Aspen Ridge to the southwest. A vicinity map is presented in Appendix A.

### c. Purpose- Amendment #1

The purpose of this Amendment #1 for Bradley Heights Filing 3 & 4 is to revise the following items:

1. Addition of Appendix G - Variances to the report. This includes three Variance Letters approved under SWENT Number STM-REV24-0587
2. Revisions to the following *Appendix B- Hydrologic Calculations* due to over-lot grading changes. (revisions clouded on each sheet)
  - a. Basin area changes (revisions clouded)
  - b. Minor and Major runoff totals (revisions clouded)
3. Revisions to the following *Appendix C- Hydraulic Calculations* due to changes required as part of the Storm Plan & Profile reviews. (revisions clouded on each sheet)
  - a. Storm CAD Layout (revisions clouded)
  - b. Pipe depths modified on northern pond storm inlet system
  - c. Type II manholes utilized instead of Type I
  - d. 5-YEAR SCENARIO -Conduit Tables, Element tables, HGL Profile Reports
  - e. 100-YEAR SCENARIO -Conduit Tables, Element tables, HGL Profile Reports

### d. Description of Property

The site is approximately 34.46 acres of undeveloped land with existing vegetation consisting of native grasses. The site is currently unplatted. The development will plat 170 single family residential lots and open space tracts. Typical lot size is 35' x 80'. Onsite elevations range from 5840' - 5920' with slopes ranging 1 - 10%. Per a NRCS soil survey, the site is made up of Type B Fort Collins Loam, Type B Nelson-Tassel fine sand loams Type B Stoneham sandy loam, and Type D Razor-Midway Complex. The NRCS soil survey is presented in Appendix A.

There are no major drainageways or irrigation facilities that traverse the site nor does the site fall within the Streamside Overlay Zone. Other onsite, existing utilities include underground fiberoptic, underground gas and underground/overhead electric/telecommunication. There is no existing storm sewer located on-site.

### e. Floodplain Statement

Based on FEMA Firm map 08041C0768G dated December 7, 2018, the site is Zone X, which are areas determined to be outside the 0.2% annual chance flood.

## II. Drainage Basins and Subbasins

### a. Major Basin Description

The site is located within the West Fork Jimmy Camp Creek and Marksheffel Tributary to Jimmy Camp Creek Drainage Basins. The site's drainage characteristics were previously studied in the following reports:

1. "Jimmy Camp Creek Drainage Basin Planning Study" prepared by Kiowa Engineering Corporation, March 9, 2015.
2. "Master Development Drainage Plan for Bradley Heights" prepared by Classic Consulting Engineers and Surveyors, approved by the City of Colorado Springs February 12, 2015.
3. "Master Development Drainage Report Amendment for Bradley Heights & Final Drainage Report for Phase I Bradley Heights Road Improvements" prepared by Matrix Design Group, December 2021, approved by City of Colorado Springs on May 6, 2022.
4. "Bradley Heights Metro District (Phase 2) Final Drainage Report" prepared by Matrix Design Group. STM-REV22-0405, Approved 9/28/2022.
5. "Final Drainage Report for Trails at Aspen Ridge Filing No. 2," approved by El Paso County July 22, 2021.
6. "Bradley Heights Filing 1&2 Final Drainage Report," June 2022. (STM-REV22-0091) Approved July 08, 2022.

The Marksheffel Tributary to Jimmy Camp Creek totals 3302 acres of sparsely vegetated slopes ranging from 0.2% to 10% which are channelized to the tributary creek. The creek eventually terminates in the existing Colorado Centre Detention Pond which discharges across Marksheffel Road to Jimmy Camp Creek.

The West Fork- Jimmy Camp Creek basin comprises the areas south of the natural ridge through the property. The slopes in this basin range from 3% to 10%. The flows are channelized southward toward the West Fork Tributary to Jimmy Camp creek and eventually terminate in Jimmy Camp Creek.

The *Master Development Drainage Plan for Bradley Heights* (Bradley Heights MDDP) established the drainage patterns for the site and surrounding areas. The site's drainage patterns will follow those established in the Bradley Heights MDDP and the site will provide on-site water quality and detention in a private, full spectrum detention pond. The private, full spectrum detention pond will release at less than historic rates.

It should be noted that Bradley Heights Metropolitan District has developed a *Master Development Drainage Plan Amendment for Bradley Heights* by Matrix Design Group (MDDPA). Drainage basins draining to the on are in conformance with the MDDP amendment. The MDDPA (STM-REV22-0046) was approved on 05/06/2022.

It should also be noted that the Bradley Heights Metropolitan District Phase 2 Final Drainage Report (P2FDR) is currently under review (STM-REV22-0405) and is referenced for all basins tributary to the Phase 2 roadway and storm improvements. The basins shared by this FDR and the P2FDR have updated values from the MDDPA drainage map as the coordination was still ongoing at the time of the MDDPA approval date.



## b. Existing Subbasin Description

The existing drainage basins and drainage patterns were analyzed and are detailed in the Bradley Heights MDDPA. The existing site is sparsely vegetated and has an east-west ridge splitting the site into two existing basins. The north portion of the site corresponds to the MDDPA Basin M3 and drains easterly towards Bradley Road. The south portion of the site corresponds to the MDDPA basin W1 and drains south and west toward Legacy Hill Drive. There is no existing storm sewer located on-site. The existing drainage map from the Bradley Heights MDDPA is presented in Appendix E. See below for existing basin descriptions:

Basin M3 is 145.8 acres of both onsite and offsite undeveloped land. Existing stormwater from this basin ( $Q_5 = 9.4$  cfs  $Q_{100} = 150.7$  cfs) sheet flows across the basin and is concentrated in an existing drainage swale. The stormwater is conveyed to design point M3.

Basin W1 is 97.93 acres of both onsite and offsite undeveloped land. Existing stormwater from this basin ( $Q_5 = 29.8$  cfs  $Q_{100} = 159.4$  cfs) sheet flows across the basin and is concentrated in an existing drainage swale. The stormwater is conveyed to design point WF1.

## c. Proposed Subbasin Description

The proposed site has been divided into 14 subbasins for analysis. A drainage map has been presented in Appendix F. See below for basin descriptions:

Basin 1 is 4.86 acres of undeveloped area, single-family residential lots, roadway, and landscaping. Stormwater from this basin ( $Q_5 = 7.1$  cfs  $Q_{100} = 17.3$  cfs) is conveyed in curb and gutter to a proposed 15' Type R on-grade inlet (public) at DP1. The flow-by from DP1 ( $Q_5 = 0.1$  cfs  $Q_{100} = 4.8$  cfs) is collected by a proposed 15' Type R on-grade inlet (public) at DP3. Basin 1 stormwater is piped to the private, full spectrum detention pond for water quality and detention. The onsite pond will henceforth be referred to as "Pond A".

Basin 2 is 3.41 acres of single-family residential lots, roadway, and landscaping. Stormwater from this basin ( $Q_5 = 9.0$  cfs  $Q_{100} = 17.8$  cfs) is conveyed in curb and gutter to a proposed 15' Type R on-grade inlet (public) at DP2. The flow-by from DP2 is ( $Q_5 = 0.6$  cfs  $Q_{100} = 5.1$  cfs) is collected by a proposed 15' Type R on-grade inlet (public) at DP4. Basin 2 stormwater is piped to and detained in Pond A.

Basin 3 is 4.57 acres of single-family residential lots, roadway, and landscaping. Stormwater from this basin ( $Q_5 = 8.3$  cfs  $Q_{100} = 18.2$  cfs) is conveyed in curb and gutter to a proposed 15' Type R on-grade inlet (public) at DP7. The DP7 flow-by ( $Q_5 = 0.4$  cfs  $Q_{100} = 5.3$  cfs) is combined with Basin 12 stormwater at DP17 and flows into Legacy Hill Drive curb and gutter. DP17 stormwater ( $Q_5 = 2.9$  cfs  $Q_{100} = 10.7$  cfs) is captured in a proposed 10' Type R sump inlet (public) at MDDPA design point AU. Basin 3 will be detained in WFJCC Pond #1 FSD, an offsite full spectrum water quality pond. WFJCC Pond #1 is designed as a part of the MDDPA by Matrix Design Group and will be constructed prior to the development of Bradley Heights Filing 3 & 4. See Appendix E for MDDPA design details

Basin 4 is 7.13 acres of single-family residential lots, roadway, and landscaping. Stormwater from this basin ( $Q_5 = 10.8$  cfs  $Q_{100} = 25.1$  cfs) is conveyed in curb and gutter to a proposed 5' Type R on-grade inlet (public) at DP8. The DP8 flow-by ( $Q_5 = 6.9$  cfs  $Q_{100} = 19.6$  cfs) is conveyed to a proposed 15' Type R sump inlet (public) at DP9. Should DP9 become clogged, a drainage swale with 1.0' of freeboard conveys the flow along the eastern property line to MDDPA design point AU. Basin 4 stormwater is piped to and detained in WFJCC Pond #1 FSD, an offsite full spectrum water quality pond. WFJCC Pond #1 is designed as a part of the MDDPA by Matrix Design Group and will be constructed prior to the development of Bradley Heights Filing 3 & 4.



Basin 5 is 2.93 acres of single-family residential lots, roadway, and landscaping. Stormwater from this basin ( $Q_5 = 5.1$  cfs  $Q_{100} = 11.0$  cfs) is conveyed in curb and gutter to a proposed 15' Type R sump inlet (public) at DP10. Basin 5 stormwater is piped to the BHMD storm sewer system in Legacy Hill Drive at DP11.1. DP11.1 flows are  $Q_5 = 22.8$  cfs  $Q_{100} = 47.6$  cfs. Per the P2FDR, Basin WF1 flows are  $Q_5 = 24.8$  cfs  $Q_{100} = 54.5$  cfs. Therefore, DP11.1 the Bradley Heights Filing 3 & 4 flow at DP11.1 is less than the original design and therefore complies with the P2FDR. Basin 5 will be detained in WFJCC Pond #1 FSD, an offsite full spectrum water quality pond. WFJCC Pond #1 is designed as a part of the MDDPA by Matrix Design Group and will be constructed prior to the development of Bradley Heights Filing 3 & 4.

Basin 7 is 0.47 acres of undeveloped that is a portion of MDDPA Basin BH1. Stormwater from this basin ( $Q_5 = 0.2$  cfs  $Q_{100} = 1.4$  cfs) follows historic drainage patterns to DP12 and conveyed by the drainage ditch along Bradley Road as part of the improvements done by the Bradley Heights Metropolitan District. Since MDDPA Basin BH1 included the area of Basin 7, the culvert at DP12 has been sized for Basin 7 flows.

Basin 8 is 0.11 acres of roadway that has been broken out from MDDPA Basin BL1. Stormwater from this basin ( $Q_5 = 0.5$  cfs  $Q_{100} = 0.9$  cfs) is conveyed by curb and gutter and flows to DP13 and combines with the Basin BL1 stormwater. Basin 8 stormwater will be captured by a proposed, offsite, 10' Type R sump inlet (public) within Bradley Landing Boulevard that corresponds to MDDPA design point BL-1. Basin 8 stormwater is detained in Bradley Heights Filing 1 and Filing 2 private detention pond.

Basin 9 is 0.49 acres of landscaping and the private, full spectrum detention pond (Pond A). Stormwater from this basin ( $Q_5 = 0.2$  cfs  $Q_{100} = 1.3$  cfs) flows directly into Pond A.

Basin 10 is 0.73 acres of landscaping and undeveloped area that is a portion of MDDPA Basin BHC. Stormwater from this basin ( $Q_5 = 0.2$  cfs  $Q_{100} = 1.4$  cfs) follows historic drainage patterns to DP14 to the roadside drainage ditch along Bradley Road per the Bradley Heights MDDPA. Basin 10 will remain undeveloped. Therefore, all downstream storm sewer infrastructure proposed within the MDDPA has been sized for Basin 10 flows

Basin 11 is 2.08 acres of landscaping and is a portion of MDDPA Basin BHC. Stormwater from this basin ( $Q_5 = 0.7$  cfs  $Q_{100} = 4.6$  cfs) follows historic drainage patterns to DP15 and is conveyed by the roadside drainage ditch along Bradley Landing Boulevard per the Bradley Heights MDDPA. Basin 11 will remain undeveloped. Therefore, all downstream storm sewer infrastructure proposed within the MDDPA has been sized for Basin 11 flows

Basin 12 is 1.11 acres of single-family residential lots, roadway, and landscaping and corresponds to the basin WF1b from the BHMD Phase 2 FDR (P2FDR). Stormwater from this basin ( $Q_5 = 2.2$  cfs  $Q_{100} = 4.8$  cfs) is conveyed in curb and gutter and combines with DP7 flow-by at DP17. DP17 stormwater is captured in a proposed 10' Type R sump inlet (public) at Phase design point AU. Basin 12 will be detained in WFJCC Pond #1 FSD, an offsite full spectrum water quality pond. WFJCC Pond #1 is designed as a part of the MDDPA by Matrix Design Group. Coordination is ongoing to ensure Basin 12 is accounted for within the pond design.

Basin WF2 is 4.35 acres of onsite and offsite single-family residential lots, roadway, and landscaping that corresponds with the P2FDR basin. Stormwater from this basin ( $Q_5 = 7.3$  cfs  $Q_{100} = 17.9$  cfs) is conveyed via curb and gutter along Legacy Hill Drive and Bradley Landing Boulevard to MDDPA design point AU where it combines with flows from DP17. Total stormwater at this design point ( $Q_5 = 9.8$  cfs  $Q_{100} = 27.8$  cfs), is captured in a proposed 10' Type R sump inlet (public). In the 100-year storm event, inlet AU will equalize across Legacy Hill to inlet AT. See the P2FDR for design details. Basin WF2 will be detained in WFJCC Pond

#1 FSD, an offsite full spectrum water quality pond. WFJCC Pond #1 is designed as a part of the P2FDR by Matrix Design Group.

Basin OS-ES is 3.79 acres of landscaping and undeveloped area that corresponds to P2FDR Basin OS-ES. Stormwater from this basin ( $Q_5 = 0.5$  cfs  $Q_{100} = 3.4$  cfs) sheet flows off site and is conveyed by an off-site drainage ditch to DPOS-E and is captured by a 3' Type C inlet, per the Trails at Aspen Ridge Final Drainage Report (TAR-FDR). Per the TAR-FDR, planned flows at DPOS-E were  $Q_5 = 3.1$  cfs  $Q_{100} = 3.4$  cfs. Therefore, Basin OS-ES complies with the original design. Stormwater from Basin OS-ES is detained in Trails at Aspen Ridge East Pond, an offsite full spectrum water quality pond. Trails at Aspen Ridge East Pond is designed as a part of the TAR-FDR and will be constructed prior to the Bradley Heights Filing 3 & 4 Development. See Appendix E for the TAR-FDR map.

**The following basins are shown in the map for context only, more details can be found in the corresponding report:**

Basin BL1 is 2.88 acres of offsite roadway (Bradley Landing Boulevard & Bradley Road) from the Bradley Heights MDDPA ( $Q_5 = 10.7$  cfs  $Q_{100} = 19.6$  cfs). Stormwater from this basin is captured in an offsite 10' Type-R sump inlet (public) within Bradley Landing Boulevard at DP BL-1 and piped to MKJCC Pond #9 for water quality and detention.

Basin BHC is 14.1 acres of onsite and offsite undeveloped land and landscaping from the Bradley Heights MDDPA ( $Q_5 = 3.1$  cfs  $Q_{100} = 20.7$  cfs).

Basin TAR-NE is 9.15 acres of single-family residential lots, roadway, and landscaping from the Bradley Heights MDDPA ( $Q_5 = 0.2$  cfs  $Q_{100} = 7.9$  cfs).

Basin LH1 is 0.18 acres of offsite roadway along Legacy Hill Drive ( $Q_5 = 0.8$  cfs  $Q_{100} = 1.4$  cfs). Stormwater from this basin is captured in an offsite 10' Type R on-grade inlet (public) along Legacy Hill Drive and piped offsite to MKJCC Pond #1 for water quality and detention.

Basin LH2 is 0.18 acres of offsite roadway along Legacy Hill Drive ( $Q_5 = 0.8$  cfs  $Q_{100} = 1.4$  cfs). Stormwater from this basin is captured in an offsite 10' Type R on-grade inlet (public) along Legacy Hill Drive and piped offsite to MKJCC Pond #1 for water quality and detention.

Basin WF3 is 0.75 acres of offsite roadway along Legacy Hill Drive ( $Q_5 = 2.9$  cfs  $Q_{100} = 5.3$  cfs). Stormwater from this basin is captured in an offsite 10' Type R sump inlet (public) along Legacy Hill Drive and piped offsite to MKJCC Pond #1 for water quality and detention.

In the event of inlet failure, the public sump inlet at DP9 would overtop the curb be conveyed to Legacy Hill Drive in a grass lined swale with 1.0' freeboard. The proposed overflow swale is designed to convey 25.5 cfs which represents the combined 100-year flow of DP8 & DP9. The swale is 2.25' deep including 1.0' of freeboard. In the event of inlet failure, the public sump inlet at DP10 would overtop the curb be conveyed to Legacy Hill Drive in a grass lined swale with 1.0' freeboard. The proposed overflow swale is designed to convey 11.0 cfs which represents the combined 100-year flow of DP10. A cross sectional analysis of the drainage swales are presented in Appendix C.

### III. Drainage Design Criteria

#### a. Development Criteria Reference

The drainage analysis, proposed storm sewer system, and proposed private, full spectrum water quality and detention pond follow the criteria from the “*City of Colorado Springs Drainage Criteria Manual*” Volumes 1 and 2” (CCSDCM, latest revision).

#### b. Hydrologic Criteria

Hydrologic data was obtained from the “*City of Colorado Springs Drainage Criteria Manual – Chapter 6 Hydrology*”. Onsite drainage improvements are designed for the 5-year storm (minor event) and 100-year storm (major event) using rainfall values from CCSDCM Table 6-2 below. Runoff was calculated per CCSDCM Section 6.3.0 - Rational Method. Private, full spectrum pond design was completed using the latest version of Mile High Flood District’s (MHFD) UD-Detention per CCSDCM Section 13.3.2.1 – Private, full spectrum Detention. Detention pond allowable release rate will be limited to less than historic rates.

Return Period (yr)	5	100
1-hr Rainfall Depth (in)	1.50	2.52

#### c. Hydraulic Criteria

Hydraulic criteria for inlets were obtained from the “*City of Colorado Springs Drainage Criteria Manual – Chapter 8 Inlets*”. Mile High Flood District’s UD-Inlet v4.06 was utilized for inlet sizing. CDOT Type R inlets will be utilized. Hydraulic criteria for storm sewer sizing were obtained from the “*City of Colorado Springs Drainage Criteria Manual – Chapter 9 Storm Sewer*”. StormCAD 10.03 was utilized for storm sewer modeling with the standard method utilized for headloss. For partially full pipes, hydraulic grade lines were calculated using open channel method, per CCSDCM Chapter 9.7.2. For pipes flowing under a pressure flow conditions, hydraulic grade lines were calculated using the pressure momentum theory, per CCSDCM Chapter 9.7.3.

### IV. Drainage Facility Design

#### a. General Concept

Basins 1 and 2 will be conveyed via Type 2 and Type 5 curb and gutter to Type R inlets. Basin 9 comprises the land area of Pond A. Stormwater from basins 1, 2, and 9 will be piped to and detained in an onsite, full spectrum water quality and detention pond, Pond A. See below for Pond A details.

The captured stormwater from Basins 3, 4, 5, 12 and WF2 will be conveyed via Type 2 and Type 5 curb and gutter to Type R inlets and will be piped offsite to WFJCC Pond #1.

Stormwater from Basins 7, 10, and 11 are undeveloped and follow historic drainage patterns to the drainage ditch along Bradley Road. These basins are undeveloped and will remain so; therefore, detention will not be provided in the context of this FDR.

Basin 8 stormwater will be conveyed via Bradley Road curb and gutter to an existing storm inlet owned by the Bradley Heights Metropolitan District located in Bradley Landing Boulevard. The captured stormwater from this inlet will then be piped to and detained in the Bradley Heights Filing 1 & 2 pond.



The stormwater from Basin OS-ES will be conveyed by an offsite drainage swale designed as part of the TAR-FDR and will be captured by a proposed Type C inlet and piped offsite to the Trails at Aspen Ridge East Pond (TAR-EP).

## b. Water Quality & Detention

### Pond Basin Comparison Chart

Pond Name	MDDPA Basins	MDDPA Basin Area and Imp. (acres, %)	Planned onsite Area and Imp. (acres, %)	HR Green Basins	Total Area and Imp. (acres, %)
Pond A	BHE2	8.8 @ 65.0%	8.8 @ 65.0%	1, 2, 9	8.8 @ 55%
WFJCC Pond 1	WF1a, WF1b, WF2	20.1 @ 60.4%	20.1 @ 60.4%	3, 4, 5, 12, WF2	20.1 @ 53%
BH ½ Pond	BL1	3.0 @ 95%	0.1 @ 100%	8	0.1 @ 100%
MKJCC Pond 10	BHC	14.1 @ 95%	2.8 @ 2%	10, 11	2.8 @ 2%
TAR East Pond	OS-ES	3.8 @ 2%	3.8 @ 2%	OS-ES	3.8 @ 2%

Water quality and detention for Basins 1, 2 and 9 is provided in a private, full spectrum detention pond (Pond A) located in the northeast corner of the site. A total of 8.76 acres at 54.8% imperviousness will be detained in Pond A. The WQCV is 0.161 ac-ft, the EURV is 0.520 ac-ft, and the 100-year volume is 0.632 ac-ft. The WQCV, EURV and 100-year storms are released in 40, 68 and 66 hours, respectively. Pond A will outfall at less than the site's historic values (Historic:  $Q_5 = 5.5$  cfs  $Q_{100} = 20.9$  cfs vs. Developed:  $Q_5 = 1.7$  cfs  $Q_{100} = 17.7$  cfs) to the drainage ditch along Bradley Road. A private, concrete forebay is located at the outfall into Pond A and a 6.0' trickle channel conveys flow towards the outlet structure. An 11' access and maintenance road is provided to the bottom of the pond to facilitate future maintenance of the pond facilities. A 36.0' emergency overflow spillway is provided that conveys the undetained, peak 100-year flow rate with 1.0' of freeboard towards the Bradley Road drainage ditch. The spillway and downstream outfall will both be lined with Type L riprap. See Pond A design calculations presented in Appendix D.

The on-site private, full spectrum detention pond utilizes 3:1 pond embankment slope to provide the full spectrum volume in a constrained location. In order to honor existing drainage patterns and the site's historic outfall, it is necessary to place the pond in the site's northeast corner which is the site's existing low point. The pond location is constrained by existing utility easements to the east and the expansion of Bradley Road to the north, as well as the development of Bradley Heights Filing 3 & 4. We respectfully request the City of Colorado Springs approve the pond with 3:1 embankments.

Basins 3, 4, 5, 12, and WF2, a total of 20.09 acres at 53% impervious, correspond to the P2FDR basins WF1A/B, and WF2. These basins will be detained in WJFCC Pond #1. WJFCC Pond #1 is an offsite, private, full spectrum detention pond located south of Legacy Hill Drive and east of Trails at Aspen Ridge Filing 1. At the time of the P2FDR, a percent impervious of 60.4% was assumed for Basin WF1A. The Bradley Heights Filing 3 & 4 FDR onsite calcs determined the percent imperviousness to be 53%. Therefore, the P2FDR was slightly conservative, however; the Bradley Heights Filing 3 & 4's design is in compliance. WFJCC Pond #1 and associated storm sewer will be approved and constructed prior to the Bradley Heights Filing 3 & 4 development. The WFJCC Pond #1 design spreadsheet is presented in Appendix E for reference.

Basin 8, 0.11 acres at 100% impervious, is the onsite portion of MDDPA Basin BL-1. Basin BL-1 is 3.0 acres at 95% impervious and includes offsite landscaped areas. The basin will be detained in the offsite, private, full spectrum detention located within Bradley Heights Filing 1 & 2. The Bradley Heights Filing 1 & 2 pond was constructed with the Bradley Heights Filing 1 & 2 development. Basin 8 area was accounted for within the Pond #1 design as the limits of Basin 10 from the Bradley Heights Filing 1 & 2 FDR encompass Filing 3 & 4

Basin 8. The Bradley Heights Filing 1 & 2 pond design spreadsheet and drainage map are presented in Appendix E, respectively.

Basins 10 and 11, a total of 2.81 undeveloped acres at 2% impervious, are the onsite portion of MDDPA Basin BHC. The basins will be detained in the future offsite, full spectrum detention pond MKJCC Pond #10 per the MDDPA. MKJCC Pond #10 is designed to detain 13.98 acres of future commercial development at 95% impervious. The onsite portion of basin BHC remains undeveloped at 2% impervious and therefore complies with the MDDPA design of MKJCC Pond #10. MKJCC Pond #10 design spreadsheet is presented in Appendix E for reference.

Basin OS-ES, 3.79 acres of undeveloped land at 2% impervious, will be detained in the Trails at Aspen Ridge East Pond (TAR-EP) according to the TAR-FDR. TAR-EP is designed to detain a total of 160.87 acres of 26.52% imperviousness. The TAR-FDR estimated Basin OS-ES at 65% impervious to account for future development. However, as Basin OS-ES remains undeveloped; TAR-EP is adequate. TAR-EP design spreadsheet and TAR-FDR drainage map are presented in Appendix E.

Basin 7 is 0.47 acres of undeveloped land at 2% impervious. Basin 7 is the onsite portion of the MDDPA Basin BH1. Per the MDDPA, Basin 7 will remain undeveloped and sheet flow directly to the Bradley Road ditch at DP12. Since Basin 7 will remain undeveloped, Basin 7 will not be detained in a full spectrum pond.

### **c. Major Drainageways**

The Marksheffel Tributary to Jimmy Camp Creek parallels the site to the east and is the ultimate outfall location for the on-site full spectrum detention pond. Drainageway improvements are anticipated in this channel to facilitate development in the tributary areas per the MDDPA. Refer to “Marksheffel Tributary Channel Improvements at Bradley Heights” by Matrix Design Group for drainageway analysis and recommended improvements.

### **d. Inspection and Maintenance**

An Inspection and maintenance manual will be submitted separately to Colorado Springs via Projectdox. The manual will specify maintenance intervals and required actions to maintain the function of the extended detention basin and appurtenances.

### **e. Grading and Erosion Control Plan**

Due to the project disturbance area, a separate Grading and Erosion Control plan will be required. The Grading and Erosion Control Plan will be submitted in conjunction with the Final Drainage Report and Construction Drawings and prior to any land disturbing activities.

### **f. Four Step Method to Minimize Adverse Impacts of Urbanization**

Step 1 – Reducing Runoff Volumes: Roof drains will route across landscape areas whenever possible to promote infiltration. An IRF for the onsite pond is presented in Appendix D. IRFs for offsite ponds are presented in Appendix E.

Step 2 – Treat and slowly release the WQCV. WQCV will be provided for the site in ponds WFJCC Pond #1, the Bradley Heights Filing 1 & 2 pond, MKJCC Pond 10, TAR-E Pond and Pond A. WQCVs are released over a period of 40 hours.

Step 3 – Stabilize stream channels: All new and re-development projects are required to construct or participate in the funding of channel stabilization measures. Drainage basin fees paid, at the time of platting,

go towards channel stabilization with the drainage basin. Drainage channels will be lined with non-erosive soils and permanently seeded to provide stabilization. If required due to erosive velocities, additional protection will be provided in the form of riprap lining and drop structures to reduce stormwater velocities and provide stabilization. Stormwater discharge points will be adequately stabilized. The private, full spectrum detention pond discharges approximately 2,750 feet from Jimmy Camp Creek.

Step 4 – Consider the need for source controls: No industrial or commercial uses are proposed within this development and therefore no source controls are proposed.

**g. Drainage and Bridge Fees**

Drainage and bridge fees for the Jimmy Camp Creek Drainage Basin are due at time of platting. See table below for anticipated drainage and bridge fees for Bradley Heights Filing 3 & 4. Fees to be deferred and used by the Bradley Heights Metro District No. 2 for drainage improvements.

Jimmy Camp Creek Drainage Basin – 2022 Drainage & Bridge Fees				
Site Acreage	Drainage Fee/acre	Bridge Fee/acre	Drainage Fee	Bridge Fee
34.46	\$9,185	\$2,993	\$316,516	\$103,139

**h. Hydraulic Grade Line Analysis**

A Hydraulic Grade Line analysis for the storm network is presented in Appendix C.

**i. Opinion of Probable Cost**

An engineer’s opinion of probable cost has been included in Appendix E.

## V. Summary

The Bradley Heights Filing 3 & 4 development remains consistent with pre-development drainage conditions with the construction of the recommended drainage improvements. The proposed development will not adversely affect downstream stormwater infrastructure or surrounding developments. This report meets the latest City of Colorado Springs Drainage criteria and is in accordance with the Bradley Heights MDDPA.

## VI. Variances

The approved variances are included in Appendix G.

## VII. Drawings

Please refer to the appendices for vicinity and drainage basin maps.

## VIII. References

1. City of Colorado Springs – Drainage Criteria Manual, May 2014, Revised January 2021.
2. Urban Storm Drainage Criteria Manual, Urban Drainage Flood Control District, January 2018.
3. “Jimmy Camp Creek Drainage Basin Planning Study” Kiowa Engineering Corporation, March 9, 2015.
4. “Master Development Drainage Plan for Bradley Heights Classic Consulting Engineers and Surveyors, February 12, 2015.
5. “Master Development Drainage Report Amendment for Bradley Heights & for Phase I Bradley Heights Road Improvements,” December 2021
6. “Bradley Heights Metro District (Phase 2) Final Drainage Report” prepared by Matrix Design Group. April 2022.
7. “Final Drainage Report for Trails at Aspen Ridge Filing No. 2,” approved by El Paso County July 22, 2021.
8. “Bradley Heights Filing 1&2 Final Drainage Report,” (STM-REV22-0091) Approved July 08, 2022.

## **APPENDIX A – VICINITY MAP, SOIL MAP, FEMA MAP**

*– NOT INCLUDED WITH AMENDMENT. UNCHANGED FROM APPROVED FDR (STM-REV22-0521)*

FDR AMENDMENT 1:  
07/30/24

## APPENDIX B – HYDROLOGIC CALCULATIONS



**BRADLEY HEIGHTS FILING 3/4**

**PROPOSED CONDITIONS**

**LOCATION: COLORADO SPRINGS, COLORADO**

**Calc'd by:**

**CBM**

**Checked by:**

**Date:**

**5/15/2024**

**SUMMARY RUNOFF TABLE**

BASIN	AREA (ac)	% IMPERVIOUS	Q <sub>5</sub> (cfs)	Q <sub>100</sub> (cfs)
1	4.86	46	7.1	17.3
2	3.41	76	9.0	17.8
3	4.57	59	8.3	18.2
4	7.13	52	10.8	25.1
5	2.93	57	5.1	11.5
7	0.47	2	0.2	1.4
8	0.11	100	0.5	0.9
9	0.49	2	0.2	1.3
10	0.73	2	0.2	1.4
11	2.08	2	0.5	3.6
12	1.11	65	2.2	4.8
WF2	4.35	44	7.3	17.9
OS-ES	3.79	2	0.5	3.4

**DESIGN POINT SUMMARY TABLE**

DESIGN POINT	UPSTREAM BASIN	ΣQ <sub>5</sub> (cfs)	ΣQ <sub>100</sub> (cfs)
1	1	7.0	12.5
2	2	8.4	12.7
3	1, DP1	0.1	4.8
4	2, DP2	0.6	5.1
4.1	DP3, DP4	0.7	9.3
5.1	DP1, DP4	7.6	21.6
6.1	DP2, DP5.1	15.0	32.9
7	3	7.9	12.9
8	4	6.9	6.5
9	4, DP8	6.9	19.6
9.1	DP8, DP9	10.8	25.1
10	5	5.1	11.5
10.1	DP7, DP10	12.8	24.0
11.1	DP9.1, DP10.1	22.8	47.6
12	7	0.2	1.4
13	8	0.5	0.9
14	10	0.2	1.4
15	11A	0.7	4.6
17	12, DP7 FLOWBY	2.9	10.7
AU	WF2, DP17	9.8	27.8
OS-E	14	0.5	3.4

**BASIN COMPARISON**

BHE2	1
	2
	3
WF1a	4
	5
WF1b	12



**BRADLEY HEIGHTS FILING 3/4**

**PROPOSED CONDITIONS**

**LOCATION: COLORADO SPRINGS, COLORADO**

**Calc'd by: CBM**

**Checked by:**

**Date: 5/15/2024**

**COMPOSITE 'C' FACTORS**

BASIN	LANDSCAPING	PAVED	SINGLE FAMILY LOT	TOTAL	SOIL TYPE	LANDSCAPING			PAVED			SINGLE FAMILY LOT			COMPOSITE IMPERVIOUSNESS & C		
	ACRES					%I	C <sub>5</sub>	C <sub>100</sub>	%I	C <sub>5</sub>	C <sub>100</sub>	%I	C <sub>5</sub>	C <sub>100</sub>	%I	C <sub>5</sub>	C <sub>100</sub>
1	2.07	1.06	1.73	4.86	B	2	0.09	0.36	100	0.90	0.96	65	0.45	0.59	46	0.39	0.57
2	0.42	1.82	1.17	3.41	B	2	0.09	0.36	100	0.90	0.96	65	0.45	0.59	76	0.65	0.76
3	1.14	1.31	2.12	4.57	B	2	0.09	0.36	100	0.90	0.96	65	0.45	0.59	59	0.49	0.64
4	2.37	1.60	3.16	7.13	B	2	0.09	0.36	100	0.90	0.96	65	0.45	0.59	52	0.43	0.60
5	0.73	0.62	1.58	2.93	B	2	0.09	0.36	100	0.90	0.96	65	0.45	0.59	57	0.45	0.61
7	0.47	0.00	0.00	0.47	B	2	0.09	0.36	100	0.90	0.96	65	0.45	0.59	2	0.09	0.36
8	0.00	0.11	0.00	0.11	B	2	0.09	0.36	100	0.90	0.96	65	0.45	0.59	100	0.90	0.96
9	0.49	0.00	0.00	0.49	B	2	0.09	0.36	100	0.90	0.96	65	0.45	0.59	2	0.09	0.36
10	0.73	0.00	0.00	0.73	B	2	0.09	0.36	100	0.90	0.96	65	0.45	0.59	2	0.09	0.36
11	2.08	0.00	0.00	2.08	B	2	0.09	0.36	100	0.90	0.96	65	0.45	0.59	2	0.09	0.36
12	0.00	0.00	1.11	1.11	B	2	0.09	0.36	100	0.90	0.96	65	0.45	0.59	65	0.45	0.59
WF2	2.25	1.66	0.44	4.35	B	2	0.09	0.36	95	0.81	0.88	65	0.45	0.59	44	0.40	0.58
OS-ES	3.79	0.00	0.00	3.79	B	2	0.09	0.36	100	0.90	0.96	65	0.45	0.59	2	0.09	0.36
<b>Pond Summary</b>	<b>Basins:</b>			<b>Area</b>													
Pond A	1,2,9			8.76											55		
WFJCC Pond 1	3,4,5,12,WF2			20.09											53		
BH 1/2 Pond	8			0.11											100		
MKJCC Pond 10	10,11			2.81											2		
TAR Pond E	OS-ES			3.79											2		
Total				35.56													



**BRADLEY HEIGHTS FILING 3/4**

**PROPOSED CONDITIONS**

**DESIGN STORM: 5-YEAR**

Calc'd by:

CBM

Checked by:

Date:

5/15/2024

STREET	DESIGN POINT	BASIN ID	DIRECT RUNOFF					TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
			AREA (ac)	C <sub>s</sub>	f <sub>c</sub> (min)	C <sub>s</sub> * A (ac)	f (in./hr.)	Q (cfs)	f <sub>c</sub> (min)	C <sub>s</sub> * A (ac)	f (in./hr.)	Q (cfs)	Q <sub>street</sub> (cfs)	C <sub>s</sub> * A (ac)	SLOPE %	Q <sub>PIPE</sub> (cfs)	C <sub>s</sub> * A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (FT)	VEL. (FPS)	
	1	1	4.86	0.39	13.2	1.92	3.71	7.1			0.1	0.03	3.5		7.0	1.88	2.0	1.5	125	3.7	0.56	DP 1 FLOWBY CAPTURED BY 15' TYPE R @ DP 3
																			15	8.4	0.03	BASIN 1 FLOW CAPTURED BY 15' TYPE R, PIPED TO DP 5.1
	2	2	3.41	0.65	10.1	2.20	4.11	9.0			0.6	0.16	3.5		8.4	2.05	2.0	1.5	125	3.7	0.56	DP 2 FLOWBY CAPTURED BY 10' TYPE R @ DP 4
																			15	8.4	0.03	BASIN 2 FLOW CAPTURED BY 15' TYPE R @ DP 2, PIPED TO DP 6.1
	3								13.7	0.03	3.65	0.1		0.1	0.03	2.0	1.5	1.5	15	8.4	0.03	DP 1 FLOWBY CAPTURED BY 15' TYPE R @ DP 3, PIPED TO DP 4.1
	4								10.7	0.16	4.03	0.6		0.6	0.16	2.0	1.5	1.5	15	8.4	0.03	DP 2 FLOWBY CAPTURED BY 10' TYPE R @ DP 4, PIPED TO DP 4.1
	4.1								13.8	0.19	3.65	0.7		0.7	0.19	2.0	1.5	1.5	15	8.4	0.03	COMBINED DP 3 & 4 @ DP 4.1, PIPED TO DP 5.1
	5.1								13.8	2.07	3.65	7.6		7.6	2.07	2.0	1.5	1.5	15	8.4	0.03	COMBINED DP 1 & DP 4.1 @ DP 5.1, PIPED TO DP 6.1
	6.1								13.8	4.12	3.65	15.0										COMBINED DP 5.1 & DP 2 @ DP 6.1, PIPED TO POND A
	7	3	4.57	0.49	13.2	2.23	3.71	8.3			0.4	0.10	3.0		7.9	2.13	2.6	1.5	195	3.5	0.94	DP 7 FLOWBY, C&G FLOW TO DP 17
																			465	9.6	0.81	BASIN 3 FLOW CAPTURED BY 15' TYPE R @DP 7 , PIPED TO DP 10.1
	8	4	7.13	0.43	15.1	3.07	3.51	10.8			6.9	1.96	1.0		3.9	1.11	2.0	1.5	120	2.0	1.00	DP 8 FLOWBY CAPTURED BY 15' TYPE R SUMP @ DP 9
																			85	8.4	0.17	BASIN 4 FLOW CAPTURED BY 5' TYPE R @ DP 8, PIPED TO DP 9.1
	9								15.1	1.96	3.51	6.9		6.9	1.96	2.0	1.5	1.5	15	8.4	0.03	DP 8 FLOWBY CAPTURED BY 15' TYPE R SUMP @ DP 9, PIPED TO 9.1
	9.1								15.1	3.07	3.51	10.8		10.8	3.07	2.0	1.5	1.5	15	8.4	0.03	COMBINED DP 8 & 9, PIPED TO DP 9.1
	10	5	2.93	0.45	12.1	1.33	3.84	5.1														BASIN 5 FLOW CAPTURED BY 10' TYPE R SUMP @ DP 10
	10.1								13.2	3.46	3.71	12.8										COMBINED DP 7 & 10 @ DP 10.1, PIPED TO 11.1
	11.1								15.2	6.53	3.50	22.8										COMBINED DP 9.1 AND 10.1 @ DP 11.1, PIPED OFFSITE TO BHMD STORM
	12	7	0.47	0.09	5.9	0.04	4.93	0.2														BASIN 7 FLOW TO DP 12
	13	8	0.11	0.90	5.0	0.10	5.17	0.5														BASIN 8 C&G FLOW TO DP 13, CONVEYED BY BRADLEY LANDING BLVD AND LEGACY HILL DR
	9																					BASIN 9 FLOW WILL BE DETAINED IN POND A
	14	10	0.73	0.09	18.9	0.07	3.17	0.2														BASIN 10 FLOW TO DP 14 TO BE CONVEYED BY BRADLEY RD DITCH
	15	11	2.08	0.09	23.4	0.19	2.85	0.5														BASIN 11 FLOW TO DP 15 TO BE CONVEYED BY BRADLEY LANDING BLVD DITCH
	17	12	1.11	0.45	8.3	0.50	4.41	2.2	14.2	0.60	3.61	2.2										BASIN 12 COMBINES WITH DP 7 FLOWBY VIA C&G FLOW AND FLOWS TO DP AU
	AU	WF2	4.35	0.40	9.7	1.75	4.17	7.3	14.2	2.35	3.61	9.8										COMBINED BASIN WF2 AND DP 17 FLOW @ MDDPA DP AU, PIPED TO WFJCC POND #1
	OS-E	OS-ES	3.79	0.09	58.5	0.34	1.48	0.5														BASIN OS-ES FLOW TO TAR-FDR DP OS-E



**BRADLEY HEIGHTS FILING 3/4**  
**PROPOSED CONDITIONS**  
**DESIGN STORM: 100-YEAR**

Calc'd by: **CBM**  
Checked by:  
Date: **5/15/2024**

STREET	DESIGN POINT	BASIN ID	DIRECT RUNOFF					TOTAL RUNOFF					STREET			PIPE				TRAVEL TIME			REMARKS
			AREA (ac)	C <sub>100</sub>	f <sub>c</sub> (min)	C <sub>100</sub> *A (ac)	/ (in./hr.)	Q (cfs)	f <sub>c</sub> (min)	C <sub>100</sub> *A (ac)	/ (in./hr.)	Q (cfs)	Q <sub>street</sub> (cfs)	C <sub>100</sub> *A (ac)	SLOPE %	Q <sub>PIPE</sub> (cfs)	C <sub>100</sub> *A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (ft)	VEL. (ft/s)	TRAVEL TIME (min)	
	1	1	4.86	0.57	13.2	2.78	6.24	17.3			4.8	0.78	3.5		12.5	2.00	2.0	1.5	125	3.7	0.56	DP 1 FLOWBY CAPTURED BY 15' TYPE R @ DP 3	
	2	2	3.41	0.76	10.1	2.59	6.90	17.8			5.1	0.75	3.5		12.7	1.84	2.0	1.5	15	8.4	0.03	BASIN 1 FLOW CAPTURED BY 15' TYPE R, PIPED TO DP 5.1	
	3										13.7	0.78	6.13	4.8		4.8	0.78	2.0	1.5	15	8.4	0.03	DP 2 FLOWBY CAPTURED BY 10' TYPE R @ DP 4
	4										10.7	0.75	6.76	5.1		5.1	0.75	2.0	1.5	15	8.4	0.03	BASIN 2 FLOW CAPTURED BY 15' TYPE R @ DP 2, PIPED TO DP 6.1
	4.1										13.8	1.52	6.13	9.3		9.3	1.52	2.0	1.5	15	8.4	0.03	DP 1 FLOWBY CAPTURED BY 15' TYPE R @ DP 3, PIPED TO DP 4.1
	5.1										13.8	3.53	6.12	21.6		21.6	3.53	2.0	1.5	15	8.4	0.03	DP 2 FLOWBY CAPTURED BY 10' TYPE R @ DP 4, PIPED TO DP 4.1
	6.1										13.8	5.37	6.12	32.9								0.03	COMBINED DP 3 & 4 @ DP 4.1, PIPED TO DP 5.1
																							COMBINED DP 1 & DP 4.1 @ DP 5.1, PIPED TO DP 6.1
																							COMBINED DP 5.1 & DP 2 @ DP 6.1, PIPED TO POND A
	7	3	4.57	0.64	13.2	2.92	6.23	18.2			5.3	0.85	3.0		12.9	2.07	2.6	1.5	195	3.5	0.94	DP 7 FLOWBY, C&G FLOW TO DP 17	
	8	4	7.13	0.60	15.1	4.25	5.90	25.1			19.6	3.32	1.0		5.5	0.93	2.0	1.5	465	9.6	0.81	BASIN 3 FLOW CAPTURED BY 15' TYPE R @ DP 7, PIPED TO DP 10.1	
	9										15.1	3.32	5.90	19.6		19.6	3.32	2.0	1.5	85	8.4	0.17	DP 8 FLOWBY CAPTURED BY 15' TYPE R SUMP @ DP 9
	9.1										15.1	4.25	5.89	25.1		25.1	4.25	2.0	1.5	15	8.4	0.03	BASIN 4 FLOW CAPTURED BY 5' TYPE R @ DP 8, PIPED TO DP 9.1
	10	5	2.93	0.61	12.1	1.79	6.44	11.5															DP 8 FLOWBY CAPTURED BY 15' TYPE R SUMP @ DP 9, PIPED TO 9.1
	10.1										13.2	3.86	6.23	24.0									COMBINED DP 8 & 9, PIPED TO DP 9.1
	11.1										15.2	8.11	5.87	47.6									BASIN 5 FLOW CAPTURED BY 10' TYPE R SUMP @ DP 10
	12	7	0.47	0.36	5.9	0.17	8.28	1.4															COMBINED DP 7 & 10 @ DP 10.1, PIPED TO 11.1
	13	8	0.11	0.96	5.0	0.11	8.68	0.9															COMBINED DP 9.1 AND 10.1 @ DP 11.1, PIPED OFFSITE TO BHMD STORM
	9		0.49	0.36	8.3	0.18	7.41	1.3															BASIN 7 FLOW TO DP 12
	14	10	0.73	0.36	18.9	0.26	5.32	1.4															BASIN 8 C&G FLOW TO DP 13, CONVEYED BY BRADLEY LANDING BLVD AND LEGACY HILL DR
	15	11	2.08	0.36	23.4	0.75	4.79	3.6															BASIN 9 FLOW WILL BE DETAINED IN POND A
	17	12	1.11	0.59	8.3	0.65	7.41	4.8			14.2	1.50	6.06	9.1									BASIN 10 FLOW TO DP 14 TO BE CONVEYED BY BRADLEY RD DITCH
AU	WF2		4.35	0.58	9.7	2.53	7.00	17.9															BASIN 11 FLOW TO DP 15 TO BE CONVEYED BY BRADLEY LANDING BLVD DITCH
OS-E	OS-ES		3.79	0.36	58.5	1.36	2.48	3.4															BASIN 12 COMBINES WITH DP 7 FLOWBY VIA C&G FLOW TO DP 17
																							COMBINED BASIN WF2 AND DP 17 FLOW @ MDDPA DP AU, PIPED TO WFJCC POND #1
																							BASIN OS-ES FLOW TO TAR-FDR DP OS-E

FDR AMENDMENT 1:  
07/30/24

## APPENDIX C – HYDRAULIC CALCULATIONS

# INLET MANAGEMENT

Worksheet Protected

<b>INLET NAME</b>	<a href="#">DP-1</a>	<a href="#">DP-2</a>	<a href="#">DP-3</a>	<a href="#">DP-7</a>
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

## USER-DEFINED INPUT

<b>User-Defined Design Flows</b>				
Minor $Q_{Known}$ (cfs)	7.1	9.0	0.1	8.3
Major $Q_{Known}$ (cfs)	17.3	17.8	4.8	18.2

<b>Bypass (Carry-Over) Flow from Upstream</b>				
Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, $Q_b$ (cfs)	0.0	0.0	0.0	0.0
Major Bypass Flow Received, $Q_b$ (cfs)	0.0	0.0	0.0	0.0

<b>Watershed Characteristics</b>				
Subcatchment Area (acres)				
Percent Impervious				
NRCS Soil Type				

<b>Watershed Profile</b>				
Overland Slope (ft/ft)				
Overland Length (ft)				
Channel Slope (ft/ft)				
Channel Length (ft)				

<b>Minor Storm Rainfall Input</b>				
Design Storm Return Period, $T_r$ (years)				
One-Hour Precipitation, $P_1$ (inches)				

<b>Major Storm Rainfall Input</b>				
Design Storm Return Period, $T_r$ (years)				
One-Hour Precipitation, $P_1$ (inches)				

## CALCULATED OUTPUT

<b>Minor Total Design Peak Flow, <math>Q</math> (cfs)</b>	<b>7.1</b>	<b>9.0</b>	<b>0.1</b>	<b>8.3</b>
<b>Major Total Design Peak Flow, <math>Q</math> (cfs)</b>	<b>17.3</b>	<b>17.8</b>	<b>4.8</b>	<b>18.2</b>
Minor Flow Bypassed Downstream, $Q_b$ (cfs)	0.1	0.6	0.0	0.4
Major Flow Bypassed Downstream, $Q_b$ (cfs)	4.8	5.1	0.0	5.3

MHFD-Inlet, Version 5.01 (April 2021)

## INLET MANAGEMENT

Worksheet Protected

<b>INLET NAME</b>	DP-8	DP-4
Site Type (Urban or Rural)	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET
Hydraulic Condition	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening

### USER-DEFINED INPUT

#### User-Defined Design Flows

Minor $Q_{known}$ (cfs)	10.8	0.6
Major $Q_{known}$ (cfs)	25.1	5.1

#### Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, $Q_b$ (cfs)	0.0	0.0
Major Bypass Flow Received, $Q_b$ (cfs)	0.0	0.0

#### Watershed Characteristics

Subcatchment Area (acres)		
Percent Impervious		
NRCS Soil Type		

#### Watershed Profile

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

#### Minor Storm Rainfall Input

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

#### Major Storm Rainfall Input

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

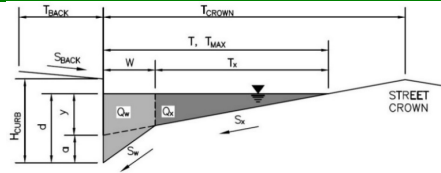
### CALCULATED OUTPUT

<b>Minor Total Design Peak Flow, <math>Q</math> (cfs)</b>	<b>10.8</b>	<b>0.6</b>
<b>Major Total Design Peak Flow, <math>Q</math> (cfs)</b>	<b>25.1</b>	<b>5.1</b>
Minor Flow Bypassed Downstream, $Q_b$ (cfs)	6.9	0.0
Major Flow Bypassed Downstream, $Q_b$ (cfs)	19.6	0.0

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

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

**Project:** BRADLEY HEIGHTS FILING 3 & 4  
**Inlet ID:** DP-1



**Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb  
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)  
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

$T_{BACK}$	=	8.0	ft
$S_{BACK}$	=	0.020	ft/ft
$n_{BACK}$	=	0.020	

Height of Curb at Gutter Flow Line  
 Distance from Curb Face to Street Crown  
 Gutter Width  
 Street Transverse Slope  
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)  
 Street Longitudinal Slope - Enter 0 for sump condition  
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$H_{CURB}$	=	6.00	inches
$T_{CROWN}$	=	17.0	ft
$W$	=	2.00	ft
$S_x$	=	0.020	ft/ft
$S_w$	=	0.063	ft/ft
$S_o$	=	0.045	ft/ft
$n_{STREET}$	=	0.016	

Max. Allowable Spread for Minor & Major Storm  
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm  
 Allow Flow Depth at Street Crown (check box for yes, leave blank for no)

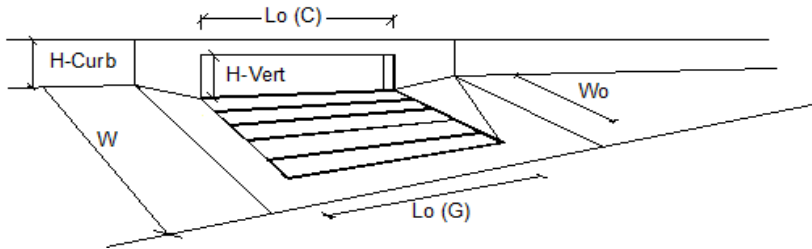
	Minor Storm	Major Storm	
$T_{MAX}$	=	17.0	ft
$d_{MAX}$	=	5.1	inches
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

MINOR STORM Allowable Capacity is based on Depth Criterion  
 MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
$Q_{allow}$	=	19.8	35.4 cfs

**Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**  
**Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**

## INLET ON A CONTINUOUS GRADE



**Design Information (Input)**

Type of Inlet CDOT Type R Curb Opening  
 Local Depression (additional to continuous gutter depression 'a')  
 Total Number of Units in the Inlet (Grate or Curb Opening)  
 Length of a Single Unit Inlet (Grate or Curb Opening)  
 Width of a Unit Grate (cannot be greater than W, Gutter Width)  
 Clogging Factor for a Single Unit Grate (typical min. value = 0.5)  
 Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)

	MINOR	MAJOR	
Type	=	CDOT Type R Curb Opening	
$a_{LOCAL}$	=	3.0	3.0 inches
No	=	3	3
$L_o$	=	5.00	5.00 ft
$W_o$	=	N/A	N/A ft
$C_{F-G}$	=	N/A	N/A
$C_{F-C}$	=	0.10	0.10

**Street Hydraulics: OK - Q < Allowable Street Capacity'**

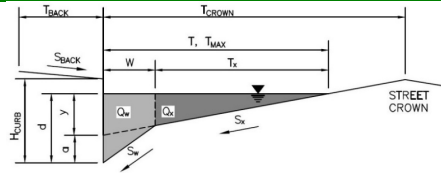
Total Inlet Interception Capacity  
 Total Inlet Carry-Over Flow (flow bypassing inlet)  
 Capture Percentage =  $Q_c/Q_o$  =

	MINOR	MAJOR	
$Q$	=	7.0	12.5 cfs
$Q_b$	=	0.1	4.8 cfs
$C\%$	=	99	72 %

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

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

**Project:** BRADLEY HEIGHTS FILING 3 & 4  
**Inlet ID:** DP-2



**Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb  
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)  
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

$T_{BACK}$	=	8.0	ft
$S_{BACK}$	=	0.020	ft/ft
$n_{BACK}$	=	0.020	

Height of Curb at Gutter Flow Line  
 Distance from Curb Face to Street Crown  
 Gutter Width  
 Street Transverse Slope  
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)  
 Street Longitudinal Slope - Enter 0 for sump condition  
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$H_{CURB}$	=	6.00	inches
$T_{CROWN}$	=	17.0	ft
$W$	=	2.00	ft
$S_x$	=	0.020	ft/ft
$S_w$	=	0.063	ft/ft
$S_o$	=	0.045	ft/ft
$n_{STREET}$	=	0.016	

Max. Allowable Spread for Minor & Major Storm  
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm  
 Allow Flow Depth at Street Crown (check box for yes, leave blank for no)

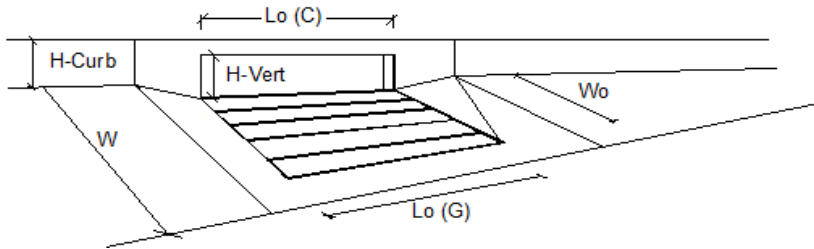
	Minor Storm	Major Storm	
$T_{MAX}$	=	17.0	ft
$d_{MAX}$	=	5.1	inches
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

MINOR STORM Allowable Capacity is based on Depth Criterion  
 MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
$Q_{allow}$	=	19.8	35.4 cfs

**Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**  
**Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**

## INLET ON A CONTINUOUS GRADE



**Design Information (Input)**

Type of Inlet: CDOT Type R Curb Opening  
 Local Depression (additional to continuous gutter depression 'a')  
 Total Number of Units in the Inlet (Grate or Curb Opening)  
 Length of a Single Unit Inlet (Grate or Curb Opening)  
 Width of a Unit Grate (cannot be greater than W, Gutter Width)  
 Clogging Factor for a Single Unit Grate (typical min. value = 0.5)  
 Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)

	MINOR	MAJOR	
Type	=	CDOT Type R Curb Opening	
$a_{LOCAL}$	=	3.0	3.0 inches
No	=	3	3
$L_o$	=	5.00	5.00 ft
$W_o$	=	N/A	N/A ft
$C_{F-G}$	=	N/A	N/A
$C_{F-C}$	=	0.10	0.10

**Street Hydraulics: OK - Q < Allowable Street Capacity'**

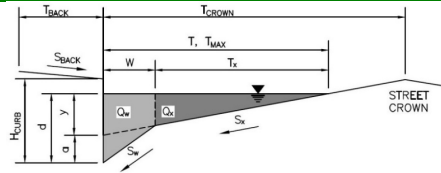
Total Inlet Interception Capacity  
 Total Inlet Carry-Over Flow (flow bypassing inlet)  
 Capture Percentage =  $Q_c/Q_o$  =

	MINOR	MAJOR	
$Q$	=	8.4	12.7 cfs
$Q_b$	=	0.6	5.1 cfs
$C\%$	=	93	71 %

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

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

**Project:** BRADLEY HEIGHTS FILING 3 & 4  
**Inlet ID:** DP-3



**Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb  
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)  
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

$T_{BACK}$	=	8.0	ft
$S_{BACK}$	=	0.020	ft/ft
$n_{BACK}$	=	0.020	

Height of Curb at Gutter Flow Line  
 Distance from Curb Face to Street Crown  
 Gutter Width  
 Street Transverse Slope  
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)  
 Street Longitudinal Slope - Enter 0 for sump condition  
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$H_{CURB}$	=	6.00	inches
$T_{CROWN}$	=	17.0	ft
$W$	=	2.00	ft
$S_x$	=	0.020	ft/ft
$S_w$	=	0.063	ft/ft
$S_o$	=	0.045	ft/ft
$n_{STREET}$	=	0.016	

Max. Allowable Spread for Minor & Major Storm  
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm  
 Allow Flow Depth at Street Crown (check box for yes, leave blank for no)

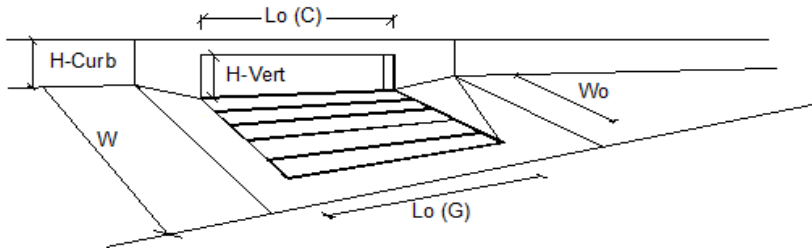
	Minor Storm	Major Storm	
$T_{MAX}$	=	17.0	ft
$d_{MAX}$	=	5.1	inches
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

MINOR STORM Allowable Capacity is based on Depth Criterion  
 MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
$Q_{allow}$	=	19.7	35.3 cfs

**Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**  
**Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**

## INLET ON A CONTINUOUS GRADE



**Design Information (Input)**

Type of Inlet: CDOT Type R Curb Opening  
 Local Depression (additional to continuous gutter depression 'a')  
 Total Number of Units in the Inlet (Grate or Curb Opening)  
 Length of a Single Unit Inlet (Grate or Curb Opening)  
 Width of a Unit Grate (cannot be greater than W, Gutter Width)  
 Clogging Factor for a Single Unit Grate (typical min. value = 0.5)  
 Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)

	MINOR	MAJOR	
Type	=	CDOT Type R Curb Opening	
$a_{LOCAL}$	=	3.0	3.0 inches
No	=	3	3
$L_o$	=	5.00	5.00 ft
$W_o$	=	N/A	N/A ft
$C_{F-G}$	=	N/A	N/A
$C_{F-C}$	=	0.10	0.10

**Street Hydraulics: OK - Q < Allowable Street Capacity'**

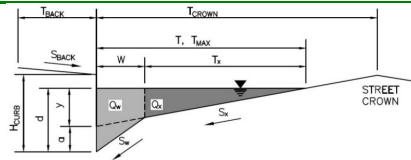
Total Inlet Interception Capacity  
 Total Inlet Carry-Over Flow (flow bypassing inlet)  
 Capture Percentage =  $Q_i/Q_o$  =

	MINOR	MAJOR	
$Q$	=	0.1	4.8 cfs
$Q_b$	=	0.0	0.0 cfs
$C\%$	=	100	100 %

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

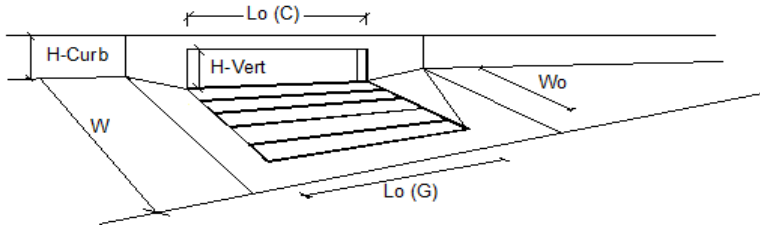
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

**Project:** BRADLEY HEIGHTS FILING 3 & 4  
**Inlet ID:** DP-4



<b>Gutter Geometry:</b>					
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 8.0$ ft				
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft				
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.020$				
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches				
Distance from Curb Face to Street Crown	$T_{CROWN} = 17.0$ ft				
Gutter Width	$W = 0.83$ ft				
Street Transverse Slope	$S_x = 0.020$ ft/ft				
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft				
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.045$ ft/ft				
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.016$				
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> </tr> <tr> <td style="text-align: center; padding: 2px;">17.0</td> <td style="text-align: center; padding: 2px;">17.0</td> </tr> </table> ft	Minor Storm	Major Storm	17.0	17.0
Minor Storm	Major Storm				
17.0	17.0				
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> </tr> <tr> <td style="text-align: center; padding: 2px;">5.1</td> <td style="text-align: center; padding: 2px;">7.9</td> </tr> </table> inches	Minor Storm	Major Storm	5.1	7.9
Minor Storm	Major Storm				
5.1	7.9				
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> </tr> <tr> <td style="text-align: center; padding: 2px;"><input type="checkbox"/></td> <td style="text-align: center; padding: 2px;"><input checked="" type="checkbox"/></td> </tr> </table>	Minor Storm	Major Storm	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Minor Storm	Major Storm				
<input type="checkbox"/>	<input checked="" type="checkbox"/>				
MINOR STORM Allowable Capacity is based on Spread Criterion					
MAJOR STORM Allowable Capacity is based on Depth Criterion					
Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'					
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'					
Max. Allowable Capacity	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> </tr> <tr> <td style="text-align: center; padding: 2px;">21.3</td> <td style="text-align: center; padding: 2px;">39.0</td> </tr> </table> cfs	Minor Storm	Major Storm	21.3	39.0
Minor Storm	Major Storm				
21.3	39.0				

## INLET ON A CONTINUOUS GRADE

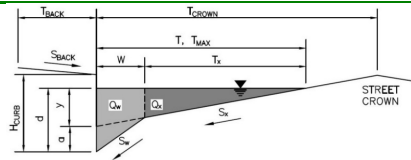


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	$a_{LOCAL} = 3.0$	$3.0$	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	3		
Length of a Single Unit Inlet (Grate or Curb Opening)	$L_o = 5.00$	$5.00$	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	N/A		ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A		
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	$C_r-G = 0.10$	$0.10$	
<b>Street Hydraulics: OK - Q &lt; Allowable Street Capacity</b>			
Total Inlet Interception Capacity	$Q = 0.6$	$5.1$	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	$Q_b = 0.0$	$0.0$	cfs
Capture Percentage = $Q_b/Q_o =$	$C\% = 100$	$100$	%

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

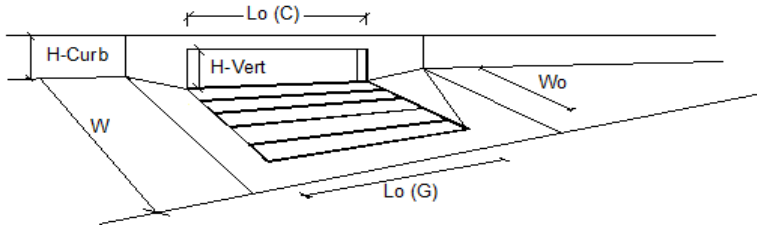
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

**Project:** BRADLEY HEIGHTS FILING 3 & 4  
**Inlet ID:** DP-7



Gutter Geometry:	
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 8.0$ ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.020$
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches
Distance from Curb Face to Street Crown	$T_{CROWN} = 17.0$ ft
Gutter Width	$W = 2.00$ ft
Street Transverse Slope	$S_x = 0.020$ ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.063$ ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.045$ ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.016$
Max. Allowable Spread for Minor & Major Storm	$T_{MAX} = \begin{matrix} \text{Minor Storm} & \text{Major Storm} \\ 17.0 & 17.0 \end{matrix}$ ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	$d_{MAX} = \begin{matrix} \text{Minor Storm} & \text{Major Storm} \\ 5.1 & 7.9 \end{matrix}$ inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)	<input type="checkbox"/> <input checked="" type="checkbox"/>
<span style="color: blue;">MINOR STORM Allowable Capacity is based on Depth Criterion</span>	
<span style="color: blue;">MAJOR STORM Allowable Capacity is based on Depth Criterion</span>	
<span style="color: red;">Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'</span>	
<span style="color: red;">Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'</span>	
	$Q_{allow} = \begin{matrix} \text{Minor Storm} & \text{Major Storm} \\ 19.7 & 35.3 \end{matrix}$ cfs

## INLET ON A CONTINUOUS GRADE



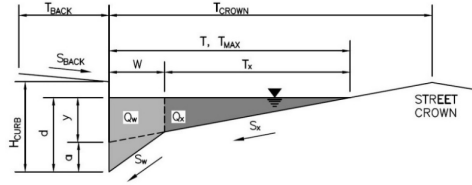
Design Information (Input)	
Type of Inlet	CDOT Type R Curb Opening
Local Depression (additional to continuous gutter depression 'a')	
Total Number of Units in the Inlet (Grate or Curb Opening)	$N_o = 3$
Length of a Single Unit Inlet (Grate or Curb Opening)	$L_o = 5.00$ ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	$W_o = N/A$ ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	$C_r-G = N/A$
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	$C_r-C = 0.10$
<b>Street Hydraulics: OK - Q &lt; Allowable Street Capacity</b>	
Total Inlet Interception Capacity	$Q = \begin{matrix} \text{MINOR} & \text{MAJOR} \\ 7.9 & 12.9 \end{matrix}$ cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	$Q_b = \begin{matrix} \text{MINOR} & \text{MAJOR} \\ 0.4 & 5.3 \end{matrix}$ cfs
Capture Percentage = $Q_b/Q_o =$	$C\% = \begin{matrix} \text{MINOR} & \text{MAJOR} \\ 96 & 71 \end{matrix}$ %

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

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

Project: **BRADLEY HEIGHTS FILING 3 & 4**

Inlet ID: **DP-8**



**Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb  
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)  
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

T <sub>BACK</sub> =	7.0	ft
S <sub>BACK</sub> =	0.020	ft/ft
n <sub>BACK</sub> =	0.020	

Height of Curb at Gutter Flow Line  
Distance from Curb Face to Street Crown  
Gutter Width  
Street Transverse Slope  
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)  
Street Longitudinal Slope - Enter 0 for sump condition  
Manning's Roughness for Street Section (typically between 0.012 and 0.020)

H <sub>CURB</sub> =	6.00	inches
T <sub>CROWN</sub> =	14.0	ft
W =	3.00	ft
S <sub>x</sub> =	0.020	ft/ft
S <sub>w</sub> =	0.063	ft/ft
S <sub>o</sub> =	0.045	ft/ft
n <sub>STREET</sub> =	0.016	

Max. Allowable Spread for Minor & Major Storm  
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm  
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)

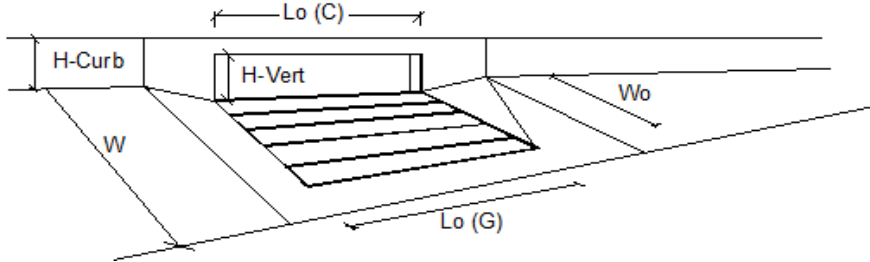
	Minor Storm	Major Storm	
T <sub>MAX</sub> =	14.0	14.0	ft
d <sub>MAX</sub> =	4.4	7.7	inches
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

MINOR STORM Allowable Capacity is based on Depth Criterion  
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q <sub>allow</sub> =	10.6	26.4	cfs

**WARNING: MINOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'**  
**Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**

## INLET ON A CONTINUOUS GRADE



**Design Information (Input)**

Type of Inlet: CDOT Type R Curb Opening  
Local Depression (additional to continuous gutter depression 'a')  
Total Number of Units in the Inlet (Grate or Curb Opening)  
Length of a Single Unit Inlet (Grate or Curb Opening)  
Width of a Unit Grate (cannot be greater than W, Gutter Width)  
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)  
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)

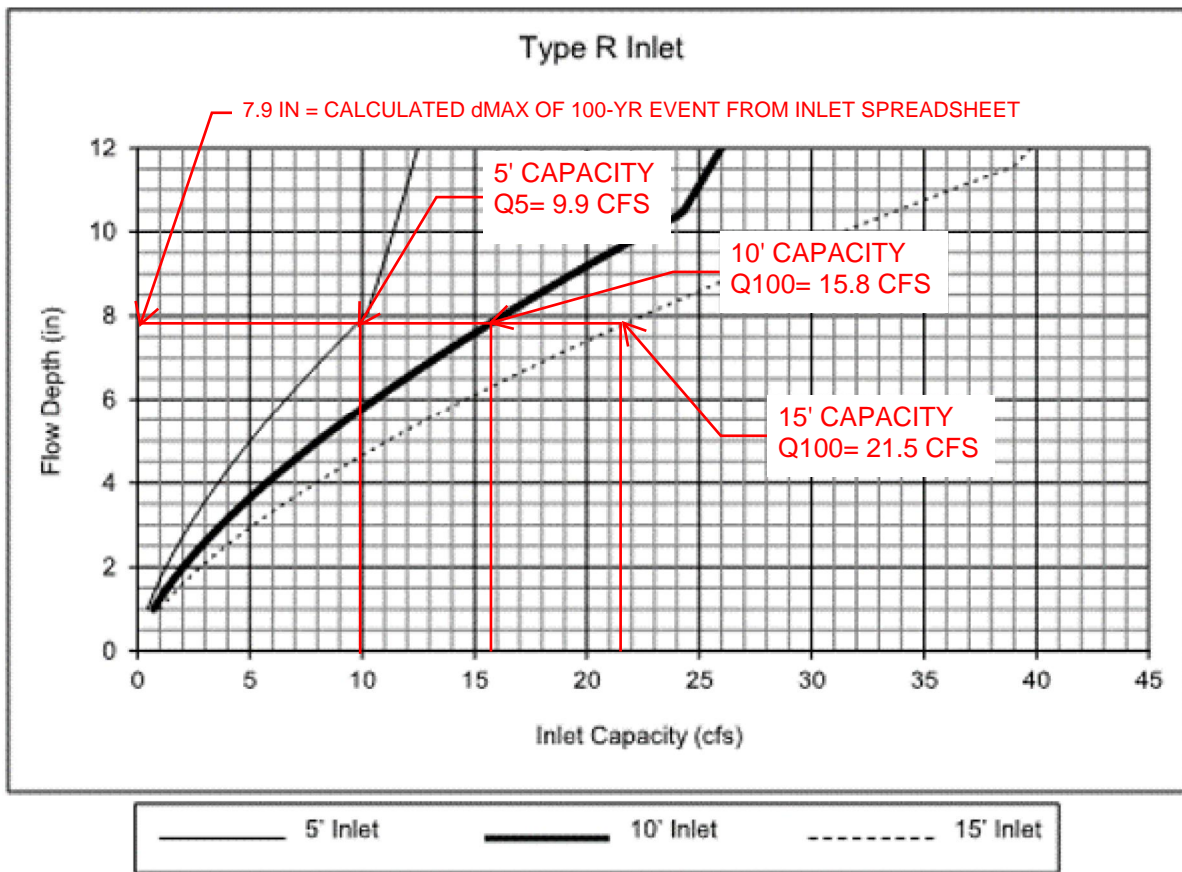
	MINOR	MAJOR	
Type =	CDOT Type R Curb Opening		
a <sub>LOCAL</sub> =	3.0	3.0	inches
No =	1	1	
L <sub>o</sub> =	5.00	5.00	ft
W <sub>o</sub> =	N/A	N/A	ft
C <sub>r-G</sub> =	N/A	N/A	
C <sub>r-C</sub> =	0.10	0.10	

**Street Hydraulics: WARNING: Q > ALLOWABLE Q FOR MINOR STORM!**

Total Inlet Interception Capacity  
Total Inlet Carry-Over Flow (flow bypassing inlet)  
Capture Percentage = Q<sub>a</sub>/Q<sub>o</sub> =

	MINOR	MAJOR	
Q =	3.9	5.5	cfs
Q <sub>b</sub> =	6.9	19.6	cfs
C% =	36	22	%

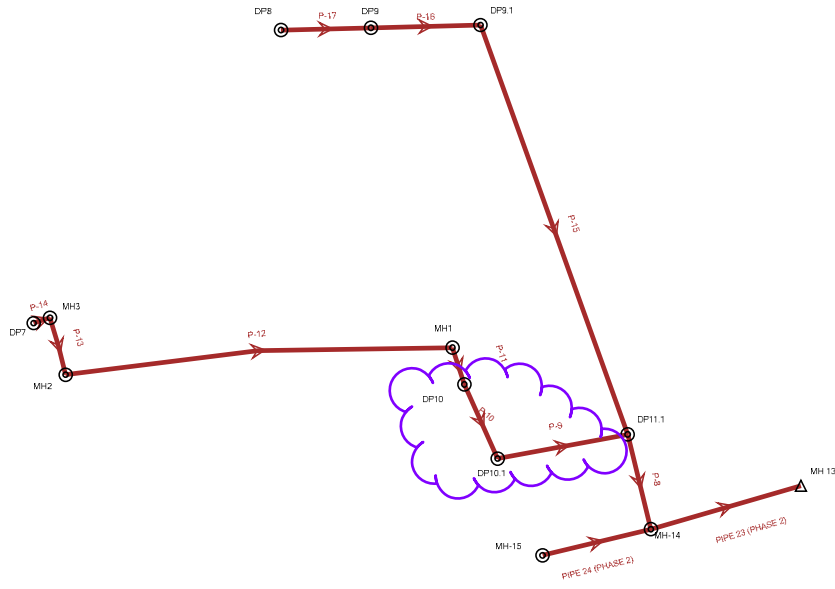
Figure 8-11. Inlet Capacity Chart Sump Conditions , Curb Opening (Type R) Inlet



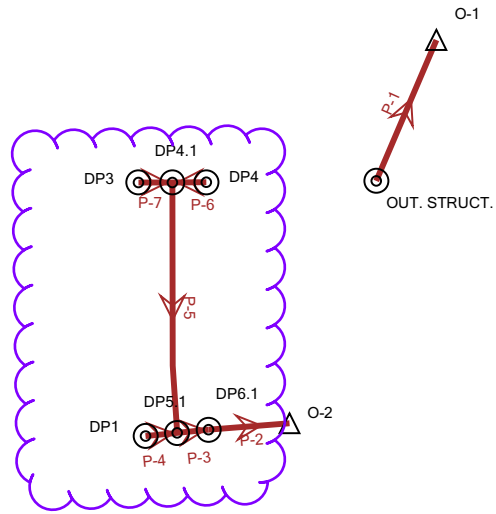
DP-9      Q100 = 19.6 cfs      15' SUMP SELECTED

DP-10      Q100 = 11.5 cfs      10' SUMP SELECTED

STORMCAD LAYOUT



STORMCAD LAYOUT



5 YEAR

FlexTable: Conduit Table

Label	Start Node	Diameter (in)	Length (Unified) (ft)	Flow (cfs)	Velocity (ft/s)	Invert (Start) (ft)	Invert (Stop) (ft)	Slope (Calculated) (ft/ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
P-3	DP5.1	24.0	17.0	7.60	7.36	5,873.00	5,872.76	0.014	5,873.98	5,873.55
P-4	DP1	18.0	17.0	7.00	7.27	5,874.23	5,873.99	0.014	5,875.44	5,875.04
P-7	DP3	18.0	17.0	0.10	3.01	5,875.20	5,874.54	0.039	5,875.32	5,874.62
P-6	DP4	18.0	17.0	0.60	3.41	5,875.20	5,875.00	0.012	5,875.49	5,875.23
P-17	DP8	24.0	82.8	3.90	6.90	5,861.85	5,860.20	0.020	5,862.55	5,860.67
P-15	DP9.1	30.0	400.1	10.80	11.00	5,857.38	5,843.53	0.035	5,858.48	5,845.37
P-14	DP7	24.0	15.8	7.90	7.63	5,857.15	5,856.91	0.015	5,858.15	5,858.29
P-13	MH3	24.0	54.3	7.90	8.51	5,856.77	5,855.66	0.021	5,857.77	5,856.94
P-12	MH2	24.0	357.8	7.90	9.21	5,855.42	5,846.28	0.026	5,856.42	5,847.50
P-9	DP10.1	30.0	121.8	12.80	5.69	5,844.13	5,843.53	0.005	5,845.37	5,845.37
P-11	MH1	24.0	35.5	7.90	7.60	5,845.98	5,845.44	0.015	5,846.98	5,846.21
P-8	DP11.1	36.0	89.7	22.80	15.91	5,843.03	5,837.99	0.056	5,844.57	5,840.82
P-5	DP4.1	24.0	125.2	0.70	3.05	5,874.04	5,873.00	0.008	5,874.47	5,874.49
P-16	DP9	30.0	100.8	6.90	7.95	5,859.70	5,857.68	0.020	5,860.57	5,859.03
P-10	DP10	30.0	74.8	5.10	4.68	5,844.85	5,844.42	0.006	5,845.60	5,845.54
P-2	DP6.1	30.0	50.6	15.00	11.45	5,872.26	5,870.75	0.030	5,873.57	5,871.59
P-1	OUT. STRUCT.	18.0	80.1	1.70	3.41	5,867.90	5,867.50	0.005	5,868.39	5,867.99
PIPE 24 (PHASE 2)	MH-15	24.0	102.6	7.30	6.43	5,839.03	5,838.00	0.010	5,840.92	5,840.82
PIPE 23 (PHASE 2)	MH-14	42.0	143.6	30.10	3.13	5,836.99	5,836.28	0.005	5,840.62	5,840.49

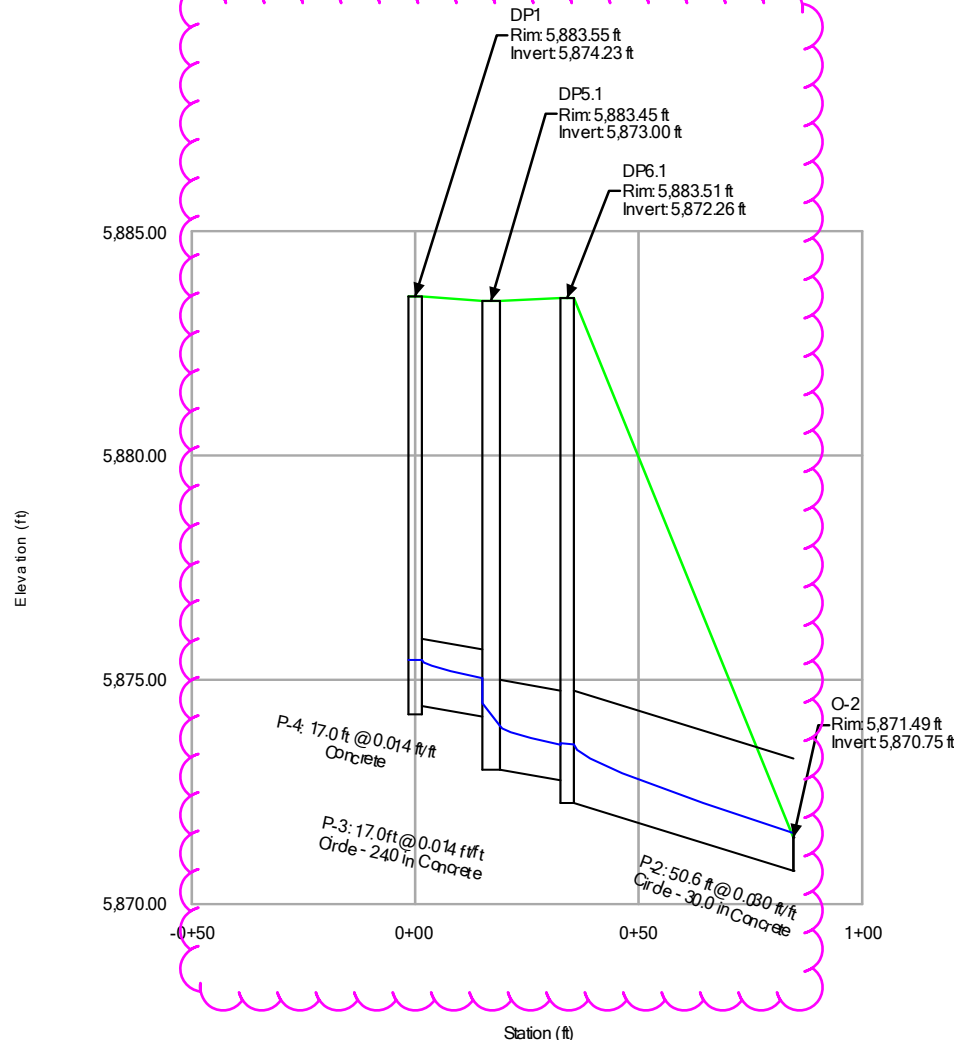
5-YEAR SCENARIO

**FlexTable: Network Elements Table**

Label	Flow (Known) (cfs)	Elevation (User Defined Tailwater) (ft)	Headloss (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
DP6.1	15.00		0.03	5,873.59	5,873.57
DP1	7.00		0.00	5,875.44	5,875.44
DP5.1	7.60		0.51	5,874.49	5,873.98
DP3	0.10		0.00	5,875.32	5,875.32
DP4	0.60		0.00	5,875.49	5,875.49
DP4.1	0.70		0.04	5,874.51	5,874.47
DP8	3.90		0.00	5,862.55	5,862.55
DP9	6.90		0.02	5,860.59	5,860.57
DP9.1	10.80		0.55	5,859.03	5,858.48
DP7	7.90		0.00	5,858.15	5,858.15
MH3	0.00		0.52	5,858.29	5,857.77
MH2	0.00		0.52	5,856.94	5,856.42
DP10.1	12.80		0.17	5,845.54	5,845.37
MH1	0.00		0.52	5,847.50	5,846.98
DP10	5.10		0.03	5,845.62	5,845.60
DP11.1	22.80		0.80	5,845.37	5,844.57
OUT. STRUCT.	1.70		0.00	5,868.39	5,868.39
MH-14	30.10		0.20	5,840.82	5,840.62
MH-15	7.30		0.00	5,840.92	5,840.92
O-2		0.00			
O-1		0.00			
MH 13		5,840.49			
P-3			0.43	5,873.98	5,873.55
P-4			0.41	5,875.44	5,875.04
P-7			0.70	5,875.32	5,874.62
P-6			0.25	5,875.49	5,875.23
P-17			1.88	5,862.55	5,860.67
P-15			13.11	5,858.48	5,845.37
P-14			-0.14	5,858.15	5,858.29
P-13			0.83	5,857.77	5,856.94
P-12			8.93	5,856.42	5,847.50
P-9			0.00	5,845.37	5,845.37
P-11			0.77	5,846.98	5,846.21
P-8			3.75	5,844.57	5,840.82
P-5			-0.01	5,874.47	5,874.49
P-16			1.54	5,860.57	5,859.03
P-10			0.05	5,845.60	5,845.54
P-2			1.98	5,873.57	5,871.59
P-1			0.40	5,868.39	5,867.99
PIPE 24 (PHASE 2)			0.10	5,840.92	5,840.82
PIPE 23 (PHASE 2)			0.13	5,840.62	5,840.49

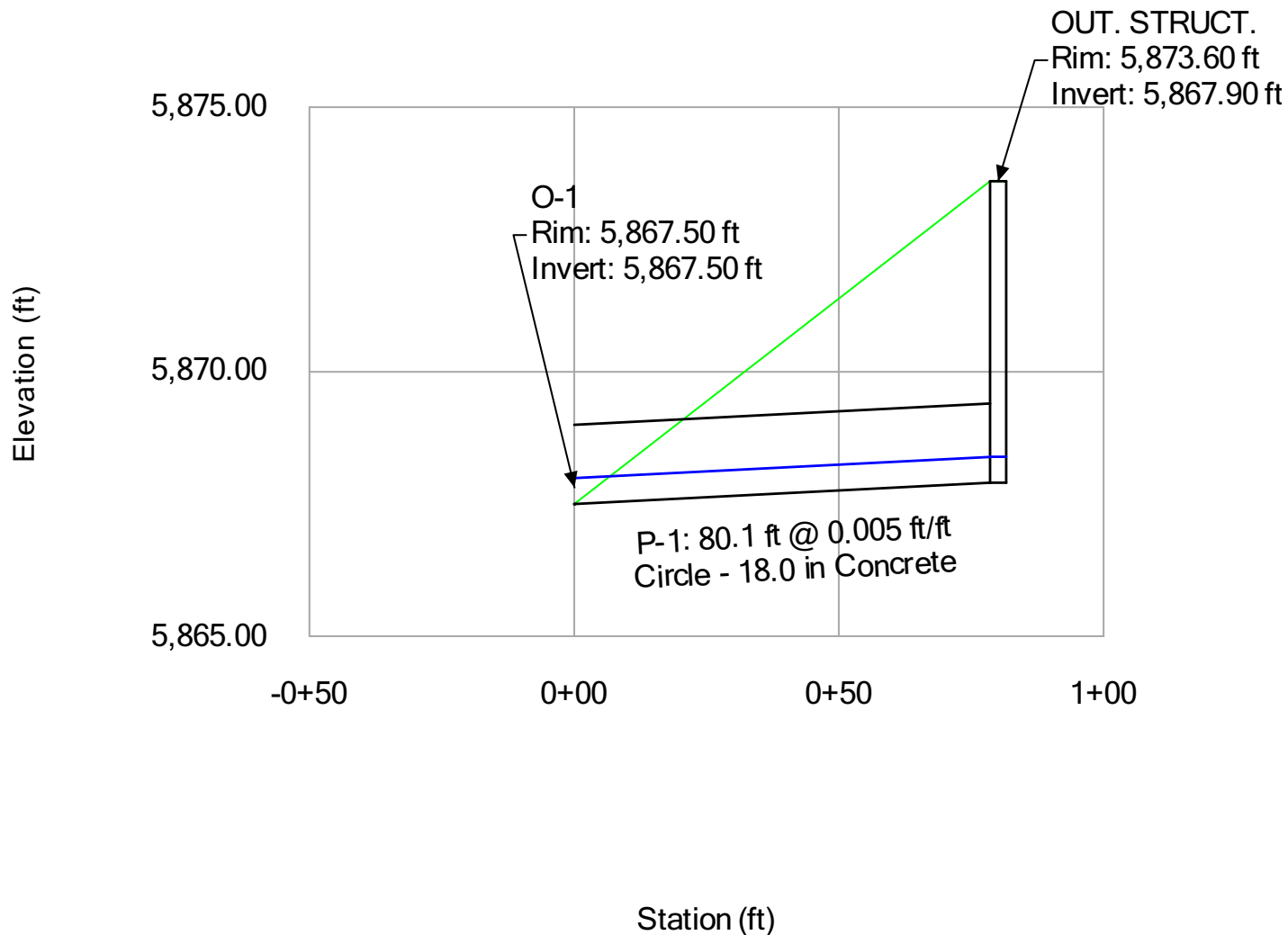
5-YEAR SCENARIO

Profile Report  
Engineering Profile - 01-stm (Bradley\_F3\_4.stsw)



5-YEAR SCENARIO

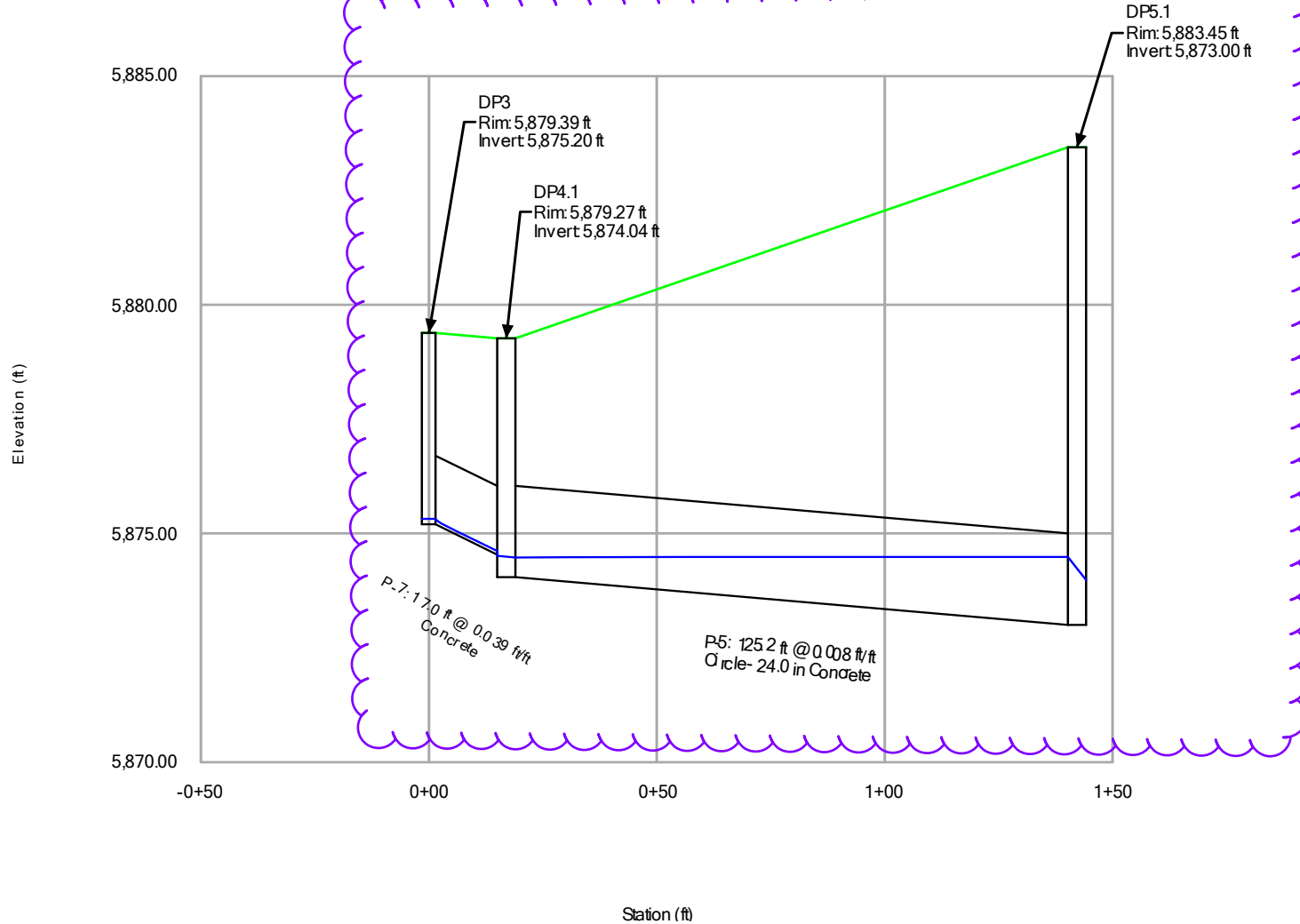
**Profile Report**  
**Engineering Profile - 01-Pond-Outfall (Bradley\_F3\_4.stsw)**



5-YEAR SCENARIO

Profile Report

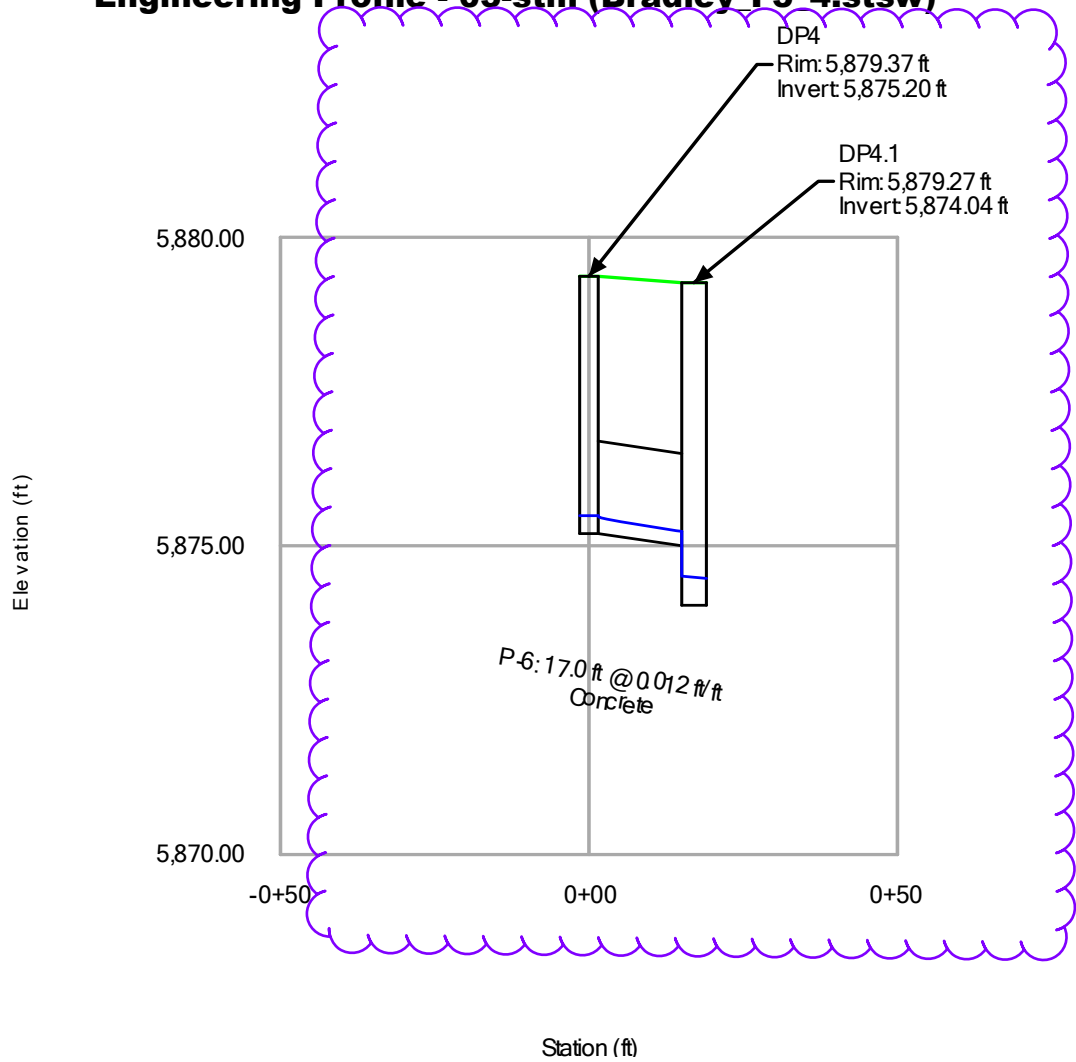
Engineering Profile - 02- stm (Bradley\_F3\_4.stsw)



5-YEAR SCENARIO

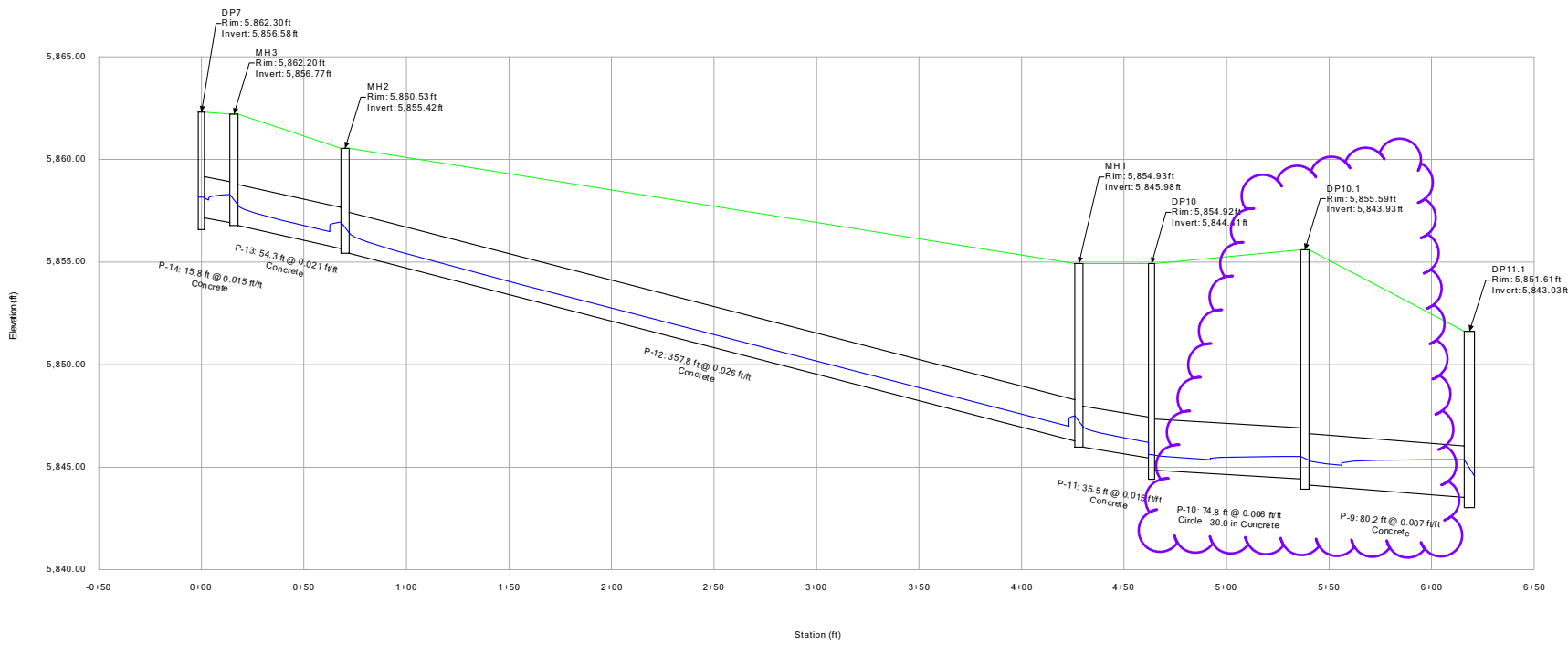
Profile Report

Engineering Profile - 03-stm (Bradley F3 4.stsw)



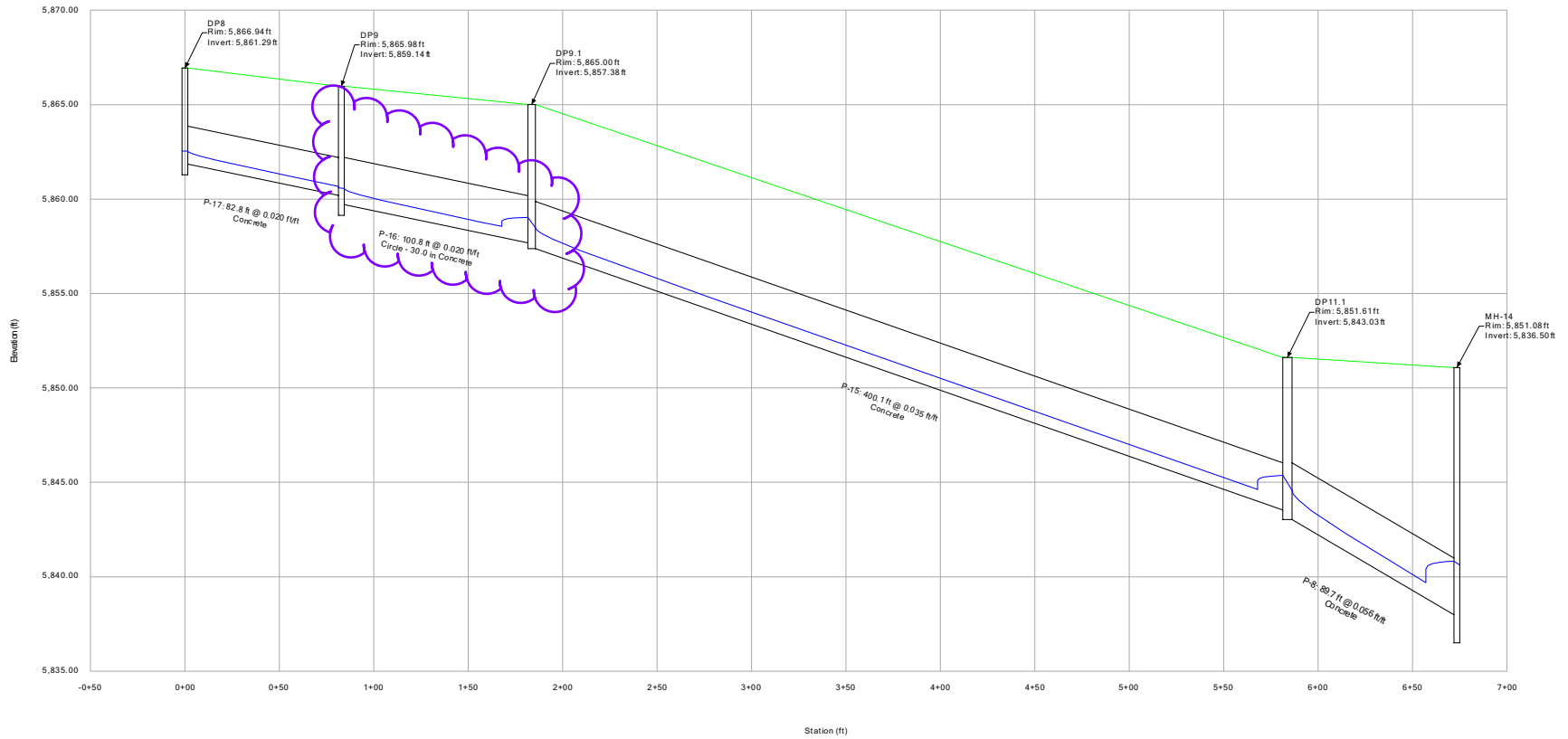
5-YEAR SCENARIO

Profile Report  
Engineering Profile - 04-stm (Bradley\_F3\_4.stsw)



5-YEAR SCENARIO

Profile Report  
Engineering Profile - 05-stm (Bradley\_F3\_4.stsw)



100 YEAR

FlexTable: Conduit Table

Label	Start Node	Diameter (in)	Length (Unified) (ft)	Flow (cfs)	Velocity (ft/s)	Invert (Start) (ft)	Invert (Stop) (ft)	Slope (Calculated) (ft/ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
P-3	DP5.1	24.0	17.0	21.60	9.51	5,873.00	5,872.76	0.014	5,874.66	5,874.23
P-4	DP1	18.0	17.0	12.50	7.07	5,874.23	5,873.99	0.014	5,876.13	5,875.89
P-7	DP3	18.0	17.0	4.80	9.53	5,875.20	5,874.54	0.039	5,876.21	5,876.28
P-6	DP4	18.0	17.0	5.10	6.27	5,875.20	5,875.00	0.012	5,876.25	5,876.28
P-17	DP8	24.0	82.8	5.50	7.62	5,861.85	5,860.20	0.020	5,862.68	5,861.23
P-15	DP9.1	30.0	400.1	25.10	13.93	5,857.38	5,843.53	0.035	5,859.09	5,846.72
P-14	DP7	24.0	15.8	12.90	8.70	5,857.15	5,856.91	0.015	5,858.78	5,858.80
P-13	MH3	24.0	54.3	12.90	9.73	5,856.77	5,855.66	0.021	5,858.06	5,857.45
P-12	MH2	24.0	357.8	12.90	10.54	5,855.42	5,846.28	0.026	5,856.71	5,848.01
P-9	DP10.1	30.0	121.8	24.00	4.89	5,844.13	5,843.53	0.005	5,847.14	5,846.72
P-11	MH1	24.0	35.5	12.90	8.66	5,845.98	5,845.44	0.015	5,847.27	5,847.35
P-8	DP11.1	36.0	89.7	47.60	19.57	5,843.03	5,837.99	0.056	5,845.28	5,842.81
P-5	DP4.1	24.0	125.2	9.30	2.96	5,874.04	5,873.00	0.008	5,876.10	5,875.89
P-16	DP9	30.0	100.8	19.60	10.68	5,859.70	5,857.68	0.020	5,861.20	5,860.10
P-10	DP10	30.0	74.8	11.50	5.86	5,844.85	5,844.42	0.006	5,847.34	5,847.29
P-2	DP6.1	30.0	50.6	32.90	14.16	5,872.26	5,870.75	0.030	5,874.21	5,873.25
P-1	OUT. STRUCT.	18.0	80.1	17.70	10.02	5,867.90	5,867.50	0.005	5,871.26	5,868.95
PIPE 24 (PHASE 2)	MH-15	24.0	102.6	32.30	10.28	5,839.03	5,838.00	0.010	5,844.90	5,842.81
PIPE 23 (PHASE 2)	MH-14	42.0	143.6	79.90	8.30	5,836.99	5,836.28	0.005	5,841.40	5,840.49

100-YEAR SCENARIO

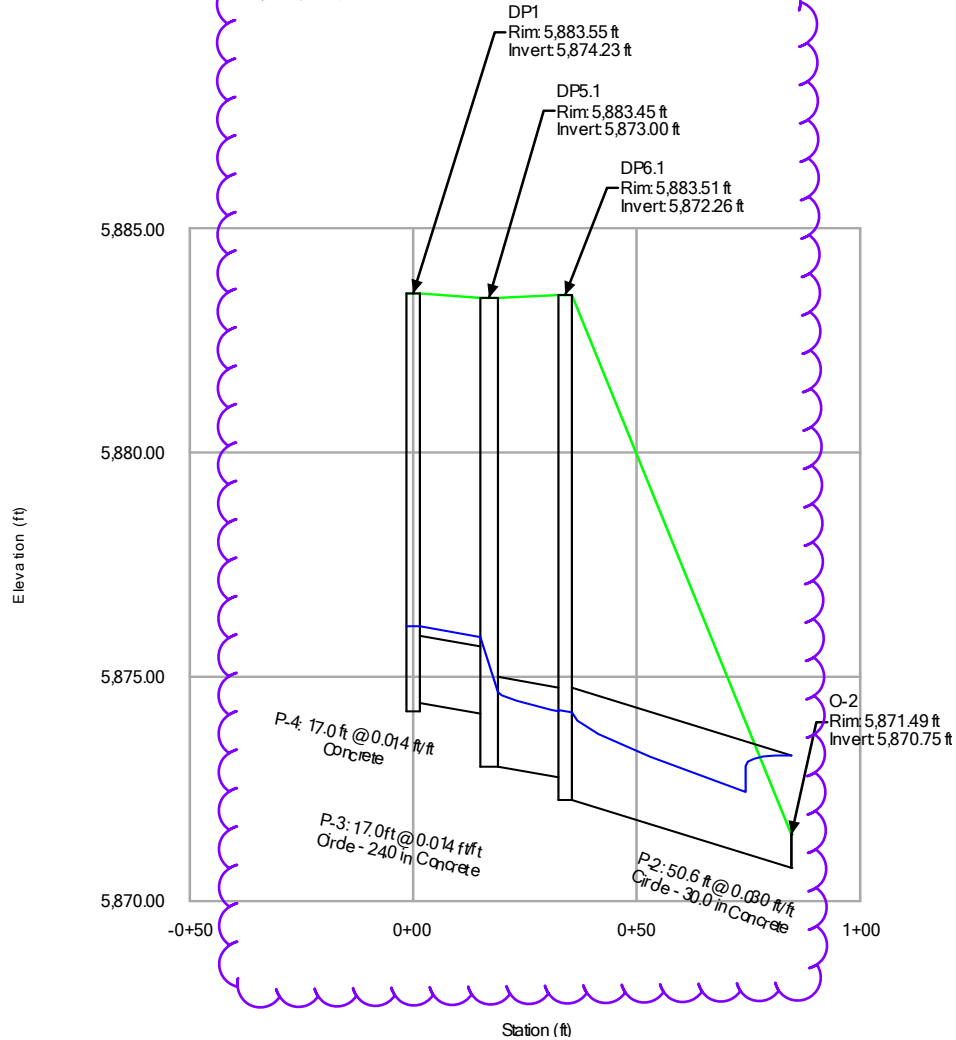
**FlexTable: Network Elements Table**

Label	Flow (Known) (cfs)	Elevation (User Defined Tailwater) (ft)	Headloss (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
DP6.1	32.90		0.05	5,874.26	5,874.21
DP1	12.50		0.00	5,876.13	5,876.13
DP5.1	21.60		1.23	5,875.89	5,874.66
DP3	4.80		0.00	5,876.21	5,876.21
DP4	5.10		0.00	5,876.25	5,876.25
DP4.1	9.30		0.18	5,876.28	5,876.10
DP8	5.50		0.00	5,862.68	5,862.68
DP9	19.60		0.03	5,861.23	5,861.20
DP9.1	25.10		1.01	5,860.10	5,859.09
DP7	12.90		0.00	5,858.78	5,858.78
MH3	0.00		0.74	5,858.80	5,858.06
MH2	0.00		0.74	5,857.45	5,856.71
DP10.1	24.00		0.15	5,847.29	5,847.14
MH1	0.00		0.74	5,848.01	5,847.27
DP10	11.50		0.01	5,847.35	5,847.34
DP11.1	47.60		1.44	5,846.72	5,845.28
OUT. STRUCT.	17.70		0.00	5,871.26	5,871.26
MH-14	79.90		1.41	5,842.81	5,841.40
MH-15	32.30		0.00	5,844.90	5,844.90
O-2		0.00			
O-1		0.00			
MH 13		5,840.49			
P-3			0.43	5,874.66	5,874.23
P-4			0.24	5,876.13	5,875.89
P-7			-0.07	5,876.21	5,876.28
P-6			-0.03	5,876.25	5,876.28
P-17			1.45	5,862.68	5,861.23
P-15			12.37	5,859.09	5,846.72
P-14			-0.03	5,858.78	5,858.80
P-13			0.61	5,858.06	5,857.45
P-12			8.70	5,856.71	5,848.01
P-9			0.42	5,847.14	5,846.72
P-11			-0.08	5,847.27	5,847.35
P-8			2.47	5,845.28	5,842.81
P-5			0.21	5,876.10	5,875.89
P-16			1.10	5,861.20	5,860.10
P-10			0.06	5,847.34	5,847.29
P-2			0.96	5,874.21	5,873.25
P-1			2.31	5,871.26	5,868.95
PIPE 24 (PHASE 2)			2.09	5,844.90	5,842.81
PIPE 23 (PHASE 2)			0.91	5,841.40	5,840.49

100-YEAR SCENARIO

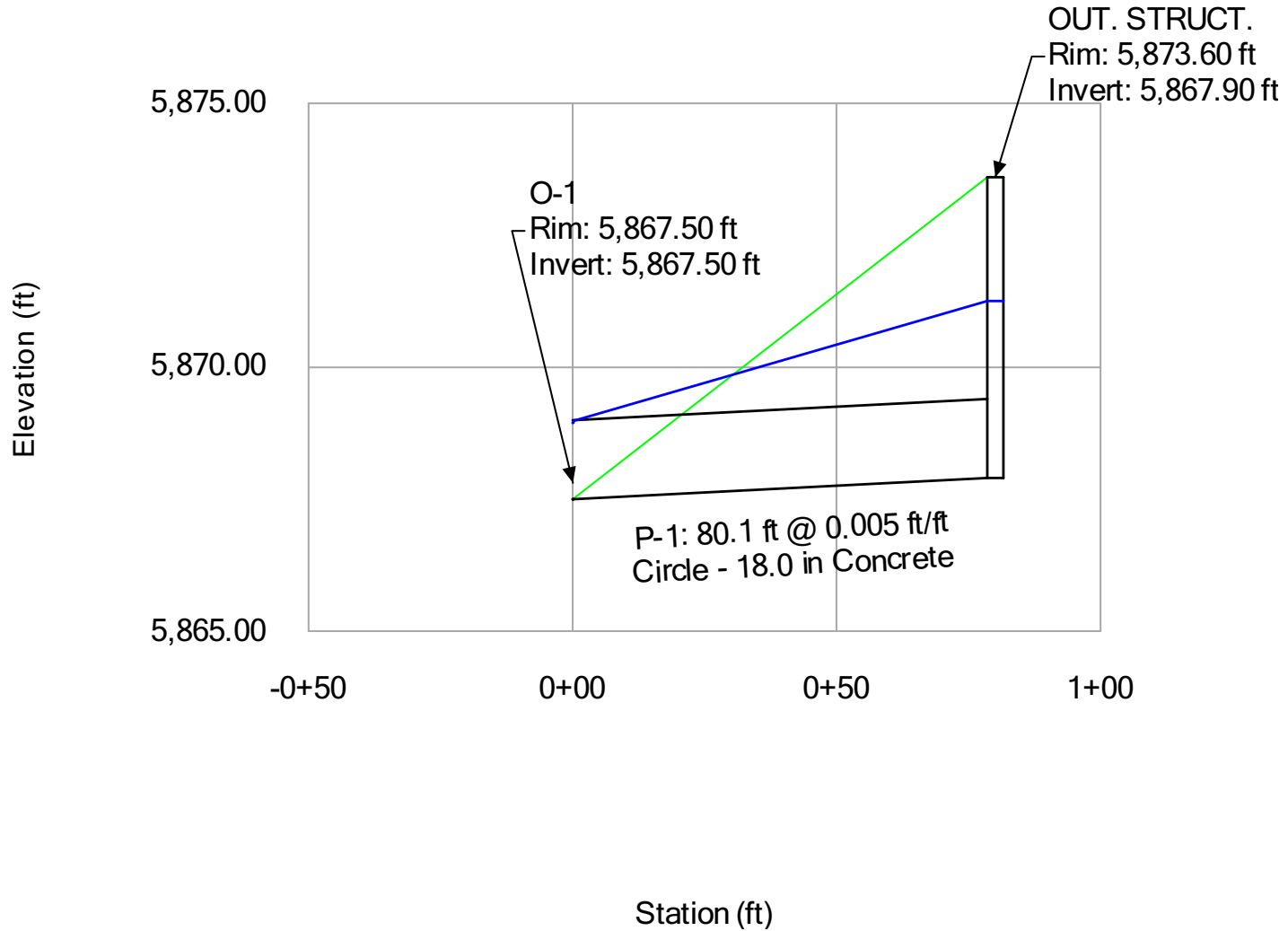
Profile Report

Engineering Profile - 01-stm (Bradley\_F3\_4.stsw)



100-YEAR SCENARIO

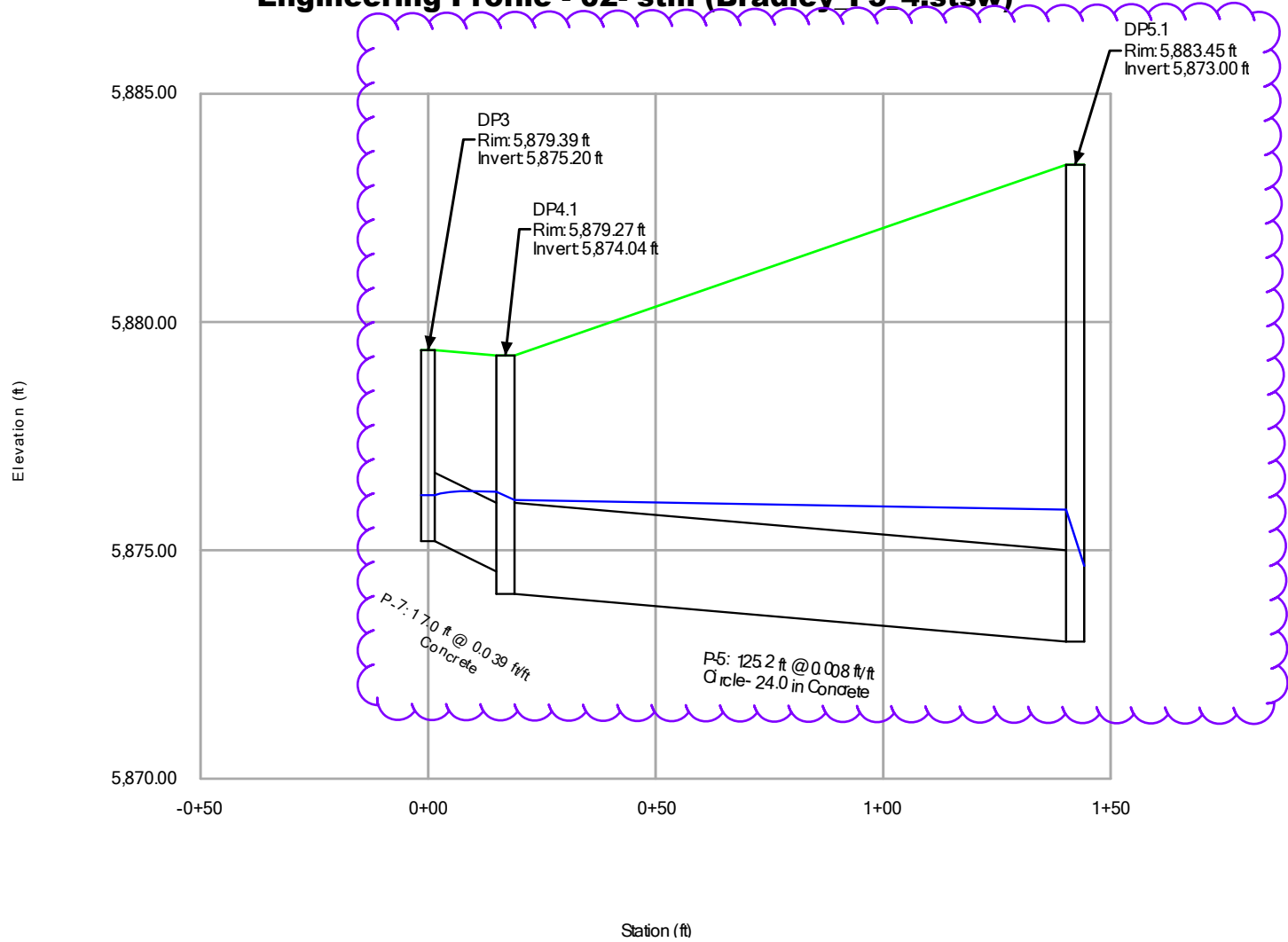
**Profile Report**  
**Engineering Profile - 01-Pond-Outfall (Bradley\_F3\_4.stsw)**



100-YEAR SCENARIO

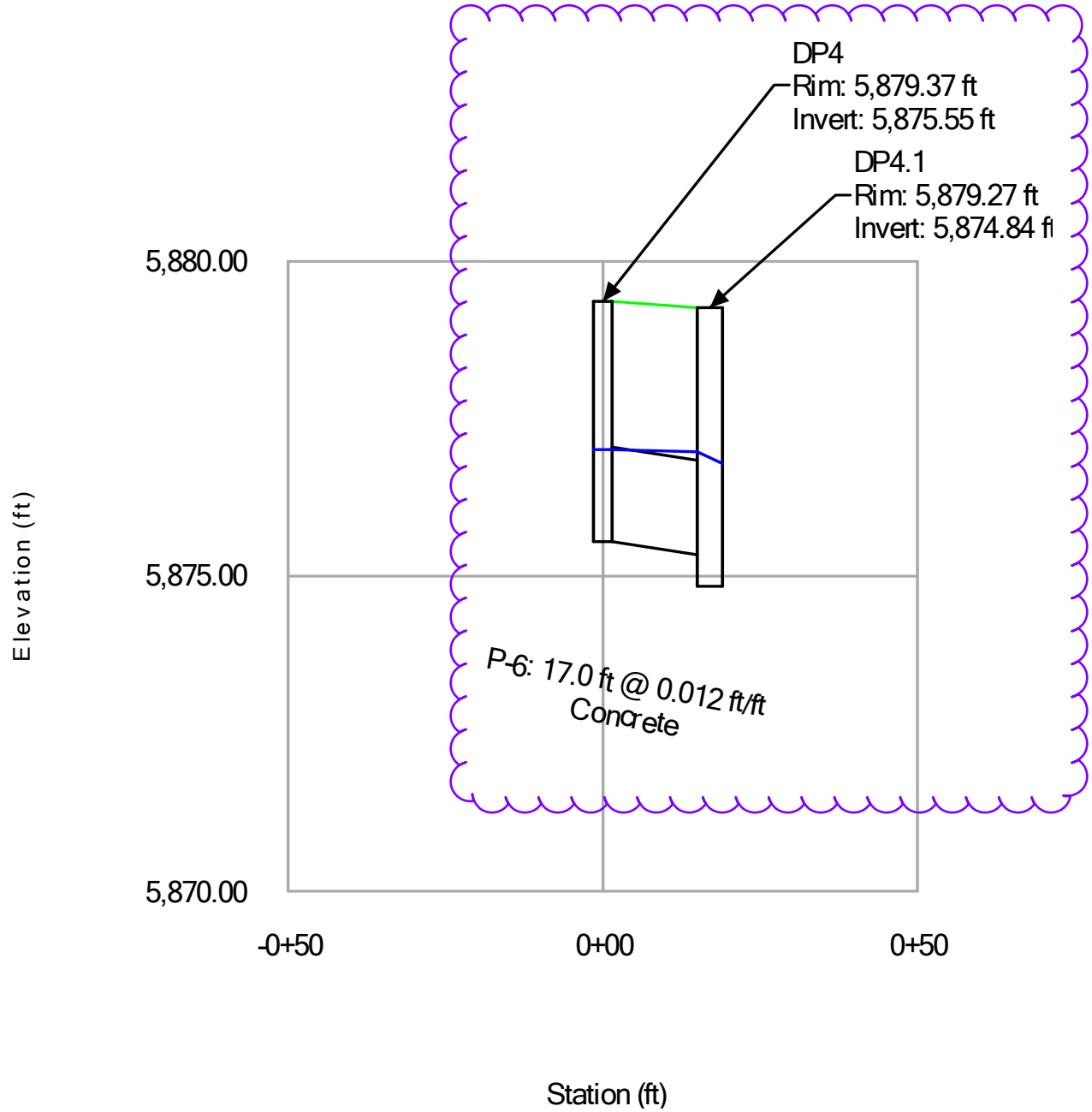
Profile Report

Engineering Profile - 02- stm (Bradley\_F3 4.stsw)



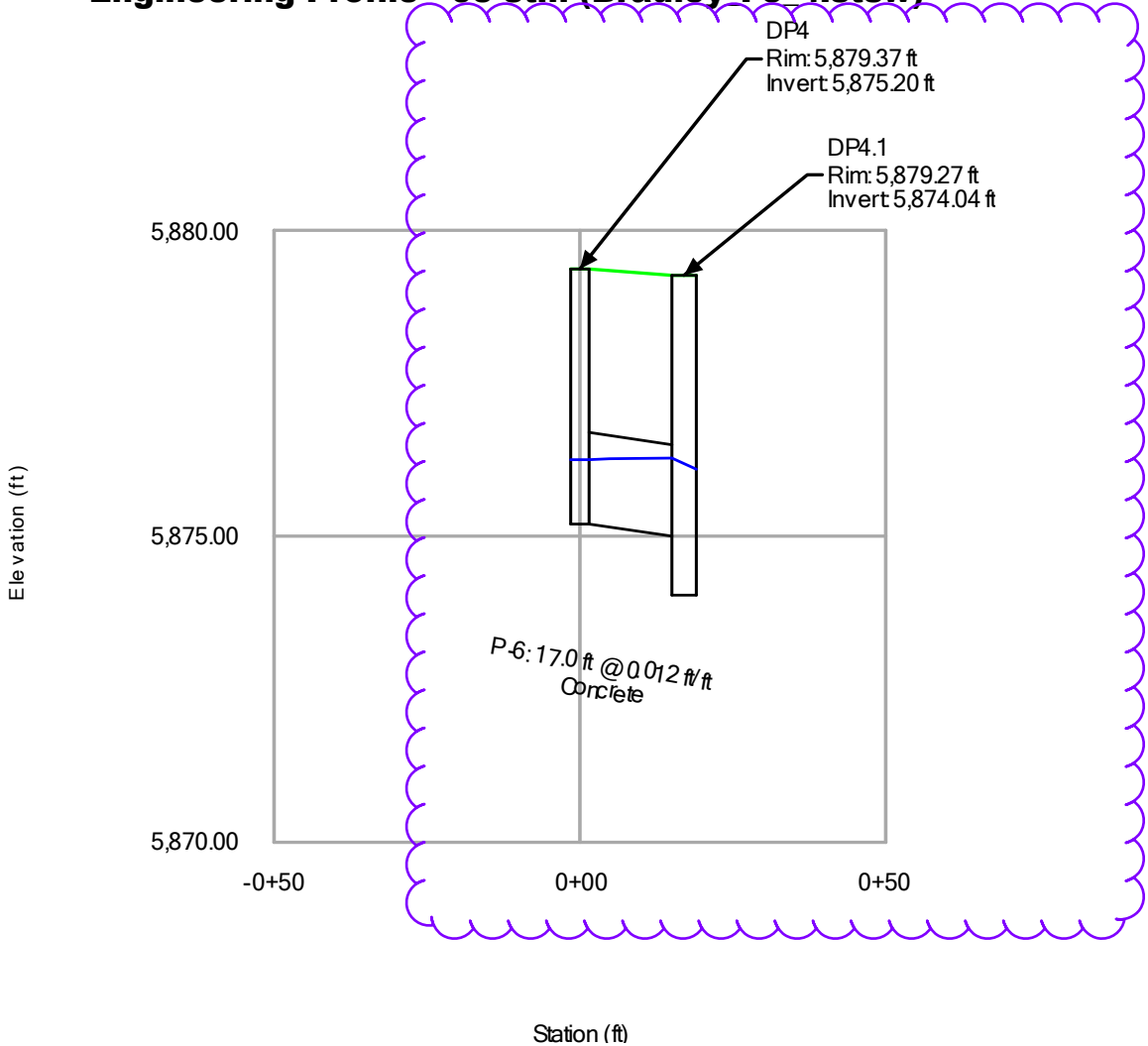
100-YEAR SCENARIO

**Profile Report**  
**Engineering Profile - 03-stm (Bradley\_F3\_4.stsw)**



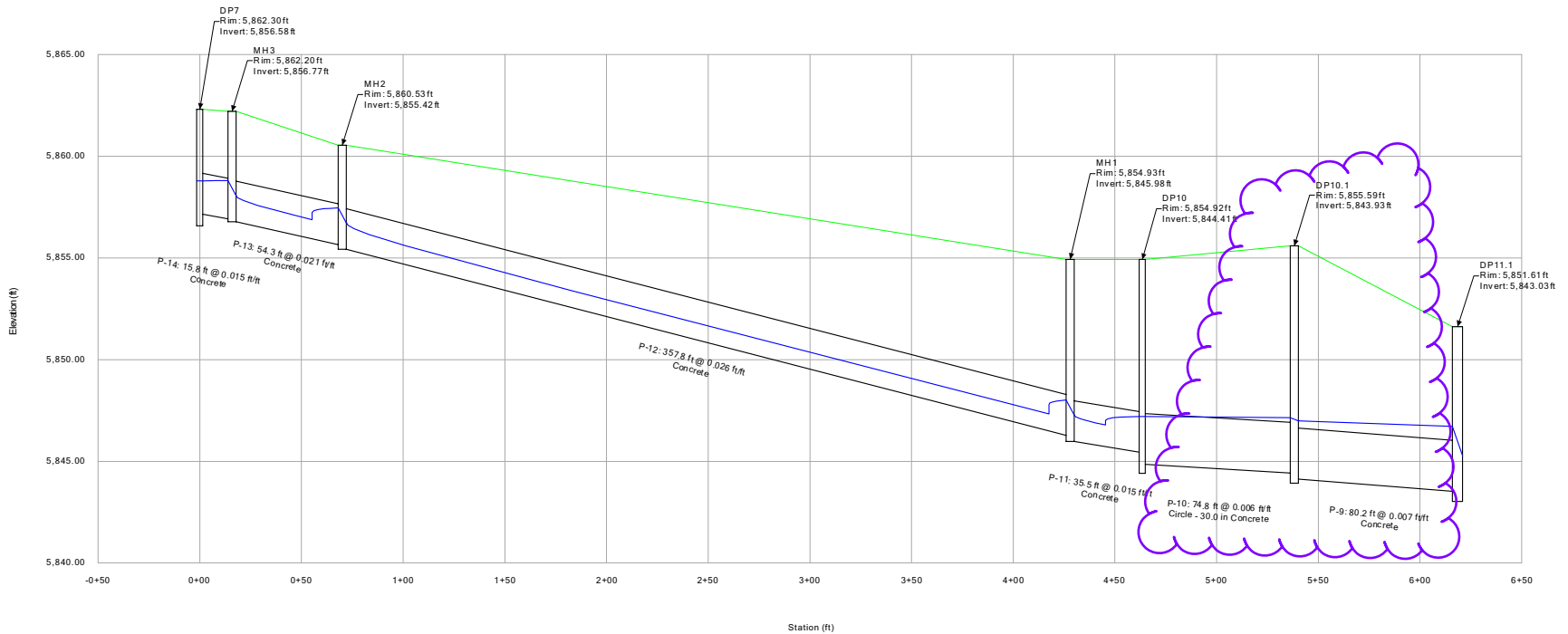
100-YEAR SCENARIO

Profile Report  
Engineering Profile - 03-stm (Bradley F3 4.stsw)



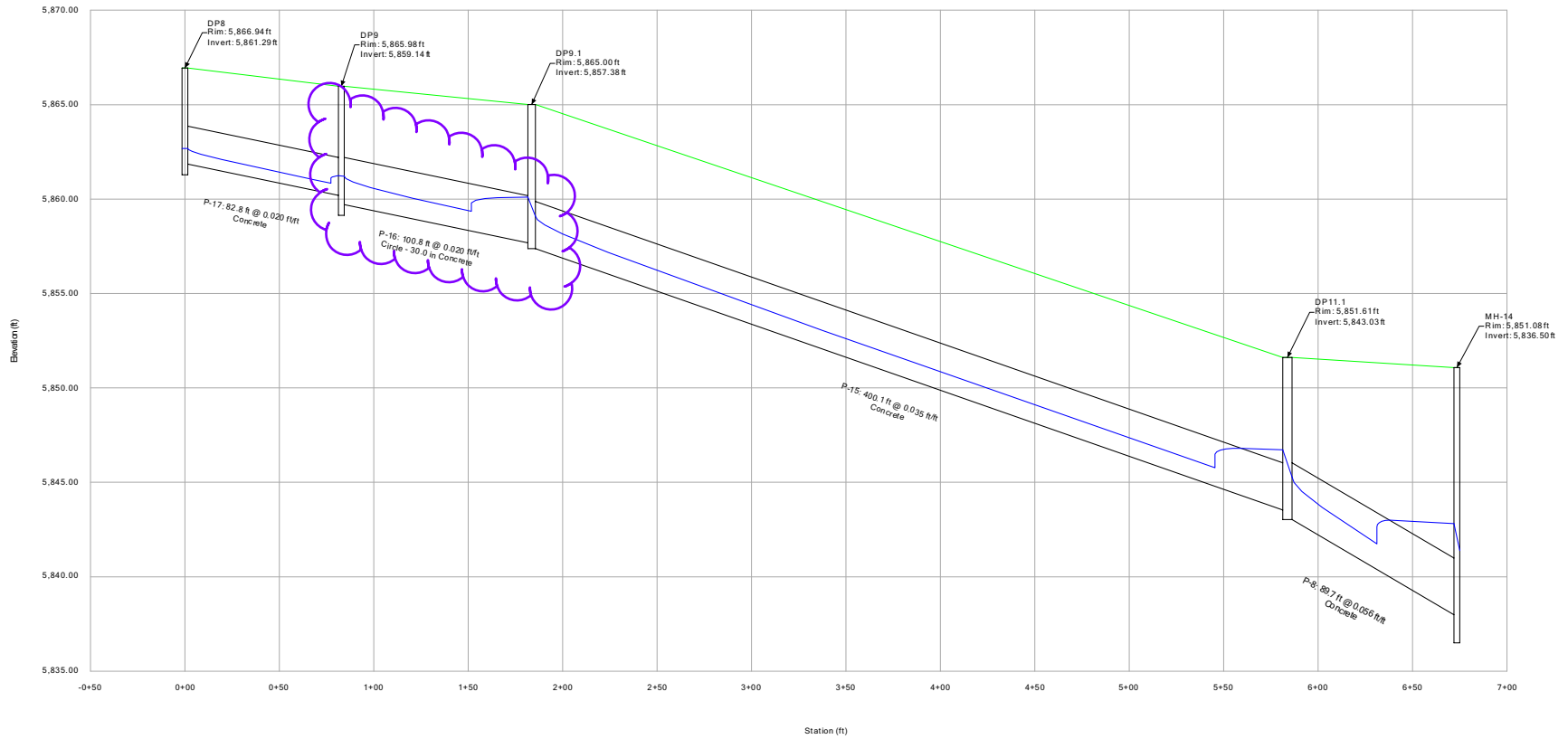
100-YEAR SCENARIO

Profile Report  
Engineering Profile - 04-stm (Bradley\_F3\_4.stsw)



100-YEAR SCENARIO

Profile Report  
Engineering Profile - 05-stm (Bradley\_F3\_4.stsw)



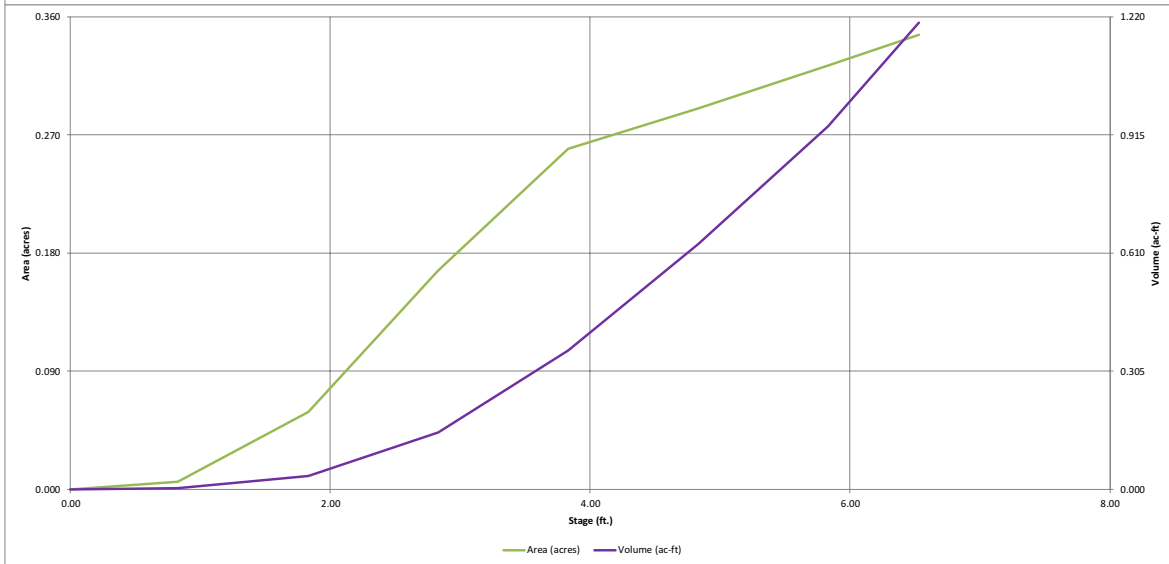
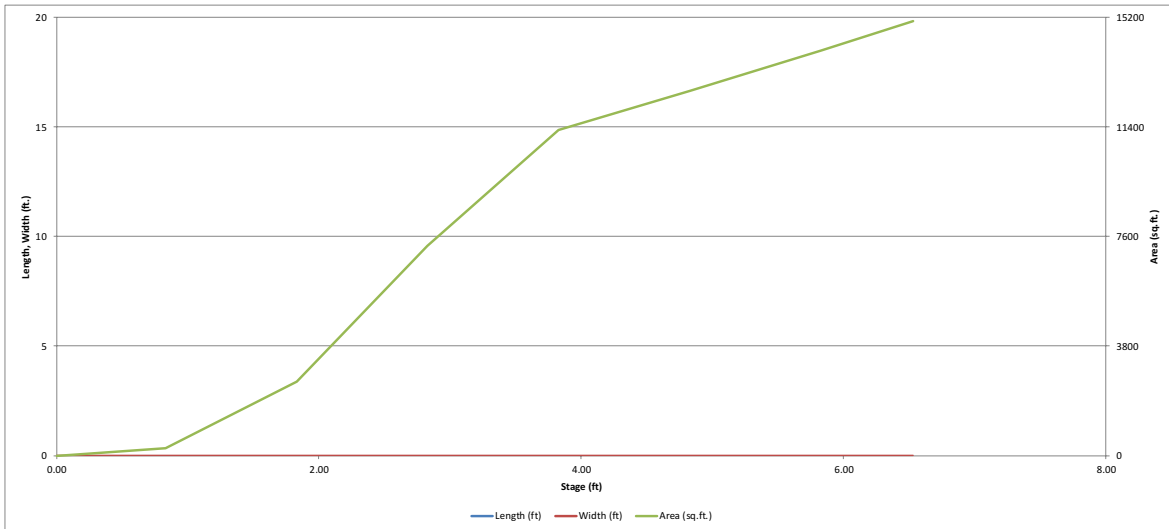
ISV Sizing	
WQCV (ft <sup>3</sup> )=	7,013
0.3% OF WQCV (ft <sup>3</sup> )=	21.0
Front Edge Length of Micropool (ft)=	4.0
Horizontal Length of Sides (ft)=	5.3
Depth (ft)=	1.0
Volume Provided (ft <sup>3</sup> )=	21.0

## **APPENDIX D – WATER QUALITY & DETENTION**



# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

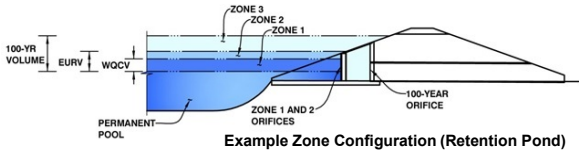
*MHFD-Detention, Version 4.04 (February 2021)*



## DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.04 (February 2021)*

**Project: Bradley Heights - Filing 3 & 4**  
**Basin ID: POND A**



**Example Zone Configuration (Retention Pond)**

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.57	0.160	Orifice Plate
Zone 2 (EURV)	5.08	0.356	Circular Orifice
Zone 3 (100-year)	6.30	0.360	Weir&Pipe (Restrict)
<b>Total (all zones)</b>		<b>0.877</b>	

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

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

Calculated Parameters for Underdrain  
Underdrain Orifice Area =  ft<sup>2</sup>  
Underdrain Orifice Centroid =  feet

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

Invert of Lowest Orifice =  ft (relative to basin bottom at Stage = 0 ft)  
Depth at top of Zone using Orifice Plate =  ft (relative to basin bottom at Stage = 0 ft)  
Orifice Plate: Orifice Vertical Spacing =  inches  
Orifice Plate: Orifice Area per Row =  inches

Calculated Parameters for Plate  
WQ Orifice Area per Row =  ft<sup>2</sup>  
Elliptical Half-Width =  feet  
Elliptical Slot Centroid =  feet  
Elliptical Slot Area =  ft<sup>2</sup>

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	1.62	2.39					
Orifice Area (sq. inches)	0.41	0.50	0.50					

	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)

	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	3.58	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	5.09	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	1.55	N/A	inches

Calculated Parameters for Vertical Orifice  
Vertical Orifice Area =  ft<sup>2</sup>  
Vertical Orifice Centroid =  feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.83	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Gate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Gate Type =	Type C Gate	N/A	
Debris Clogging % =	0%	N/A	%

Calculated Parameters for Overflow Weir  
Height of Gate Upper Edge, H<sub>1</sub> =  feet  
Overflow Weir Slope Length =  feet  
Gate Open Area / 100-yr Orifice Area =  ft<sup>2</sup>  
Overflow Gate Open Area w/o Debris =  ft<sup>2</sup>  
Overflow Gate Open Area w/ Debris =  ft<sup>2</sup>

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.60	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	14.60		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate  
Outlet Orifice Area =  ft<sup>2</sup>  
Outlet Orifice Centroid =  feet  
Half-Central Angle of Restrictor Plate on Pipe =  radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

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

**Routed Hydrograph Results**

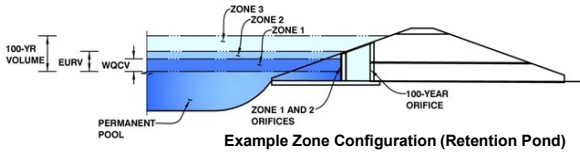
*The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).*

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =									
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.00
CUHP Runoff Volume (acre-ft) =	0.160	0.517	0.419	0.588	0.735	0.926	1.084	1.282	1.595
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.419	0.588	0.735	0.926	1.084	1.282	1.595
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.9	5.5	8.1	13.0	16.4	20.9	26.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.22	0.63	0.92	1.49	1.88	2.38	3.08
Peak Inflow Q (cfs) =	N/A	N/A	11.0	15.7	20.3	26.7	31.6	35.8	44.1
Peak Outflow Q (cfs) =	0.1	4.5	0.1	1.7	3.3	10.9	15.7	17.3	24.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.4	0.8	1.0	0.8	0.9
Structure Controlling Flow =	Plate	Overflow Weir 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Gate 1 (fps) =	N/A	0.58	N/A	0.1	0.3	1.0	1.4	1.5	1.6
Max Velocity through Gate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	64	62	65	63	61	60	58	56
Time to Drain 99% of Inflow Volume (hours) =	41	69	67	70	69	68	68	67	66
Maximum Ponding Depth (ft) =	3.57	5.08	4.64	4.92	4.98	5.18	5.28	5.51	5.68
Area at Maximum Ponding Depth (acres) =	0.17	0.28	0.26	0.27	0.27	0.28	0.28	0.29	0.30
Maximum Volume Stored (acre-ft) =	0.161	0.518	0.399	0.474	0.490	0.546	0.574	0.640	0.687

## DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.04 (February 2021)*

**Project: Bradley Heights - Filing 3 & 4**  
**Basin ID: POND A**



**Example Zone Configuration (Retention Pond)**

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.57	0.160	Orifice Plate
Zone 2 (EURV)	5.08	0.356	Circular Orifice
Zone 3 (100-year)	6.30	0.360	Weir&Pipe (Restrict)
<b>Total (all zones)</b>		<b>0.877</b>	

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

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

Calculated Parameters for Underdrain  
Underdrain Orifice Area =  ft<sup>2</sup>  
Underdrain Orifice Centroid =  feet

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

Invert of Lowest Orifice =  ft (relative to basin bottom at Stage = 0 ft)  
Depth at top of Zone using Orifice Plate =  ft (relative to basin bottom at Stage = 0 ft)  
Orifice Plate: Orifice Vertical Spacing =  inches  
Orifice Plate: Orifice Area per Row =  inches

Calculated Parameters for Plate  
WQ Orifice Area per Row =  ft<sup>2</sup>  
Elliptical Half-Width =  feet  
Elliptical Slot Centroid =  feet  
Elliptical Slot Area =  ft<sup>2</sup>

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	1.62	2.39					
Orifice Area (sq. inches)	0.41	0.50	0.50					

	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)

	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	<input type="text" value="3.58"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	<input type="text" value="5.09"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	<input type="text" value="1.55"/>	<input type="text" value="N/A"/>	inches

Calculated Parameters for Vertical Orifice  
Vertical Orifice Area =  ft<sup>2</sup>  
Vertical Orifice Centroid =  feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	<input type="text" value="4.83"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	<input type="text" value="4.00"/>	<input type="text" value="N/A"/>	feet
Overflow Weir Gate Slope =	<input type="text" value="0.00"/>	<input type="text" value="N/A"/>	H:V
Horiz. Length of Weir Sides =	<input type="text" value="5.25"/>	<input type="text" value="N/A"/>	feet
Overflow Gate Type =	<input type="text" value="Type C Gate"/>	<input type="text" value="N/A"/>	
Debris Clogging % =	<input type="text" value="50%"/>	<input type="text" value="N/A"/>	%

Calculated Parameters for Overflow Weir  
Height of Gate Upper Edge, H<sub>g</sub> =  feet  
Overflow Weir Slope Length =  feet  
Grate Open Area / 100-yr Orifice Area =  ft<sup>2</sup>  
Overflow Gate Open Area w/o Debris =  ft<sup>2</sup>  
Overflow Gate Open Area w/ Debris =  ft<sup>2</sup>

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	<input type="text" value="0.60"/>	<input type="text" value="N/A"/>	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	<input type="text" value="18.00"/>	<input type="text" value="N/A"/>	inches
Restrictor Plate Height Above Pipe Invert =	<input type="text" value="14.60"/>	<input type="text" value="N/A"/>	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate  
Outlet Orifice Area =  ft<sup>2</sup>  
Outlet Orifice Centroid =  feet  
Half-Central Angle of Restrictor Plate on Pipe =  radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

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

**Routed Hydrograph Results**

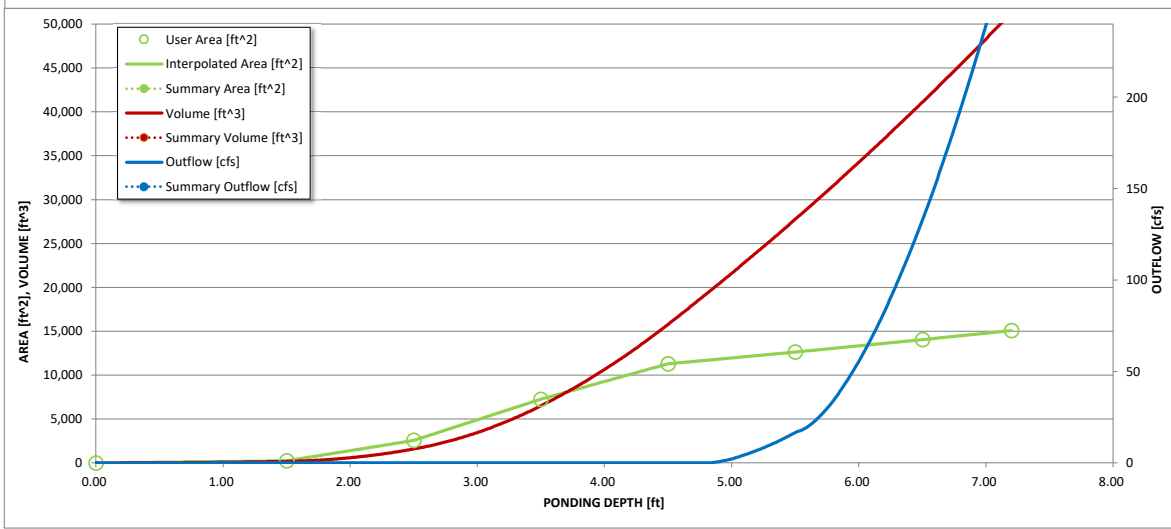
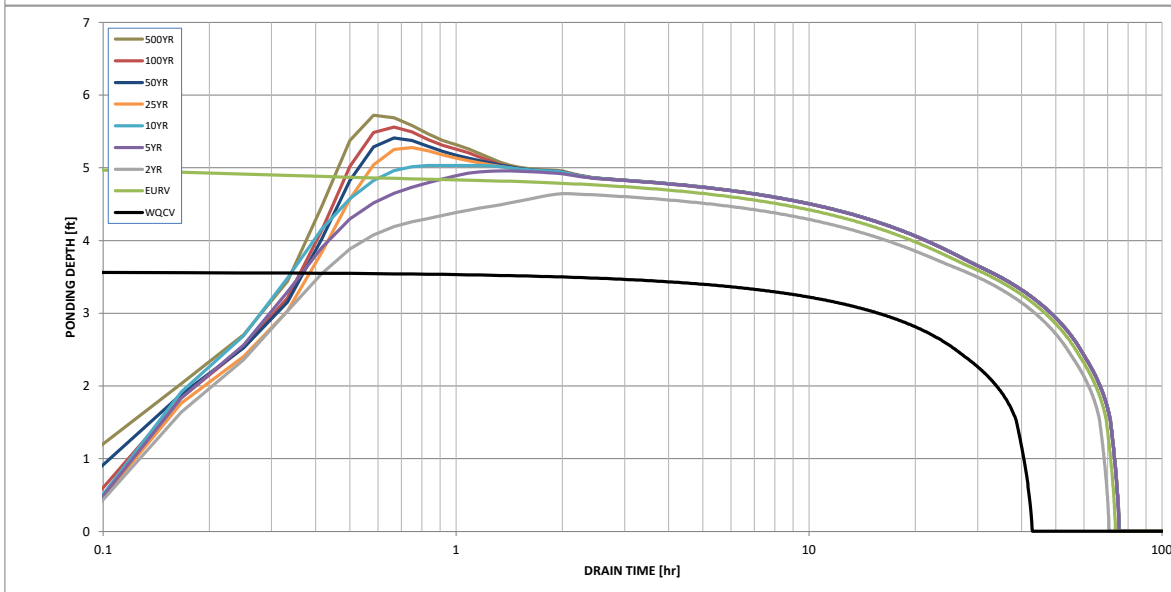
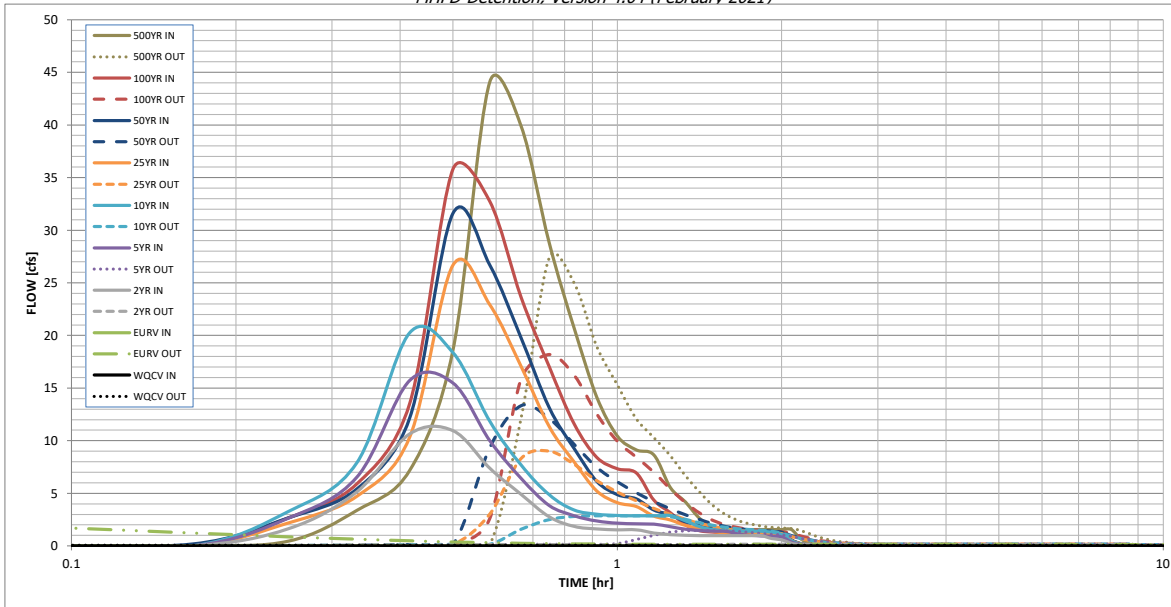
*The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).*

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.00
One-Hour Rainfall Depth (in) =	0.160	0.517	0.419	0.588	0.735	0.926	1.084	1.282	1.595
CUHP Runoff Volume (acre-ft) =	N/A	N/A	0.419	0.588	0.735	0.926	1.084	1.282	1.595
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.9	5.5	8.1	13.0	16.4	20.9	26.9
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.22	0.63	0.92	1.49	1.88	2.38	3.08
Peak Inflow Q (cfs) =	N/A	N/A	11.0	15.7	20.3	26.7	31.6	35.8	44.1
Peak Outflow Q (cfs) =	0.1	3.0	0.1	1.5	2.9	9.0	13.3	18.2	27.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.4	0.7	0.8	0.9	1.0
Structure Controlling Flow =	Plate	Overflow Weir 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway	Spillway
Max Velocity through Gate 1 (fps) =	N/A	0.25	N/A	0.1	0.2	0.6	0.9	1.2	1.2
Max Velocity through Gate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	64	62	65	64	62	60	58	56
Time to Drain 99% of Inflow Volume (hours) =	<b>41</b>	69	67	70	70	69	68	67	66
Maximum Ponding Depth (ft) =	3.57	5.08	4.64	4.95	5.03	5.27	5.41	5.56	5.72
Area at Maximum Ponding Depth (acres) =	0.17	0.28	0.26	0.27	0.28	0.28	0.29	0.29	0.30
Maximum Volume Stored (acre-ft) =	0.161	0.518	0.399	0.482	0.504	0.571	0.608	0.652	0.699

100-YEAR WSEL = 5874.06

### DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)



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.

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	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	0.18	0.02	0.46
	0:15:00	0.00	0.00	1.64	2.66	3.29	2.20	2.67	2.67	3.39
	0:20:00	0.00	0.00	5.15	6.54	7.90	4.73	5.40	5.90	7.18
	0:25:00	0.00	0.00	10.66	15.72	20.26	10.34	12.16	13.52	18.58
	0:30:00	0.00	0.00	10.96	15.49	18.37	26.69	31.59	35.78	44.06
	0:35:00	0.00	0.00	7.38	10.02	11.85	22.94	26.71	32.75	39.90
	0:40:00	0.00	0.00	4.91	6.42	7.69	17.08	19.78	23.64	28.80
	0:45:00	0.00	0.00	2.76	3.85	4.86	11.34	13.15	17.02	20.67
	0:50:00	0.00	0.00	1.85	2.88	3.42	7.98	9.25	11.57	14.18
	0:55:00	0.00	0.00	1.61	2.36	3.02	5.23	6.15	8.44	10.44
	1:00:00	0.00	0.00	1.53	2.16	2.90	4.11	4.89	7.33	9.12
	1:05:00	0.00	0.00	1.54	2.10	2.86	3.75	4.48	6.94	8.65
	1:10:00	0.00	0.00	1.23	2.07	2.87	2.83	3.40	4.34	5.56
	1:15:00	0.00	0.00	1.08	1.83	2.88	2.48	2.98	3.17	4.16
	1:20:00	0.00	0.00	1.02	1.58	2.39	1.94	2.30	2.01	2.60
	1:25:00	0.00	0.00	0.98	1.46	1.82	1.68	1.97	1.45	1.85
	1:30:00	0.00	0.00	0.98	1.40	1.56	1.37	1.58	1.31	1.65
	1:35:00	0.00	0.00	0.98	1.39	1.43	1.23	1.39	1.25	1.55
	1:40:00	0.00	0.00	0.98	1.13	1.40	1.18	1.33	1.25	1.55
	1:45:00	0.00	0.00	0.98	1.01	1.40	1.15	1.30	1.25	1.55
	1:50:00	0.00	0.00	0.98	0.96	1.40	1.15	1.30	1.25	1.55
	1:55:00	0.00	0.00	0.71	0.93	1.30	1.15	1.30	1.25	1.55
	2:00:00	0.00	0.00	0.58	0.86	1.10	1.15	1.30	1.25	1.55
	2:05:00	0.00	0.00	0.25	0.38	0.48	0.51	0.58	0.55	0.69
	2:10:00	0.00	0.00	0.09	0.15	0.18	0.21	0.23	0.22	0.27
	2:15:00	0.00	0.00	0.03	0.05	0.06	0.07	0.08	0.07	0.09
	2:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	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



## **APPENDIX E – REFERENCE MATERIAL**

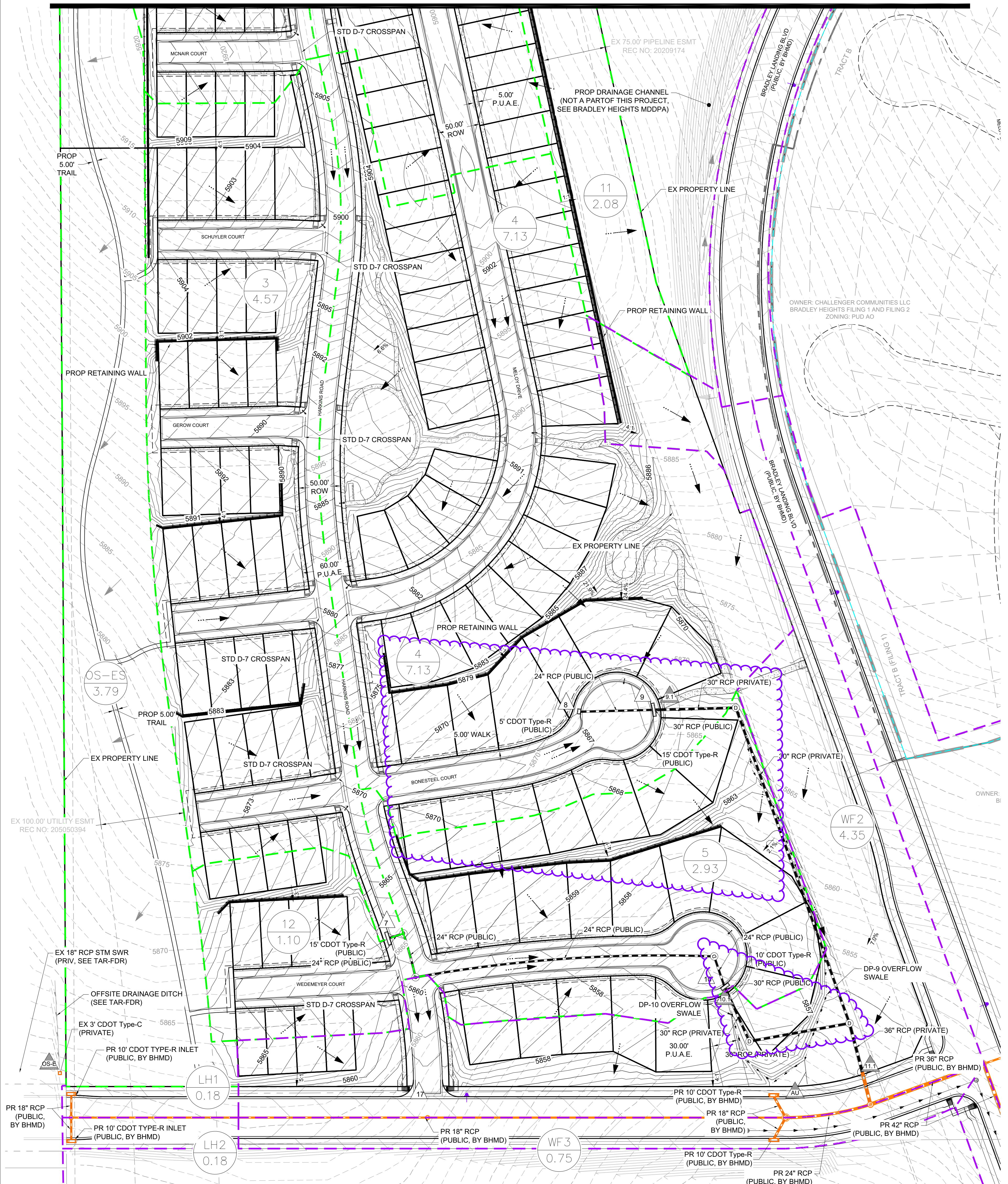
*– NOT INCLUDED WITH AMENDMENT. UNCHANGED FROM APPROVED FDR (STM-REV22-0521)*



## **APPENDIX F – DRAINAGE MAPS**



SEE SHEET 1



OWNER: CHALLENGER COMMUNITIES LLC  
BRADLEY HEIGHTS FILING 1 AND FILING 2  
ZONING: PUD AO

OWNER: BI

BASIN	AREA (ac)	% IMPERVIOUS	Q <sub>s</sub> (cfs)	Q <sub>100</sub> (cfs)
1	4.86	46	7.1	17.3
2	3.41	76	9.0	17.8
3	4.57	59	8.3	18.2
4	7.13	52	10.8	25.1
5	2.93	57	5.1	11.5
7	0.47	2	0.2	1.4
8	0.11	100	0.5	0.9
9	0.49	2	0.2	1.3
10	0.73	2	0.2	1.4
11	2.08	2	0.5	3.6
12	1.11	65	2.2	4.8
WF2	4.35	44	7.3	17.9
OS-ES	3.79	2	0.5	3.4

DESIGN POINT	UPSTREAM BASIN	ΣQ <sub>s</sub> (cfs)	ΣQ <sub>100</sub> (cfs)
1	1	7.0	12.5
2	2	8.4	12.7
3	1, DP1	0.1	4.8
4	2, DP2	0.6	5.1
4.1	DP3, DP4	0.7	9.3
5.1	DP1, DP4	7.6	21.6
6.1	DP2, DP5.1	15.0	32.9
7	3	7.9	12.9
8	4	3.9	5.5
9	4, DP8	6.9	19.6
9.1	DP8, DP9	10.8	25.1
10	5	5.1	11.5
10.1	DP7, DP10	12.8	24.0
11.1	DP9.1, DP10.1	22.8	47.6
12	7	0.2	1.4
13	8	0.5	0.9
14	10	0.2	1.4
15	11A	0.7	4.6
17	12, DP7 FLOWBY	2.9	10.7
AU	WF2, DP17	9.8	27.8
OS-E	14	0.5	3.4

**DRAINAGE MAP NOTES:**

- ALL PROPOSED CURB AND GUTTER IS COLORADO SPRINGS TYPE 2 AND TYPE 5. TYPE 5 CURB IS LOCATED IN ALL LOCATIONS FRONTING LOTS AND TYPE 2 CURB IS USED IN ALL OTHER LOCATIONS.
- ALL PROPOSED CROSS PANS ARE CITY OF COLORADO SPRINGS STANDARD D-7.
- PROPOSED STORM SEWER LOCATED WITHIN RIGHT-OF-WAY WILL BE PUBLICLY OWNED AND MAINTAINED. STORM SEWER LOCATED OUTSIDE OF RIGHT-OF-WAY WILL BE PRIVATELY OWNED AND MAINTAINED.
- DRAINAGE IMPROVEMENTS "BY BHMD" INDICATE IMPROVEMENT BY THE BRADLEY HEIGHTS METROPOLITAN DISTRICT. SEE THE "MASTER DEVELOPMENT DRAINAGE PLAN AMENDMENT FOR BRADLEY HEIGHTS" (BRADLEY HEIGHTS MDDP) BY MATRIX DESIGN GROUP (APPROVED 05-06-22).

**ABBREVIATIONS:**  
BHMD - BRADLEY HEIGHTS METROPOLITAN DISTRICT

**LEGEND:**

- PROPOSED MAJOR CONTOUR ——— 5250 ———
- PROPOSED MINOR CONTOUR - - - - - 5250 - - - - -
- EXISTING MAJOR CONTOUR - - - - - 5250 - - - - -
- EXISTING MINOR CONTOUR - - - - - 5250 - - - - -
- PROPOSED STORM SEWER ————
- PROPOSED DRAINAGE SWALE ————
- PROPERTY LINE ————
- PROPOSED FLOW DIRECTION ————
- EXISTING FLOW DIRECTION ————
- PROPOSED DRAINAGE BASIN ————
- PROPOSED DRAINAGE BASIN (BRADLEY HEIGHTS MDDP) ————
- FILING BOUNDARY ————
- DESIGN POINT ————
- PROPOSED BASIN LABEL ————
- BASIN DESIGNATION ————
- AREA (AC.) ————

**SHEET 2**

BAR IS ONE INCH ON OFFICIAL DRAWINGS  
IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY

DRAWN BY: CBM  
APPROVED BY: KMH  
JOB DATE: 5/15/2024  
JOB NO: 211448

**BRADLEY HEIGHTS FILING 3 & 4**  
COLORADO SPRINGS, CO

CAD DATE: 5/20/2024  
CAD FILE: J:\2021\211448\CAD\Drawings\Drainage\FDR\FDR\_Drainage\_Map

**DRAINAGE PLAN**  
SHEET 2 OF 3

**HRGreen**

HR GREEN - COLORADO SPRINGS  
7222 COMMERCE CENTER DR. SUITE 220  
COLORADO SPRINGS CO 80919  
PHONE: 719.622.6222  
FAX: 944.273.1057

NO.	DATE	BY	REVISION DESCRIPTION

HR GREEN Xref: x:\row: xc-03.dgn; xc-03.row; xc-03.tbl; xc-dgn-matrix; sgt-1-d01; dmain; map; legend; FDR; map; notes; xc-row; xc-dgn-matrix





## APPENDIX G – VARIANCES



▷ 1975 Research Parkway | Suite 230 | Colorado Springs, CO 80920  
Main 720.602.4999 + Fax 844.273.1057

▷HRGREEN.COM

## Bradley Heights Filing 3 & 4 Variance Request Inlets as Junction (3 locations)

May 15, 2024

HR Green Project No: 211448

AR PUD 22-00279

STM-REV22-0521 (FDR)

STM-MP22-0167

### Prepared For:

Challenger Communities LLC

Contact: Erin Ganaway

8605 Explorer Drive, Suite 220

Colorado Springs, CO 80920

### Prepared By:

HR Green Development, LLC

Contact: Ken Huhn, PE

[khuhn@hrgreen.com](mailto:khuhn@hrgreen.com)

(720) 602-4965

PROJECT	DESCRIPTION	LOCATION	STATUS
<a href="#">STM-REV24-0587</a>	Variance Letter	South	Approved



May 15, 2024

Sara Rivera

Colorado Springs Stormwater Enterprise  
City Administration Building  
30 S. Nevada Ave., Suite 401  
Colorado Springs, CO 80903

Re: Bradley Heights Filing 3 - Variance Request #1:

Dear Ms. Rivera,

We are in receipt of your review comments dated 03/27/24 for the Bradley Heights Filing 3&4 Development Plan. Per DCM criteria, *"Inlets may not be used as junctions along trunk lines larger than 24" in diameter on public systems."* We have proposed a public inlet that connects a public 24" pipe to a public 30" outfall pipe. Consolidating this sump inlet location into a junction that carries the stormwater immediately to the pond reduces utility conflicts and simplifies the design. This variance request is summarized below:

Code Section: Section 9.6.2 of the Colorado Springs Drainage Criteria Manual Volume 1 states: *"Inlets may not be used as junctions along trunk lines larger than 24" in diameter on public systems, subject to limitations on individual structure details"*

Request for Variance: On behalf of Challenger Communities LLC we are requesting approval of a public Type-R inlet to be used as a junction between a public 24" storm sewer pipe and a public 30" storm sewer pipe.

Reason for Variance: The public Type-R inlet (I-4) is proposed to connect a public 24" RCP to a public 30" RCP which continues and discharges into an onsite pond. The alternative to utilizing I-4 as a junction would require an additional manhole and additional run of pipe to bring the captured stormwater to the stormwater main. Along with the added pipes and structures, two extra utility crossings would be required in this scenario. Therefore the inlet is proposed to be utilized as a junction to reduce the number of manholes and simplify the storm sewer system design in a congested utility location.

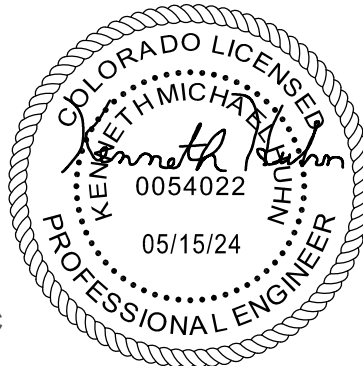
Plan reference: See attached Bradley Heights Filing 4 Storm Sewer Construction Plans (Sheet 3).

Approval of this variance would not result in a change in peak flows and water quality to Fountain Creek.

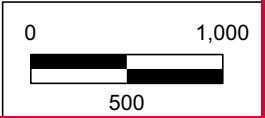
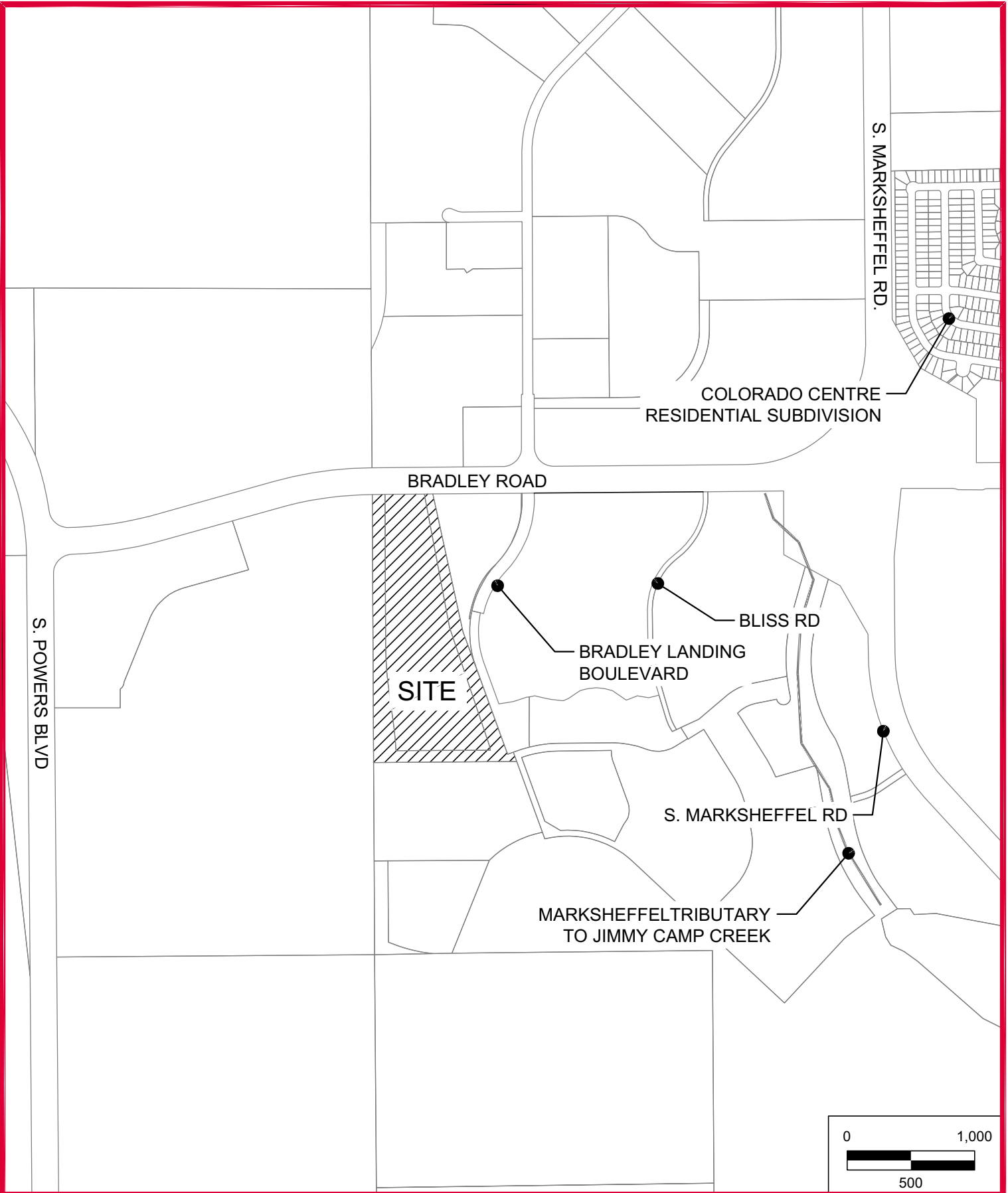
Sincerely,

**HR GREEN, INC**

**Kenneth M. Huhn, P.E.**  
Senior Project Manager



CC: Erin Ganaway, Challenger Communities LLC



Xrefs: 8.5x11\_Titleblock



HRGreen.com

HRGreen



SHEET  
VICINITY MAP

SCALE: 1"=1,000'  
DATE: 08/24/2022





May 15, 2024

Sara Rivera

Colorado Springs Stormwater Enterprise  
City Administration Building  
30 S. Nevada Ave., Suite 401  
Colorado Springs, CO 80903

Re: Bradley Heights Filing 4- Variance Request #2:

Dear Ms. Rivera,

We are in receipt of your review comments dated 03/27/24 for the Bradley Heights Filing 3&4 Development Plan. Per DCM criteria, *“Inlets may not be used as junctions along trunk lines larger than 24” in diameter on public systems.”* We have proposed a public inlet that connects a public 24” pipe to a public 30” pipe. Consolidating this sump inlet location into a junction that carries the stormwater through simplifies the storm design and ease of construction.

Code Section: Section 9.6.2 of the Colorado Springs Drainage Criteria Manual Volume 1 states: *“Inlets may not be used as junctions along trunk lines larger than 24” in diameter on public systems, subject to limitations on individual structure details”*

Request for Variance: On behalf of Challenger Communities LLC we are requesting approval of a public Type-R sump inlet to be used as a junction between a public 24” storm sewer pipe and a public 30” storm sewer pipe.

Reason for Variance: The public Type-R inlet (I-7) is proposed to connect a public 24” RCP to a public 30” RCP which continues and carries the stormwater offsite. The alternative to utilizing I-7 as a junction would require an additional manhole and additional run of pipe to bring the captured stormwater to the stormwater main. Therefore the inlet is proposed to be utilized as a junction to reduce the number of manholes and simplify the storm sewer design in a congested utility location.

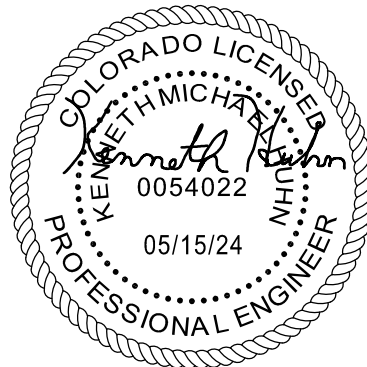
Plan reference: See attached Bradley Heights Filing 4 Storm Sewer Construction Plans (Sheets 3 and 4).

Approval of this variance would not result in a change in peak flows and water quality to Fountain Creek.

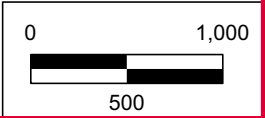
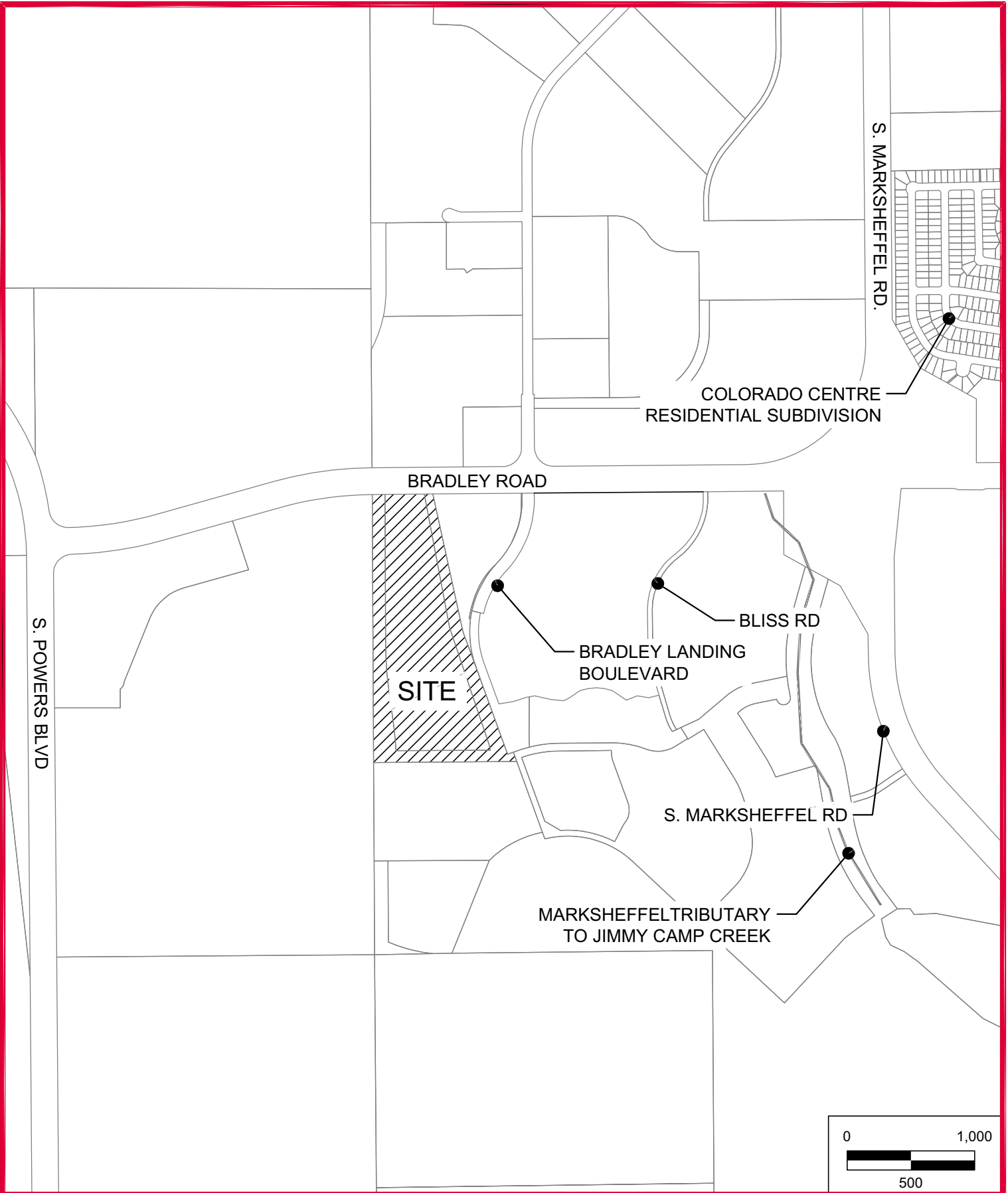
Sincerely,

**HR GREEN, INC**

**Kenneth M. Huhn, P.E.**  
Senior Project Manager



CC: Erin Ganaway, Challenger Communities LLC



Xrefs: 8.5x11\_Titleblock



HRGreen.com

HRGreen



SHEET  
VICINITY MAP

SCALE: 1"=1,000'

DATE: 08/24/2022





May 15, 2024

Sara Rivera

Colorado Springs Stormwater Enterprise  
City Administration Building  
30 S. Nevada Ave., Suite 401  
Colorado Springs, CO 80903

Re: Bradley Heights Filing 4 - Variance Request #3:

Dear Ms. Rivera,

We are in receipt of your review comments dated 03/27/24 for the Bradley Heights Filing 3&4 Development Plan. Per DCM criteria, *"Inlets may not be used as junctions along trunk lines larger than 24" in diameter on public systems."* We have proposed an inlet that connects a 24" pipe to a 30" pipe. Consolidating this sump inlet location into a junction that carries the stormwater through reduces costs and ease of construction. This variance request is summarized below:

Code Section: Section 9.6.2 of the Colorado Springs Drainage Criteria Manual Volume 1 states: *"Inlets may not be used as junctions along trunk lines larger than 24" in diameter on public systems, subject to limitations on individual structure details"*

Request for Variance: On behalf of Challenger Communities LLC we are requesting approval of a Type-R sump inlet to be used as a junction between a 24" storm sewer pipe and a 30" storm sewer pipe.

Reason for Variance: The Type-R inlet (I-8) is proposed to connect a 24" RCP to a 30" RCP which continues and carries the stormwater offsite. The alternative to utilizing I-8 as a junction would require an additional manhole and additional run of pipe to bring the captured stormwater to the stormwater main. Therefore the inlet is proposed to be utilized as a junction to reduce the number of manholes in a congested utility location.

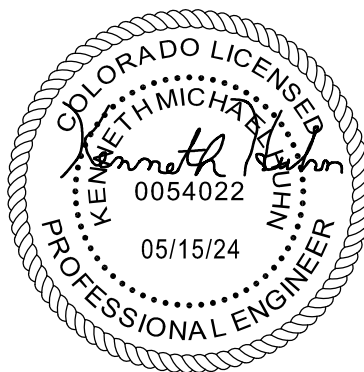
Plan reference: See attached Bradley Heights Filing 4 Storm Sewer Construction Plans (Sheets 3 and 4).

Approval of this variance would not result in a change in peak flows and water quality to Fountain Creek.

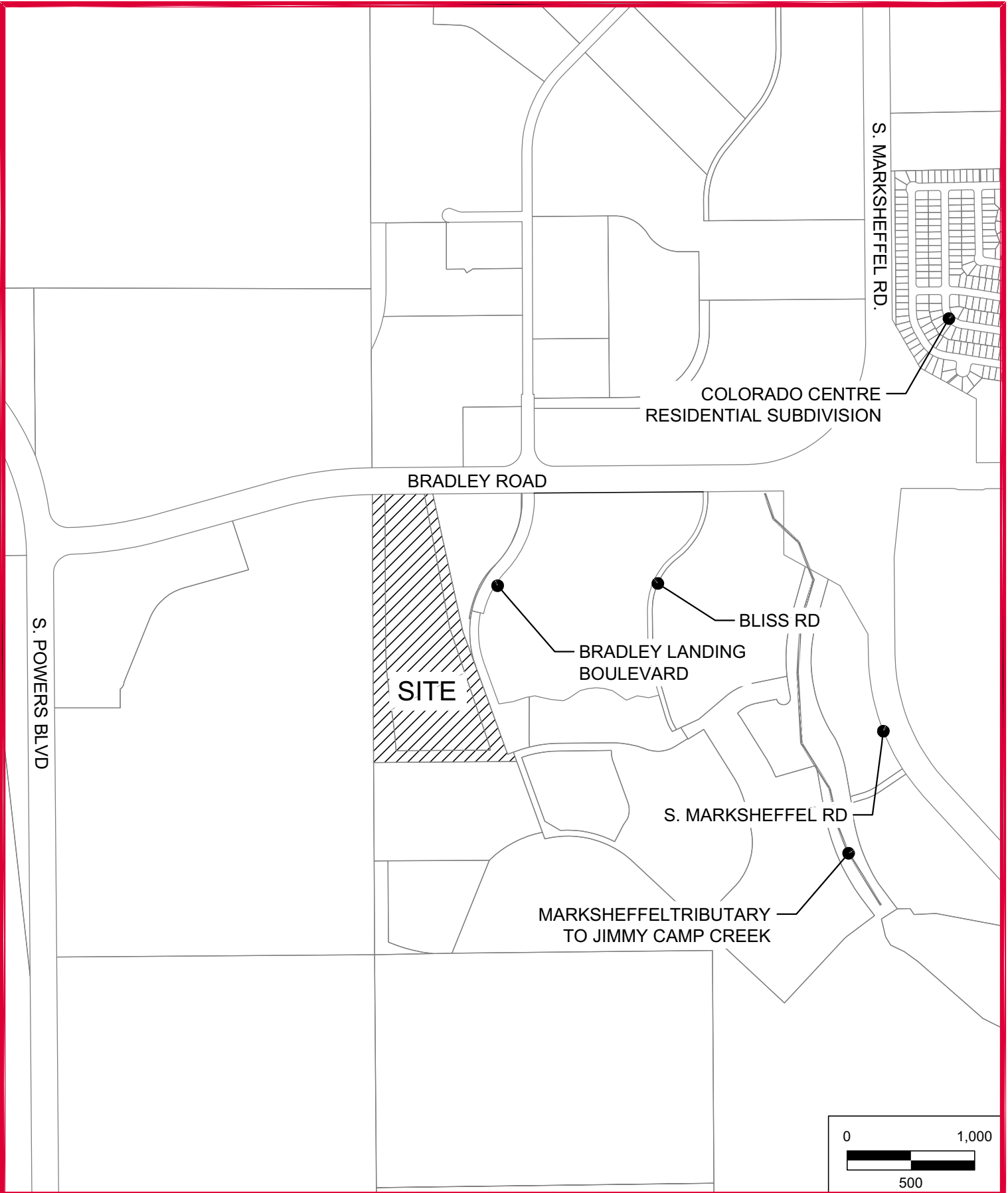
Sincerely,

**HR GREEN, INC**

**Kenneth M. Huhn, P.E.**  
Senior Project Manager



CC: Erin Ganaway, Challenger Communities LLC

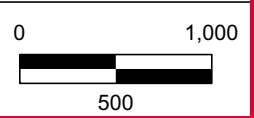


Xrefs: 8.5x11\_Titleblock



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SHEET  
VICINITY MAP  
SCALE: 1"=1,000'  
DATE: 08/24/2022

