Master Development Drainage Plan (MDDP) Amendment / Final Drainage Report

Westgate at Powers Filing No. 3
Colorado Springs, Colorado

Prepared for:

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Master Project Number: STM-MP21-0474
Final Drainage Report: STM-REV23-0162

Project #: 196217000

Prepared: February 7th, 2023
Revised: March 28, 2023
Revised: May 24th, 2023
Revised: July 12th, 2023
Revised: July 31st, 2023

Kimley»Horn

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CERTIFICATION

ENGINEERS STATEMENT

"This report and plan for the drainage design of Westgate at Powers Subdivision Filing No. 3 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 provisions of the City of Colorado Springs Drainage Criteria Manual and is in conformity with the master plan of the drainage basin. I understand that 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."

SIGNATURE: ____
Mitchell Hess, P.E. Colorado P.E. No. 53916 Date

DEVELOPER'S STATEMENT

RS Westgate, LLC. hereby certifies that the drainage facilities for the Westgate at Powers Subdivision Filing No. 3 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 7.7.906 of the City Code; and cannot, on behalf of Westgate at Powers Subdivision Filing No. 3 guarantee that final drainage design review will absolve RS Westgate, LLC. 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.

RS Westgate, LLC
Name of Developer

07/31/203
Authorized Signature Date

Jeff A Hanks
Printed Name

CFO for RS Westgate, LLC
Title

2089 East Fort Union Blvd, Salt Lake City, UT. 84121
Address:

CITY OF COLORADO SPRINGS STATEMENT

Hao Vo

Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

Hao Vo 08/02/2023

For City Engineer Date

Conditions:

GENERAL LOCATION AND DESCRIPTION

PURPOSE AND SCOPE OF STUDY

The purpose of this Master Development Drainage Plan (MDDP) Amendment / Final Drainage Report (the "FDR") is to provide the hydrologic and hydraulic calculations and to document and finalize the drainage design methodology in support of the proposed Westgate at Powers Subdivision Filing No. 3 (the "Project"). The Project is located within the jurisdictional limits of the City of Colorado Springs (the "City"). Thus, the guidelines for the hydrologic and hydraulic design were based on the criteria outlined by the City of Colorado Springs Drainage Criteria Manual.

The Project is located within the Sand Creek Drainage Basin and is part of the subject area of the Master Development Drainage Plan for Westgate at Powers dated April 30, 2012 prepared by JPS Engineering (the "MDDP"). Additionally, the subject area is analyzed in the Final Drainage Report for Westgate at Powers Phase 1 dated March 28, 2018 prepared by JPS Engineering. Furthermore, the East Fork Sand Creek Drainage Channel was recently realigned and stabilized as outlined within the Channel Design Report for Westgate at Powers Sand Creek Center Tributary Channel (the "Channel Study") dated March 28, 2018 and prepared by JPS Engineering.

LOCATION

The Project is located on Joystone Drive, northwest of the intersection Airport Rd and S Powers Blvd. The Project is bound by Joystone Drive to the east, Sand Creek to the West, vacant land to the north, and a residential development to the south. The site will be accessed by three proposed driveways, each connecting to Joystone Drive. More specifically, the Project is within a portion of the south half of section 13, township 14 south, range 66 west of the 6th P.M., City of Colorado Springs, County of El Paso, State of Colorado.

DESCRIPTION OF PROPERTY

The Project is located on approximately 27.70 acres of undeveloped land with limited vegetation and grass cover. The total disturbance for the Project is 27.71 acres. The Site is currently vacant and resides between Sand Creek, and Sand Creek East Fork. The proposed services in the development include the following: water, sewer, electric service, natural gas service, telephone service, and fire protection.

NRCS soil data is available for the Site (See Appendix) and the onsite soils are approximately 66% USCS Hydrologic Soil Groups A and 34% Group B. This site specifically is predominately comprised of Sampson loam and Trickton sandy loam. Reference the Soils Report included in the **Appendix** for additional information.

PROJECT CHARACTERISTICS

The proposed development involves the construction of 19 apartment buildings totaling 456 units. The proposed development also includes the construction of two clubhouses, pool deck areas, surface parking, utilities to service the buildings, detached garages, and an open amenity area. Water quality and detention is provided on-site at two different extended detention basins.

As part of the utility infrastructure improvements, a proposed storm sewer system will be constructed to collect runoff. Stormwater will be conveyed via overland flow across the lots, within the curb and gutter of the proposed streets before being captured in proposed storm inlets. The storm sewer system will then convey runoff into the private full-spectrum extended detention basins before being discharged offsite into existing drainage channels. The site is bound by two separate streamside zones, as both the eastern and western boundaries of the site are included in the Streamside Zone, and carries the 'SS' zoning tag. Refer to the Streamside and Land Suitability Plans included as a part of the Development Plan for additional information.

DRAINAGE DESIGN CRITERIA

DEVELOPMENT CRITERIA REFERENCE

The proposed storm facilities follow the City of Colorado Springs Storm Drainage Criteria (the "CRITERIA") and the Mile High Flood Control District Manual (the "MANUAL"). Site drainage is not significantly impacted by such constraints as utilities or existing development. Further detail regarding on-Site drainage patterns provided in the Drainage Facility Design Section.

HYDROLOGIC CRITERIA

The 5-year and 100-year design storm events were used in determining rainfall and runoff for the proposed drainage system per chapter 6 of the CRITERIA. Table 6-2 of the CRITERIA is the source for rainfall data for the 5-year and 100-year design storm events. Design runoff was calculated using the Rational Method for developed conditions as established in the CRITERIA and MANUAL. Runoff coefficients for the proposed development were determined using Table 6-6 of the CRITERIA by calculating weighted impervious values for each specific site basin. The detention storage requirement was calculated using Full Spectrum Detention methods as specified in the CRITERIA and MANUAL. The detention basin's outlet structure was designed to release the Water Quality Capture Volume (WQCV) in 40 hours or more and the Excess Urban Runoff Volume (EURV) in 68-72 hours. Based upon this approach, we feel that the drainage design provided for the Site is in keeping with the zoning and historic drainage concept for the area.

The Site is also located outside the 100-year floodplain and within Zone X (an area of minimal flood hazard) as noted on the FEMA FIRM Map No. 08041C0753G revised on December 7, 2018 (See Appendix).

HYDRAULIC CRITERIA

The proposed drainage facilities were designed in accordance with the CRITERIA and MANUAL. Floodplain identification was determined using FIRM panels by FEMA and information provided in the CRITERIA. Hydraulic calculations were computed using StormCAD. Per Volume 1, Chapter 9, Section 7.4 of the CRITERIA, Bentley StormCAD is an acceptable analysis tool if the coefficients for bends and losses as shown in Table 9-4 of the CRITERIA are utilized. These coefficients were utilized in the hydraulic analysis.

VARIANCES FROM CRITERIA

There are two variances from the CRITERIA approved for this Project which are included in the Appendix.

A variance is requested from the following sections of CRITERIA:

1. DCM, Volume 1, Chapter 9, Section 7.2, *"A minimum velocity of 3 ft/sec is required when the storm sewer conveys runoff from flow equal to the minor design storm flow rate."*
2. DCM, Volume 1, Chapter 9, Section 7.3, *"The minimum allowable longitudinal slope shall be 0.005 ft/ft (0.50 percent) for pipes 30 inches in diameter and smaller."*

DRAINAGE BASINS AND SUB-BASINS

SUB-BASIN DESCRIPTION

Historic Drainage Patterns

The Site has existing grades of approximate 2-4% and slopes to both the northwest and southeast with a central ridge through the eastern third of the site. The western portion of the Site surface flows over existing vegetation directly into Sand Creek. The eastern portion of the Site surface flows similarly over vegetated areas directly into the East Fork Sand Creek which borders the eastern edge of the Project. There is no existing storm sewer infrastructure on the Site.

The historic drainage patterns of the Site will be maintained in the proposed condition with two separate outfalls into East Fork Sand Creek and Sand Creek.

MAJOR DRAINAGE BASIN DESCRIPTION

The Project is located within the Sand Creek Drainage Basin. The major drainage basin is mostly developed. The Property is ultimately tributary to Sand Creek and East Fork Sand Creek, both of which have recently been stabilized per the MDDP. There are no additional planned improvements to either of these drainageways known at this time. There are no known major irrigation facilities within 100 feet of the property.

EXISTING DRAINAGE BASIN

The MDDP subdivides the existing Site into 5 different sub-basins that split flows between outfall locations. An exhibit is provided in Appendix F which shows the basin delineation. Sub-Basin A7, located on the eastern half of the Site accounts for approximately 5.1 acres which flows southeast, toward the Sand Creek East Fork. The developed flows anticipated from this sub-basin are 16.64 cfs and 31.60 cfs in the 5-year and 100-year events respectively. Sub-basins C1-C4, located on the western half of the Site have combined anticipated developed flows of 48.8 cfs and 94.0 cfs in the 5-year and 100-year events respectively. These combined flows have an ultimate outfall into Sand Creek. Both of these sub-basins will be detained and treated on Site before outfall into their respective drainageways.

The Site is also located outside the 100-year floodplain and within Zone X (an area of minimal flood hazard) as noted on the FEMA FIRM Map No. 08041C0753G revised on December 7, 2018 (See Appendix).

DRAINAGE FACILITY DESIGN

GENERAL CONCEPT

PROPOSED DRAINAGE PATTERNS

The developed runoff from the Project will generally be collected by means of curb and gutter and the private storm sewer system with inlets located within the internal drives of each delineated sub-basin area. When possible, runoff is directed through pervious areas before entering the proposed extended detention basins to promote infiltration on Site.

The Property has been divided into thirty-eight (38) on-site sub-basins, and 1 off-site basin. Sub-basins P1-P9, R1-R17, OS1-OS-2, and OF1 are all captured within the proposed northern private full-spectrum extended detention basin (“Pond N”), while sub-basins P10-P13, R18-R21, and OF3-OF4 flow into the proposed southern private full-spectrum extended detention basin (“Pond S”). Both full-spectrum extended detention basins will be privately owned and maintained and include a water quality outlet structure before discharge. The controlled 5-year and 100-year storm event release from the outlet structure will discharge through a proposed private storm sewer into the respective drainage ways.

All proposed storm sewer improvements for the Project are private.

Sub-Basin P1

(6.86 acres, 42.9% Impervious, Q_5=11.78 cfs / Q_{100}=28.07 cfs)

Sub-basin P1 consists of the northern perimeter of the site and includes the parking area, drive aisle, landscaping, and is inclusive of Pond N. The runoff in this area will be routed via curb and gutter and through slotted curb to vegetated landscape areas before entering Pond N. This basin is identified specifically on the Green Infrastructure exhibit within Appendix E and is unique to the site in that runoff is not collected in storm sewer inlets within this sub-basin. Runoff reduction calculations for this sub-basin are included in Appendix B. In the event that the outlet structure becomes completely clogged runoff will be directed over the emergency spillway for Pond N, and flow into Sand Creek.

Sub-Basin P2

(1.14 acres, 71.9% Impervious, Q_5=3.39 cfs / Q_{100}=6.72 cfs)

Sub-basin P2 consists of a portion of the western perimeter of the site and includes the parking area, drive aisle, and adjacent landscaping. The runoff in this area will overland flow via curb and gutter to a private 10’ Type R Curb Inlet in sump condition (DP-2), where it is then routed through the storm sewer network to Pond N. In the event that this inlet becomes completely clogged runoff will be directed over the proposed curb and gutter and flow westward through undeveloped land into Sand Creek.

Sub-Basin P3

(1.67 acres, 84.7% Impervious, Q_5=5.39 cfs / Q_{100}=10.15 cfs)

Sub-basin P3 consists of the drive aisle and parking areas on the southwestern perimeter of the Site. Runoff is this area will flow to a proposed 4' wide concrete pan which will direct flows west to a private 10' Type R Curb Inlet in sump condition (DP-3). Flows are then directed via the private storm sewer network to Pond N. In the event that this inlet becomes completely clogged runoff will be directed over the proposed curb and gutter and flow westward through undeveloped land into Sand Creek.

Sub-Basin P4

(0.68 acres, 9.4% Impervious, Q_5=0.55 cfs / Q_{100}=2.42 cfs)

Sub-basin P4 consists of the landscaped area between buildings 14, 15, 16, and 17. Runoff in this area will overland flow through vegetated areas and be captured by a private 30" standard nyloplast grate inlet in sump condition (DP-4). Flows are then directed via the private storm sewer network to Pond N. In the event that this inlet becomes completely clogged runoff will flow between buildings 16 and 17 and into Sub-Basin P2 where it will then follow the same overflow path as runoff originating in Sub-Basin P2.

Sub-Basin P5

(0.49 acres, 1.1% Impervious, Q_5=0.23 cfs / Q_{100}=1.53 cfs)

Sub-basin P5 consists of the landscaped area between buildings 18, 19, and 20. Runoff in this area will overland flow through vegetated areas and be captured by a private 30" standard nyloplast grate inlet in sump condition (DP-5). Flows are then directed via the private storm sewer network to Pond N. In the event that this inlet becomes completely clogged runoff will flow between buildings 20 and 21 and into Sub-Basin P1 where it will then follow the same overflow path as runoff originating in Sub-Basin P1.

Sub-Basin P6

(1.45 acres, 76.5% Impervious, Q_5=4.71 cfs / Q_{100}=9.14 cfs)

Sub-basin P6 consists of the drive aisle and parking area running east/west on the western half of the site. Runoff in this area will overland flow to a private 10' Type R Curb Inlet in sump condition (DP-6), where it is then routed through the storm network to Pond N. In the event that this inlet becomes completely clogged runoff will flow between buildings 16 and 18 and into Sub-Basin P2 where it will then follow the same overflow path as runoff originating in Sub-Basin P2.

Sub-Basin P7

(0.90 acres, 83.7% Impervious, Q_5=3.55 cfs / Q_{100}=6.70 cfs)

Sub-basin P7 consists of the drive aisle and parking area between buildings 12 and 15. Runoff in this area will overland flow to a private 15' Type R Curb Inlet in sump condition (DP-7), where it is then routed through the storm network to Pond N. In the event that this inlet becomes completely clogged runoff will flow between buildings 16 and 18 and into Sub-Basin P2 where it will then follow the same overflow path as runoff originating in Sub-Basin P2.

Sub-Basin P8

(0.82 acres, 6.3% Impervious, Q_5=0.43 cfs / Q_{100}=2.11 cfs)

Sub-basin P8 consists of the landscaped area between buildings 6, 7, 8 and 9. Runoff in this area will overland flow through vegetated areas and be captured by a private 30" standard nyloplast grate inlet in sump condition (DP-8). Flows are then directed via the private storm sewer network to Pond N. In the event that this inlet becomes completely clogged runoff will flow between buildings 7 and 8 and into Sub-Basin P1 where it will then follow the same overflow path as runoff originating in Sub-Basin P1.

Sub-Basin P9

(0.77 acres, 9.3% Impervious, Q_5=0.63 cfs / Q_{100}=2.74 cfs)

Sub-basin P9 consists of the landscaped area between buildings 10, 11, 12 and 13. Runoff in this area will overland flow through vegetated areas and be captured by a private 30" standard nyloplast grate inlet in sump condition (DP-9). Flows are then directed via the private storm sewer network to Pond N. In the event that this inlet becomes completely clogged runoff will flow between buildings 11 and 12 and into Sub-Basin P6 where it will then follow the same overflow path as runoff originating in Sub-Basin P6.

Sub-Basin R1-R15

(0.22 acres, 90.0% Impervious, Q_5=0.83 cfs / Q_{100}=1.54 cfs)

Sub-basins R1-R15 consists of the individual apartment buildings on Site. Each of these structures will have downspouts which will either connect directly into the proposed storm sewer network on Site, or splash on-grade and surface flow to a nearby area or curb inlet. All flows from these roof basins will ultimately outfall into Pond N, where they will be detained, treated, and discharged into Sand Creek.

Sub-Basin R16

(0.07 acres, 90.0% Impervious, Q_5=0.26 cfs / Q_{100}=0.48 cfs)

Sub-basin R16 consists of the phase 2 clubhouse. The rooftop basin will release flows to splash on-grade via downspouts and splash blocks to surface flow to the northern detention basin. The entirety of this basin will flow into Pond N, where it will be detained, treated, and discharged into Sand Creek.

Sub-Basin R17

(0.17 acres, 90.0% Impervious, Q_5=0.63 cfs / Q_{100}=1.18 cfs)

Sub-basin R17 consists of the phase 1 clubhouse. The rooftop basin will release flows to splash on-grade via downspouts and splash blocks to surface flow to the northern detention basin. The entirety of this basin will flow into Pond N, where it will be detained, treated, and discharged into Sand Creek.

Sub-Basin OF1

(0.99 acres, 5.8% Impervious, Q_5=0.52 cfs / Q_{100}=2.25 cfs)

Sub-basin OF1 consists of the northwest corner of the site that will flow directly into Sand Creek. This area will remain undisturbed and continue to follow historic drainage patterns.

Sub-Basin OF2

(0.74 acres, 0.1% Impervious, Q_5=0.31 cfs / Q_{100}=2.25 cfs)

Sub-basin OF2 consists of the landscape area on the southern perimeter of the site which will flow off-site onto the neighboring property. This sub-basin will follow historic drainage patters and will not negatively impact drainage patterns off-site.

Sub-Basin OS1

(1.20 acres, 0.0% Impervious, Q_5=0.41 cfs / Q_{100}=5.39 cfs)

Sub-basin OS1 consists of the area to the north of the Project which will flow onto the Site and directly into Pond N. This area is currently vacant and is expected to be captured on-site at the time of development.

Sub-Basin P10

(1.52 acres, 14.7% Impervious, Q_5=1.23 cfs / Q_{100}=4.52 cfs)

Sub-basin P10 consists of the southeastern corner of the site and includes the landscape/amenity area south of the entrance drive aisle as well as Pond S. The runoff in this area will overland flow directly into Pond S. In the event that the outlet structure becomes completely clogged runoff will be directed over the emergency spillway for Pond S, and flow into East Fork Sand Creek.

Sub-Basin P11

(2.58 acres, 47.5% Impervious, Q_5=4.82 cfs / Q_{100}=11.02 cfs)

Sub-basin P11 consists of the drive aisle, parking areas, and landscaping on the eastern perimeter of the Site. Runoff is this area will flow via curb and gutter to a proposed private 15' Type R Curb Inlet in sump condition (DP-11). Flows are then directed via the private storm sewer network to Pond S. In the event that this inlet becomes completely clogged runoff will overtop the curb and gutter and flow into Sub-Basin P10 where it will then follow the same overflow path as runoff originating in Sub-Basin P10.

Sub-Basin P12

(1.41 acres, 76.5% Impervious, Q_5=4.50 cfs / Q_{100}=8.73 cfs)

Sub-basin P12 consists of the drive aisle, parking areas, and landscaping between buildings 3, 4, 6, and 7. Runoff is this area will flow via curb and gutter to a proposed private 15' Type R Curb Inlet in sump condition (DP-12). Flows are then directed via the private storm sewer network to Pond S. In the event that this inlet becomes completely clogged runoff will overtop the curb and gutter and flow into Sub-Basin P10 where it will then follow the same overflow path as runoff originating in Sub-Basin P10.

Sub-Basin P13

(0.60 acres, 10.4% Impervious, Q_5=0.45 cfs / Q_{100}=1.88 cfs)

Sub-basin P13 consists of the landscaped area between buildings 1, 2, 3, and 4. Runoff in this area will overland flow through vegetated areas and be captured by a private 30" standard nyloplast grate inlet in sump condition (DP-13). Flows are then directed via the private storm sewer network to Pond S. In the event that this inlet becomes completely clogged runoff will flow between buildings 1 and 4 and into Sub-Basin P12 where it will then follow the same overflow path as runoff originating in Sub-Basin P12.

Sub-Basin R18-R21

(0.22 acres, 90.0% Impervious, Q_5=0.83 cfs / Q_{100}=1.54 cfs)

Sub-basins R18-R21 consists of the individual apartment buildings on Site. Each of these structures will have downspouts which will either connect directly into the proposed storm sewer network or splash on-grade before surface flowing to a nearby area or curb inlet on Site. Flows from these roof basins will ultimately outfall into Pond S, where they will be detained, treated, and discharged into Sand Creek.

Sub-Basin OF3

(0.40 acres, 57.0% Impervious, Q_5=1.12 cfs / Q_{100}=2.40 cfs)

Sub-basin OF3 consists of the area along Joystone Drive which flows off-site, back into Joystone Drive. These flows are routed past the Site directly into East Fork Sand Creek and are not detained or treated. These flows are following historic drainage patterns and will not negatively impact the downstream drainageway.

Sub-Basin OF4

(0.29 acres, 0% Impervious, Q_5=0.10 cfs / Q_{100}=0.71 cfs)

Sub-basin OF4 consists of the portion of the Site to the south of Pond S which does not flow into Pond S. This area will remain undisturbed and continue to follow historic drainage patterns.

EMERGENCY OVERFLOW ROUTING

Emergency overflow routing for Pond N will direct flows across the proposed regional trail along Sand Creek and directly into Sand Creek. The emergency overflow routing for Pond S will take a similar approach but will result in flows going east and directly into East Fork Sand Creek. A designated emergency spillway has been designed for each pond and is shown on the Proposed Drainage Exhibit in Appendix E.

FOUR-STEP PROCESS

The four-step process per the USDCM provides guidance and requirements for the selection and siting of structural Control Measures (CCMs) for new development and significant redevelopment. Compliance with this process is outlined below.

Step 1: Employ Runoff Reduction Practices

Currently the site is vacant undeveloped land. Development of the site will increase current runoff conditions due to increased imperviousness values. However, stormwater runoff reduction techniques will be used to promote stormwater infiltration and reduce the amount of runoff. As documented in the runoff reduction calculations and exhibit found in the Appendix, the site was divided into Upstream Impervious Areas (UIA) and Receiving Pervious Area (RPA) per the City of Colorado Springs criteria. A runoff reduction of 18% was achieved and the site is generally in compliance with the requirements of the Green Infrastructure Manual. The stormwater runoff for sub-basin P1 will be directed over the various RPA's directly into the private full-spectrum extended detention basin.

Step 2: Provide Water Quality Capture Volume (WQCV)

The water quality capture volumes after runuff reduction for Pond N and Pond S, 0.256 ac-ft and 0.132 ac-ft respectively will be detained and treated using a proposed private full-spectrum extended detention basins and outlet structures. Pond S does not receive any reduction in water quality capture volume. These detention basins will capture, treat, and detain 21.25 acres and 7.66 acres, respectively, which includes a portion of the offsite sub-

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basin to the north of the Site, OS1. In total, only 0.08 (0.2%) acres of the site does not receive water quality treatment.

Design Point	Associated Disturbance Area (ac)	Treatment Method	Ownership / Maintenance
1	1.07	EDB – Pond N	Private
2	1.50	EDB – Pond N	Private
3	0.74	EDB – Pond N	Private
4	0.62	100% WQVC Reduction	Private
5	0.15	100% WQVC Reduction	Private
6	6.51	EDB – Pond N	Private
7	3.52	EDB – Pond S	Private
8	1.20	75% Infiltration	Private
9	0.29	75% Infiltration	Private
10	8.43	EDB – Pond N	Private
11	3.59	EDB – Pond S	Private
12	0.08	Not treated	N/A
Total	27.7		

Step 3: Stabilize Drainageways
The proposed private stormwater outfalls from the Site will use a 24” RCP storm pipe with restrictor plate and concrete flared end sections. The proposed development will not negatively impact the Sand Creek or East Fork Sand Creek drainageways as the outfall flows will remain below the historical rates defined in the MDDP. The East Fork Sand Creek drainageway was recently realigned and consists of a trapezoidal channel with a bottom width of 50-ft, 3:1 side slopes with buried riprap lining and a depth of 5-ft. Grouted sloping boulder drop structures were also constructed within the channel. The stabilization of the channel is further discussed in the Channel Study. The Sand Creek drainageway stabilization consists of sloping boulder drop structures upstream and downstream of this Project. Colorado Springs Utilities is currently designing further stabilization for this reach of Sand Creek which will include additional grouted boulder drop structures and Type M soil riprap stabilized side slopes. It is anticipated that construction for these additional channel improvements will commence Fall 2024. No additional drainageway stabilization will be required as a part of this Project. The Pond N outfall discharges into a densely vegetated area and no evidence of erosion has been seen in this area. The proposed outfall discharges at the boundary of a wetland area and the proposed riprap for the outfall pipe and emergency spillway will extend to the bench of the channel which runs through the wetland. In effort not to disturb the wetland, riprap will not extend into the channel, but will terminate at the bench. Based on an upstream area of 13.58 acres and an existing impervious value of 80%, it was found that flows within the wetland area travel at a velocity of 2.78 ft/s in the 100-year storm event. Due to the low velocity, the riprap has only been sized for outfall and emergency spillway flows. Calculations for flows within the wetland area are provided in Appendix C and D. The Pond S outfall has been proposed to discharge at an existing grouted sloping boulder drop structure and any demolished grouted boulders will be replaced in kind. This proposed location will allow discharges from Pond S to enter the Sand Creek East Fork drainageway without causing erosion and because the grouted boulders will be replaced in kind, the riprap will match previously approved riprap that has been designed for the anticipated flows within this drainageway. Enhanced erosion protection measures beyond standard riprap outfall protection (Pond N) and replacing disturbed grouted boulders in kind (Pond S) are not proposed due to the placement of both outfalls

into stable channels. The Pond N outfall discharges outside of the 100-year floodplain. The Pond S outfall will be installed within the 100-year floodplain. It is anticipated that a non-notifying Nationwide Permit 58 will be obtained for this storm drain outfall as the disturbance to the floodplain will not exceed 1/10th of an acre. The Project is not increasing the flow at either location from what was planned for in the MDDP, therefore additional downstream stabilization measures are not required as part of the Project.

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 toward channel stabilization within the drainage basin.

Step 4: Implement Site Specific and Other Source Control CCMs
The Site does not require specialized CCMs in the final constructed condition. The Project consists of a residential development and does not require source control CCMs such as Covering Outdoor Storage and Handling Areas, Spill Prevention Containment and Control, and Disposal of Household Waste. All flows leaving the Site will be released at or below the historically planned rates and are not anticipated to cause adverse impact to downstream facilities and additional offsite improvements are not required by this Project.

DETENTION STORAGE

Existing drainage patterns include un-detained and un-controlled release from the Site. The proposed private full-spectrum extended detention basins, with associated controlled release rates, represents an improvement over the existing conditions. Calculations included in the Appendix provide details regarding the private full-spectrum extended detention basin sizing. The calculations include determination of the storage volume required for each of the full-spectrum extended detention basins for the Site. The total acreage contributing to the northern extended detention basin (Pond N) is 21.25 acres with a design percent imperviousness of 50.0% (49.2% actual). Overall, 1.953 acre-feet (85,073 cubic feet) of detention storage volume is required. The proposed private full spectrum extended detention basin provides 2.748 acre-feet of storage with 1’ of freeboard. The total acreage contributing to the sourthern extended detention basin (Pond S) is 7.66 acres with a design percent imperviousness of 50.0% (47.0% actual). Overall, 0.706 acre-feet (30,753 cubic feet) of detention storage volume is required. The proposed private full-spectrum extended detention basin provides 1.127 acre-feet of storage with 1’ of freeboard.

Two different scenarios were modeled using StormCAD in order to demostrate that flows on-site were adequately conveyed to, and through the proposed private full-spectrum extended detention basins. The first scenario utilizes a fixed tailwater condition, with the tailwater elevation being equal to the water surface elevation of each pond during the given 5 or 100-year storm event. The second scenario utilizes a free outfall condition to demonstrate that the proposed storm network can adequately convey flows through the site under ideal conditions, before the ponds have begun to detain flows. The first condition mentioned shows that although the standard hydraulic grade line requirements are not met (HGL is within the pipe during the minor event, and 1’ below finished grade during the major event) the proposed storm sewer network is capable of conveying the major storm event flows without the system becoming inundated, and ponding occuring on-site. It is not anticipated that under the modeled conditions the proposed apartment buildings, garages, or amenities on site be negatively impacted.

OUTLET REQUIREMENTS

The water quality standards established by the CRITERIA in section 13.5.10 are met by the proposed water quality outlet structure. The private full-spectrum extended detention basins and

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water quality outlet structures were designed per the specifications in section 13.5.10 of the CRITERIA. The orifice plates of the structures were designed based on section 13.4.2.2 of the CRITERIA. The orifice plates will allow the Water Quality Capture Volume to be drained from the structures in 40 hours or more, not to exceed 72 hours, and the EURV to be drained within 68 to 72 hours. The 100-year design release rate was determined by using Table 13-2 of the CRITERIA. The runoff release will be via a private storm sewer which directly into existing drainageways. All flows leaving the Site will be released at or below the historically planned rates and are not anticipated to cause adverse impact to downstream facilities and additional offsite improvements are not required by this Project.

Riprap sizing for the outlet pipe associated with the North Pond can be found in Appendix C. The South Pond outlet pipe discharges into the side of a grouted sloping boulder drop structure and an excerpt from the Channel Study has been included in Appendix F. This excerpt includes the boulder sizing required as the existing boulders will be removed for the oulet pipe installation and then replaced in kind.

MAINTENANCE AND OPERATIONS

It is our recommendation that the detention basins maintenance cycle consist of bi-annual inspections (spring and fall), evaluation of sedimentation within the basin, and removal of sediment if levels exceed two inches deep or if discharge is otherwise deemed insufficient. Maintenace shall be completed by the owner. This satisfies the maintenance and access requirement set by the CRITERIA.

GRADING AND EROSION CONTROL PLAN

Erosion Control Plans will be submitted separately as a standalone construction document to the Stormwater Enterprise for review and approval prior to construction.

COST OF PROPOSED DRAINAGE FACILITIES

An Opinion of Probable Construction Cost (OPCC) is provided in the Appendix of the report. There are no public drainage facilities. All improvements with this Project will be private.

DRAINAGE AND BRIDGE FEES

The Project is located in the Sand Creek Basin, and all applicable fees were paid at the time of platting.

CONCLUSION

The drainage design presented within this report for Westgate at Powers Filing No. 3 is in conformance with all previously approved reports which included this Site and conforms to the City of Colorado Springs Drainage Criteria Manual Volumes 1 and 2 and the Mile High Flood District Urban Storm Drainage Criteria Manual. Additionally, Site runoff and storm drain facilities will not adversely affect the downstream and surrounding developments, will not result in any increase in peak flows, nor will it result in any decrease in water quality downstream in Sand Creek. The report and its findings are consistent with the drainage requirements documented in the MDDP. A comparison of is provided below for reference.

Proposed Pond N (Detention Basin C per the previously approved FDR)

21.25 AC | 0.7 cfs 5-year | 15.4 cfs 100-year (23.35 AC | 27.99 cfs 5-year | 62.66 cfs 100-year)

Proposed Pond S (Detention Basin A9 per the previously approved FDR)

7.66 AC | 0.2 cfs 5-year | 6.6 cfs 100-year (6.26 AC | 11.69 cfs 5-year | 24.82 cfs 100-year)

REFERENCES

1. City of Colorado Springs Drainage Criteria Manual, May 2014

    Volume 1: Revised January 2021

    Volume 2: Revised December 2020

2. Mile High Flood District Drainage Criteria Manual (MHFDCM), Vol. 1, prepared by Wright-McLaughlin Engineers, June 2001, with latest revisions.

3. Flood Insurance Rate Map, El Paso County, Colorado and Incorporated Areas, Map Number 08041C0753G, Effective Date December 7, 2018, prepared by the Federal Emergency Management Agency (FEMA).

4. Master Development Drainage Plan for Westgate at Powers, City of Colorado Springs, Colorado. Prepared by JPS Engineering. Prepared April 30, 2012.

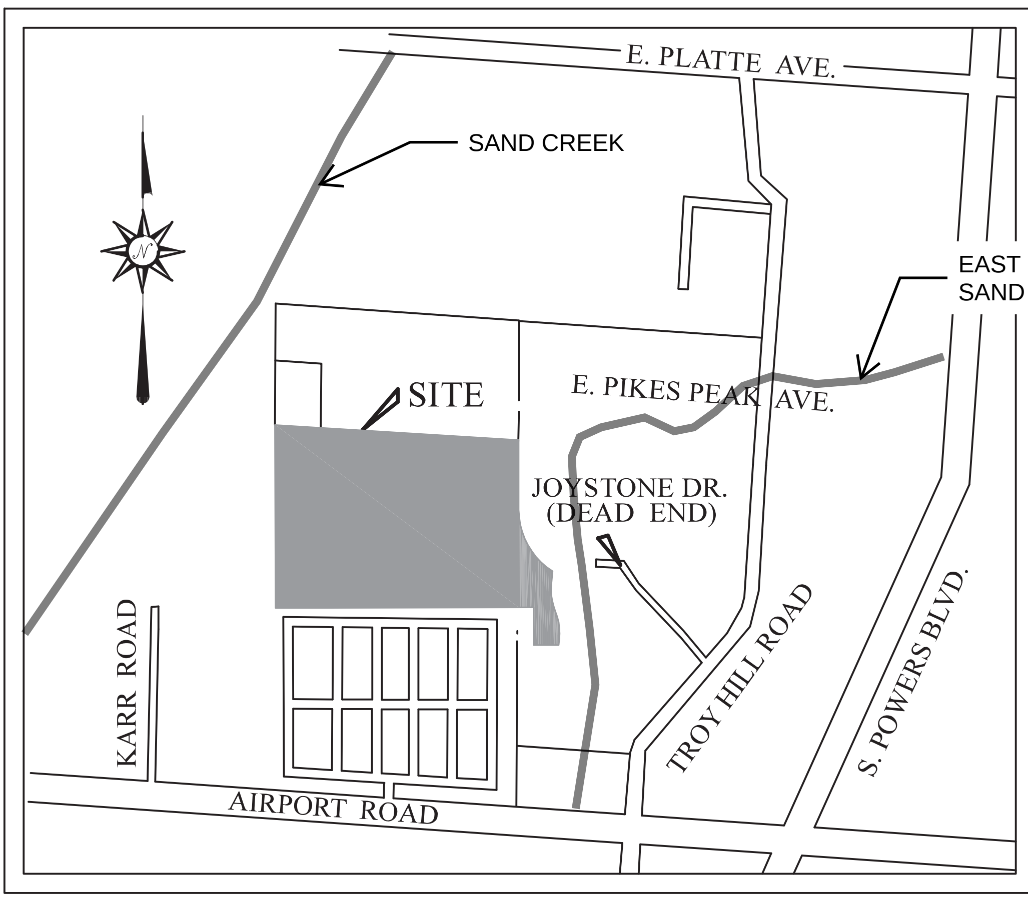
5. Natural Resources Conservation Service, Web Soil Survey Map, dated 11/17/22

6. Final Drainage Report for Westgate at Powers Phase 1, City of Colorado Springs. Prepared by JPS Engineering. Prepared March 28, 2018.

7. Channel Design Report for Westgate at Powers Sand Creek Center Tributary Channel. Prepared by JPS Engineering. Prepared March 28, 2018.

APPENDIX

APPENDIX A –VICINITY MAP, FEMA FIRM MAP, AND USGS SOILS MAP

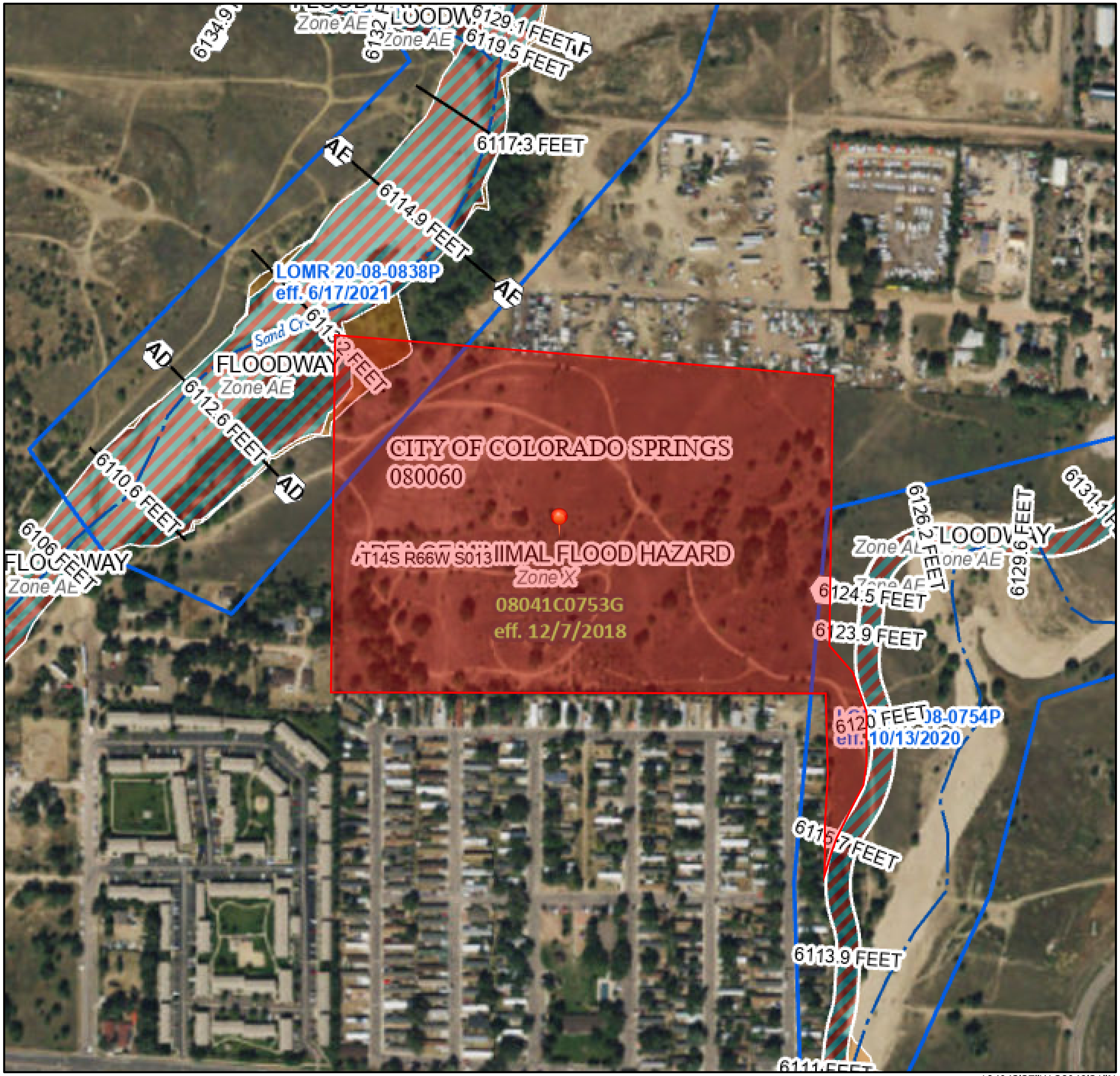


VICINITY MAP
(NOT TO SCALE)

National Flood Hazard Layer FIRMette

FEMA

104°44'14"W 38°49'59"N



Feet

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

1:6,000

104°43'37"W 38°49'31"N

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

Legend

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

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

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/3/2023 at 12:39 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for

El Paso County Area, Colorado

November 17, 2022

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

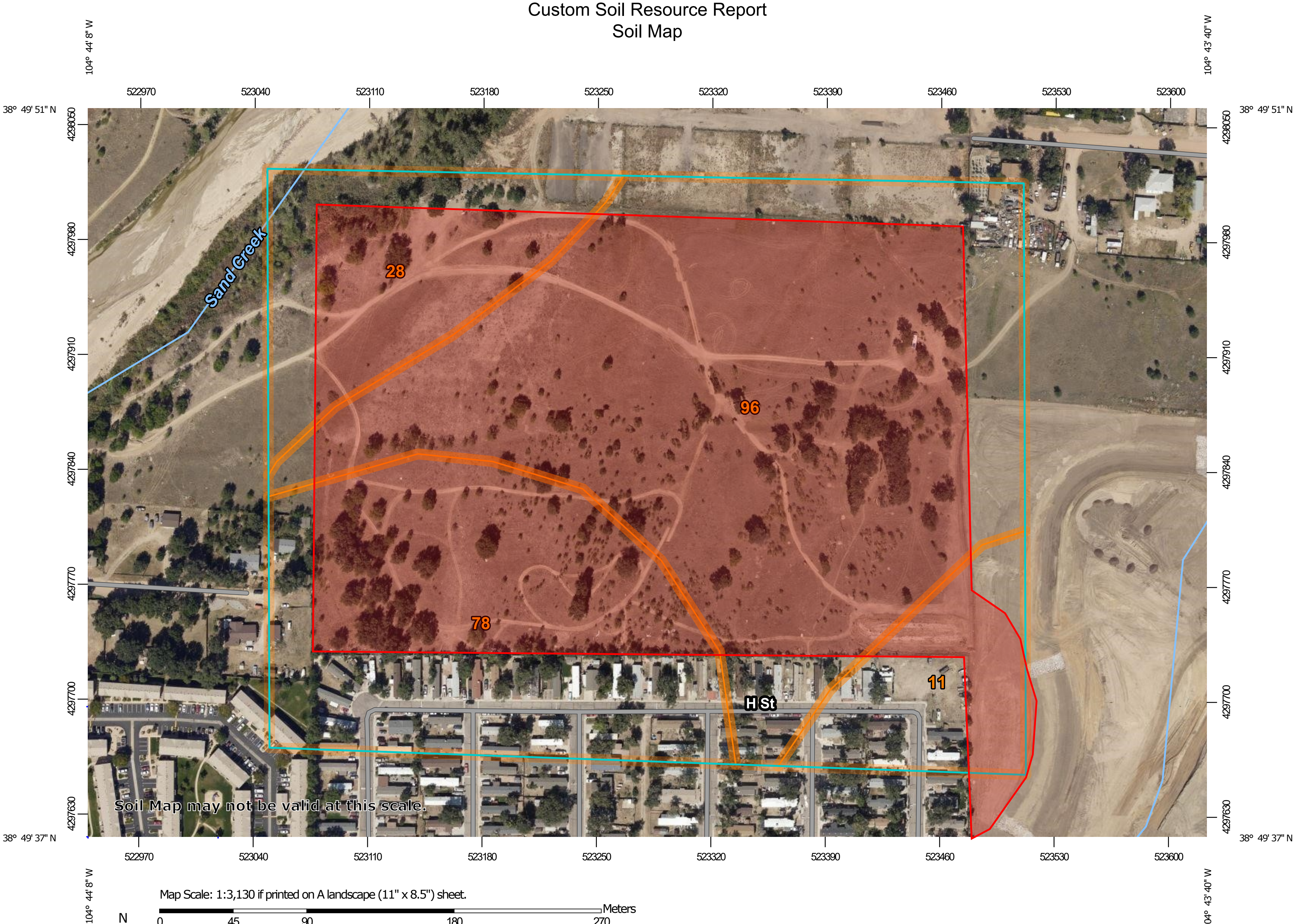
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map



Map Scale: 1:3,130 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 45, 90, 180, 270

Feet: 0, 150, 300, 600, 900

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
11	Bresser sandy loam, cool, 0 to 3 percent slopes	3.3	8.0%
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	5.3	12.9%
78	Sampson loam, 0 to 3 percent slopes	10.8	26.5%
96	Truckton sandy loam, 0 to 3 percent slopes	21.5	52.6%
Totals for Area of Interest		**40.9**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

El Paso County Area, Colorado

11—Bresser sandy loam, cool, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2tlph
Elevation: 5,850 to 6,880 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 100 to 130 days
Farmland classification: Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60

Map Unit Composition

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

Description of Bresser, Cool

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Tertiary aged alluvium derived from arkose

Typical profile

Ap - 0 to 5 inches: sandy loam
Bt1 - 5 to 8 inches: sandy loam
Bt2 - 8 to 27 inches: sandy clay loam
Bt3 - 27 to 36 inches: sandy loam
C - 36 to 80 inches: loamy coarse sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

Truckton

Percent of map unit: 10 percent
Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Yoder

Percent of map unit: 5 percent
Landform: Alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R049XY214CO - Gravelly Foothill
Hydric soil rating: No

28—Ellicott loamy coarse sand, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 3680
Elevation: 5,500 to 6,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Ellicott and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ellicott

Setting

Landform: Stream terraces, flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium

Typical profile

A - 0 to 4 inches: loamy coarse sand
C - 4 to 60 inches: stratified coarse sand to sandy loam

Properties and qualities

Slope: 0 to 5 percent

Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: NoneFrequent
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A
Ecological site: R069XY031CO - Sandy Bottomland
Other vegetative classification: SANDY BOTTOMLAND (069AY031CO)
Hydric soil rating: No

Minor Components

Fluvaquentic haplaquoll

Percent of map unit: 1 percent
Landform: Swales
Hydric soil rating: Yes

Other soils

Percent of map unit: 1 percent
Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

78—Sampson loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 369s
Elevation: 5,500 to 6,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Sampson and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sampson

Setting

Landform: Terraces, alluvial fans, depressions
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 15 inches: loam
Bt - 15 to 34 inches: clay loam
Bk - 34 to 60 inches: sandy clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: B
Ecological site: R049XB202CO - Loamy Foothill
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 4 percent
Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

96—Truckton sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2yvrd
Elevation: 5,400 to 7,000 feet
Mean annual precipitation: 14 to 23 inches

Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 90 to 155 days
Farmland classification: Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60

Map Unit Composition

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

Description of Truckton

Setting

Landform: Fan remnants, interfluves
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Wind re-worked alluvium derived from arkose

Typical profile

A - 0 to 4 inches: sandy loam
Bt1 - 4 to 12 inches: sandy loam
Bt2 - 12 to 19 inches: sandy loam
C - 19 to 80 inches: sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 1 percent
Maximum salinity: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.6 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

Blakeland

Percent of map unit: 5 percent
Landform: Hills, interfluves
Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Bresser

Percent of map unit: 5 percent
Landform: Terraces, interfluves
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Pleasant, frequently ponded

Percent of map unit: 2 percent
Landform: Closed depressions
Down-slope shape: Concave, linear
Across-slope shape: Concave
Ecological site: R067BY010CO - Closed Upland Depression
Hydric soil rating: Yes

Urban land

Percent of map unit: 2 percent
Hydric soil rating: No

Ellicott, occasionally flooded

Percent of map unit: 1 percent
Landform: Drainageways, flood plains
Down-slope shape: Linear
Across-slope shape: Linear, concave
Ecological site: R067BY031CO - Sandy Bottomland
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

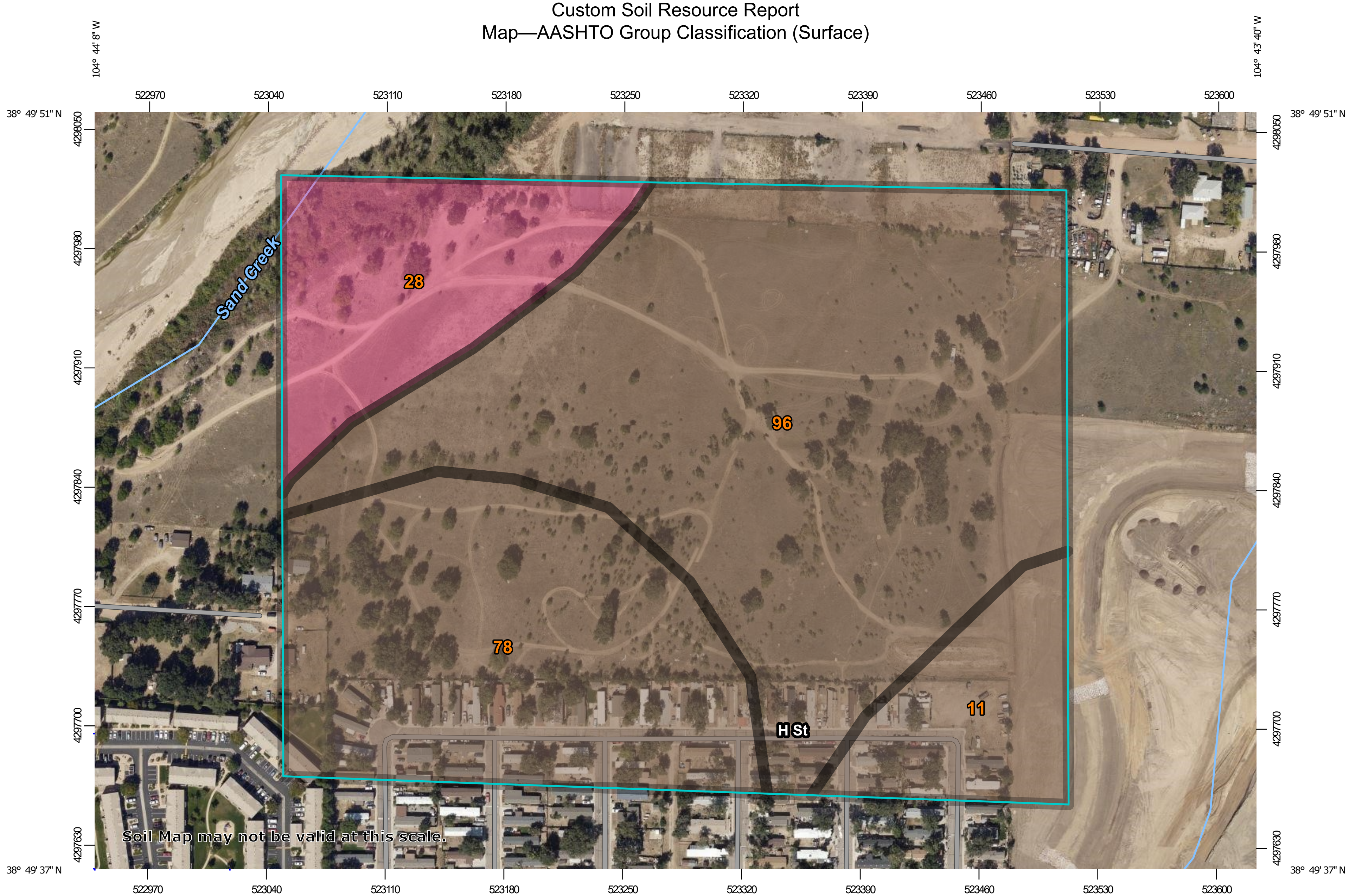
AASHTO Group Classification (Surface)

AASHTO group classification is a system that classifies soils specifically for geotechnical engineering purposes that are related to highway and airfield construction. It is based on particle-size distribution and Atterberg limits, such as liquid limit and plasticity index. This classification system is covered in AASHTO Standard No. M 145-82. The classification is based on that portion of the soil that is smaller than 3 inches in diameter.

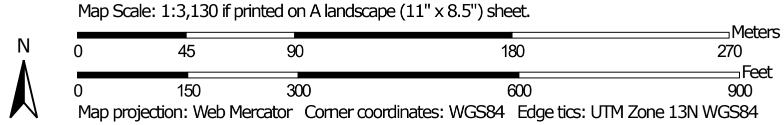
The AASHTO classification system has two general classifications: (i) granular materials having 35 percent or less, by weight, particles smaller than 0.074 mm in diameter and (ii) silt-clay materials having more than 35 percent, by weight, particles smaller than 0.074 mm in diameter. These two divisions are further subdivided into seven main group classifications, plus eight subgroups, for a total of fifteen for mineral soils. Another class for organic soils is used.

For each soil horizon in the database one or more AASHTO Group Classifications may be listed. One is marked as the representative or most commonly occurring. The representative classification is shown here for the surface layer of the soil.

Custom Soil Resource Report
Map—AASHTO Group Classification (Surface)



Map Scale: 1:3,130 if printed on A landscape (11" x 8.5") sheet.



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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A-1
A-1-a
A-1-b
A-2
A-2-4
A-2-5
A-2-6
A-2-7
A-3
A-4
A-5
A-6
A-7
A-7-5
A-7-6
A-8
Not rated or not available

Soil Rating Lines

A-1
A-1-a
A-1-b
A-2
A-2-4
A-2-5
A-2-6
A-2-7
A-3
A-4
A-5
A-6
A-7
A-7-5
A-7-6
A-8
Not rated or not available

Soil Rating Points

A-1
A-1-a
A-1-b
A-2
A-2-4
A-2-5
A-2-6
A-2-7
A-3
A-4
A-5
A-6
A-7
A-7-5
A-7-6
A-8
Not rated or not available

Water Features

Streams and Canals

Transportation

Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—AASHTO Group Classification (Surface)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
11	Bresser sandy loam, cool, 0 to 3 percent slopes	A-4	3.3	8.0%
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	A-1-b	5.3	12.9%
78	Sampson loam, 0 to 3 percent slopes	A-4	10.8	26.5%
96	Truckton sandy loam, 0 to 3 percent slopes	A-4	21.5	52.6%
Totals for Area of Interest			**40.9**	**100.0%**

Rating Options—AASHTO Group Classification (Surface)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

Hydrologic Soil Group

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

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

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

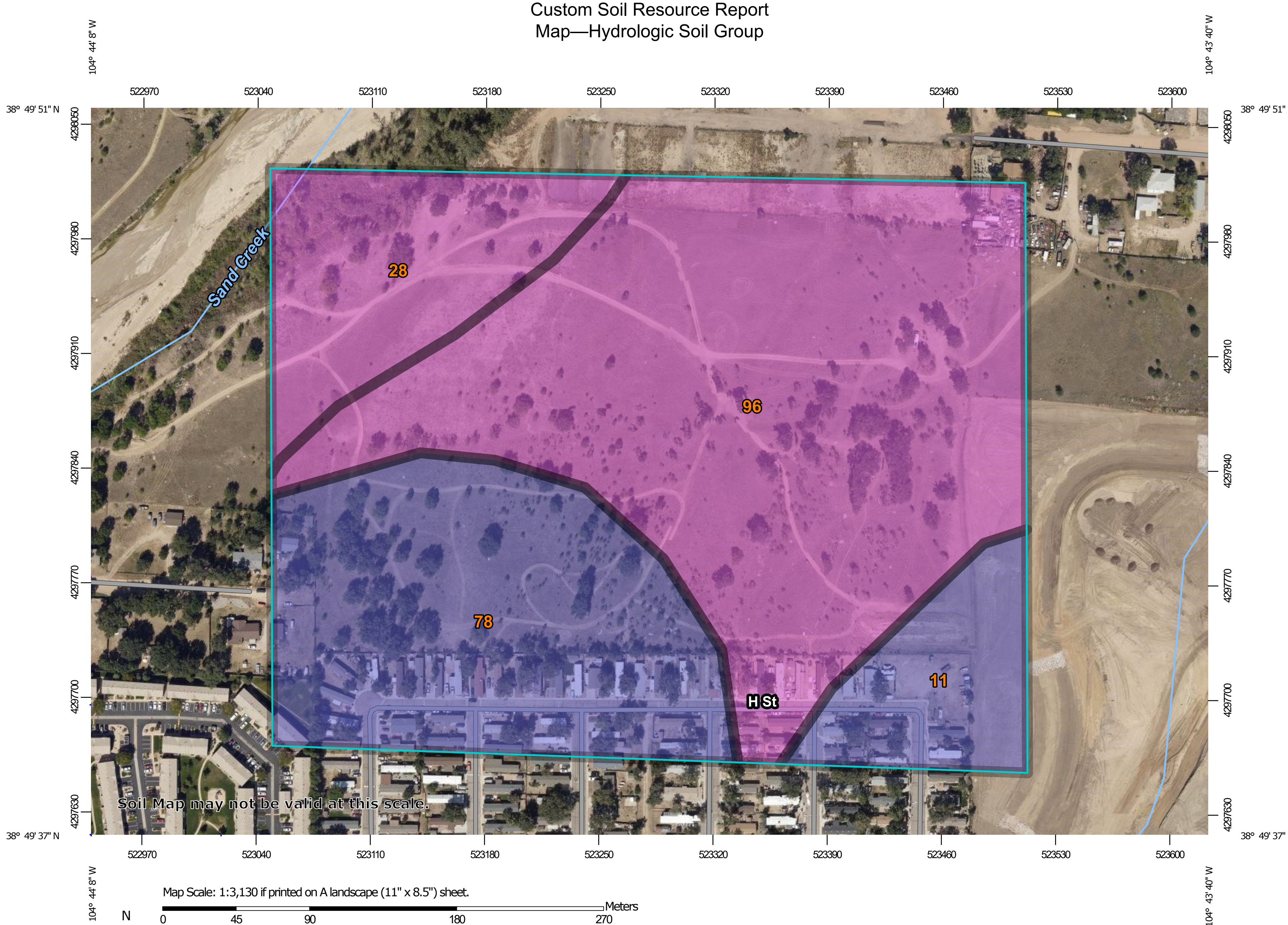
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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

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

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

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:3,130 if printed on A landscape (11" x 8.5") sheet.

Meters: 0 45 90 180 270

Feet: 0 150 300 600 900

N

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
11	Bresser sandy loam, cool, 0 to 3 percent slopes	B	3.3	8.0%
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	A	5.3	12.9%
78	Sampson loam, 0 to 3 percent slopes	B	10.8	26.5%
96	Truckton sandy loam, 0 to 3 percent slopes	A	21.5	52.6%
Totals for Area of Interest			**40.9**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

References

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APPENDIX B – HYDROLOGIC CALCULATIONS

IDF Equations:

$I_{100} = -2.52\ln(D) + 12.735$

$I_{50} = -2.25\ln(D) + 11.375$

$I_{25}\ -2.00\ln(D) + 10.111$

$I_{10}\ -1.75\ln(D) + 8.847$

$I_{5}\ -1.50\ln(D) + 7.583$

$I_{2}\ -1.19\ln(D) + 6.035$

Where:

I = Rainfall Intensity (in/hr)

D= Duration (minutes)

	2-yr	5-yr	10-yr	100-yr
P_1 =	1.19	1.50	1.75	2.52

Time Intensity Frequency Tabulation

TIME	2 YR	5 YR	10 YR	100 YR
5	4.12	5.17	6.03	8.68
10	3.29	4.13	4.82	6.93
15	2.81	3.52	4.11	5.91
30	1.99	2.48	2.89	4.16
60	1.16	1.44	1.68	2.42
120	0.34	0.40	0.47	0.67

Proposed Weighted Imperviousness Calculations

SUB-BASIN	AREA	AREA	ROOF	ROOF	ROOF				LANDSCAPE	LANDSCAPE	LANDSCAPE				PAVEMENT	PAVEMENT	PAVEMENT				WEIGHTED	WEIGHTED COEFFICIENTS			
	(SF)	(Acres)	AREA	IMPERVIOUSNESS	C2	C5	C10	C100	AREA	IMPERVIOUSNESS	C2	C5	C10	C100	AREA	IMPERVIOUSNESS	C2	C5	C10	C100	IMPERVIOUSNESS	C2	C5	C10	C100
P1	299,024	6.86	9,630	90%	0.71	0.73	0.75	0.81	169,881	0%	0.02	0.08	0.15	0.35	119,513	100%	0.89	0.90	0.92	0.96	42.9%	0.39	0.43	0.48	0.61
P2	49,692	1.14	4,680	90%	0.71	0.73	0.75	0.81	13,472	0%	0.02	0.08	0.15	0.35	31,540	100%	0.89	0.90	0.92	0.96	71.9%	0.64	0.66	0.70	0.78
P3	72,855	1.67	9,360	90%	0.71	0.73	0.75	0.81	10,197	0%	0.02	0.08	0.15	0.35	53,298	100%	0.89	0.90	0.92	0.96	84.7%	0.75	0.76	0.79	0.86
P4	29,763	0.68	0	90%	0.71	0.73	0.75	0.81	26,966	0%	0.02	0.08	0.15	0.35	2,797	100%	0.89	0.90	0.92	0.96	9.4%	0.10	0.16	0.22	0.41
P5	21,552	0.49	0	90%	0.71	0.73	0.75	0.81	21,313	0%	0.02	0.08	0.15	0.35	239	100%	0.89	0.90	0.92	0.96	1.1%	0.03	0.09	0.16	0.36
P6	63,366	1.45	0	90%	0.71	0.73	0.75	0.81	14,984	0%	0.02	0.08	0.15	0.35	48,382	100%	0.89	0.90	0.92	0.96	76.4%	0.68	0.71	0.74	0.82
P7	39,075	0.90	0	90%	0.71	0.73	0.75	0.81	6,382	0%	0.02	0.08	0.15	0.35	32,693	100%	0.89	0.90	0.92	0.96	83.7%	0.75	0.77	0.79	0.86
P8	35,831	0.82	0	90%	0.71	0.73	0.75	0.81	33,566	0%	0.02	0.08	0.15	0.35	2,265	100%	0.89	0.90	0.92	0.96	6.3%	0.07	0.13	0.20	0.39
P9	33,745	0.77	0	90%	0.71	0.73	0.75	0.81	30,598	0%	0.02	0.08	0.15	0.35	3,147	100%	0.89	0.90	0.92	0.96	9.3%	0.10	0.16	0.22	0.41
R1	9,530	0.22	9,530	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	90.0%	0.71	0.73	0.75	0.81
R2	9,530	0.22	9,530	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	90.0%	0.71	0.73	0.75	0.81
R3	9,530	0.22	9,530	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	90.0%	0.71	0.73	0.75	0.81
R4	9,530	0.22	9,530	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	90.0%	0.71	0.73	0.75	0.81
R5	9,530	0.22	9,530	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	90.0%	0.71	0.73	0.75	0.81
R6	9,530	0.22	9,530	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	90.0%	0.71	0.73	0.75	0.81
R7	9,530	0.22	9,530	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	90.0%	0.71	0.73	0.75	0.81
R8	9,530	0.22	9,530	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	90.0%	0.71	0.73	0.75	0.81
R9	9,530	0.22	9,530	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	90.0%	0.71	0.73	0.75	0.81
R10	9,530	0.22	9,530	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	90.0%	0.71	0.73	0.75	0.81
R11	9,530	0.22	9,530	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	90.0%	0.71	0.73	0.75	0.81
R12	9,530	0.22	9,530	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	90.0%	0.71	0.73	0.75	0.81
R13	9,530	0.22	9,530	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	90.0%	0.71	0.73	0.75	0.81
R14	9,530	0.22	9,530	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	90.0%	0.71	0.73	0.75	0.81
R15	9,530	0.22	9,530	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	90.0%	0.71	0.73	0.75	0.81
R16	2,989	0.07	2,989	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	90.0%	0.71	0.73	0.75	0.81
R17	7,290	0.17	7,290	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	90.0%	0.71	0.73	0.75	0.81
OF1	42,956	0.99	0	90%	0.71	0.73	0.75	0.81	40,483	0%	0.02	0.08	0.15	0.35	2,473	100%	0.89	0.90	0.92	0.96	5.8%	0.07	0.13	0.19	0.39
OF2	32,240	0.74	0	90%	0.71	0.73	0.75	0.81	32,199	0%	0.02	0.08	0.15	0.35	41	100%	0.89	0.90	0.92	0.96	0.1%	0.02	0.08	0.15	0.35
OS1	52,150	1.20	0	90%	0.71	0.73	0.75	0.81	52,150	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	0.0%	0.02	0.08	0.15	0.35
POND N TOTAL	925,478	21.25	176,899	90%	0.71	0.73	0.75	0.81	452,191	0%	0.02	0.08	0.15	0.35	296,388	100%	0.89	0.90	0.92	0.96	49.2%	0.43	0.47	0.51	0.63
P10	66,301	1.52	0	90%	0.71	0.73	0.75	0.81	56,576	0%	0.02	0.08	0.15	0.35	9,725	100%	0.89	0.90	0.92	0.96	14.7%	0.15	0.20	0.26	0.44
P11	112,194	2.58	0	90%	0.71	0.73	0.75	0.81	58,846	0%	0.02	0.08	0.15	0.35	53,348	100%	0.89	0.90	0.92	0.96	47.5%	0.43	0.47	0.52	0.64
P12	61,328	1.41	3,510	90%	0.71	0.73	0.75	0.81	14,045	0%	0.02	0.08	0.15	0.35	43,773	100%	0.89	0.90	0.92	0.96	76.5%	0.68	0.70	0.73	0.81
P13	26,080	0.60	0	90%	0.71	0.73	0.75	0.81	23,377	0%	0.02	0.08	0.15	0.35	2,703	100%	0.89	0.90	0.92	0.96	10.4%	0.11	0.16	0.23	0.41
R18	9,530	0.22	9,530	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	90.0%	0.71	0.73	0.75	0.81
R19	9,530	0.22	9,530	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	90.0%	0.71	0.73	0.75	0.81
R20	9,530	0.22	9,530	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	90.0%	0.71	0.73	0.75	0.81
R21	9,530	0.22	9,530	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	90.0%	0.71	0.73	0.75	0.81
OF3	17,246	0.40	0	90%	0.71	0.73	0.75	0.81	7,408	0%	0.02	0.08	0.15	0.35	9,838	100%	0.89	0.90	0.92	0.96	57.0%	0.52	0.55	0.59	0.70
OF4	12,443	0.29	0	90%	0.71	0.73	0.75	0.81	12,443	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	0.0%	0.02	0.08	0.15	0.35
POND S TOTAL	333,712	7.66	41,630	90%	0.71	0.73	0.75	0.81	172,695	0%	0.02	0.08	0.15	0.35	119,387	100%	0.89	0.90	0.92	0.96	47.0%	0.42	0.45	0.50	0.63
ONSITE TOTAL	1,207,040	27.71	218,529	90%	0.71	0.73	0.75	0.81	572,736	0%	0.02	0.08	0.15	0.35	415,775	100%	0.89	0.90	0.92	0.96	50.7%	0.44	0.48	0.52	0.64
OFFSITE TOTAL	52,150	1.20	0	90%	0.71	0.73	0.75	0.81	52,150	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	0.0%	0.02	0.08	0.15	0.35

Westgate Apartments - Final Drainage Report

Proposed Runoff Calculations

Time of Concentration

Watercourse Coefficient

Forest & Meadow	2.50	Short Grass Pasture & Lawns	7.00	Grassed Waterway	15.00
Fallow or Cultivation	5.00	Nearly Bare Ground	10.00	Paved Area & Shallow Gutter	20.00

	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA sq. ft.	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	L/180+10	min.
1	P1	299,024	6.86	0.43	100	5.4%	7.0	790	2.9%	20.00	3.4	3.9	10.9	890	14.9	10.9
2	P2	49,692	1.14	0.66	100	1.6%	6.8	180	2.1%	20.00	2.9	1.0	7.8	280	11.6	7.8
3	P3	72,855	1.67	0.76	73	3.0%	3.7	700	1.1%	20.00	2.1	5.7	9.4	773	14.3	9.4
4	P4	29,763	0.68	0.16	0	2.0%	0.1	167	2.1%	20.00	2.9	1.0	5.0	167	10.9	5.0
5	P5	21,552	0.49	0.09	0	2.0%	0.1	182	2.0%	20.00	2.8	1.1	5.0	182	11.0	5.0
6	P6	63,366	1.45	0.71	100	2.1%	5.6	315	2.2%	20.00	3.0	1.8	7.4	415	12.3	7.4
7	P7	39,075	0.90	0.77	0	2.0%	0.0	200	3.2%	20.00	3.6	0.9	5.0	200	11.1	5.0
8	P8	35,831	0.82	0.13	100	5.1%	10.3	190	2.2%	20.00	3.0	1.1	11.4	290	11.6	11.4
9	P9	33,745	0.77	0.16	0	2.0%	0.1	185	3.4%	20.00	3.7	0.8	5.0	185	11.0	5.0
R1	R1	9,530	0.22	0.73	35	2.0%	3.2	-	1.0%	20.00	2.0	0.0	5.0	35	10.2	5.0
R2	R2	9,530	0.22	0.73	35	2.0%	3.2	-	1.0%	20.00	2.0	0.0	5.0	35	10.2	5.0
R3	R3	9,530	0.22	0.73	35	2.0%	3.2	-	1.0%	20.00	2.0	0.0	5.0	35	10.2	5.0
R4	R4	9,530	0.22	0.73	35	2.0%	3.2	-	1.0%	20.00	2.0	0.0	5.0	35	10.2	5.0
R5	R5	9,530	0.22	0.73	35	2.0%	3.2	-	1.0%	21.00	2.1	0.0	5.0	35	10.2	5.0
R6	R6	9,530	0.22	0.73	35	2.0%	3.2	-	1.0%	22.00	2.2	0.0	5.0	35	10.2	5.0
R7	R7	9,530	0.22	0.73	35	2.0%	3.2	-	1.0%	20.00	2.0	0.0	5.0	35	10.2	5.0
R8	R8	9,530	0.22	0.73	35	2.0%	3.2	-	1.0%	20.00	2.0	0.0	5.0	35	10.2	5.0
R9	R9	9,530	0.22	0.73	35	2.0%	3.2	-	1.0%	20.00	2.0	0.0	5.0	35	10.2	5.0
R10	R10	9,530	0.22	0.73	35	2.0%	3.2	-	1.0%	20.00	2.0	0.0	5.0	35	10.2	5.0
R11	R11	9,530	0.22	0.73	35	2.0%	3.2	-	1.0%	20.00	2.0	0.0	5.0	35	10.2	5.0
R12	R12	9,530	0.22	0.73	35	2.0%	3.2	-	1.0%	20.00	2.0	0.0	5.0	35	10.2	5.0
R13	R13	9,530	0.22	0.73	35	2.0%	3.2	-	1.0%	20.00	2.0	0.0	5.0	35	10.2	5.0
R14	R14	9,530	0.22	0.73	35	2.0%	3.2	-	1.0%	20.00	2.0	0.0	5.0	35	10.2	5.0
R15	R15	9,530	0.22	0.73	35	2.0%	3.2	-	1.0%	20.00	2.0	0.0	5.0	35	10.2	5.0
R16	R16	2,989	0.07	0.73	35	2.0%	3.2	-	1.0%	20.00	2.0	0.0	5.0	35	10.2	5.0
R17	R17	7,290	0.17	0.73	35	2.0%	3.2	-	1.0%	20.00	2.0	0.0	5.0	35	10.2	5.0
OF1	OF1	42,956	0.99	0.13	100	5.5%	10.1	-	1.0%	7.00	0.7	0.0	10.1	100	10.6	10.1
OF2	OF2	32,240	0.74	0.08	25	20.0%	3.4	-	5.0%	8.00	1.8	0.0	5.0	25	10.1	5.0
OS1	OS1	52,150	1.20	0.08	100	8.0%	9.3	-	5.0%	9.00	2.0	0.0	9.3	100	10.6	9.3
10	P10	66,301	1.52	0.20	100	4.6%	9.9	100	1.1%	20.00	2.1	0.8	10.7	200	11.1	10.7
11	P11	112,194	2.58	0.47	80	1.8%	8.5	450	2.2%	20.00	2.9	2.5	11.0	530	12.9	11.0
12	P12	61,328	1.41	0.70	55	0.8%	5.7	261	1.4%	20.00	2.3	1.9	7.6	316	11.8	7.6
13	P13	26,080	0.60	0.16	25	2.0%	6.8	200	3.6%	20.00	3.8	0.9	7.7	225	11.3	7.7
R18	R18	9,530	0.22	0.73	35	2.0%	3.2	-	1.0%	20.00	2.0	0.0	5.0	35	10.2	5.0
R19	R19	9,530	0.22	0.73	35	2.0%	3.2	-	1.0%	20.00	2.0	0.0	5.0	35	10.2	5.0
R20	R20	9,530	0.22	0.73	35	2.0%	3.2	-	1.0%	20.00	2.0	0.0	5.0	35	10.2	5.0
R21	R21	9,530	0.22	0.73	35	2.0%	3.2	-	1.0%	20.00	2.0	0.0	5.0	35	10.2	5.0
OF3	OF3	17,246	0.40	0.55	30	2.0%	4.4	-	1.0%	7.00	0.7	0.0	5.0	30	10.2	5.0
OF4	OF4	12,443	0.29	0.08	75	5.0%	9.5	-	1.0%	7.00	0.7	0.0	9.5	75	10.4	9.5

Westgate Apartments - Final Drainage Report
Proposed Runoff Calculations ***Design Storm 5 Year***
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF				CUMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
1	P1	6.86	0.43	10.9	2.94	4.00	11.78					
2	P2	1.14	0.66	7.8	0.75	4.49	3.39					
3	P3	1.67	0.76	9.4	1.28	4.22	5.39					
4	P4	0.68	0.16	5.0	0.11	5.17	0.55					
5	P5	0.49	0.09	5.0	0.04	5.17	0.23					
6	P6	1.45	0.71	7.4	1.03	4.59	4.71					
7	P7	0.90	0.77	5.0	0.69	5.17	3.55					
8	P8	0.82	0.13	11.4	0.11	3.94	0.43					
9	P9	0.77	0.16	5.0	0.12	5.17	0.63					
R1	R1	0.22	0.73	5.0	0.16	5.17	0.83					
R2	R2	0.22	0.73	5.0	0.16	5.17	0.83					
R3	R3	0.22	0.73	5.0	0.16	5.17	0.83					
R4	R4	0.22	0.73	5.0	0.16	5.17	0.83					
R5	R5	0.22	0.73	5.0	0.16	5.17	0.83					
R6	R6	0.22	0.73	5.0	0.16	5.17	0.83					
R7	R7	0.22	0.73	5.0	0.16	5.17	0.83					
R8	R8	0.22	0.73	5.0	0.16	5.17	0.83					
R9	R9	0.22	0.73	5.0	0.16	5.17	0.83					
R10	R10	0.22	0.73	5.0	0.16	5.17	0.83					
R11	R11	0.22	0.73	5.0	0.16	5.17	0.83					
R12	R12	0.22	0.73	5.0	0.16	5.17	0.83					
R13	R13	0.22	0.73	5.0	0.16	5.17	0.83					
R14	R14	0.22	0.73	5.0	0.16	5.17	0.83					
R15	R15	0.22	0.73	5.0	0.16	5.17	0.83					
R16	R16	0.07	0.73	5.0	0.05	5.17	0.26					
R17	R17	0.17	0.73	5.0	0.12	5.17	0.63					
OF1	OF1	0.99	0.13	10.1	0.13	4.11	0.52					
OF2	OF2	0.74	0.08	5.0	0.06	5.17	0.31					
OS1	OS1	1.20	0.08	9.3	0.10	4.24	0.41					
10	P10	1.52	0.20	10.7	0.30	4.03	1.23					
11	P11	2.58	0.47	11.0	1.21	3.98	4.82					
12	P12	1.41	0.70	7.6	0.99	4.55	4.50					
13	P13	0.60	0.16	7.7	0.10	4.53	0.45					
R18	R18	0.22	0.73	5.0	0.16	5.17	0.83					
R19	R19	0.22	0.73	5.0	0.16	5.17	0.83					
R20	R20	0.22	0.73	5.0	0.16	5.17	0.83					
R21	R21	0.22	0.73	5.0	0.16	5.17	0.83					
OF3	OF3	0.40	0.55	5.0	0.22	5.17	1.12					
OF4	OF4	0.29	0.08	9.5	0.02	4.21	0.10					

Westgate Apartments - Final Drainage Report
Proposed Runoff Calculations ***Design Storm*** ***100 Year***
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF				CUMULATIVE RUNOFF				
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	NOTES
1	P1	6.86	0.61	10.9	4.18	6.72	28.07					
2	P2	1.14	0.78	7.8	0.89	7.54	6.72					
3	P3	1.67	0.86	9.4	1.43	7.09	10.15					
4	P4	0.68	0.41	5.0	0.28	8.68	2.42					
5	P5	0.49	0.36	5.0	0.18	8.68	1.53					
6	P6	1.45	0.82	7.4	1.19	7.70	9.14					
7	P7	0.90	0.86	5.0	0.77	8.68	6.70					
8	P8	0.82	0.39	11.4	0.32	6.61	2.11					
9	P9	0.77	0.41	5.0	0.32	8.68	2.74					
R1	R1	0.22	0.81	5.0	0.18	8.68	1.54					
R2	R2	0.22	0.81	5.0	0.18	8.68	1.54					
R3	R3	0.22	0.81	5.0	0.18	8.68	1.54					
R4	R4	0.22	0.81	5.0	0.18	8.68	1.54					
R5	R5	0.22	0.81	5.0	0.18	8.68	1.54					
R6	R6	0.22	0.81	5.0	0.18	8.68	1.54					
R7	R7	0.22	0.81	5.0	0.18	8.68	1.54					
R8	R8	0.22	0.81	5.0	0.18	8.68	1.54					
R9	R9	0.22	0.81	5.0	0.18	8.68	1.54					
R10	R10	0.22	0.81	5.0	0.18	8.68	1.54					
R11	R11	0.22	0.81	5.0	0.18	8.68	1.54					
R12	R12	0.22	0.81	5.0	0.18	8.68	1.54					
R13	R13	0.22	0.81	5.0	0.18	8.68	1.54					
R14	R14	0.22	0.81	5.0	0.18	8.68	1.54					
R15	R15	0.22	0.81	5.0	0.18	8.68	1.54					
R16	R16	0.07	0.81	5.0	0.06	8.68	0.48					
R17	R17	0.17	0.81	5.0	0.14	8.68	1.18					
OF1	OF1	0.99	0.39	10.1	0.38	6.91	2.62					
OF2	OF2	0.74	0.35	5.0	0.26	8.68	2.25					
OS1	OS1	1.20	0.63	9.3	0.76	7.12	5.39					
10	P10	1.52	0.44	10.7	0.67	6.76	4.52					
11	P11	2.58	0.64	11.0	1.65	6.68	11.02					
12	P12	1.41	0.81	7.6	1.14	7.63	8.73					
13	P13	0.60	0.41	7.7	0.25	7.60	1.88					
R18	R18	0.22	0.81	5.0	0.18	8.68	1.54					
R19	R19	0.22	0.81	5.0	0.18	8.68	1.54					
R20	R20	0.22	0.81	5.0	0.18	8.68	1.54					
R21	R21	0.22	0.81	5.0	0.18	8.68	1.54					
OF3	OF3	0.40	0.70	5.0	0.28	8.68	2.40					
OF4	OF4	0.29	0.35	9.5	0.10	7.06	0.71					

SUMMARY - PROPOSED RUNOFF TABLE								
DESIGN POINT	**BASIN DESIGNATION**	**BASIN AREA (ACRES)**	**DIRECT 5-YR RUNOFF (CFS)**	**DIRECT 100-YR RUNOFF (CFS)**	**CUM. 5-YR RUNOFF (CFS)**	**CUM. 100-YR RUNOFF (CFS)**	**BASIN IMP. (%)**	**100-YR RUNOFF COEF.**
1	P1	6.86	11.78	28.07	0.00	0.00	42.9%	0.61
2	P2	1.14	3.39	6.72	0.00	0.00	71.9%	0.78
3	P3	1.67	5.39	10.15	0.00	0.00	84.7%	0.86
4	P4	0.68	0.55	2.42	0.00	0.00	9.4%	0.41
5	P5	0.49	0.23	1.53	0.00	0.00	1.1%	0.36
6	P6	1.45	4.71	9.14	0.00	0.00	76.4%	0.82
7	P7	0.90	3.55	6.70	0.00	0.00	83.7%	0.86
8	P8	0.82	0.43	2.11	0.00	0.00	6.3%	0.39
9	P9	0.77	0.63	2.74	0.00	0.00	9.3%	0.41
R1	R1	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R2	R2	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R3	R3	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R4	R4	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R5	R5	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R6	R6	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R7	R7	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R8	R8	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R9	R9	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R10	R10	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R11	R11	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R12	R12	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R13	R13	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R14	R14	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R15	R15	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R16	R16	0.07	0.26	0.48	0.00	0.00	90.0%	0.81
R17	R17	0.17	0.63	1.18	0.00	0.00	90.0%	0.81
OF1	OF1	0.99	0.52	2.62	0.00	0.00	5.8%	0.39
OF2	OF2	0.74	0.31	2.25	0.00	0.00	0.1%	0.35
OS1	OS1	1.20	0.41	5.39	0.00	0.00	0.0%	0.35
Pond N Total		21.25	45.17	104.56	0.00	0.00	49.2%	0.63
10	P10	1.52	1.23	4.52	0.00	0.00	14.7%	0.44
11	P11	2.58	4.82	11.02	0.00	0.00	47.5%	0.64
12	P12	1.41	4.50	8.73	0.00	0.00	76.5%	0.81
13	P13	0.60	0.45	1.88	0.00	0.00	10.4%	0.41
R18	R18	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R19	R19	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R20	R20	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R21	R21	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
OF3	OF3	0.40	1.12	2.40	0.00	0.00	57.0%	0.70
OF4	OF4	0.29	0.10	0.71	0.00	0.00	0.0%	0.35
Pond S Total		7.66	15.51	35.40	0.00	0.00	47.0%	0.63

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Designer: Joseph Menke
Company: Kimley-Horn & Associates
Date: July 12, 2023
Project: Westgate Apartments
Location: Joystone Dr. - Full Disturbed Area

SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth: 0.60 inches

Depth of Average Runoff Producing Storm, d_6 = 0.43 inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

Area Type	UIA:RPA	UIA:RPA	UIA:RPA	UIA:RPA	UIA:RPA	SPA	SPA	SPA	SPA	DCIA	DCIA	DCIA
Area ID	1	2	3	4	5	6	7	8	9	10	11	12
Downstream Design Point ID	1 - N	2 - N	3 - N	OF1	OF3	6 - N	7 - S	OF2	OF4	10 - N	11 - S	12
Downstream BMP Type	EDB	EDB	EDB	None	None	EDB	EDB	None	None	EDB	EDB	None
DCIA (ft^2)	--	--	--	--	--	--	--	--	--	367,259	156,354	3,513
UIA (ft^2)	35,362	49,514	24,261	2,741	2,697	--	--	--	--	--	--	--
RPA (ft^2)	11,439	16,017	7,848	21,060	3,784	--	--	--	--	--	--	--
SPA (ft^2)	--	--	--	--	--	283,627	153,527	60,132	12,443	--	--	--
HSG A (%)	100%	100%	100%	100%	50%	66%	66%	34%	0%	--	--	--
HSG B (%)	0%	0%	0%	0%	50%	34%	34%	66%	100%	--	--	--
HSG C/D (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	--	--	--
Average Slope of RPA (ft/ft)	0.040	0.040	0.040	0.100	0.050	--	--	--	--	--	--	--
UIA:RPA Interface Width (ft)	415.00	367.00	485.00	272.00	537.00	--	--	--	--	--	--	--

CALCULATED RUNOFF RESULTS

Area ID	1	2	3	4	5	6	7	8	9	10	11	12
UIA:RPA Area (ft^2)	46,801	65,531	32,109	23,801	6,481	--	--	--	--	--	--	--
L / W Ratio	0.27	0.49	0.14	0.32	0.06	--	--	--	--	--	--	--
UIA / Area	0.7556	0.7556	0.7556	0.1152	0.4161	--	--	--	--	--	--	--
Runoff (in)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50
Runoff (ft^3)	0	0	0	0	0	0	0	0	0	15302	6515	146
Runoff Reduction (ft^3)	1473	2063	1011	114	112	14181	7676	3007	622	0	0	0

CALCULATED WQCV RESULTS

Area ID	1	2	3	4	5	6	7	8	9	10	11	12
WQCV (ft^3)	1473	2063	1011	114	112	0	0	0	0	15302	6515	146
WQCV Reduction (ft^3)	1473	2063	1011	114	112	0	0	0	0	0	0	0
WQCV Reduction (%)	100%	100%	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
Untreated WQCV (ft^3)	0	0	0	0	0	0	0	0	0	15302	6515	146

CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

Downstream Design Point ID	1 - N	2 - N	3 - N	OF1	OF3	6 - N	7 - S	OF2	OF4	10 - N	11 - S	12
DCIA (ft^2)	0	0	0	0	0	0	0	0	0	367,259	156,354	3,513
UIA (ft^2)	35,362	49,514	24,261	2,741	2,697	0	0	0	0	0	0	0
RPA (ft^2)	11,439	16,017	7,848	21,060	3,784	0	0	0	0	0	0	0
SPA (ft^2)	0	0	0	0	0	283,627	153,527	60,132	12,443	0	0	0
Total Area (ft^2)	46,801	65,531	32,109	23,801	6,481	283,627	153,527	60,132	12,443	367,259	156,354	3,513
Total Impervious Area (ft^2)	35,362	49,514	24,261	2,741	2,697	0	0	0	0	367,259	156,354	3,513
WQCV (ft^3)	1,473	2,063	1,011	114	112	0	0	0	0	15,302	6,515	146
WQCV Reduction (ft^3)	1,473	2,063	1,011	114	112	0	0	0	0	0	0	0
WQCV Reduction (%)	100%	100%	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
Untreated WQCV (ft^3)	0	0	0	0	0	0	0	0	0	15,302	6,515	146

CALCULATED SITE RESULTS (sums results from all columns in worksheet)

Total Area (ft^2)	1,211,578
Total Impervious Area (ft^2)	641,701
WQCV (ft^3)	26,738
WQCV Reduction (ft^3)	4,774
WQCV Reduction (%)	18%
Untreated WQCV (ft^3)	21,964

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 1

Designer: Joseph Menke
Company: Kimley-Horn & Associates
Date: July 12, 2023
Project: Westgate Apartments
Location: Joystone Dr. - North Pond Only

SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth: 0.60 inches

Depth of Average Runoff Producing Storm, d_6 = 0.43 inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

Area Type	UIA:RPA	UIA:RPA	UIA:RPA	SPA	DCIA							
Area ID	1	2	3	6	10							
Downstream Design Point ID	1 - N	2 - N	3 - N	6 - N	10 - N							
Downstream BMP Type	EDB	EDB	EDB	EDB	EDB							
DCIA (ft^2)	--	--	--	--	367,259							
UIA (ft^2)	35,362	49,514	24,261	--	--							
RPA (ft^2)	11,439	16,017	7,848	--	--							
SPA (ft^2)	--	--	--	283,627	--							
HSG A (%)	100%	100%	100%	66%	--							
HSG B (%)	0%	0%	0%	34%	--							
HSG C/D (%)	0%	0%	0%	0%	--							
Average Slope of RPA (ft/ft)	0.040	0.040	0.040	--	--							
UIA:RPA Interface Width (ft)	415.00	367.00	485.00	--	--							

CALCULATED RUNOFF RESULTS

Area ID	1	2	3	6	10							
UIA:RPA Area (ft^2)	46,801	65,531	32,109	--	--							
L / W Ratio	0.27	0.49	0.14	--	--							
UIA / Area	0.7556	0.7556	0.7556	--	--							
Runoff (in)	0.00	0.00	0.00	0.00	0.50							
Runoff (ft^3)	0	0	0	0	15302							
Runoff Reduction (ft^3)	1473	2063	1011	14181	0							

CALCULATED WQCV RESULTS

Area ID	1	2	3	6	10							
WQCV (ft^3)	1473	2063	1011	0	15302							
WQCV Reduction (ft^3)	1473	2063	1011	0	0							
WQCV Reduction (%)	100%	100%	100%	0%	0%							
Untreated WQCV (ft^3)	0	0	0	0	15302							

CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

Downstream Design Point ID	1 - N	2 - N	3 - N	6 - N	10 - N							
DCIA (ft^2)	0	0	0	0	367,259							
UIA (ft^2)	35,362	49,514	24,261	0	0							
RPA (ft^2)	11,439	16,017	7,848	0	0							
SPA (ft^2)	0	0	0	283,627	0							
Total Area (ft^2)	46,801	65,531	32,109	283,627	367,259							
Total Impervious Area (ft^2)	35,362	49,514	24,261	0	367,259							
WQCV (ft^3)	1,473	2,063	1,011	0	15,302							
WQCV Reduction (ft^3)	1,473	2,063	1,011	0	0							
WQCV Reduction (%)	100%	100%	100%	0%	0%							
Untreated WQCV (ft^3)	0	0	0	0	15,302							

CALCULATED SITE RESULTS (sums results from all columns in worksheet)

Total Area (ft^2)	795,327
Total Impervious Area (ft^2)	476,396
WQCV (ft^3)	19,850
WQCV Reduction (ft^3)	4,547
WQCV Reduction (%)	23%
Untreated WQCV (ft^3)	15,302

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Designer:	**Joseph Menke**
Company:	**Kimley-Horn & Associates**
Date:	**July 12, 2023**
Project:	**Westgate Apartments**
Location:	**Joystone Dr. - South Pond Only**

SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth: 0.60 inches

Depth of Average Runoff Producing Storm, d_6 = 0.43 inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

Area Type	SPA	DCIA										
Area ID	7	11										
Downstream Design Point ID	7 - S	11 - S										
Downstream BMP Type	EDB	EDB										
DCIA (ft^2)	--	156,354										
UIA (ft^2)	--	--										
RPA (ft^2)	--	--										
SPA (ft^2)	153,527	--										
HSG A (%)	66%	--										
HSG B (%)	34%	--										
HSG C/D (%)	0%	--										
Average Slope of RPA (ft/ft)	--	--										
UIA:RPA Interface Width (ft)	--	--										

CALCULATED RUNOFF RESULTS

Area ID	7	11										
UIA:RPA Area (ft^2)	--	--										
L / W Ratio	--	--										
UIA / Area	--	--										
Runoff (in)	0.00	0.50										
Runoff (ft^3)	0	6515										
Runoff Reduction (ft^3)	7676	0										

CALCULATED WQCV RESULTS

Area ID	7	11										
WQCV (ft^3)	0	6515										
WQCV Reduction (ft^3)	0	0										
WQCV Reduction (%)	0%	0%										
Untreated WQCV (ft^3)	0	6515										

CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

Downstream Design Point ID	7 - S	11 - S										
DCIA (ft^2)	0	156,354										
UIA (ft^2)	0	0										
RPA (ft^2)	0	0										
SPA (ft^2)	153,527	0										
Total Area (ft^2)	153,527	156,354										
Total Impervious Area (ft^2)	0	156,354										
WQCV (ft^3)	0	6,515										
WQCV Reduction (ft^3)	0	0										
WQCV Reduction (%)	0%	0%										
Untreated WQCV (ft^3)	0	6,515										

CALCULATED SITE RESULTS (sums results from all columns in worksheet)

Total Area (ft^2)	309,881
Total Impervious Area (ft^2)	156,354
WQCV (ft^3)	6,515
WQCV Reduction (ft^3)	0
WQCV Reduction (%)	0%
Untreated WQCV (ft^3)	6,515

Offsite Analysis for low flow channel east of Sand Creek

IDF Equations:

I_{100} = -2.52ln(D) + 12.735
I_{50} = -2.25ln(D) + 11.375
I_{25} -2.00ln(D) + 10.111
I_{10} -1.75ln(D) + 8.847
I_{5} -1.50ln(D) + 7.583
I_{2} -1.19ln(D) + 6.035

Where:
I = Rainfall Intensity (in/hr)
D= Duration (minutes)

	2-yr	5-yr	10-yr	100-yr
P_1 =	1.19	1.5	1.75	2.52

Time Intensity Frequency Tabulation

Time	2 YR	5 YR	10 YR	25 YR	50 YR	100 YR
5	4.12	5.17	6.03	6.89	7.75	8.68
10	3.29	4.13	4.82	5.51	6.19	6.93
15	2.81	3.52	4.11	4.69	5.28	5.91
30	1.99	2.48	2.89	3.31	3.72	4.16
60	1.16	1.44	1.68	1.92	2.16	2.42
120	0.34	0.40	0.47	0.54	0.60	0.67

*The Design Point Rainfall Values and Time Intensity Frequency Tabulation are found in Table 6-2 and Figure 6-5 respectively, of the Colorado Springs Drainage Criteria Manual, Volume 1

Offsite Analysis for low flow channel east of Sand Creek

Weighted Imperviousness Calculations

SUB-BASIN	AREA (SF)	AREA (Acres)	ROOF AREA	ROOF IMPERVIOUSNESS	ROOF C2	ROOF C5	ROOF C10	ROOF C100	LANDSCAPE AREA	LANDSCAPE IMPERVIOUSNESS	LANDSCAPE C2	LANDSCAPE C5	LANDSCAPE C10	LANDSCAPE C100	PAVEMENT AREA	GRAVEL IMPERVIOUSNESS	PAVEMENT C2	PAVEMENT C5	PAVEMENT C10	PAVEMENT C100	WEIGHTED IMPERVIOUSNESS	WEIGHTED COEFFICIENTS C2	WEIGHTED COEFFICIENTS C5	WEIGHTED COEFFICIENTS C10	WEIGHTED COEFFICIENTS C100
EX	591,545	13.58	0	90%	0.71	0.73	0.75	0.81	0	5%	0.02	0.08	0.15	0.35	591,545	80%	0.57	0.59	0.63	0.70	80.0%	0.57	0.59	0.63	0.70
TOTAL	591,545	13.58	0	90%	0.71	0.73	0.75	0.81	0	5%	0.02	0.08	0.15	0.35	591,545	80%	0.57	0.59	0.63	0.70	80.0%	0.57	0.59	0.63	0.70

Offsite Analysis for low flow channel east of Sand Creek

Humane Society Subdivision Filing No. 1 - Drainage Letter
Proposed Runoff Calculations
Time of Concentration

Watercourse Coefficient

Forest & Meadow	2.50	Short Grass Pasture & Lawns	7.00	Grassed Waterway	15.00
Fallow or Cultivation	5.00	Nearly Bare Ground	10.00	Paved Area & Shallow Gutter	20.00

	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA sq. ft.	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	L/180+10	min.
EX	EX	591,545	13.58	0.59	300	9.7%	7.6	1100	1.0%	2.50	0.3	73.3	80.9	1400	17.8	17.8

Offsite Analysis for low flow channel east of Sand Creek

Humane Society Subdivision Filing No. 1 - Drainage Letter
Proposed Runoff Calculations ***Design Storm*** ***5 Year***
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
EX	EX	13.58	0.59	17.8	8.01	3.26	26.15					

Offsite Analysis for low flow channel east of Sand Creek

Humane Society Subdivision Filing No. 1 - Drainage Letter

Proposed Runoff Calculations ***Design Storm 100 Year***

(Rational Method Procedure)

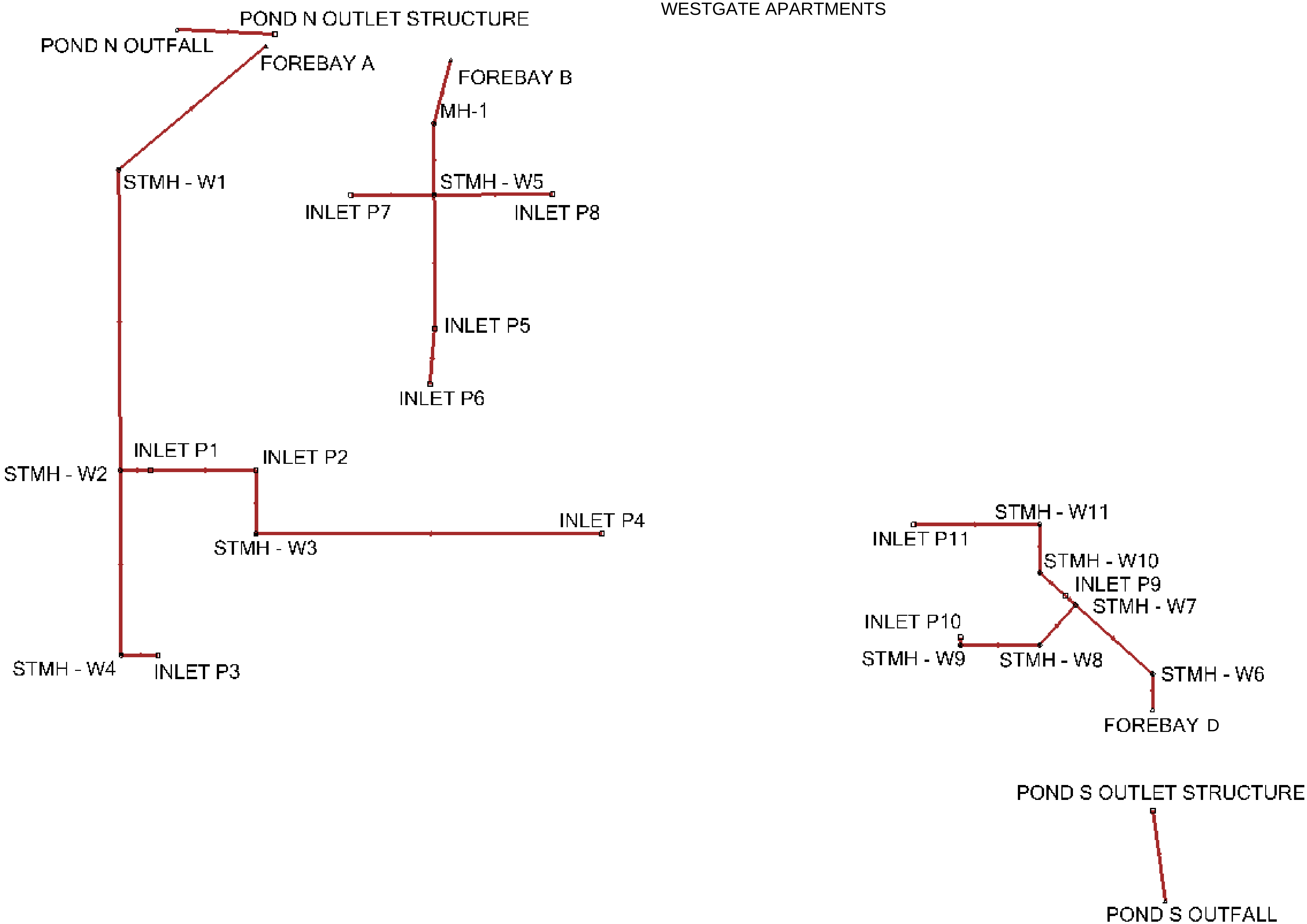
BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
EX	EX	13.58	0.70	17.8	9.51	5.48	52.09					

Offsite Analysis for low flow channel east of Sand Creek

SUMMARY - PROPOSED RUNOFF TABLE						
DESIGN POINT	**BASIN DESIGNATION**	**BASIN AREA (ACRES)**	**DIRECT 5-YR RUNOFF (CFS)**	**DIRECT 100-YR RUNOFF (CFS)**	**CUMULATIVE 5-YR RUNOFF (CFS)**	**CUMULATIVE 100-YR RUNOFF (CFS)**
EX	EX	13.58	26.15	52.09	26.15	52.09

APPENDIX C – HYDRAULIC CALCULATIONS

OVERALL MAP VIEW
WESTGATE APARTMENTS



Westgate Apartments

5-YEAR TAILWATER MODEL

Conduit Table - Time: 0.00 hours

Start Node	Stop Node	Invert (Start) (ft)	Invert (Stop) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Flow (cfs)	Velocity (ft/s)	Capacity (Design) (cfs)	Flow / Capacity (Design) (%)	Manning's n	Headloss (ft)	Froude Number (Normal)
INLET P11	STMH - W11	6,122.20	6,121.37	167.0	0.005	18.0	2.24	3.67	7.40	30.3	0.013	0.82	0.999
STMH - W11	STMH - W10	6,121.17	6,120.85	64.2	0.005	18.0	2.24	3.68	7.41	30.2	0.013	0.32	1.001
STMH - W10	INLET P9	6,120.65	6,120.42	45.7	0.005	18.0	2.24	3.69	7.45	30.1	0.013	0.23	1.006
INLET P5	STMH - W5	6,115.15	6,113.81	178.0	0.007	30.0	11.84	6.51	35.52	33.3	0.013	0.23	1.331
INLET P7	STMH - W5	6,116.76	6,114.90	110.5	0.020	18.0	1.12	4.95	14.87	7.5	0.013	1.09	1.981
INLET P8	STMH - W5	6,118.50	6,117.71	157.5	0.005	18.0	1.85	3.49	7.43	24.9	0.013	0.79	1.008
INLET P4	STMH - W3	6,119.79	6,117.49	460.7	0.005	18.0	3.46	4.13	7.43	46.6	0.013	2.31	0.974
INLET P10	STMH - W9	6,120.66	6,120.61	10.7	0.005	24.0	5.99	4.61	15.49	38.7	0.013	0.00	1.005
STMH - W9	STMH - W8	6,120.41	6,119.88	105.6	0.005	24.0	5.99	4.73	16.03	37.4	0.013	0.37	1.043
INLET P9	STMH - W7	6,119.42	6,119.32	18.6	0.005	30.0	7.06	5.00	30.07	23.5	0.013	0.00	1.139
STMH - W7	STMH - W6	6,119.12	6,118.44	137.6	0.005	30.0	13.05	5.73	28.84	45.3	0.013	0.02	1.057
STMH - W8	STMH - W7	6,119.68	6,119.32	71.6	0.005	24.0	5.99	4.74	16.04	37.3	0.013	0.02	1.044
STMH - W6	FOREBAY D	6,118.24	6,118.00	47.2	0.005	30.0	13.05	5.79	29.24	44.6	0.013	0.02	1.073
INLET P6	INLET P5	6,117.88	6,115.65	74.3	0.030	24.0	5.34	8.73	39.18	13.6	0.013	2.55	2.587
STMH - W3	INLET P2	6,116.99	6,116.56	84.8	0.005	24.0	3.46	4.06	16.00	21.6	0.013	0.20	1.059
INLET P2	INLET P1	6,116.26	6,115.56	140.1	0.005	24.0	5.72	4.67	15.99	35.8	0.013	0.72	1.043
INLET P3	STMH - W4	6,116.04	6,115.80	49.1	0.005	24.0	5.61	4.64	16.00	35.1	0.013	0.22	1.044
INLET P1	STMH - W2	6,115.06	6,113.77	40.3	0.032	30.0	9.11	10.18	73.41	12.4	0.013	0.23	2.769
STMH - W2	STMH - W1	6,113.27	6,112.07	400.3	0.003	36.0	14.72	4.89	36.53	40.3	0.013	0.17	0.858
STMH - W4	STMH - W2	6,115.50	6,114.27	246.0	0.005	24.0	5.61	4.64	15.99	35.1	0.013	0.50	1.044
POND S OUTLET STRUCTURE	POND S OUTFALL	6,114.00	6,112.00	121.7	0.014	18.0	0.20	2.61	12.46	1.6	0.013	2.03	1.538
STMH - W1	FOREBAY A	6,111.87	6,111.10	255.3	0.003	36.0	14.72	2.08	36.53	40.3	0.013	0.12	0.858
POND N OUTLET STRUCTURE	POND N OUTFALL	6,110.17	6,109.70	129.8	0.003	24.0	0.70	2.23	13.21	5.3	0.013	0.49	0.845
STMH - W5	STMH-W12	6,113.61	6,113.14	94.7	0.005	30.0	16.45	6.09	28.97	56.8	0.013	0.10	1.031
STMH-W12	FOREBAY B	6,112.94	6,112.50	87.9	0.005	30.0	16.45	3.35	29.02	56.7	0.013	0.14	1.033

Westgate Apartments

5-YEAR TAILWATER MODEL

Catch Basin Table - Time: 0.00 hours

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Headloss Method	Headloss (ft)	Flow (Additional Subsurface) (cfs)	Flow (Total Out) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
INLET P3	6,120.72	6,116.04	Standard	0.00	5.61	5.61	6,116.88	6,116.88
INLET P1	6,119.05	6,115.06	Standard	0.02	3.39	9.11	6,116.09	6,116.07
INLET P2	6,120.01	6,116.26	Standard	0.33	2.26	5.72	6,117.43	6,117.11
INLET P4	6,124.51	6,119.79	Standard	0.00	3.46	3.46	6,120.51	6,120.51
POND N OUTLET STRUCTURE	6,117.00	6,110.17	Standard	0.00	0.70	0.70	6,110.48	6,110.48
INLET P7	6,120.99	6,116.76	Standard	0.00	1.12	1.12	6,117.16	6,117.16
INLET P8	6,122.01	6,118.50	Standard	0.00	1.85	1.85	6,119.01	6,119.01
INLET P5	6,122.32	6,115.15	Standard	0.04	6.50	11.84	6,116.35	6,116.30
INLET P6	6,122.48	6,117.88	Standard	0.00	5.34	5.34	6,118.69	6,118.69
INLET P11	6,125.51	6,122.20	Standard	0.00	2.24	2.24	6,122.77	6,122.77
INLET P9	6,123.91	6,119.42	Standard	0.00	4.82	7.06	6,120.83	6,120.82
INLET P10	6,124.48	6,120.66	Standard	0.00	5.99	5.99	6,121.71	6,121.71
POND S OUTLET STRUCTURE	6,117.76	6,114.00	Standard	0.00	0.20	0.20	6,114.16	6,114.16

Westgate Apartments

5-YEAR TAILWATER MODEL

Manhole Table - Time: 0.00 hours

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Headloss Method	Headloss Coefficient (Standard)	Headloss (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)
STMH - W11	6,127.76	6,121.17	Standard	1.020	0.21	2.24	6,121.74	6,121.95
STMH - W10	6,125.91	6,120.65	Standard	0.400	0.08	2.24	6,121.22	6,121.30
STMH - W5	6,124.91	6,113.61	Standard	1.520	0.32	16.45	6,115.75	6,116.07
STMH - W9	6,124.38	6,120.41	Standard	1.320	0.43	5.99	6,121.28	6,121.71
STMH - W7	6,124.22	6,119.12	Standard	1.020	0.40	13.05	6,120.42	6,120.83
STMH - W8	6,124.10	6,119.68	Standard	0.400	0.06	5.99	6,120.84	6,120.90
STMH - W6	6,122.94	6,118.24	Standard	0.400	0.05	13.05	6,120.34	6,120.40
STMH - W3	6,121.91	6,116.99	Standard	1.020	0.24	3.46	6,117.64	6,117.88
STMH - W2	6,119.48	6,113.27	Standard	1.020	0.09	14.72	6,115.75	6,115.84
STMH - W4	6,119.14	6,115.50	Standard	1.020	0.32	5.61	6,116.34	6,116.66
STMH - W1	6,117.08	6,111.87	Standard	0.400	0.03	14.72	6,115.55	6,115.58
STMH-W12	6,119.71	6,112.94	Standard	0.400	0.07	16.45	6,115.57	6,115.64

Outfall Table - Time: 0.00 hours

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)	Boundary Condition Type	Elevation (User Defined Tailwater) (ft)
FOREBAY D	6,120.35	6,118.00	6,120.32	13.05	User Defined Tailwater	6,120.32
POND S OUTFALL	6,115.35	6,112.00	6,112.13	0.20	User Defined Tailwater	6,111.40
FOREBAY B	6,114.35	6,112.50	6,115.43	16.45	User Defined Tailwater	6,115.43
FOREBAY A	6,113.35	6,111.10	6,115.43	14.72	User Defined Tailwater	6,115.43
POND N OUTFALL	6,112.47	6,109.70	6,109.99	0.70	User Defined Tailwater	6,109.02

Westgate Apartments

100-YEAR TAILWATER MODEL

Conduit Table - Time: 0.00 hours

Start Node	Stop Node	Invert (Start) (ft)	Invert (Stop) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Flow (cfs)	Velocity (ft/s)	Capacity (Design) (cfs)	Flow / Capacity (Design) (%)	Manning's n	Headloss (ft)	Froude Number (Normal)
INLET P11	STMH - W11	6,122.20	6,121.37	167.0	0.005	18.0	5.24	2.97	7.40	70.8	0.013	0.42	0.900
STMH - W11	STMH - W10	6,121.17	6,120.85	64.2	0.005	18.0	5.24	2.97	7.41	70.7	0.013	0.16	0.901
STMH - W10	INLET P9	6,120.65	6,120.42	45.7	0.005	18.0	5.24	2.97	7.45	70.3	0.013	0.11	0.907
INLET P5	STMH - W5	6,115.15	6,113.81	178.0	0.007	30.0	22.56	4.60	35.52	63.5	0.013	0.54	1.237
INLET P7	STMH - W5	6,116.76	6,114.90	110.5	0.020	18.0	3.21	1.82	14.87	21.6	0.013	0.09	2.021
INLET P8	STMH - W5	6,118.50	6,117.71	157.5	0.005	18.0	4.77	2.70	7.43	64.2	0.013	0.32	0.926
INLET P4	STMH - W3	6,119.79	6,117.49	460.7	0.005	18.0	8.06	4.56	7.43	108.5	0.013	2.71	0.657
INLET P10	STMH - W9	6,120.66	6,120.61	10.7	0.005	24.0	11.53	3.67	15.49	74.4	0.013	0.03	0.903
STMH - W9	STMH - W8	6,120.41	6,119.88	105.6	0.005	24.0	11.53	3.67	16.03	71.9	0.013	0.27	0.945
INLET P9	STMH - W7	6,119.42	6,119.32	18.6	0.005	30.0	16.26	3.31	30.07	54.1	0.013	0.03	1.078
STMH - W7	STMH - W6	6,119.12	6,118.44	137.6	0.005	30.0	27.79	5.66	28.84	96.4	0.013	0.63	0.827
STMH - W8	STMH - W7	6,119.68	6,119.32	71.6	0.005	24.0	11.53	3.67	16.04	71.9	0.013	0.19	0.946
STMH - W6	FOREBAY D	6,118.24	6,118.00	47.2	0.005	30.0	27.79	5.66	29.24	95.0	0.013	0.22	0.851
INLET P6	INLET P5	6,117.88	6,115.65	74.3	0.030	24.0	10.06	3.20	39.18	25.7	0.013	0.15	2.588
STMH - W3	INLET P2	6,116.99	6,116.56	84.8	0.005	24.0	8.06	2.57	16.00	50.4	0.013	0.11	1.011
INLET P2	INLET P1	6,116.26	6,115.56	140.1	0.005	24.0	13.70	4.36	15.99	85.7	0.013	0.51	0.877
INLET P3	STMH - W4	6,116.04	6,115.80	49.1	0.005	24.0	10.57	3.36	16.00	66.1	0.013	0.11	0.964
INLET P1	STMH - W2	6,115.06	6,113.77	40.3	0.032	30.0	20.42	4.16	73.41	27.8	0.013	0.10	2.770
STMH - W2	STMH - W1	6,113.27	6,112.07	400.3	0.003	36.0	30.99	4.38	36.53	84.8	0.013	0.86	0.731
STMH - W4	STMH - W2	6,115.50	6,114.27	246.0	0.005	24.0	10.57	3.36	15.99	66.1	0.013	0.54	0.964
POND S OUTLET STRUCTURE	POND S OUTFALL	6,114.00	6,112.00	121.7	0.014	18.0	6.60	3.73	12.46	53.0	0.013	0.56	1.607
STMH - W1	FOREBAY A	6,111.87	6,111.10	255.3	0.003	36.0	30.99	4.38	36.53	84.8	0.013	0.55	0.731
POND N OUTLET STRUCTURE	POND N OUTFALL	6,110.17	6,109.70	129.8	0.003	24.0	15.40	4.90	13.21	116.6	0.013	0.86	0.611
STMH - W5	STMH-W12	6,113.61	6,113.14	94.7	0.005	30.0	33.62	6.85	28.97	116.1	0.013	0.64	0.764
STMH-W12	FOREBAY B	6,112.94	6,112.50	87.9	0.005	30.0	33.62	6.85	29.02	115.9	0.013	0.59	0.764

Westgate Apartments

100-YEAR TAILWATER MODEL

Catch Basin Table - Time: 0.00 hours

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Headloss Method	Headloss (ft)	Flow (Additional Subsurface) (cfs)	Flow (Total Out) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
INLET P3	6,120.72	6,116.04	Standard	0.00	10.57	10.57	6,119.07	6,119.07
INLET P1	6,119.05	6,115.06	Standard	0.01	6.72	20.42	6,118.36	6,118.35
INLET P2	6,120.01	6,116.26	Standard	0.30	5.64	13.70	6,119.18	6,118.87
INLET P4	6,124.51	6,119.79	Standard	0.00	8.06	8.06	6,122.10	6,122.10
POND N OUTLET STRUCTURE	6,117.00	6,110.17	Standard	0.00	15.40	15.40	6,111.97	6,111.97
INLET P7	6,120.99	6,116.76	Standard	0.00	3.21	3.21	6,120.99	6,120.99
INLET P8	6,122.01	6,118.50	Standard	0.00	4.77	4.77	6,121.78	6,121.78
INLET P5	6,122.32	6,115.15	Standard	0.03	12.50	22.56	6,122.02	6,121.99
INLET P6	6,122.48	6,117.88	Standard	0.00	10.06	10.06	6,122.17	6,122.17
INLET P11	6,125.51	6,122.20	Standard	0.00	5.24	5.24	6,123.79	6,123.79
INLET P9	6,123.91	6,119.42	Standard	0.01	11.02	16.26	6,122.90	6,122.90
INLET P10	6,124.48	6,120.66	Standard	0.00	11.53	11.53	6,123.71	6,123.71
POND S OUTLET STRUCTURE	6,117.76	6,114.00	Standard	0.00	6.60	6.60	6,116.26	6,116.26

Westgate Apartments

100-YEAR TAILWATER MODEL

Manhole Table - Time: 0.00 hours

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Headloss Method	Headloss Coefficient (Standard)	Headloss (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)
STMH - W11	6,127.76	6,121.17	Standard	1.020	0.14	5.24	6,123.23	6,123.37
STMH - W10	6,125.91	6,120.65	Standard	0.400	0.05	5.24	6,123.02	6,123.07
STMH - W5	6,124.91	6,113.61	Standard	1.520	1.11	33.62	6,120.34	6,121.45
STMH - W9	6,124.38	6,120.41	Standard	1.320	0.28	11.53	6,123.41	6,123.69
STMH - W7	6,124.22	6,119.12	Standard	1.020	0.51	27.79	6,122.36	6,122.87
STMH - W8	6,124.10	6,119.68	Standard	0.400	0.08	11.53	6,123.05	6,123.14
STMH - W6	6,122.94	6,118.24	Standard	0.400	0.20	27.79	6,121.53	6,121.73
STMH - W3	6,121.91	6,116.99	Standard	1.020	0.10	8.06	6,119.28	6,119.39
STMH - W2	6,119.48	6,113.27	Standard	1.020	0.30	30.99	6,117.94	6,118.25
STMH - W4	6,119.14	6,115.50	Standard	1.020	0.18	10.57	6,118.78	6,118.96
STMH - W1	6,117.08	6,111.87	Standard	0.400	0.12	30.99	6,117.08	6,117.20
STMH-W12	6,119.71	6,112.94	Standard	0.400	0.29	33.62	6,119.45	6,119.74

Outfall Table - Time: 0.00 hours

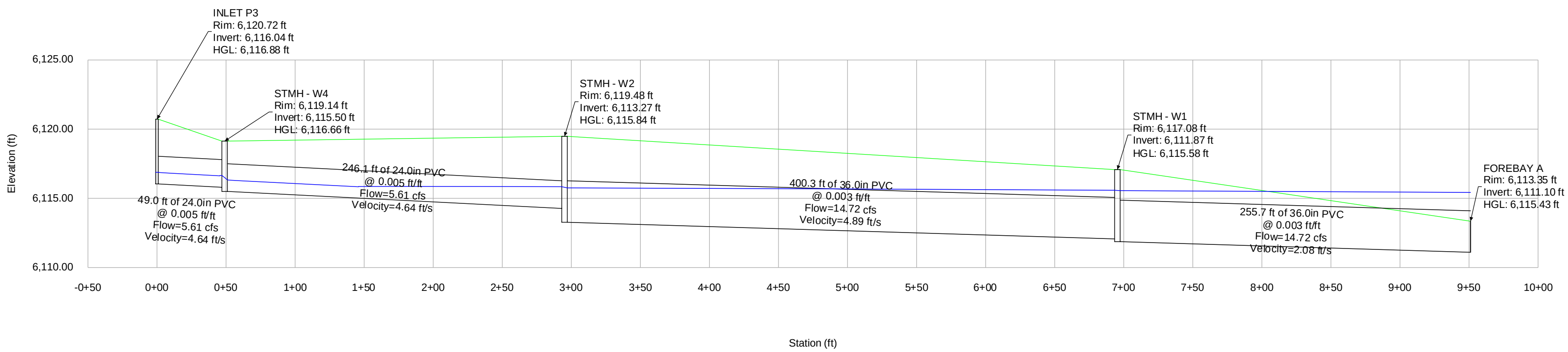
Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)	Boundary Condition Type	Elevation (User Defined Tailwater) (ft)
FOREBAY D	6,120.35	6,118.00	6,121.31	27.79	User Defined Tailwater	6,121.31
POND S OUTFALL	6,115.35	6,112.00	6,115.70	6.60	User Defined Tailwater	6,115.70
FOREBAY B	6,114.35	6,112.50	6,118.86	33.62	User Defined Tailwater	6,118.86
FOREBAY A	6,113.35	6,111.10	6,118.86	30.99	User Defined Tailwater	6,118.86
POND N OUTFALL	6,112.47	6,109.70	6,111.11	15.40	User Defined Tailwater	6,109.61

Westgate Apartments

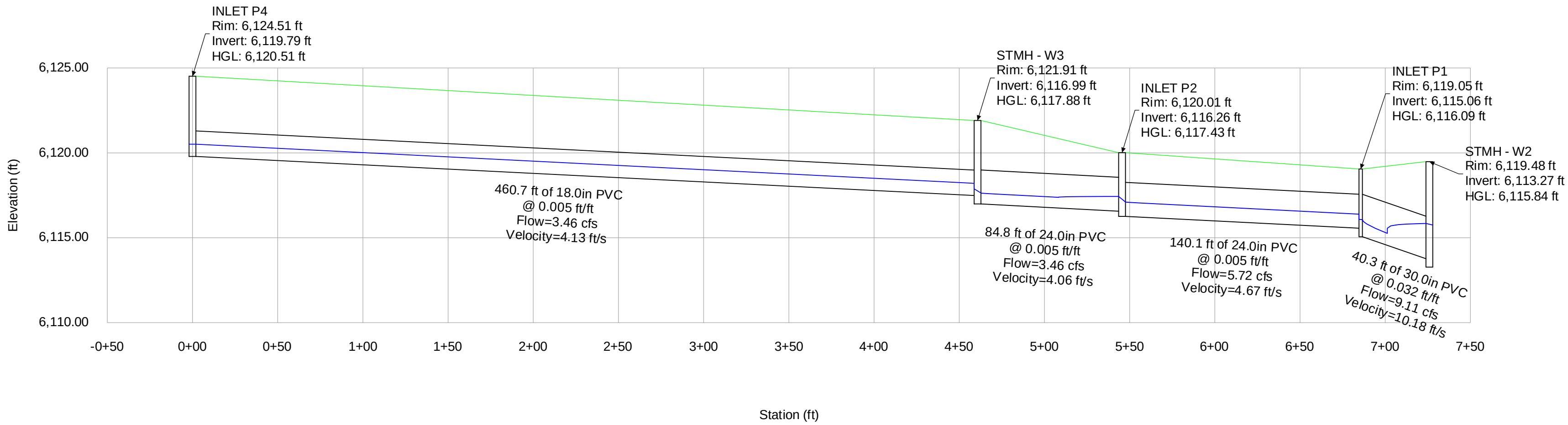
Profile Report

Engineering Profile - Storm A (Westgate.stsw)

Active Scenario: 5 - YEAR TAILWATER MODEL



Westgate Apartments
Profile Report
Engineering Profile - Storm B (Westgate.stsw)
Active Scenario: 5 - YEAR TAILWATER MODEL

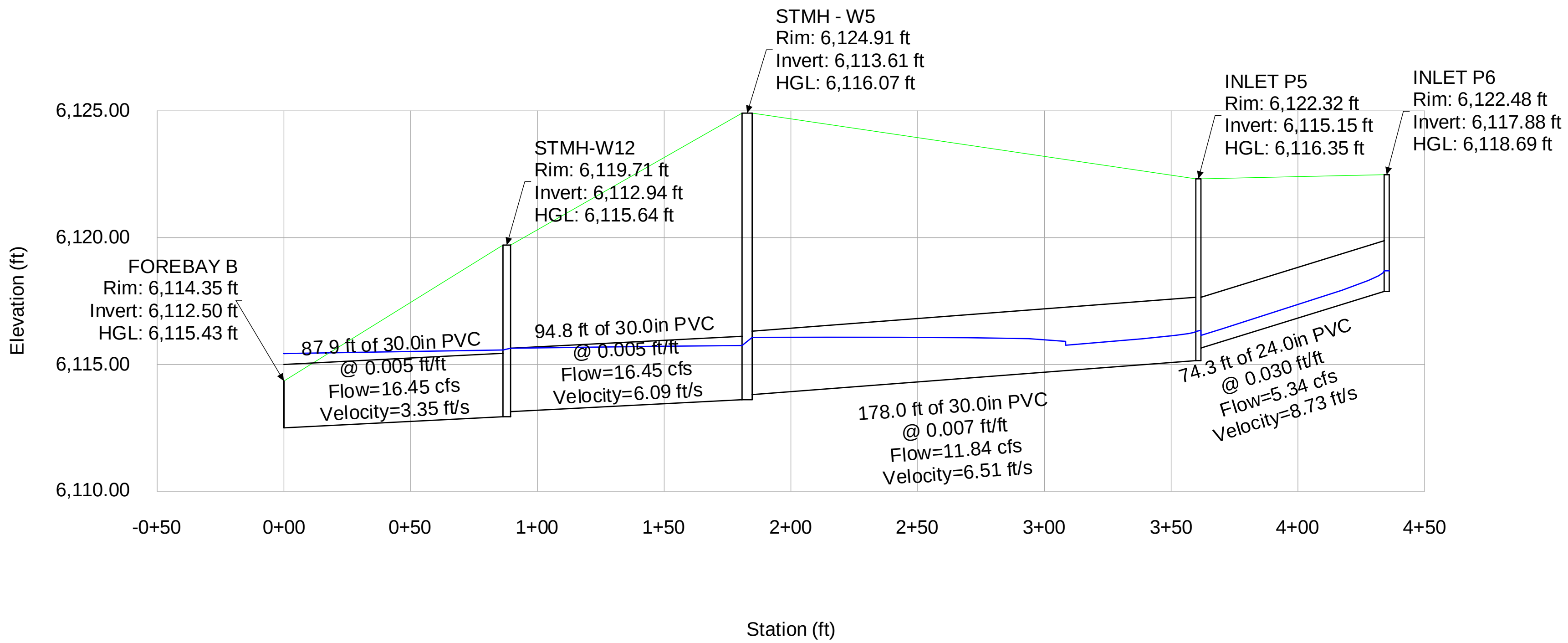


Westgate Apartments

Profile Report

Engineering Profile - Storm C (Westgate.stsw)

Active Scenario: 5 - YEAR TAILWATER MODEL

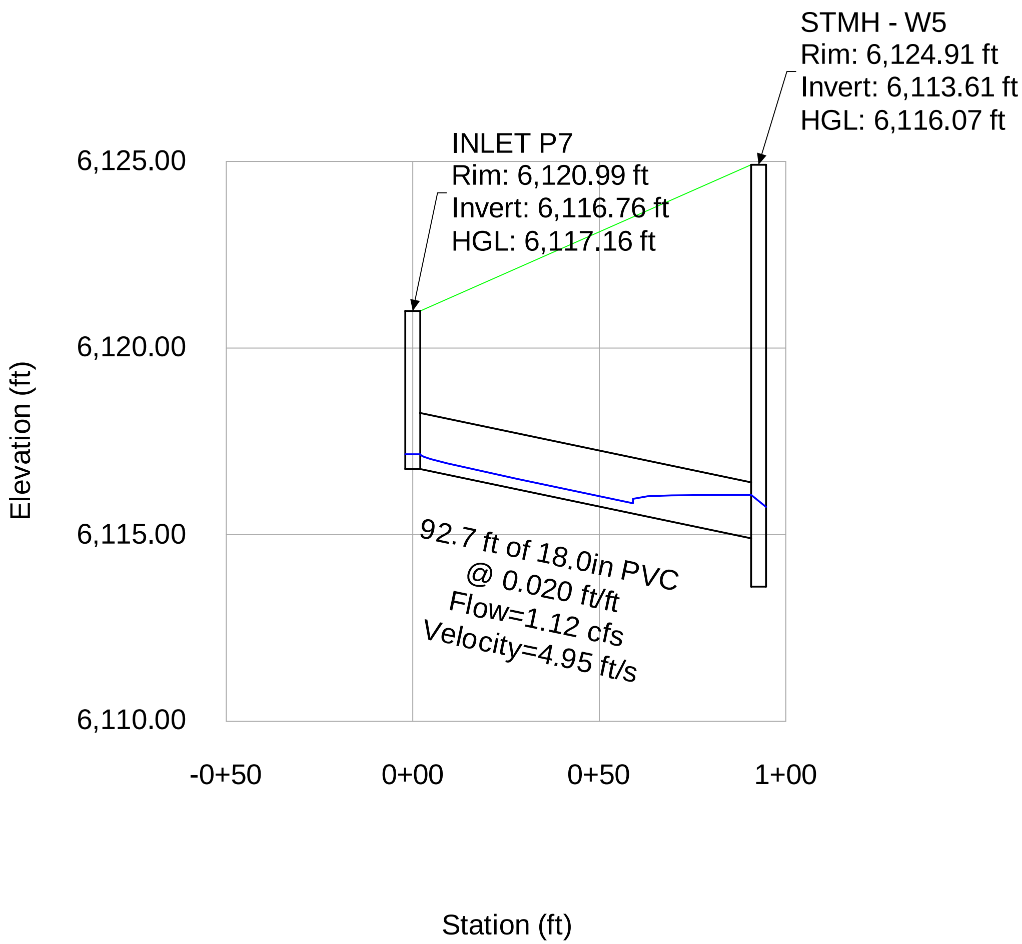


Westgate Apartments

Profile Report

Engineering Profile - Storm D1 (Westgate.stsw)

Active Scenario: 5 - YEAR TAILWATER MODEL

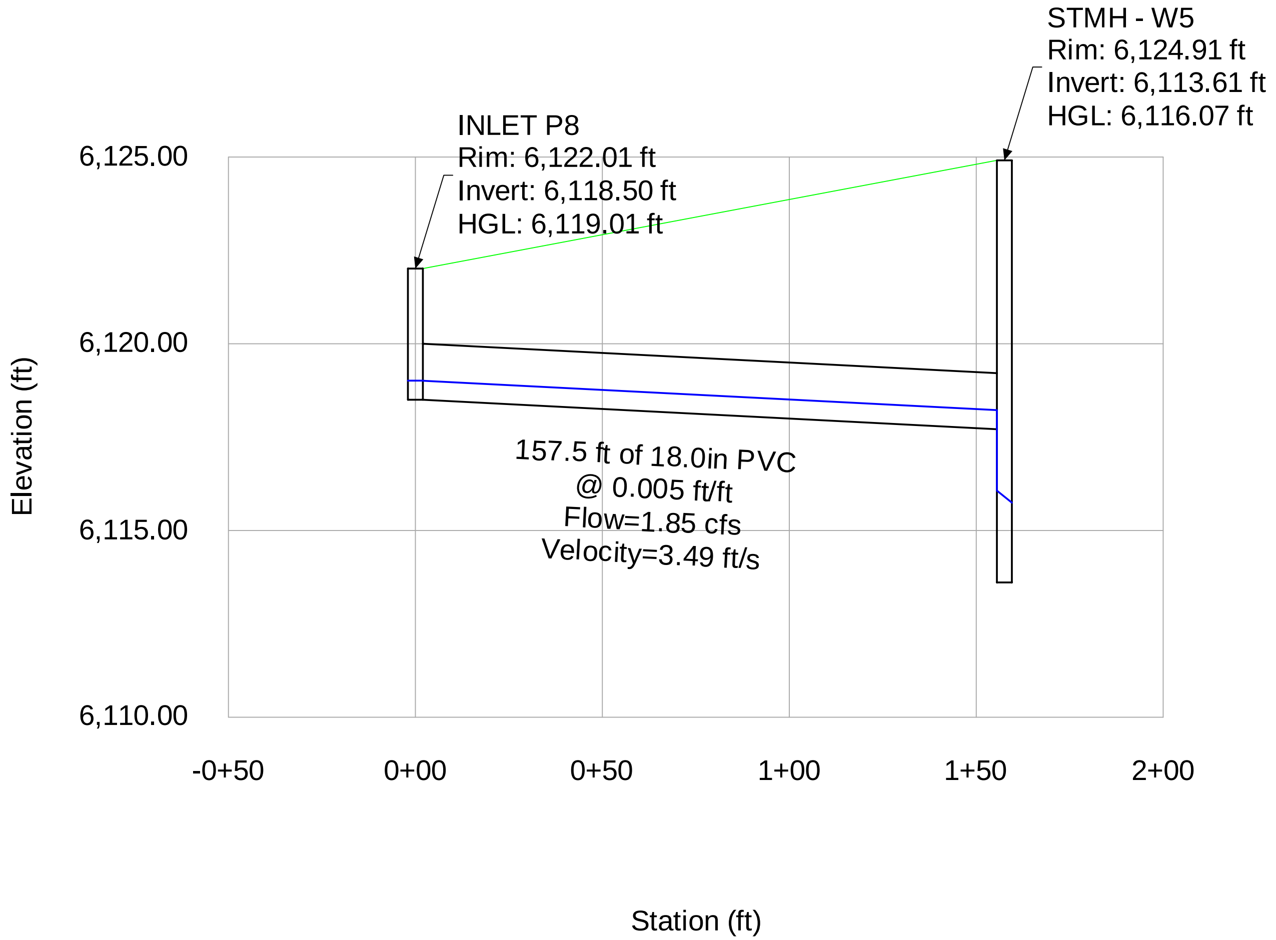


Westgate Apartments

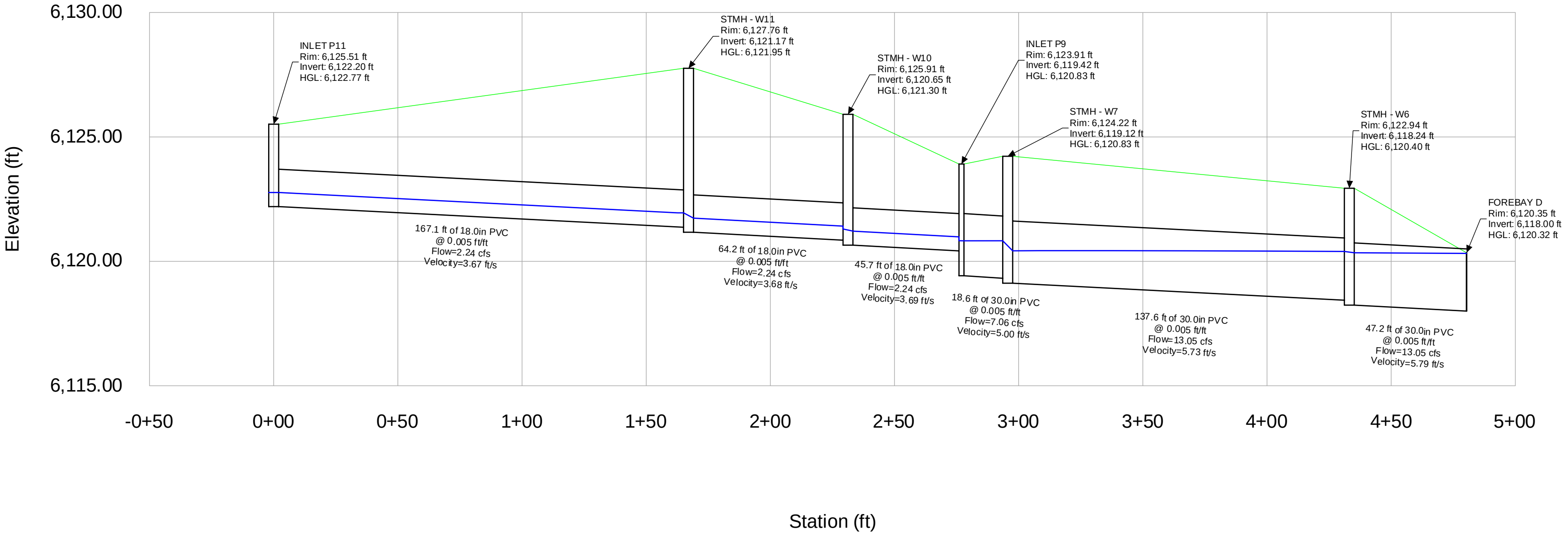
Profile Report

Engineering Profile - Storm D2 (Westgate.stsw)

Active Scenario: 5 - YEAR TAILWATER MODEL



Westgate Apartments
Profile Report
Engineering Profile - Storm E (Westgate.stsw)
Active Scenario: 5 - YEAR TAILWATER MODEL

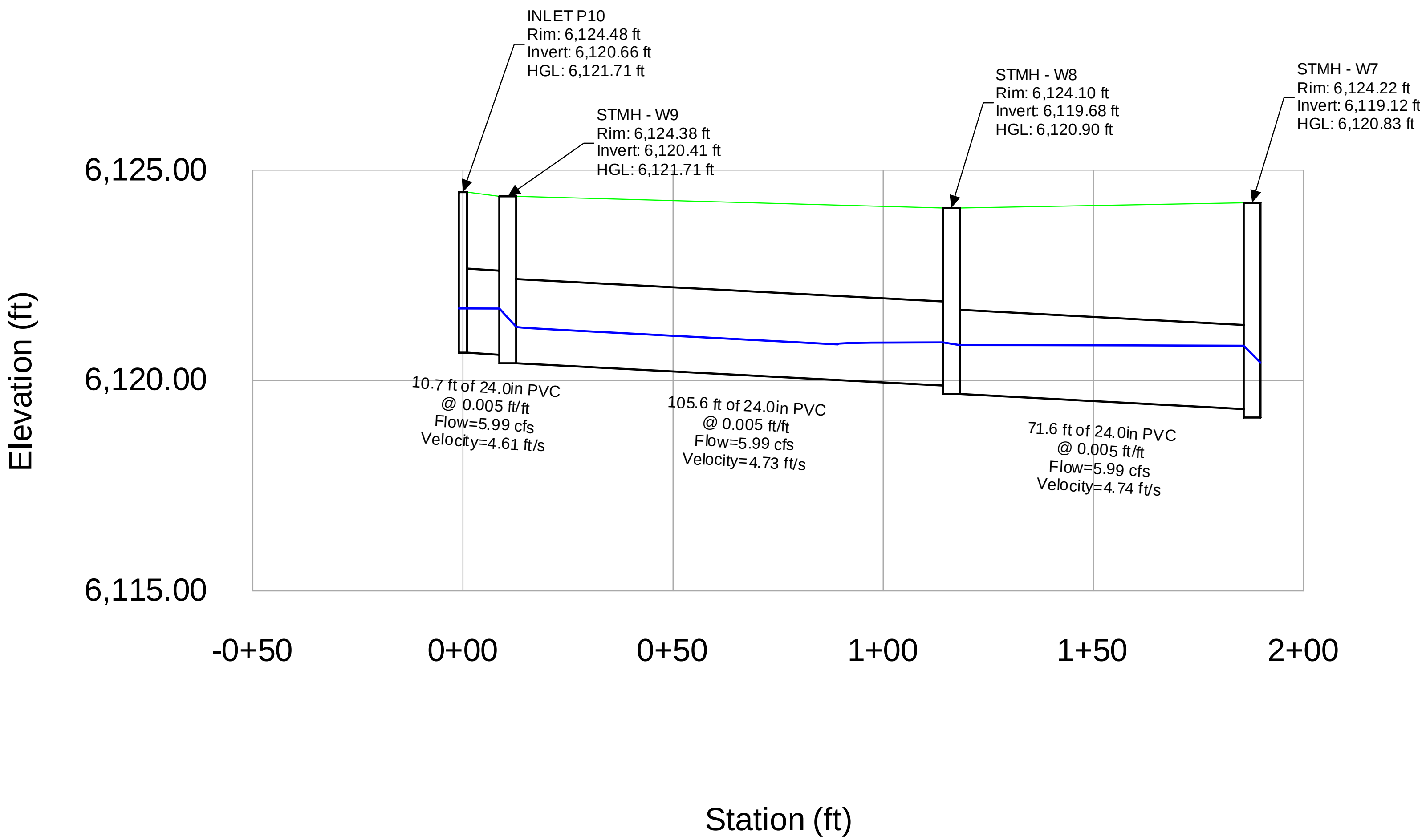


Westgate Apartments

Profile Report

Engineering Profile - Storm F (Westgate.stsw)

Active Scenario: 5 - YEAR TAILWATER MODEL

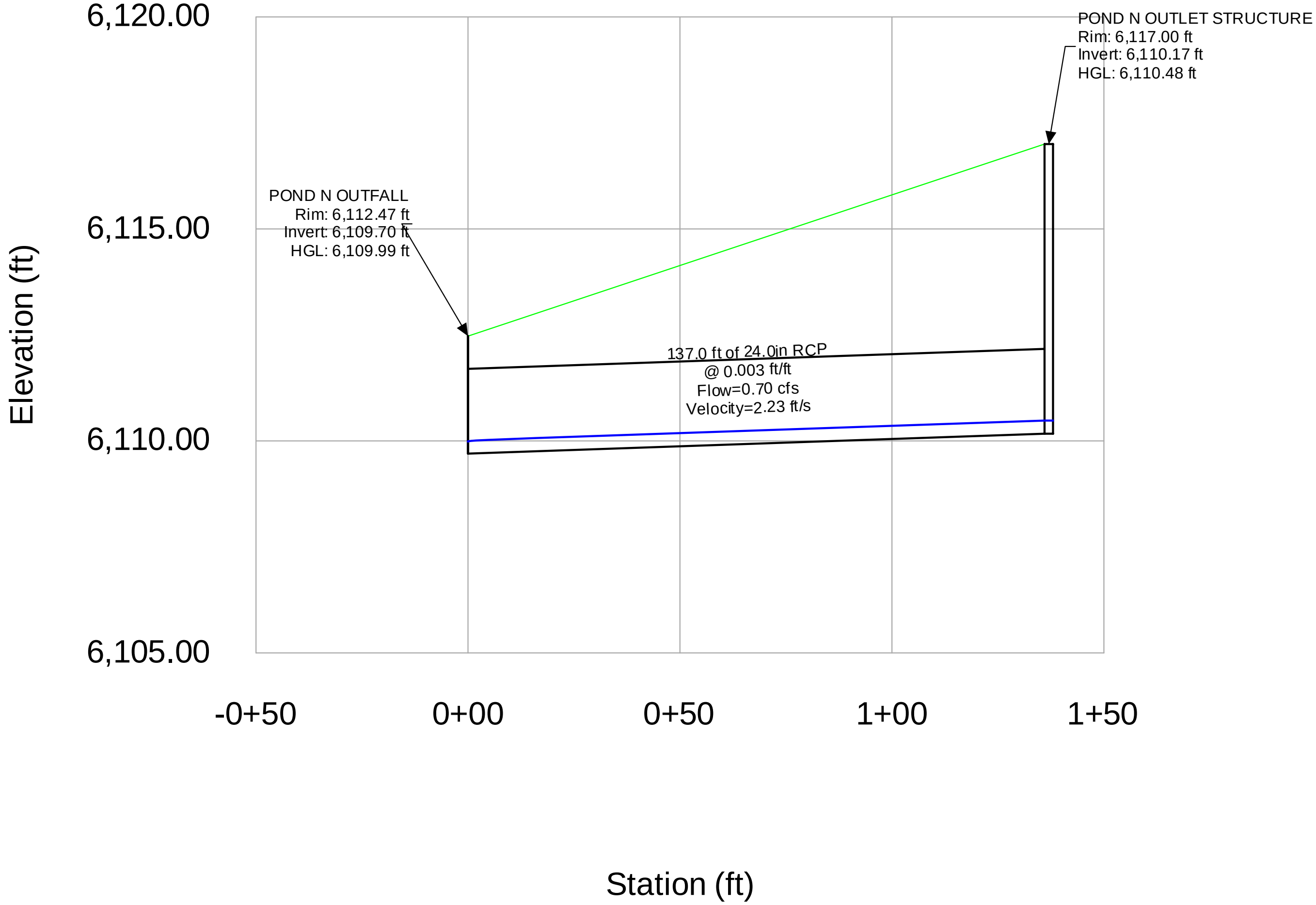


Westgate Apartments

Profile Report

Engineering Profile - Pond N Outfall (Westgate.stsw)

Active Scenario: 5 - YEAR TAILWATER MODEL

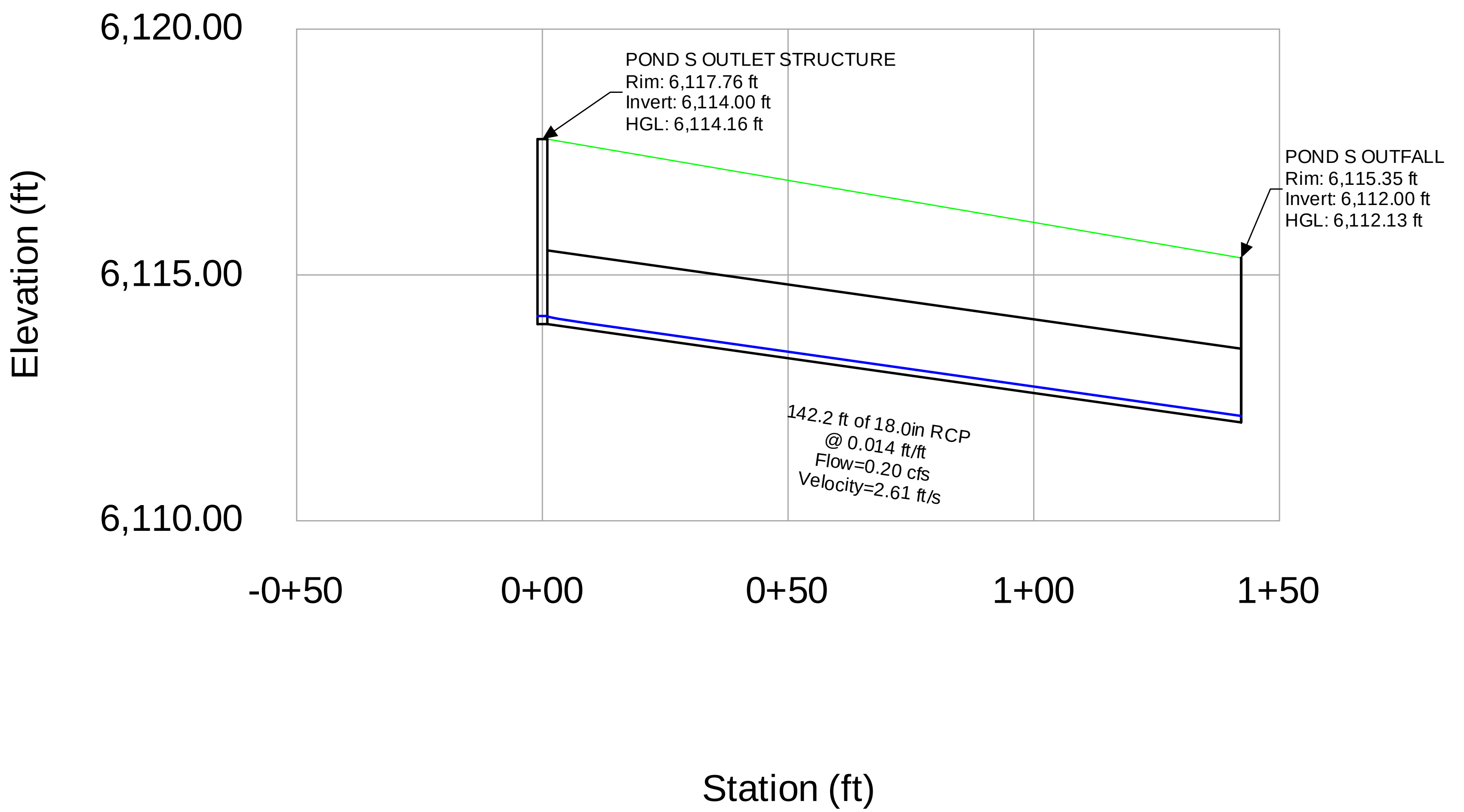


Westgate Apartments

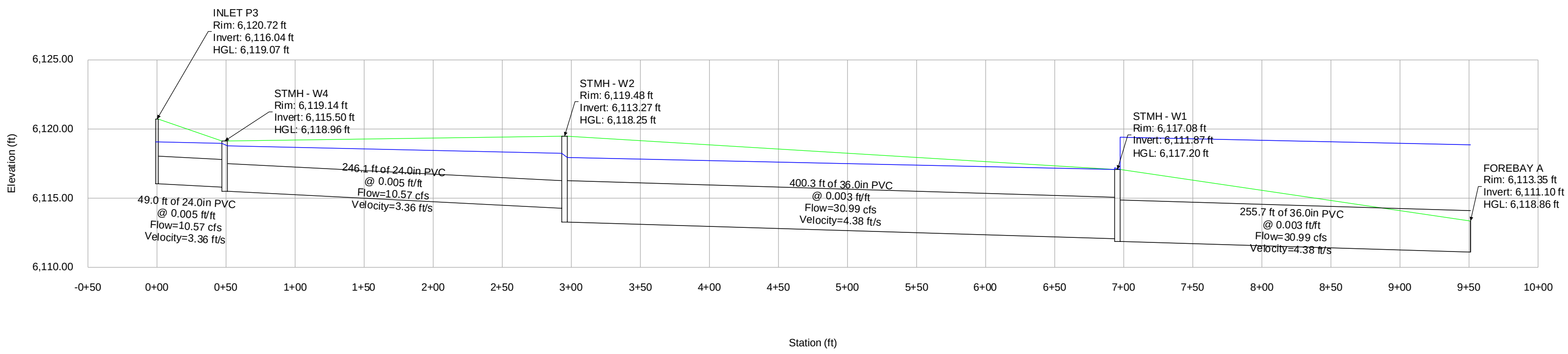
Profile Report

Engineering Profile - Pond S Outfall (Westgate.stsw)

Active Scenario: 5 - YEAR TAILWATER MODEL



Westgate Apartments
Profile Report
Engineering Profile - Storm A (Westgate.stsw)
Active Scenario: 100 - YEAR TAILWATER MODEL

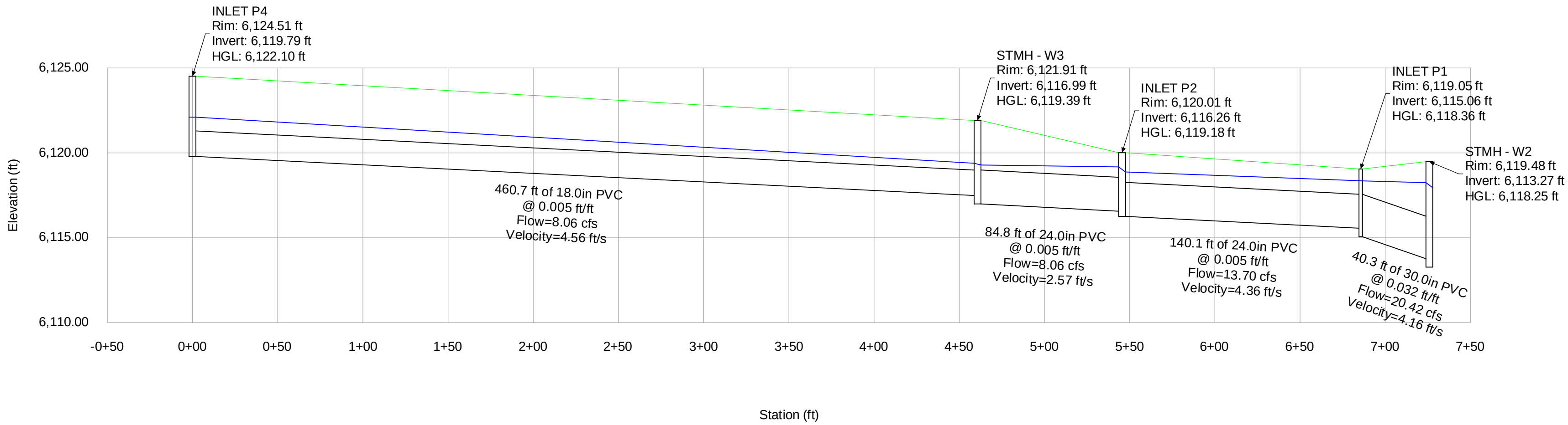


Westgate Apartments

Profile Report

Engineering Profile - Storm B (Westgate.stsw)

Active Scenario: 100 - YEAR TAILWATER MODEL

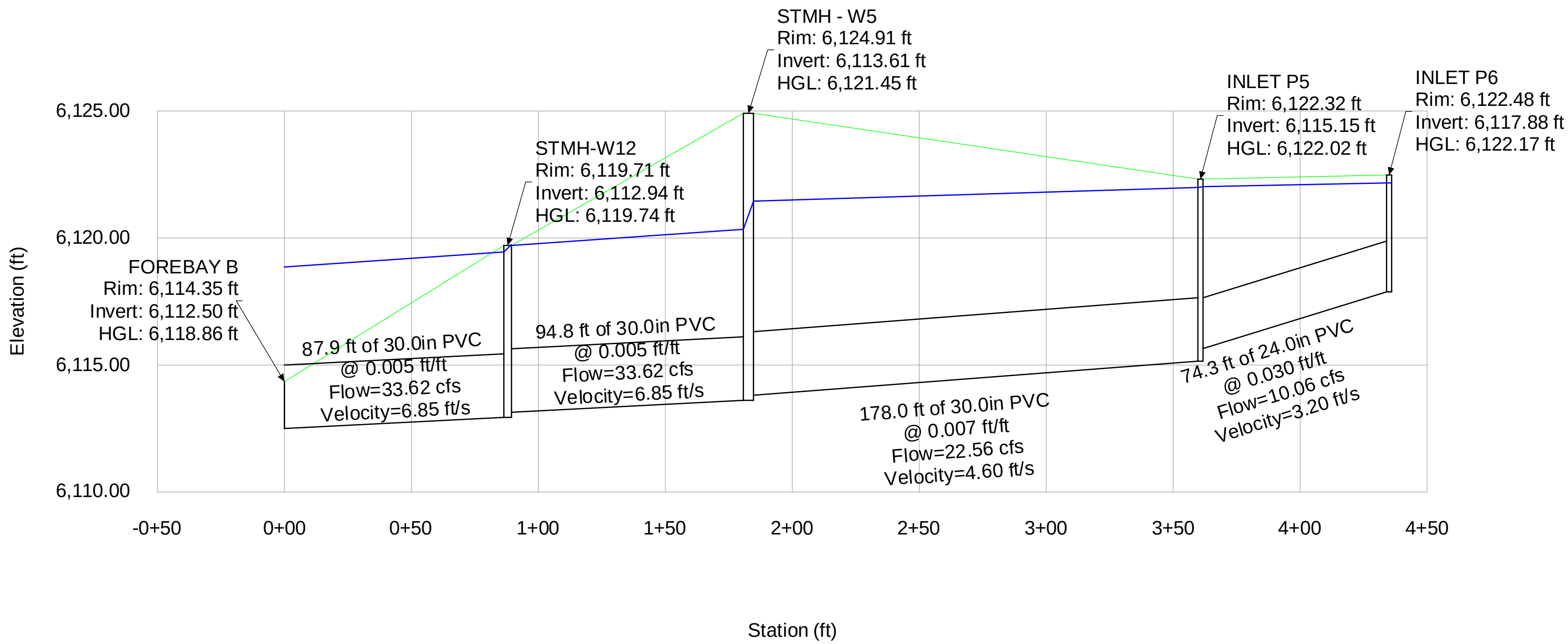


Westgate Apartments

Profile Report

Engineering Profile - Storm C (Westgate.stsw)

Active Scenario: 100 - YEAR TAILWATER MODEL

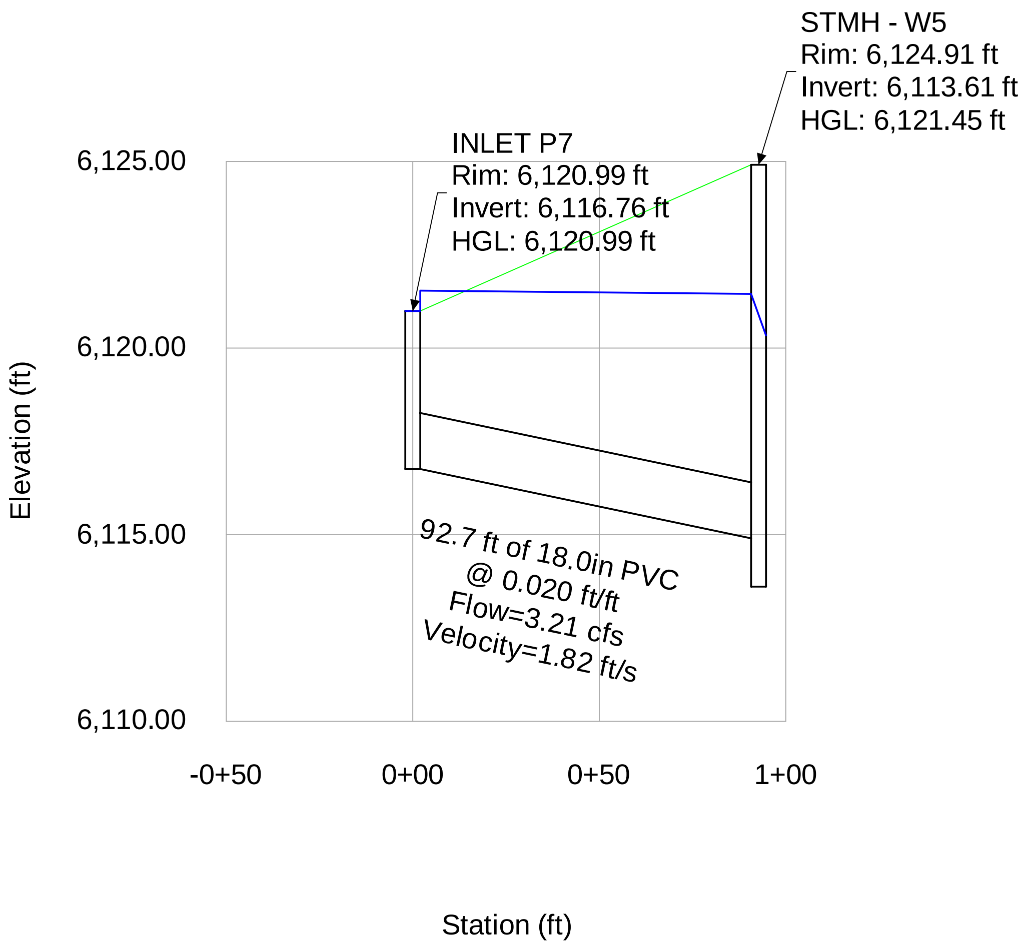


Westgate Apartments

Profile Report

Engineering Profile - Storm D1 (Westgate.stsw)

Active Scenario: 100 - YEAR TAILWATER MODEL

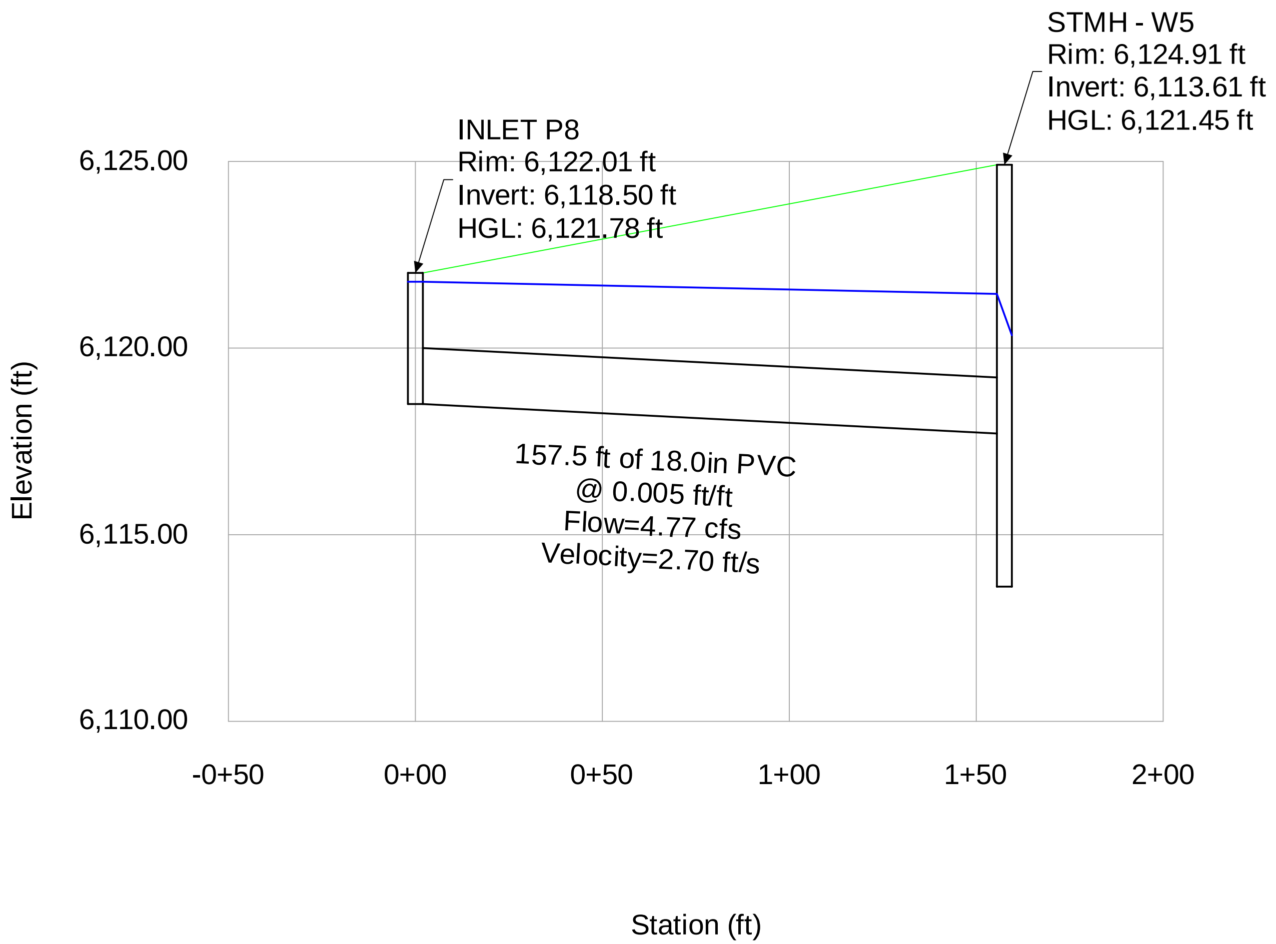


Westgate Apartments

Profile Report

Engineering Profile - Storm D2 (Westgate.stsw)

Active Scenario: 100 - YEAR TAILWATER MODEL

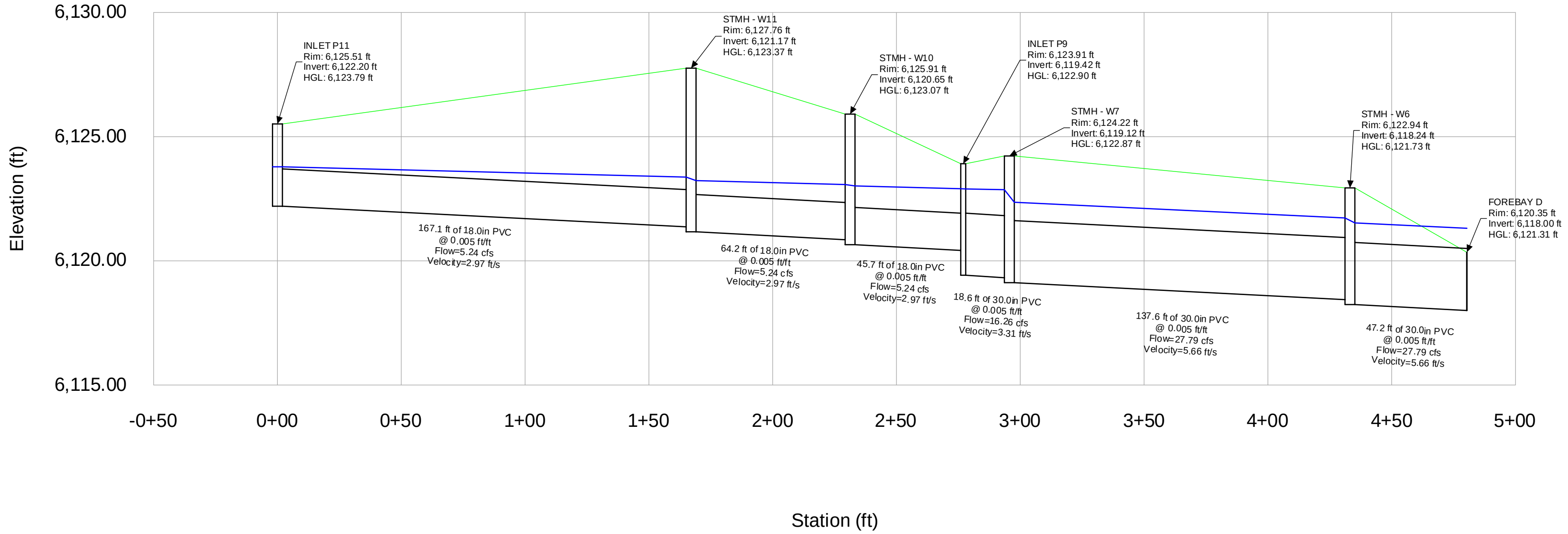


Westgate Apartments

Profile Report

Engineering Profile - Storm E (Westgate.stsw)

Active Scenario: 100 - YEAR TAILWATER MODEL

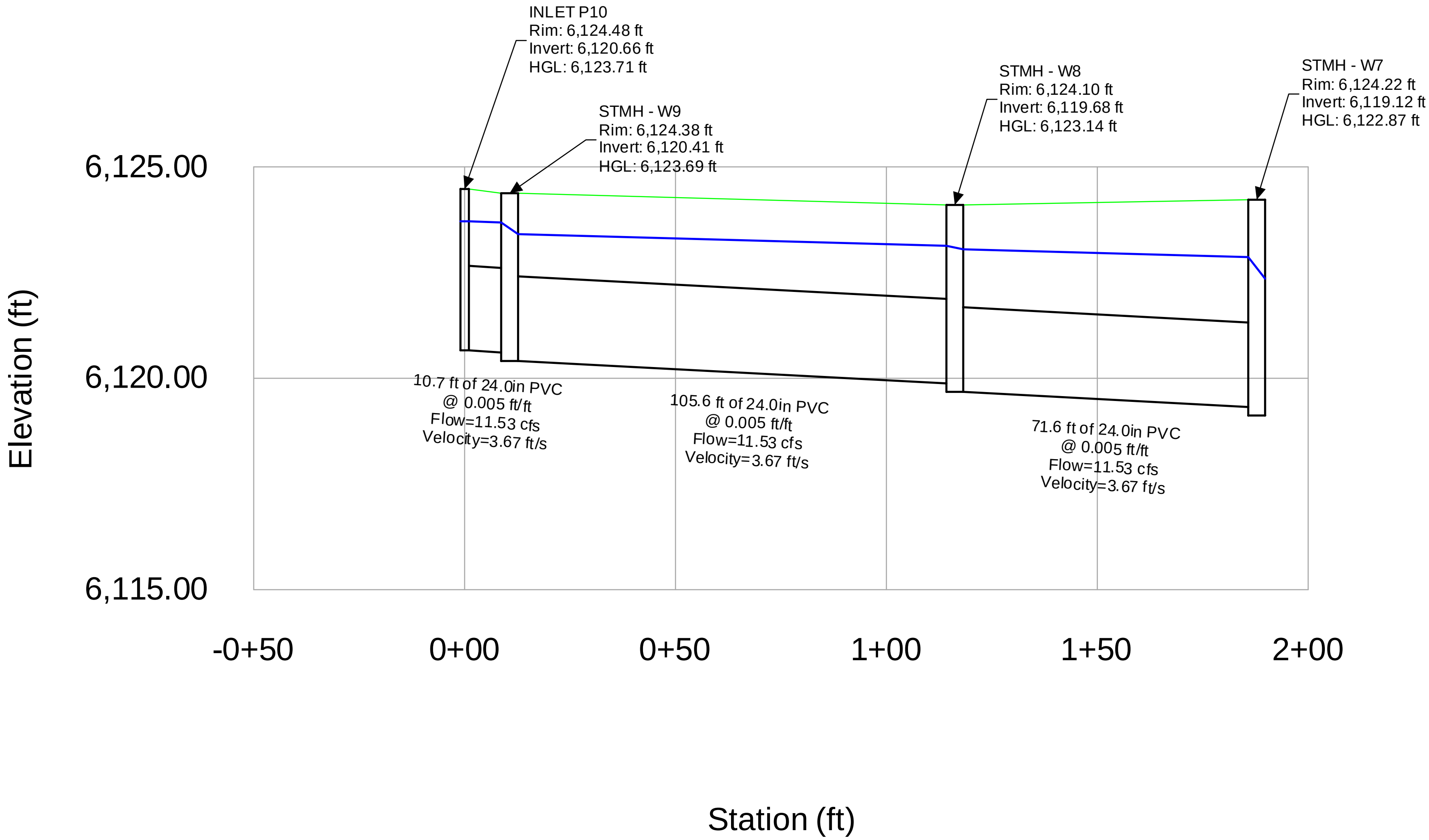


Westgate Apartments

Profile Report

Engineering Profile - Storm F (Westgate.stsw)

Active Scenario: 100 - YEAR TAILWATER MODEL

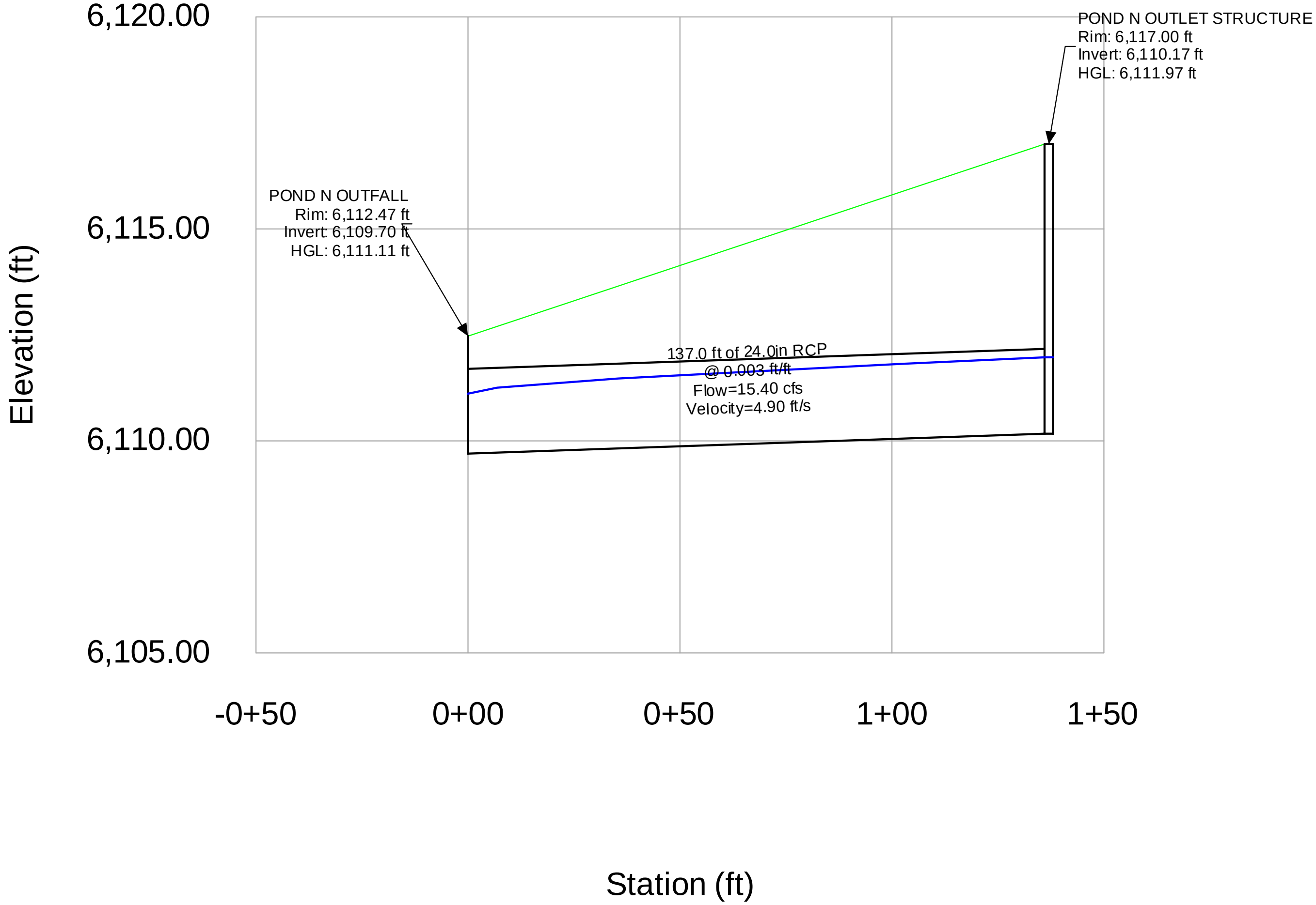


Westgate Apartments

Profile Report

Engineering Profile - Pond N Outfall (Westgate.stsw)

Active Scenario: 100 - YEAR TAILWATER MODEL

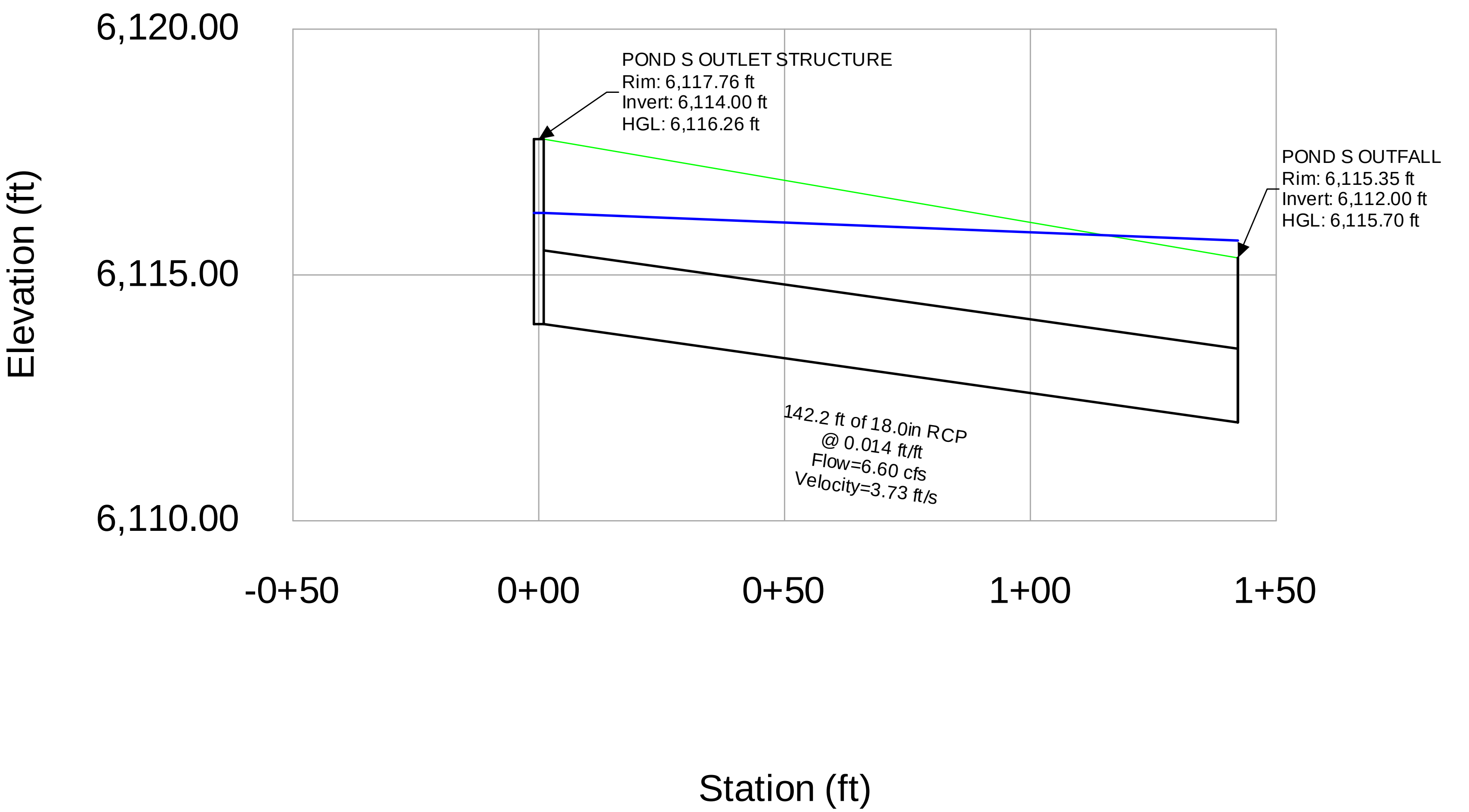


Westgate Apartments

Profile Report

Engineering Profile - Pond S Outfall (Westgate.stsw)

Active Scenario: 100 - YEAR TAILWATER MODEL



Westgate Apartments

5 - YEAR FREE OUTFALL

Conduit Table

Start Node	Stop Node	Invert (Start) (ft)	Invert (Stop) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Flow (cfs)	Velocity (ft/s)	Capacity (Design) (cfs)	Flow / Capacity (Design) (%)	Manning's n	Headloss (ft)	Froude Number (Normal)
INLET P11	STMH - W11	6,122.20	6,121.37	167.0	0.005	18.0	2.24	3.67	7.40	30.3	0.013	0.82	0.999
STMH - W11	STMH - W10	6,121.17	6,120.85	64.2	0.005	18.0	2.24	3.68	7.41	30.2	0.013	0.32	1.001
STMH - W10	INLET P9	6,120.65	6,120.42	45.7	0.005	18.0	2.24	3.69	7.45	30.1	0.013	0.23	1.006
INLET P5	STMH - W5	6,115.15	6,113.81	178.0	0.007	30.0	11.84	6.51	35.52	33.3	0.013	0.48	1.331
INLET P7	STMH - W5	6,116.76	6,114.90	110.5	0.020	18.0	1.12	4.95	14.87	7.5	0.013	1.33	1.981
INLET P8	STMH - W5	6,118.50	6,117.71	157.5	0.005	18.0	1.85	3.49	7.43	24.9	0.013	0.79	1.008
INLET P4	STMH - W3	6,119.79	6,117.49	460.7	0.005	18.0	3.46	4.13	7.43	46.6	0.013	2.31	0.974
INLET P10	STMH - W9	6,120.66	6,120.61	10.7	0.005	24.0	5.99	4.61	15.49	38.7	0.013	0.00	1.005
STMH - W9	STMH - W8	6,120.41	6,119.88	105.6	0.005	24.0	5.99	4.73	16.03	37.4	0.013	0.38	1.043
INLET P9	STMH - W7	6,119.42	6,119.32	18.6	0.005	30.0	7.06	5.00	30.07	23.5	0.013	0.00	1.139
STMH - W7	STMH - W6	6,119.12	6,118.44	137.6	0.005	30.0	13.05	5.73	28.84	45.3	0.013	0.71	1.057
STMH - W8	STMH - W7	6,119.68	6,119.32	71.6	0.005	24.0	5.99	4.74	16.04	37.3	0.013	0.02	1.044
STMH - W6	FOREBAY D	6,118.24	6,118.00	47.2	0.005	30.0	13.05	5.79	29.24	44.6	0.013	0.28	1.073
INLET P6	INLET P5	6,117.88	6,115.65	74.3	0.030	24.0	5.34	8.73	39.18	13.6	0.013	2.55	2.587
STMH - W3	INLET P2	6,116.99	6,116.56	84.8	0.005	24.0	3.46	4.06	16.00	21.6	0.013	0.20	1.059
INLET P2	INLET P1	6,116.26	6,115.56	140.1	0.005	24.0	5.72	4.67	15.99	35.8	0.013	0.72	1.043
INLET P3	STMH - W4	6,116.04	6,115.80	49.1	0.005	24.0	5.61	4.64	16.00	35.1	0.013	0.22	1.044
INLET P1	STMH - W2	6,115.06	6,113.77	40.3	0.032	30.0	9.11	10.18	73.41	12.4	0.013	1.09	2.769
STMH - W2	STMH - W1	6,113.27	6,112.07	400.3	0.003	36.0	14.72	4.89	36.53	40.3	0.013	1.25	0.858
STMH - W4	STMH - W2	6,115.50	6,114.27	246.0	0.005	24.0	5.61	4.64	15.99	35.1	0.013	1.25	1.044
POND S OUTLET STRUCTURE	POND S OUTFALL	6,114.00	6,112.00	121.7	0.014	18.0	0.20	2.61	12.46	1.6	0.013	2.03	1.538
STMH - W1	FOREBAY A	6,111.87	6,111.10	255.3	0.003	36.0	14.72	4.89	36.53	40.3	0.013	0.87	0.858
POND N OUTLET STRUCTURE	POND N OUTFALL	6,110.17	6,109.70	129.8	0.003	24.0	0.70	2.23	13.21	5.3	0.013	0.49	0.845
STMH - W5	STMH-W12	6,113.61	6,113.14	94.7	0.005	30.0	16.45	6.09	28.97	56.8	0.013	0.45	1.031
STMH-W12	FOREBAY B	6,112.94	6,112.50	87.9	0.005	30.0	16.45	6.10	29.02	56.7	0.013	0.46	1.033

Westgate Apartments

5 - YEAR FREE OUTFALL

Catch Basin Table

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Headloss Method	Headloss (ft)	Flow (Additional Subsurface) (cfs)	Flow (Total Out) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
INLET P3	6,120.72	6,116.04	Standard	0.00	5.61	5.61	6,116.88	6,116.88
INLET P1	6,119.05	6,115.06	Standard	0.02	3.39	9.11	6,116.09	6,116.07
INLET P2	6,120.01	6,116.26	Standard	0.33	2.26	5.72	6,117.43	6,117.11
INLET P4	6,124.51	6,119.79	Standard	0.00	3.46	3.46	6,120.51	6,120.51
POND N OUTLET STRUCTURE	6,117.00	6,110.17	Standard	0.00	0.70	0.70	6,110.48	6,110.48
INLET P7	6,120.99	6,116.76	Standard	0.00	1.12	1.12	6,117.16	6,117.16
INLET P8	6,122.01	6,118.50	Standard	0.00	1.85	1.85	6,119.01	6,119.01
INLET P5	6,122.32	6,115.15	Standard	0.04	6.50	11.84	6,116.35	6,116.30
INLET P6	6,122.48	6,117.88	Standard	0.00	5.34	5.34	6,118.69	6,118.69
INLET P11	6,125.51	6,122.20	Standard	0.00	2.24	2.24	6,122.77	6,122.77
INLET P9	6,123.91	6,119.42	Standard	0.00	4.82	7.06	6,120.82	6,120.82
INLET P10	6,124.48	6,120.66	Standard	0.00	5.99	5.99	6,121.71	6,121.71
POND S OUTLET STRUCTURE	6,117.76	6,114.00	Standard	0.00	0.20	0.20	6,114.16	6,114.16

Westgate Apartments

5 - YEAR FREE OUTFALL

Manhole Table

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Headloss Method	Headloss Coefficient (Standard)	Headloss (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)
STMH - W11	6,127.76	6,121.17	Standard	1.020	0.21	2.24	6,121.74	6,121.95
STMH - W10	6,125.91	6,120.65	Standard	0.400	0.08	2.24	6,121.22	6,121.30
STMH - W5	6,124.91	6,113.61	Standard	1.520	0.84	16.45	6,114.98	6,115.83
STMH - W9	6,124.38	6,120.41	Standard	1.320	0.43	5.99	6,121.28	6,121.71
STMH - W7	6,124.22	6,119.12	Standard	1.020	0.48	13.05	6,120.33	6,120.82
STMH - W8	6,124.10	6,119.68	Standard	0.400	0.06	5.99	6,120.83	6,120.90
STMH - W6	6,122.94	6,118.24	Standard	0.400	0.19	13.05	6,119.45	6,119.64
STMH - W3	6,121.91	6,116.99	Standard	1.020	0.24	3.46	6,117.64	6,117.88
STMH - W2	6,119.48	6,113.27	Standard	1.020	0.38	14.72	6,114.59	6,114.97
STMH - W4	6,119.14	6,115.50	Standard	1.020	0.32	5.61	6,116.34	6,116.66
STMH - W1	6,117.08	6,111.87	Standard	0.400	0.15	14.72	6,113.19	6,113.34
STMH-W12	6,119.71	6,112.94	Standard	0.400	0.22	16.45	6,114.31	6,114.53

Outfall Table

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)	Boundary Condition Type	Elevation (User Defined Tailwater) (ft)
FOREBAY D	6,120.35	6,118.00	6,119.17	13.05	Free Outfall	6,120.32
POND S OUTFALL	6,115.35	6,112.00	6,112.13	0.20	Free Outfall	6,111.40
FOREBAY B	6,114.35	6,112.50	6,113.85	16.45	Free Outfall	6,115.43
FOREBAY A	6,113.35	6,111.10	6,112.32	14.72	Free Outfall	6,115.43
POND N OUTFALL	6,112.47	6,109.70	6,109.99	0.70	Free Outfall	6,609.02

Westgate Apartments

100 - YEAR FREE OUTFALL

Conduit Table

Start Node	Stop Node	Invert (Start) (ft)	Invert (Stop) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Flow (cfs)	Velocity (ft/s)	Capacity (Design) (cfs)	Flow / Capacity (Design) (%)	Manning's n	Headloss (ft)	Froude Number (Normal)
INLET P11	STMH - W11	6,122.20	6,121.37	167.0	0.005	18.0	5.24	4.54	7.40	70.8	0.013	0.70	0.900
STMH - W11	STMH - W10	6,121.17	6,120.85	64.2	0.005	18.0	5.24	4.55	7.41	70.7	0.013	0.15	0.901
STMH - W10	INLET P9	6,120.65	6,120.42	45.7	0.005	18.0	5.24	4.57	7.45	70.3	0.013	0.08	0.907
INLET P5	STMH - W5	6,115.15	6,113.81	178.0	0.007	30.0	22.56	4.60	35.52	63.5	0.013	0.54	1.237
INLET P7	STMH - W5	6,116.76	6,114.90	110.5	0.020	18.0	3.21	6.71	14.87	21.6	0.013	0.16	2.021
INLET P8	STMH - W5	6,118.50	6,117.71	157.5	0.005	18.0	4.77	4.46	7.43	64.2	0.013	0.82	0.926
INLET P4	STMH - W3	6,119.79	6,117.49	460.7	0.005	18.0	8.06	4.56	7.43	108.5	0.013	2.62	0.657
INLET P10	STMH - W9	6,120.66	6,120.61	10.7	0.005	24.0	11.53	5.40	15.49	74.4	0.013	0.03	0.903
STMH - W9	STMH - W8	6,120.41	6,119.88	105.6	0.005	24.0	11.53	5.55	16.03	71.9	0.013	0.27	0.945
INLET P9	STMH - W7	6,119.42	6,119.32	18.6	0.005	30.0	16.26	6.25	30.07	54.1	0.013	0.02	1.078
STMH - W7	STMH - W6	6,119.12	6,118.44	137.6	0.005	30.0	27.79	6.69	28.84	96.4	0.013	0.64	0.827
STMH - W8	STMH - W7	6,119.68	6,119.32	71.6	0.005	24.0	11.53	3.67	16.04	71.9	0.013	0.19	0.946
STMH - W6	FOREBAY D	6,118.24	6,118.00	47.2	0.005	30.0	27.79	6.78	29.24	95.0	0.013	0.36	0.851
INLET P6	INLET P5	6,117.88	6,115.65	74.3	0.030	24.0	10.06	10.44	39.18	25.7	0.013	1.16	2.588
STMH - W3	INLET P2	6,116.99	6,116.56	84.8	0.005	24.0	8.06	5.10	16.00	50.4	0.013	0.05	1.011
INLET P2	INLET P1	6,116.26	6,115.56	140.1	0.005	24.0	13.70	5.72	15.99	85.7	0.013	0.79	0.877
INLET P3	STMH - W4	6,116.04	6,115.80	49.1	0.005	24.0	10.57	5.44	16.00	66.1	0.013	0.09	0.964
INLET P1	STMH - W2	6,115.06	6,113.77	40.3	0.032	30.0	20.42	12.80	73.41	27.8	0.013	0.67	2.770
STMH - W2	STMH - W1	6,113.27	6,112.07	400.3	0.003	36.0	30.99	5.80	36.53	84.8	0.013	1.20	0.731
STMH - W4	STMH - W2	6,115.50	6,114.27	246.0	0.005	24.0	10.57	5.44	15.99	66.1	0.013	0.76	0.964
POND S OUTLET STRUCTURE	POND S OUTFALL	6,114.00	6,112.00	121.7	0.014	18.0	6.60	7.15	12.46	53.0	0.013	2.22	1.607
STMH - W1	FOREBAY A	6,111.87	6,111.10	255.3	0.003	36.0	30.99	5.80	36.53	84.8	0.013	1.07	0.731
POND N OUTLET STRUCTURE	POND N OUTFALL	6,110.17	6,109.70	129.8	0.003	24.0	15.40	4.90	13.21	116.6	0.013	0.86	0.611
STMH - W5	STMH-W12	6,113.61	6,113.14	94.7	0.005	30.0	33.62	6.85	28.97	116.1	0.013	0.62	0.764
STMH-W12	FOREBAY B	6,112.94	6,112.50	87.9	0.005	30.0	33.62	6.85	29.02	115.9	0.013	0.77	0.764

Westgate Apartments

100 - YEAR FREE OUTFALL

Catch Basin Table

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Headloss Method	Headloss (ft)	Flow (Additional Subsurface) (cfs)	Flow (Total Out) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
INLET P3	6,120.72	6,116.04	Standard	0.00	10.57	10.57	6,117.25	6,117.25
INLET P1	6,119.05	6,115.06	Standard	0.03	6.72	20.42	6,116.63	6,116.59
INLET P2	6,120.01	6,116.26	Standard	0.52	5.64	13.70	6,118.21	6,117.69
INLET P4	6,124.51	6,119.79	Standard	0.00	8.06	8.06	6,121.21	6,121.21
POND N OUTLET STRUCTURE	6,117.00	6,110.17	Standard	0.00	15.40	15.40	6,111.97	6,111.97
INLET P7	6,120.99	6,116.76	Standard	0.00	3.21	3.21	6,117.44	6,117.44
INLET P8	6,122.01	6,118.50	Standard	0.00	4.77	4.77	6,119.37	6,119.37
INLET P5	6,122.32	6,115.15	Standard	0.03	12.50	22.56	6,117.85	6,117.82
INLET P6	6,122.48	6,117.88	Standard	0.00	10.06	10.06	6,119.01	6,119.01
INLET P11	6,125.51	6,122.20	Standard	0.00	5.24	5.24	6,123.13	6,123.13
INLET P9	6,123.91	6,119.42	Standard	0.01	11.02	16.26	6,121.83	6,121.83
INLET P10	6,124.48	6,120.66	Standard	0.00	11.53	11.53	6,122.65	6,122.65
POND S OUTLET STRUCTURE	6,117.76	6,114.00	Standard	0.00	6.60	6.60	6,114.99	6,114.99

Westgate Apartments

100 - YEAR FREE OUTFALL

Manhole Table

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Headloss Method	Headloss Coefficient (Standard)	Headloss (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)
STMH - W11	6,127.76	6,121.17	Standard	1.020	0.31	5.24	6,122.13	6,122.43
STMH - W10	6,125.91	6,120.65	Standard	0.400	0.07	5.24	6,121.91	6,121.98
STMH - W5	6,124.91	6,113.61	Standard	1.520	1.11	33.62	6,116.17	6,117.28
STMH - W9	6,124.38	6,120.41	Standard	1.320	0.28	11.53	6,122.34	6,122.62
STMH - W7	6,124.22	6,119.12	Standard	1.020	0.71	27.79	6,121.10	6,121.80
STMH - W8	6,124.10	6,119.68	Standard	0.400	0.08	11.53	6,121.99	6,122.07
STMH - W6	6,122.94	6,118.24	Standard	0.400	0.29	27.79	6,120.16	6,120.46
STMH - W3	6,121.91	6,116.99	Standard	1.020	0.23	8.06	6,118.26	6,118.49
STMH - W2	6,119.48	6,113.27	Standard	1.020	0.53	30.99	6,115.39	6,115.92
STMH - W4	6,119.14	6,115.50	Standard	1.020	0.47	10.57	6,116.69	6,117.16
STMH - W1	6,117.08	6,111.87	Standard	0.400	0.21	30.99	6,113.98	6,114.19
STMH-W12	6,119.71	6,112.94	Standard	0.400	0.31	33.62	6,115.24	6,115.56

Outfall Table

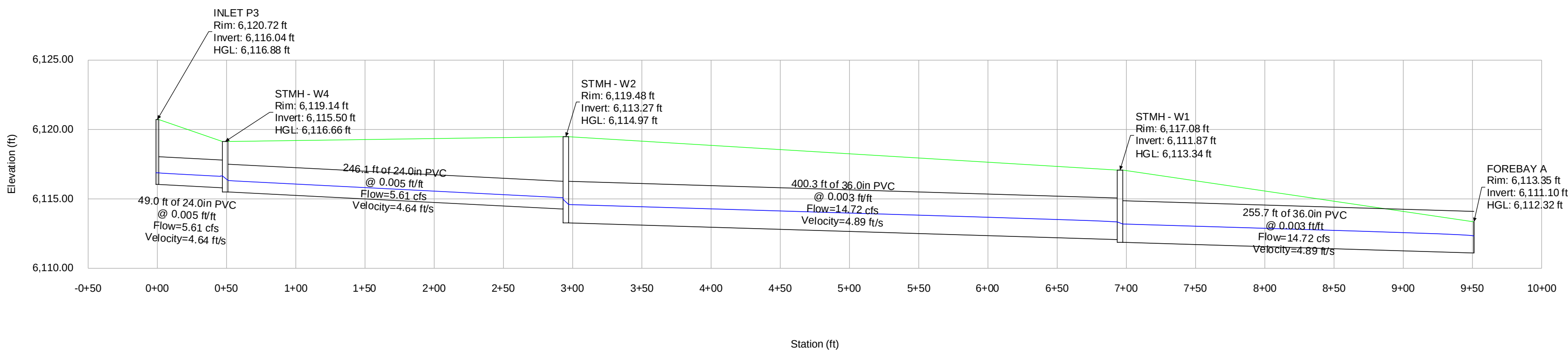
Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)	Boundary Condition Type	Elevation (User Defined Tailwater) (ft)
FOREBAY D	6,120.35	6,118.00	6,119.80	27.79	Free Outfall	6,121.31
POND S OUTFALL	6,115.35	6,112.00	6,112.78	6.60	Free Outfall	6,115.70
FOREBAY B	6,114.35	6,112.50	6,114.47	33.62	Free Outfall	6,118.86
FOREBAY A	6,113.35	6,111.10	6,112.91	30.99	Free Outfall	6,118.86
POND N OUTFALL	6,112.47	6,109.70	6,111.11	15.40	Free Outfall	6,609.61

Westgate Apartments

Profile Report

Engineering Profile - Storm A (Westgate.stsw)

Active Scenario: 5 - YEAR FREE OUTFALL

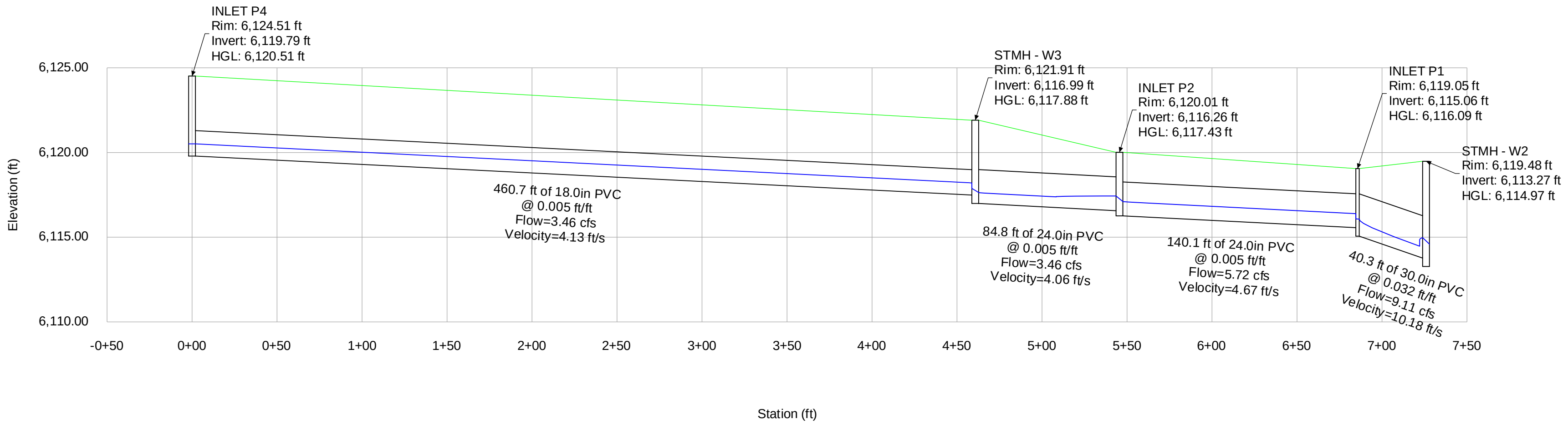


Westgate Apartments

Profile Report

Engineering Profile - Storm B (Westgate.stsw)

Active Scenario: 5 - YEAR FREE OUTFALL

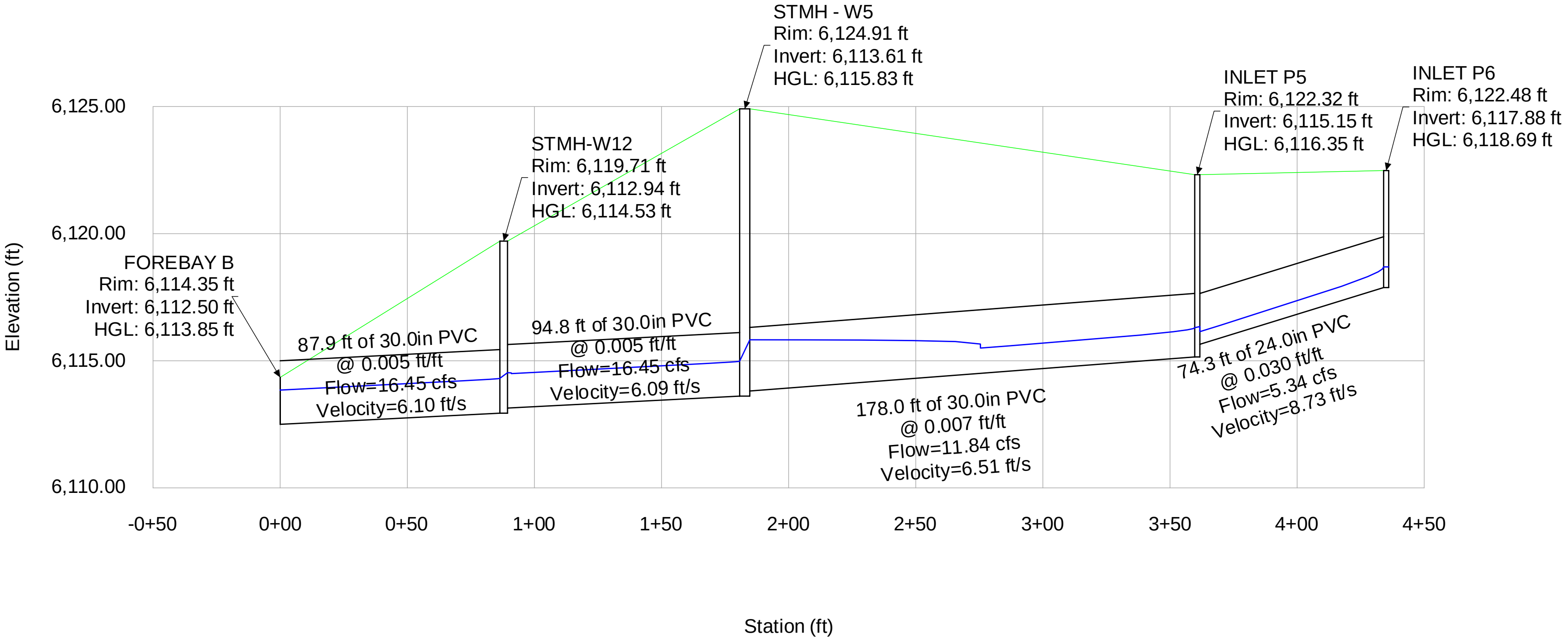


Westgate Apartments

Profile Report

Engineering Profile - Storm C (Westgate.stsw)

Active Scenario: 5 - YEAR FREE OUTFALL

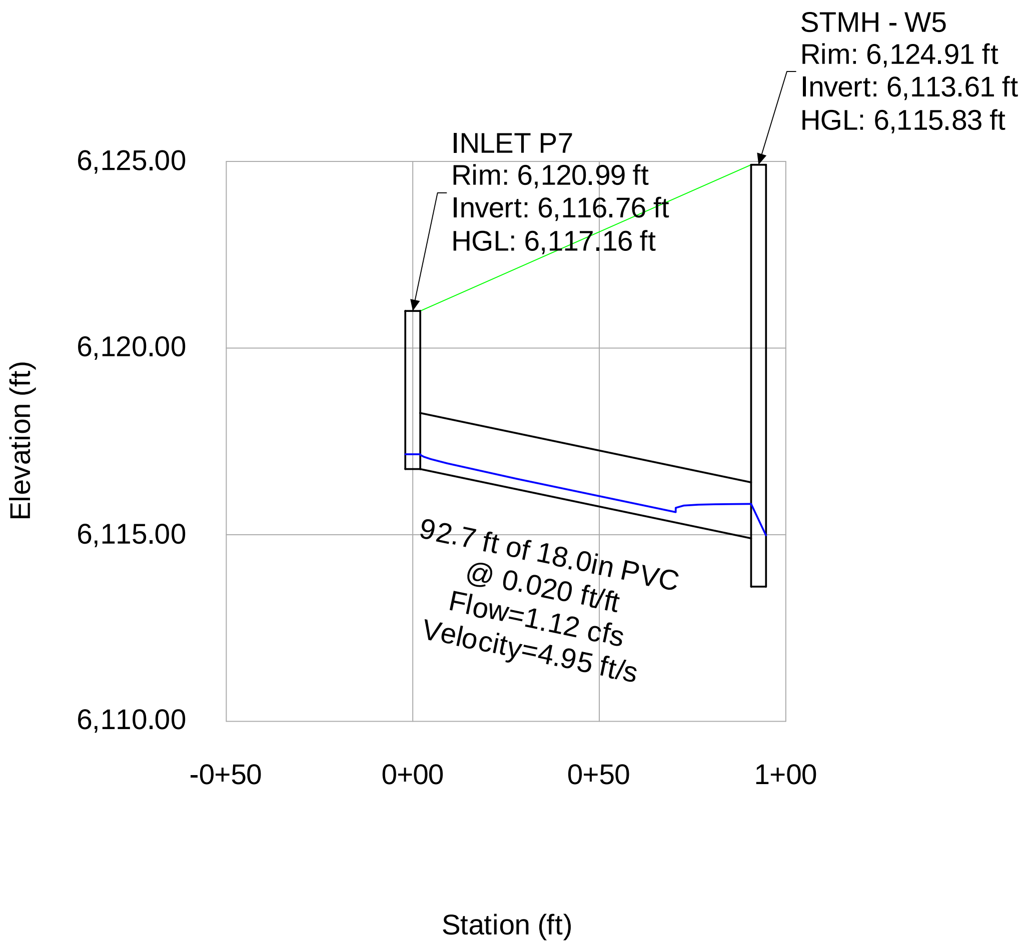


Westgate Apartments

Profile Report

Engineering Profile - Storm D1 (Westgate.stsw)

Active Scenario: 5 - YEAR FREE OUTFALL

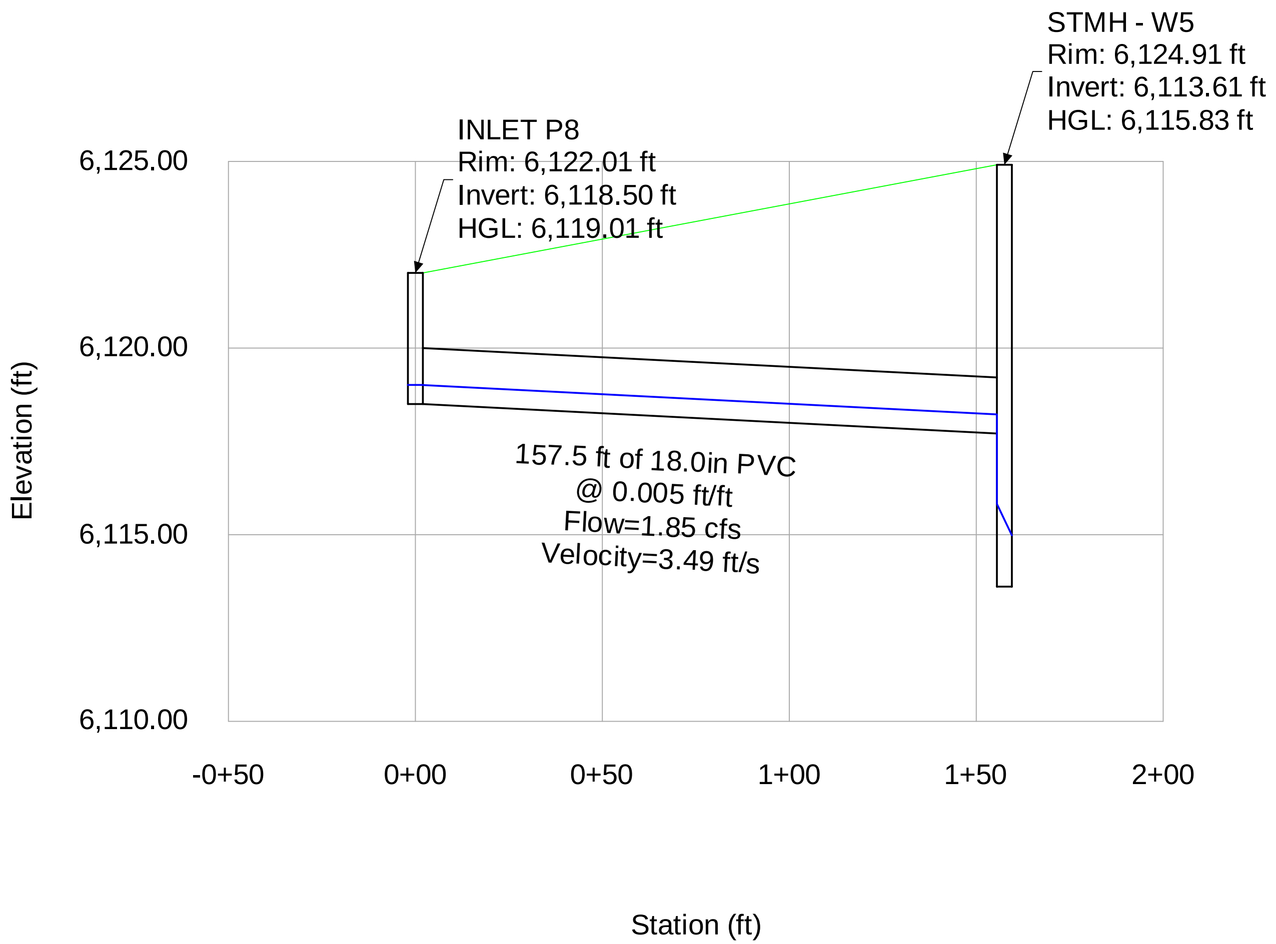


Westgate Apartments

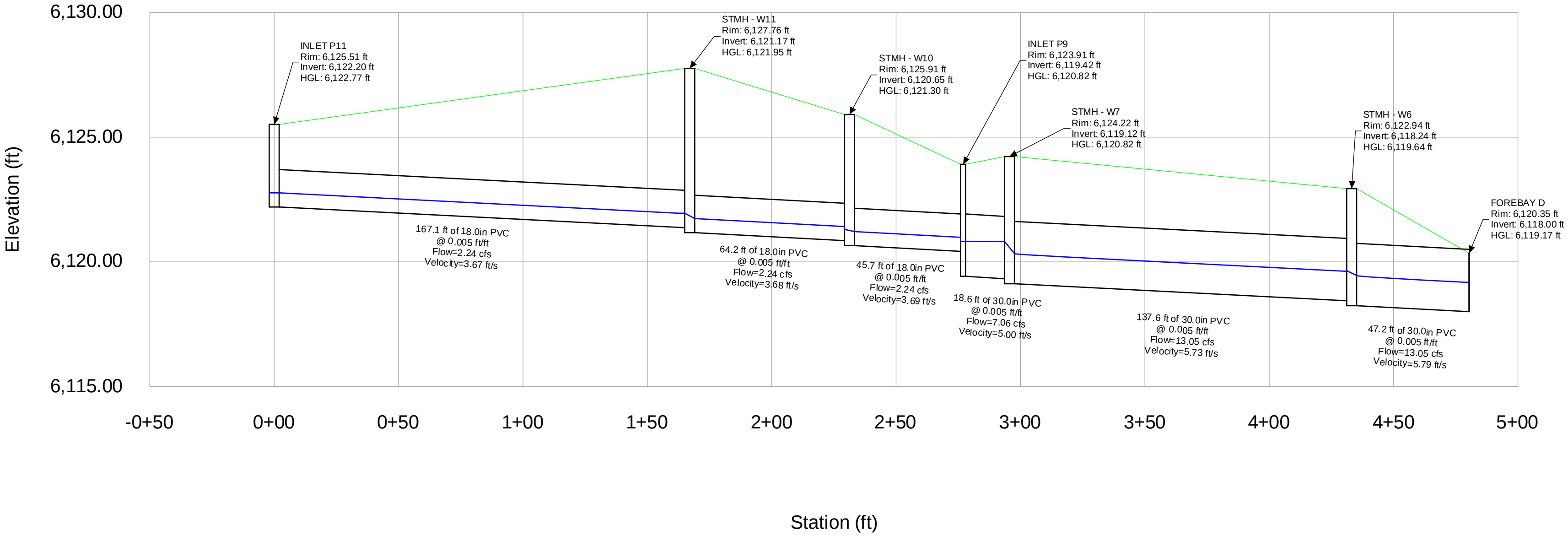
Profile Report

Engineering Profile - Storm D2 (Westgate.stsw)

Active Scenario: 5 - YEAR FREE OUTFALL



Westgate Apartments
Profile Report
Engineering Profile - Storm E (Westgate.stsw)
Active Scenario: 5 - YEAR FREE OUTFALL

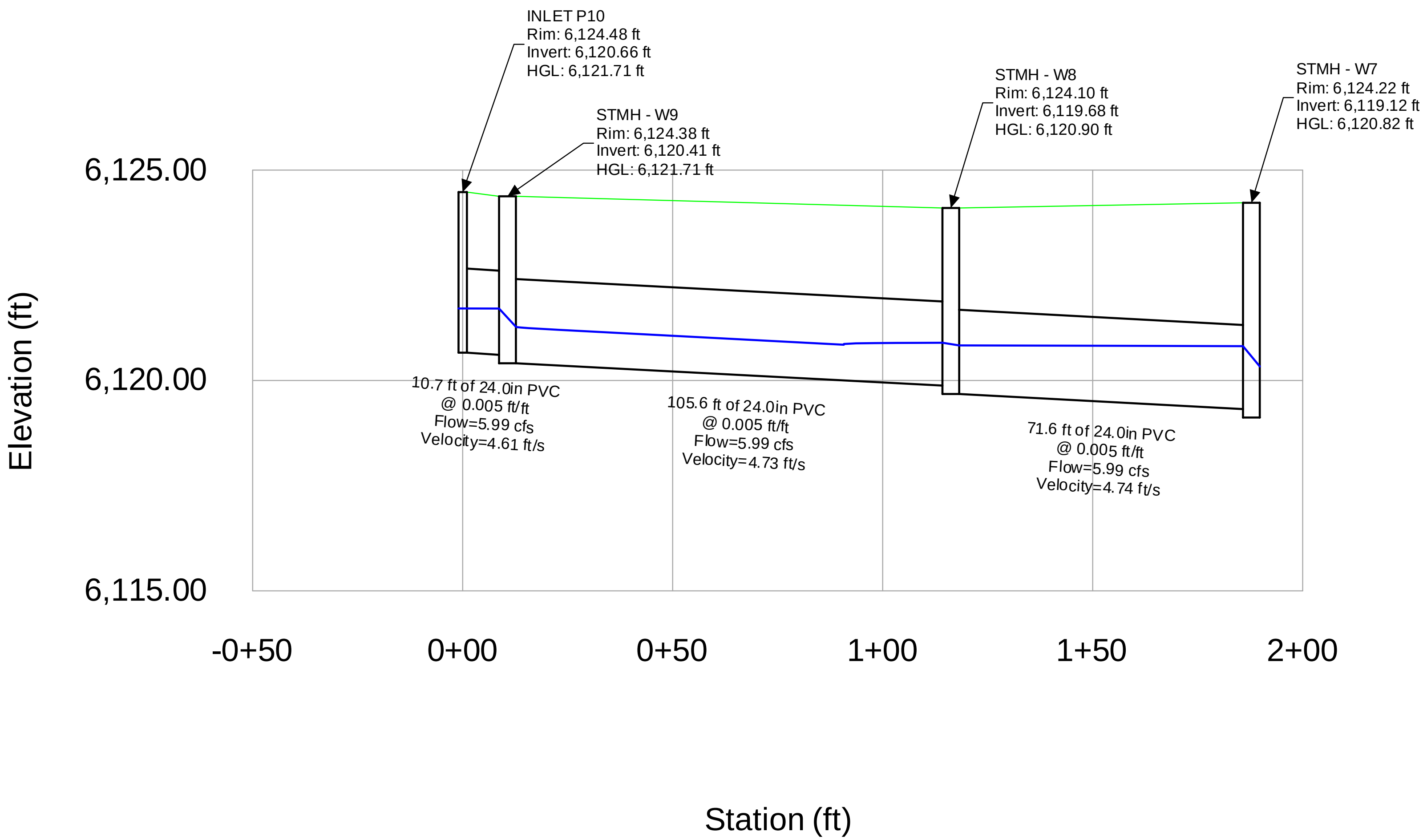


Westgate Apartments

Profile Report

Engineering Profile - Storm F (Westgate.stsw)

Active Scenario: 5 - YEAR FREE OUTFALL

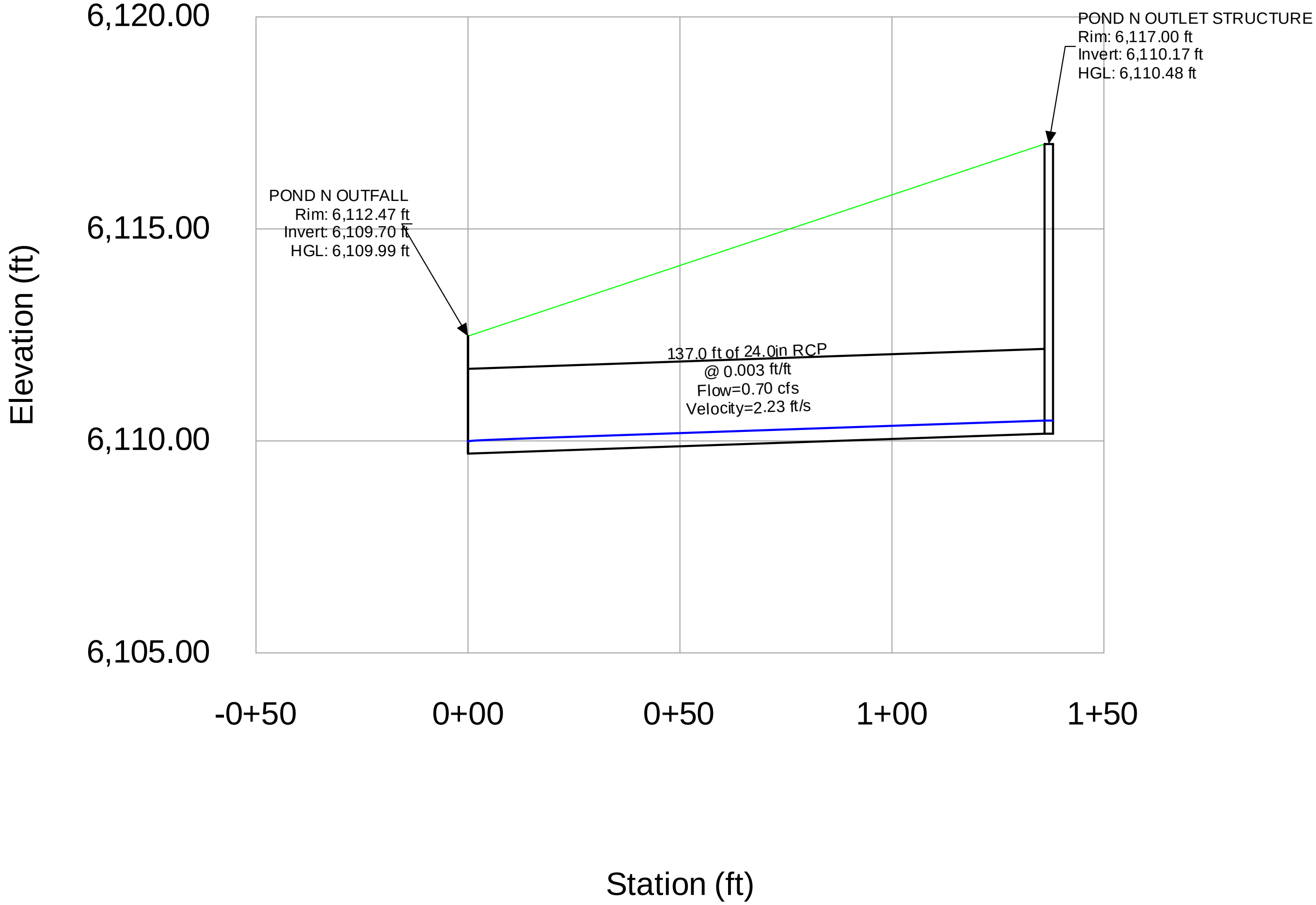


Westgate Apartments

Profile Report

Engineering Profile - Pond N Outfall (Westgate.stsw)

Active Scenario: 5 - YEAR FREE OUTFALL

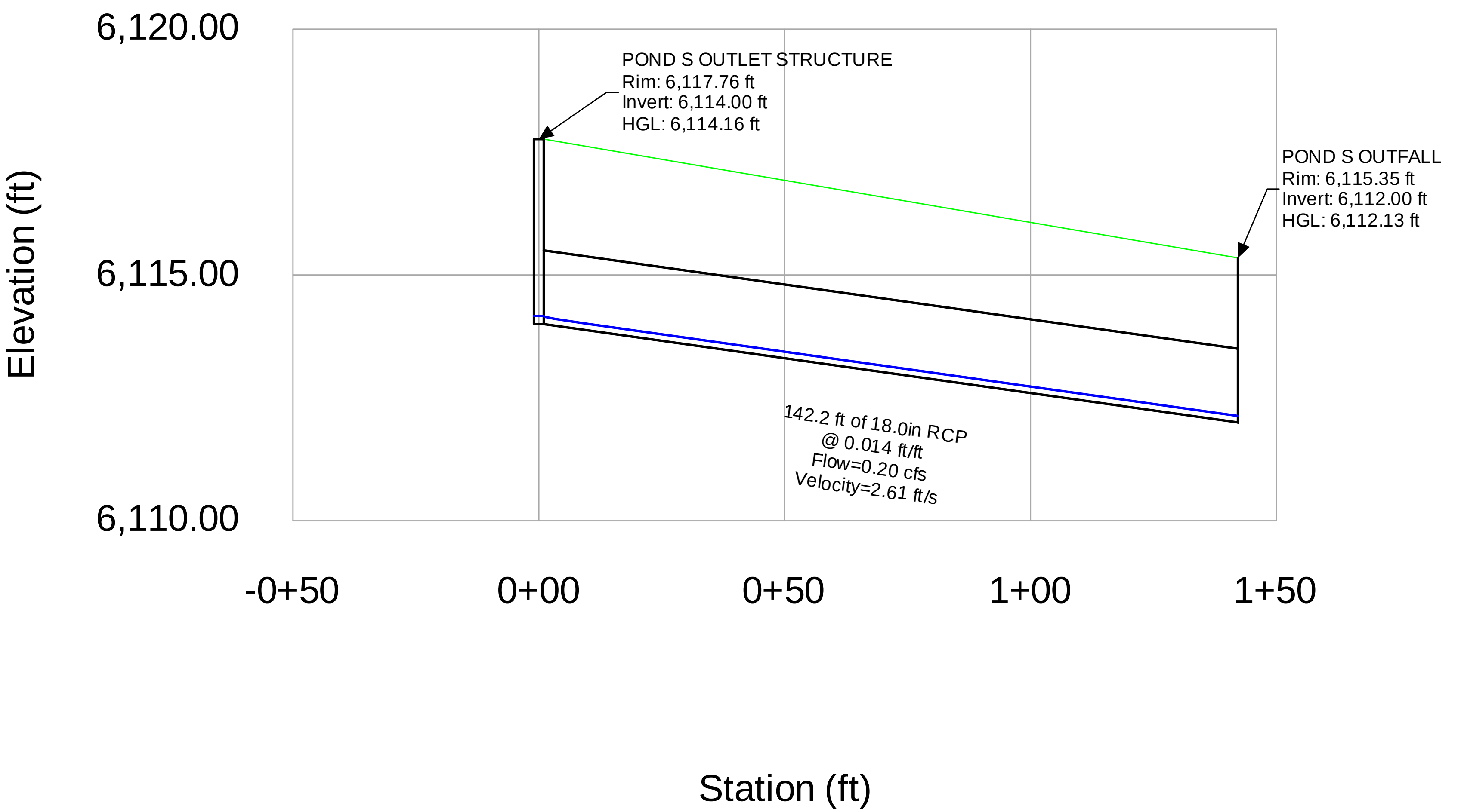


Westgate Apartments

Profile Report

Engineering Profile - Pond S Outfall (Westgate.stsw)

Active Scenario: 5 - YEAR FREE OUTFALL

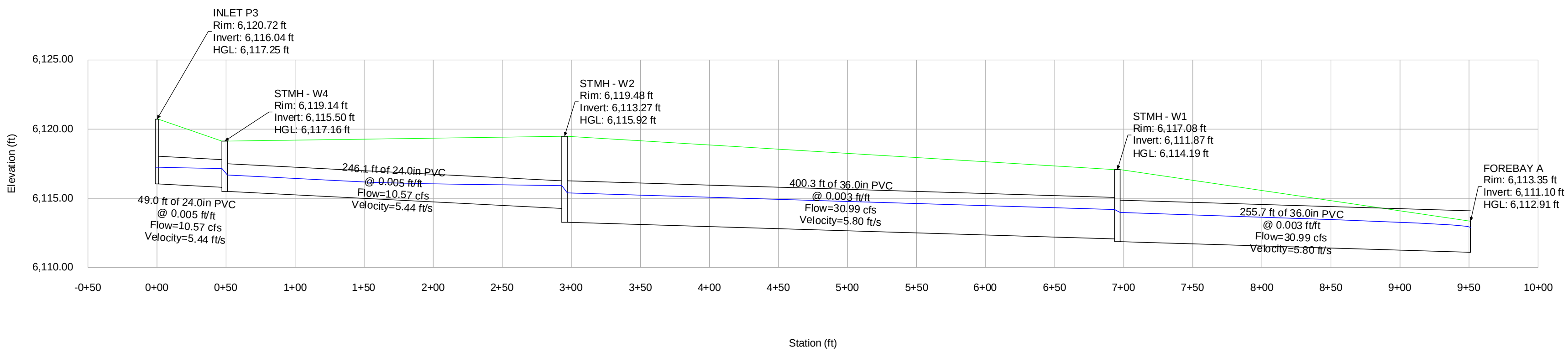


Westgate Apartments

Profile Report

Engineering Profile - Storm A (Westgate.stsw)

Active Scenario: 100 - YEAR FREE OUTFALL

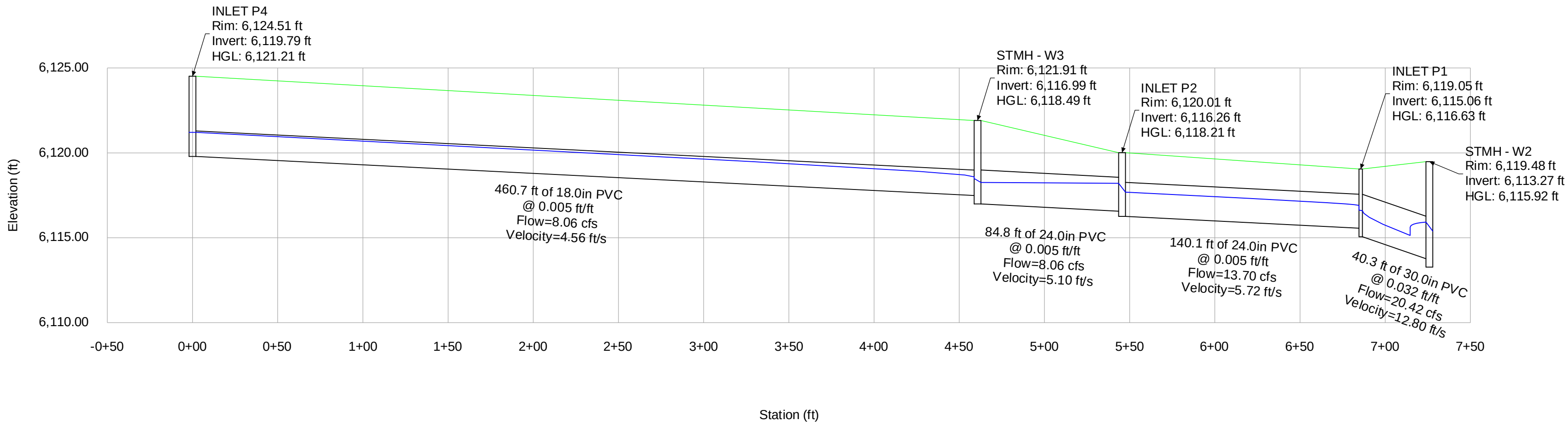


Westgate Apartments

Profile Report

Engineering Profile - Storm B (Westgate.stsw)

Active Scenario: 100 - YEAR FREE OUTFALL

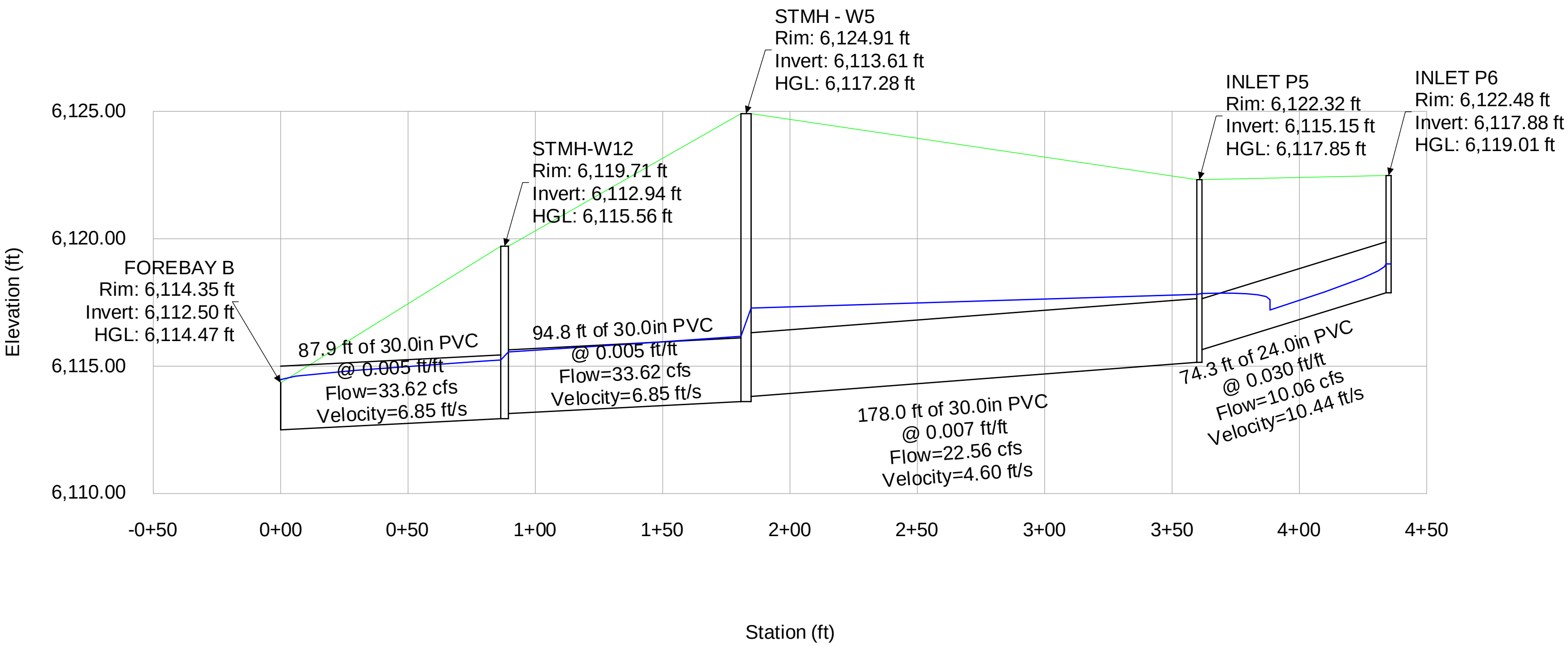


Westgate Apartments

Profile Report

Engineering Profile - Storm C (Westgate.stsw)

Active Scenario: 100 - YEAR FREE OUTFALL

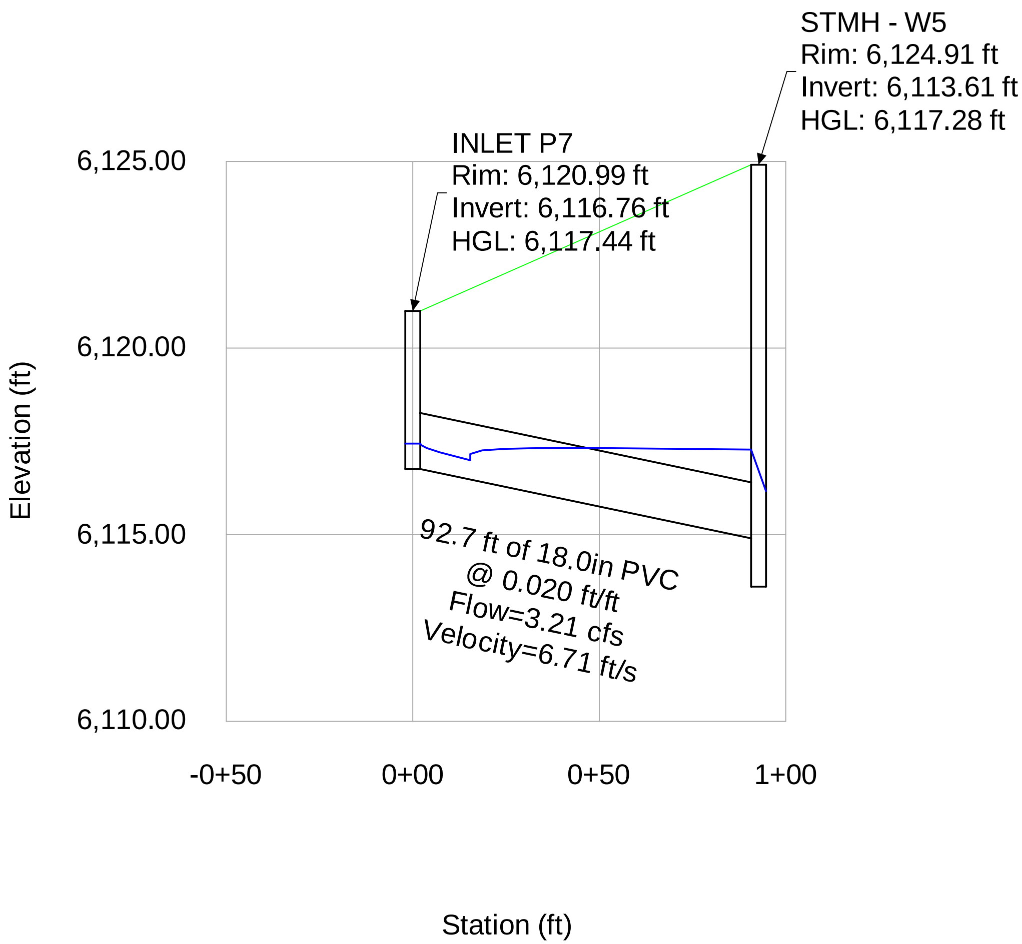


Westgate Apartments

Profile Report

Engineering Profile - Storm D1 (Westgate.stsw)

Active Scenario: 100 - YEAR FREE OUTFALL

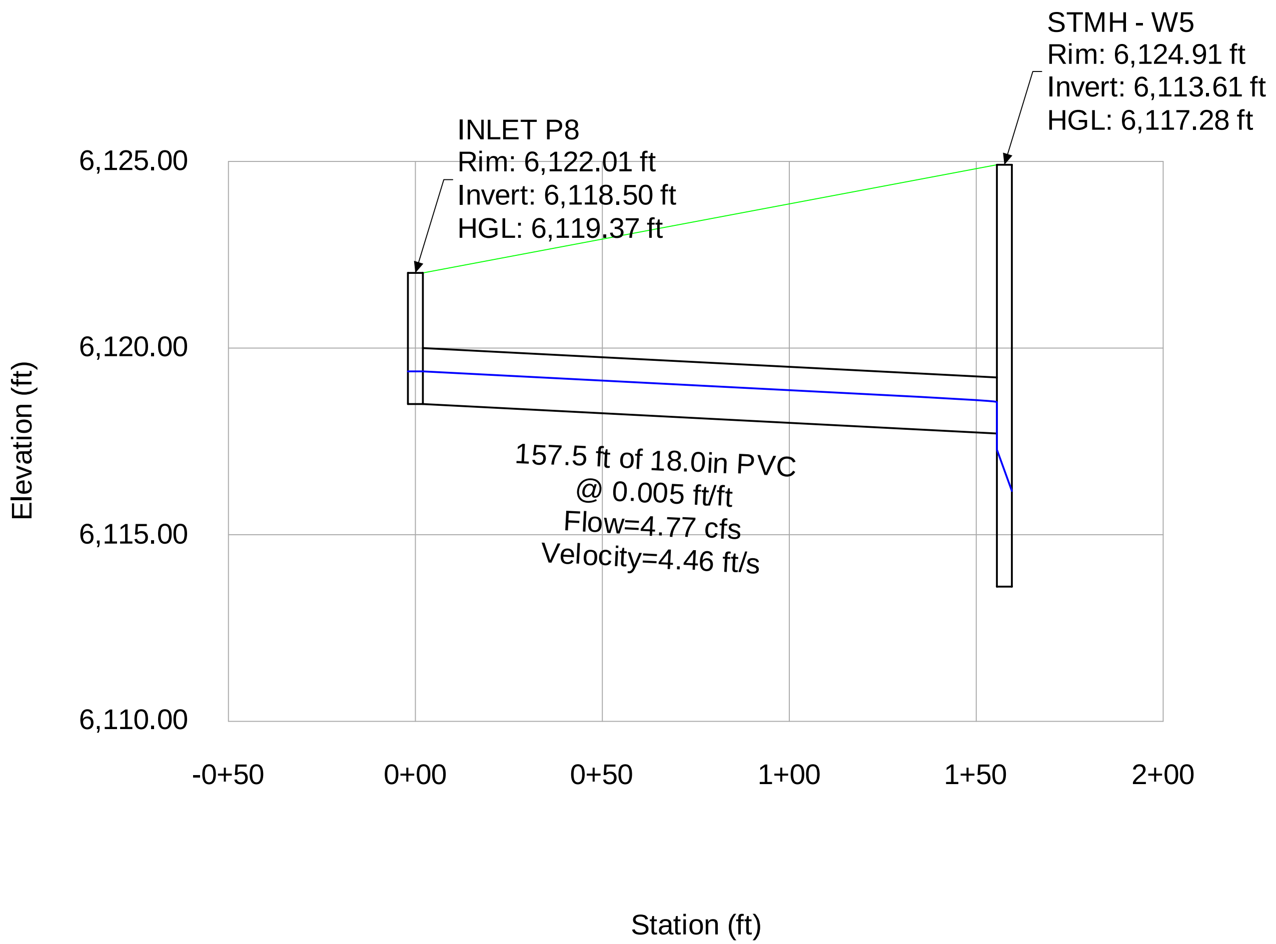


Westgate Apartments

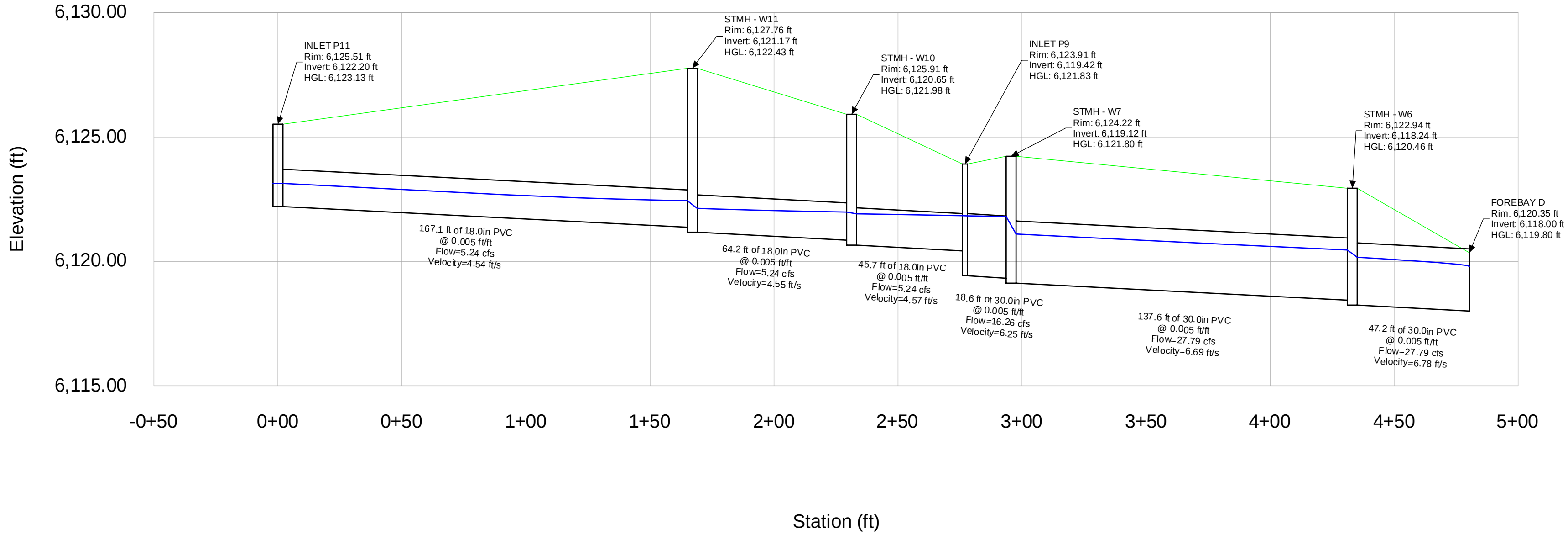
Profile Report

Engineering Profile - Storm D2 (Westgate.stsw)

Active Scenario: 100 - YEAR FREE OUTFALL



Westgate Apartments
Profile Report
Engineering Profile - Storm E (Westgate.stsw)
Active Scenario: 100 - YEAR FREE OUTFALL

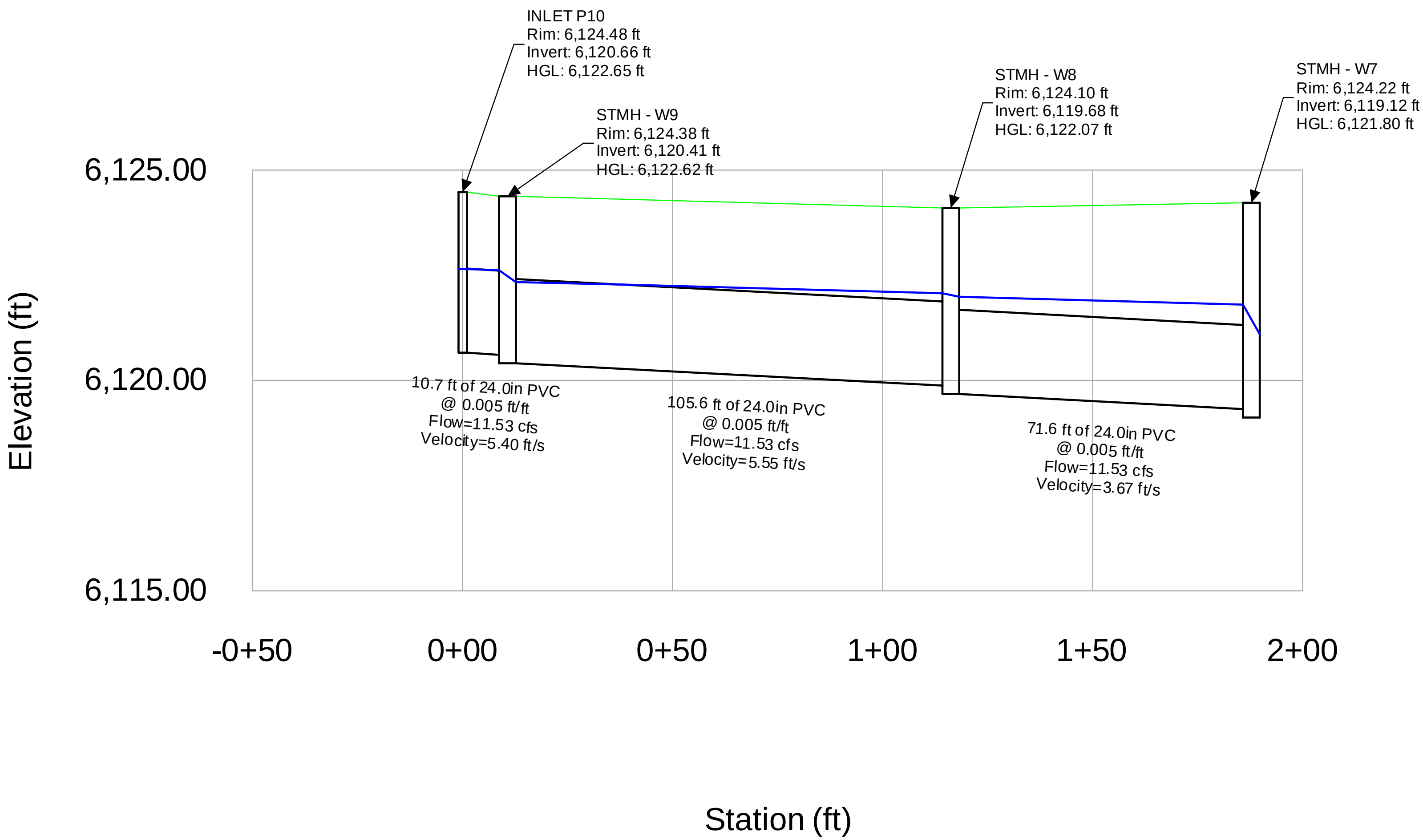


Westgate Apartments

Profile Report

Engineering Profile - Storm F (Westgate.stsw)

Active Scenario: 100 - YEAR FREE OUTFALL

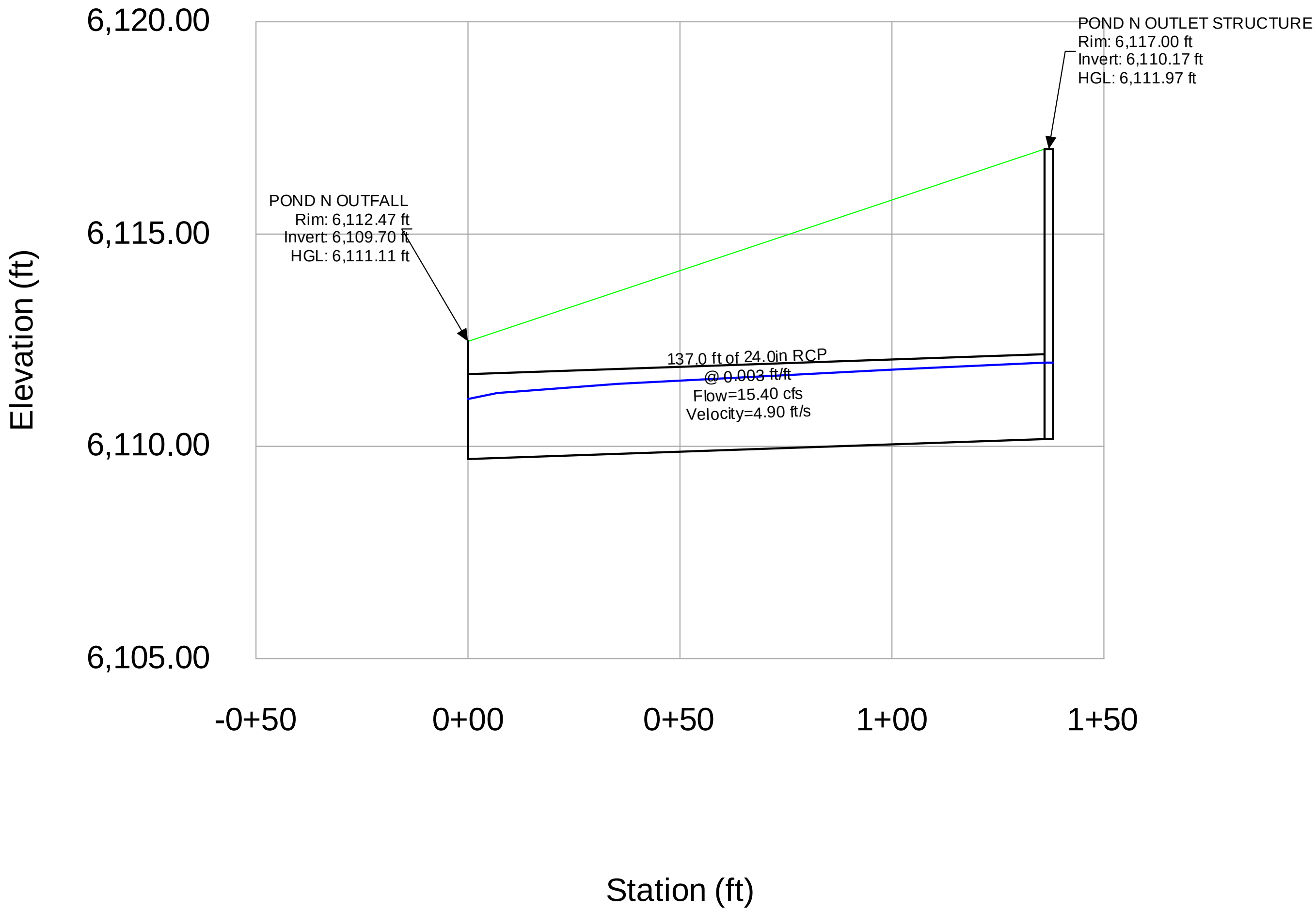


Westgate Apartments

Profile Report

Engineering Profile - Pond N Outfall (Westgate.stsw)

Active Scenario: 100 - YEAR FREE OUTFALL

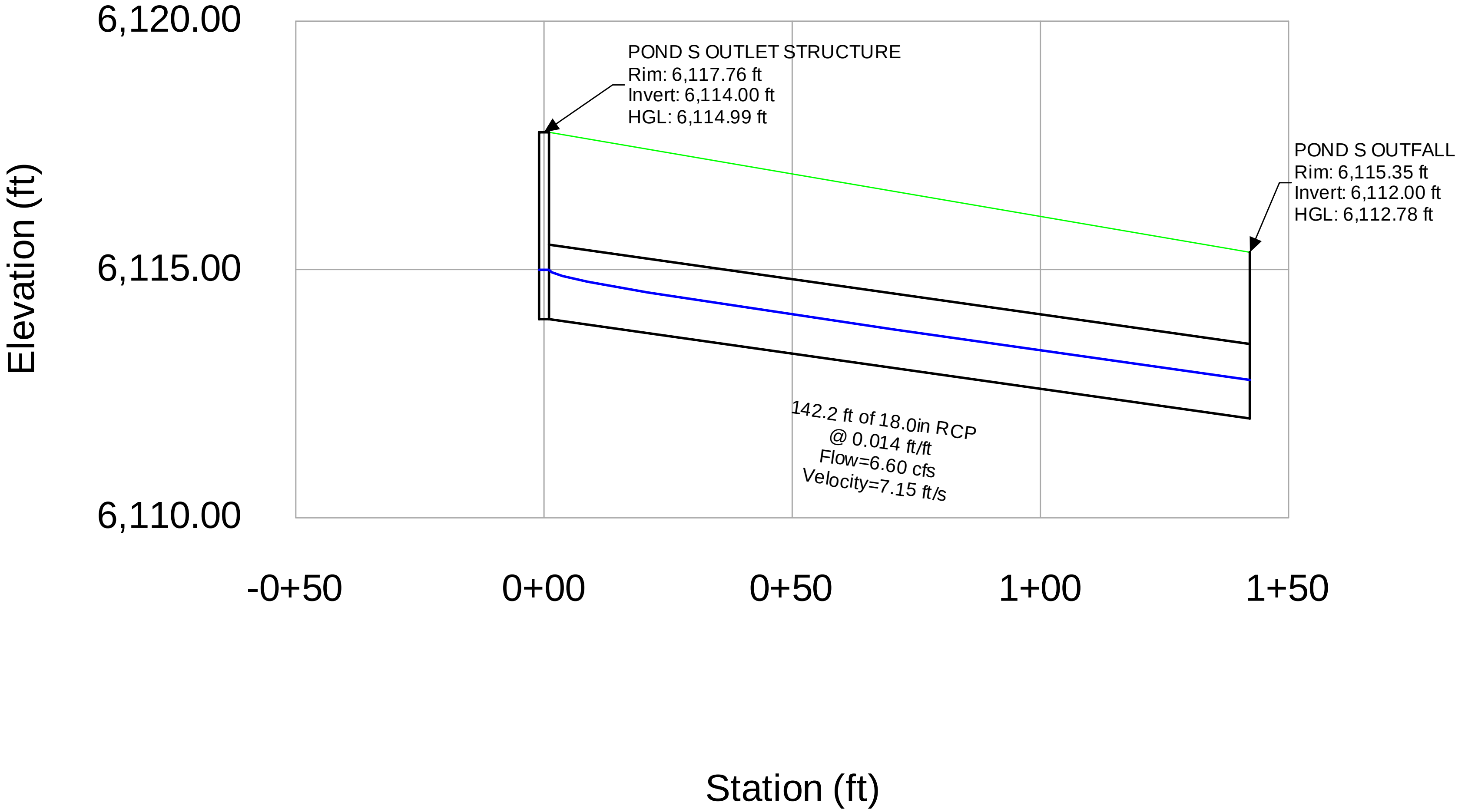


Westgate Apartments

Profile Report

Engineering Profile - Pond S Outfall (Westgate.stsw)

Active Scenario: 100 - YEAR FREE OUTFALL

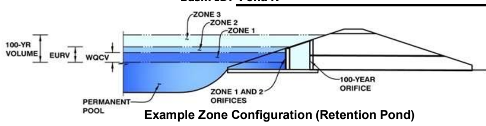


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Westgate Apartments - North Pond**

Basin ID: **Pond N**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**			
Watershed Area =	21.20	acres		
Watershed Length =	1,000	ft		
Watershed Length to Centroid =	450	ft		
Watershed Slope =	0.020	ft/ft		
Watershed Imperviousness =	50.00%	percent		
Percentage Hydrologic Soil Group A =	75.0%	percent		
Percentage Hydrologic Soil Group B =	25.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.260	acre-feet	0.260 *	acre-feet
Excess Urban Runoff Volume (EURV) =	1.200	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.912	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.206	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.489	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.963	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	2.344	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.856	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	3.905	acre-feet		inches
Approximate 2-yr Detention Volume =	0.803	acre-feet		
Approximate 5-yr Detention Volume =	1.069	acre-feet		
Approximate 10-yr Detention Volume =	1.335	acre-feet		
Approximate 25-yr Detention Volume =	1.583	acre-feet		
Approximate 50-yr Detention Volume =	1.737	acre-feet		
Approximate 100-yr Detention Volume =	1.953	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.260	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.940	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.753	acre-feet
Total Detention Basin Volume =	1.953	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

*Result of unadjusted WQCV (0.364 ac-ft) - reduced WQCV (0.104 ac-ft)

Depth Increement = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	37	0.001		
BOP	--	0.50	--	--	--	372	0.009	102	0.002
	--	1.00	--	--	--	1,679	0.039	615	0.014
	--	1.50	--	--	--	4,920	0.113	2,265	0.052
	--	2.00	--	--	--	6,527	0.150	5,126	0.118
	--	2.50	--	--	--	7,894	0.181	8,732	0.200
	--	3.00	--	--	--	8,796	0.202	12,904	0.296
	--	3.50	--	--	--	10,249	0.235	17,665	0.406
	--	4.00	--	--	--	11,245	0.258	23,039	0.529
	--	4.50	--	--	--	12,782	0.293	29,046	0.667
	--	5.00	--	--	--	13,846	0.318	35,703	0.820
	--	5.50	--	--	--	15,482	0.355	43,035	0.988
	--	6.00	--	--	--	16,599	0.381	51,055	1.172
	--	6.50	--	--	--	18,306	0.420	59,781	1.372
	--	7.00	--	--	--	19,448	0.446	69,220	1.589
Emergency Spill	--	7.50	--	--	--	21,187	0.486	79,378	1.822
	--	8.00	--	--	--	22,409	0.514	90,277	2.072
	--	8.50	--	--	--	24,364	0.559	101,971	2.341
	--	9.00	--	--	--	25,703	0.590	114,487	2.628
TOP	--	9.50	--	--	--	28,278	0.649	127,983	2.938
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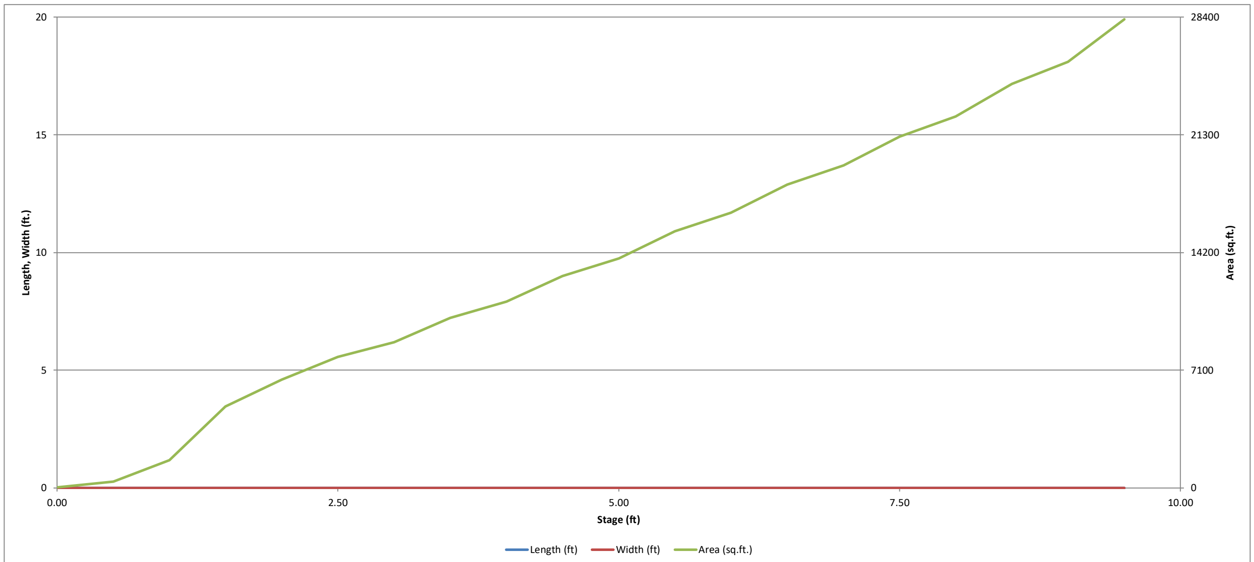
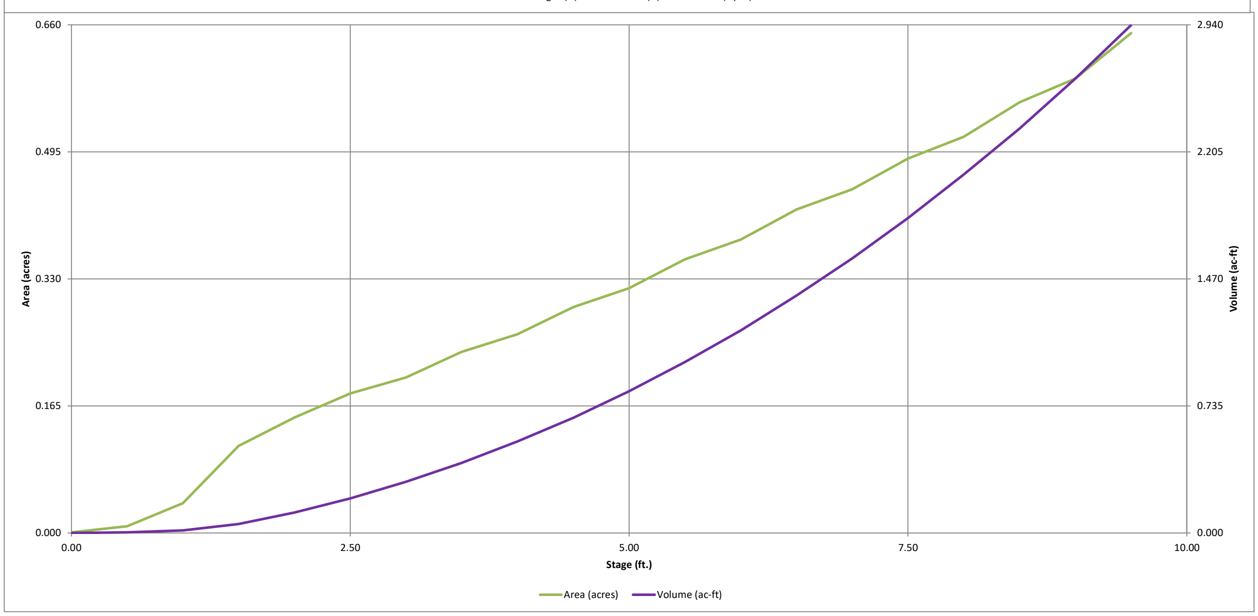
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



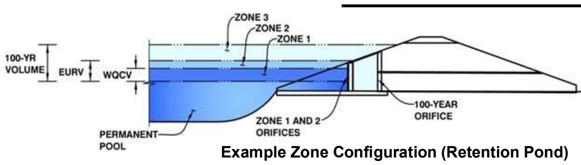


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Westgate Apartments - North Pond**

Basin ID: **Pond N**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.82	0.260	Orifice Plate
Zone 2 (EURV)	6.08	0.940	Orifice Plate
Zone 3 (100-year)	7.77	0.753	Weir&Pipe (Restrict)
Total (all zones)		1.953	

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^2
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)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	6.00	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	sq. inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.00	2.00	3.00	0.00	0.00	0.00	0.00
Orifice Area (sq. inches)	0.79	1.23	0.79	4.91				

	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)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	6.08	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	6.08	N/A	feet
Overflow Weir Slope Length =	4.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	7.09	N/A	
Overflow Grate Open Area w/o Debris =	11.14	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.57	N/A	ft^2

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 =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	12.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.57	N/A	ft^2
Outlet Orifice Centroid =	0.58	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.57	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	25.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.78	feet
Stage at Top of Freeboard =	9.28	feet
Basin Area at Top of Freeboard =	0.62	acres
Basin Volume at Top of Freeboard =	2.80	acre-ft

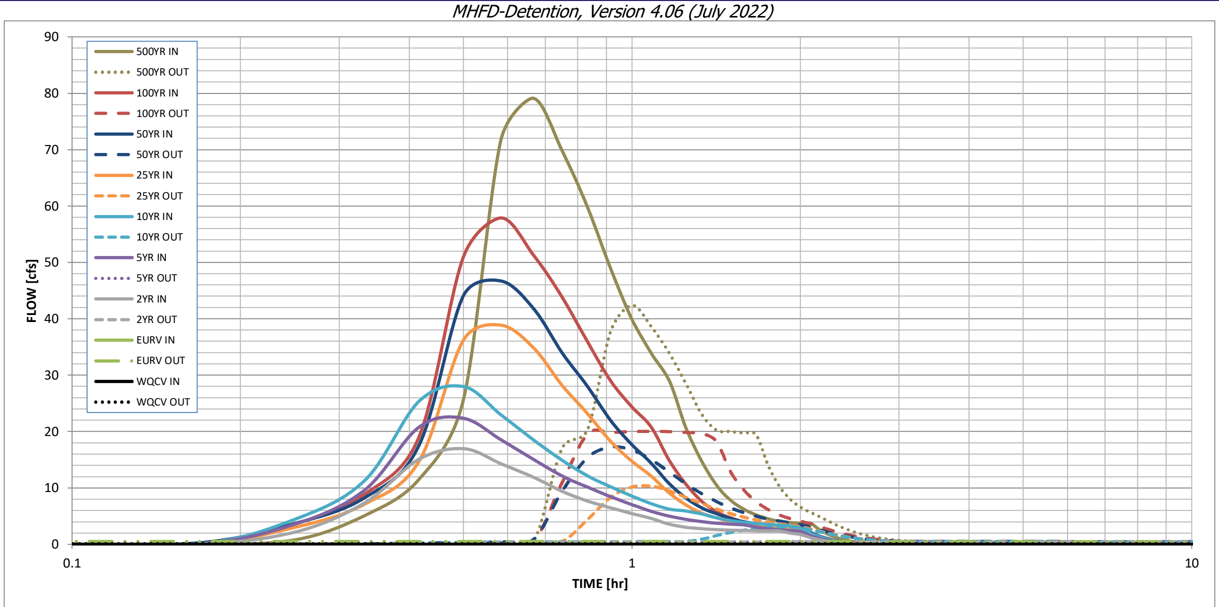
Routed Hydrograph Results

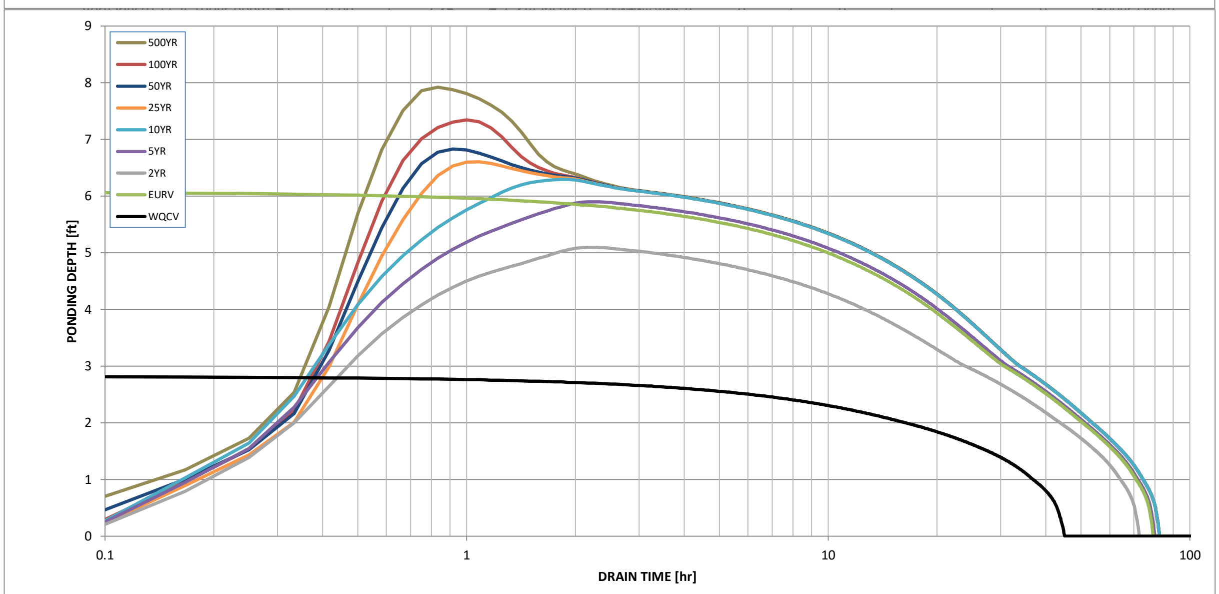
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

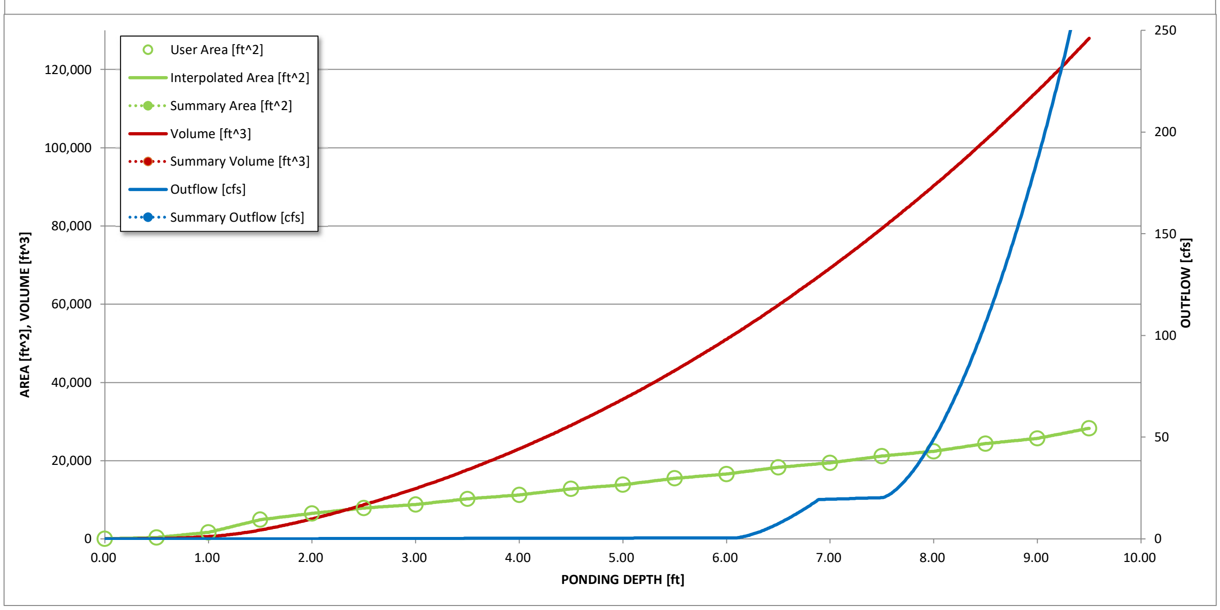
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.260	1.200	0.912	1.206	1.489	1.963	2.344	2.856	3.905
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.912	1.206	1.489	1.963	2.344	2.856	3.905
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.3	0.5	2.8	11.3	16.3	23.1	37.5
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.02	0.03	0.13	0.53	0.77	1.09	1.77
Peak Inflow Q (cfs) =	N/A	N/A	17.0	22.4	28.0	38.9	46.7	57.9	79.1
Peak Outflow Q (cfs) =	0.1	0.5	0.4	0.5	3.1	10.3	17.2	20.0	42.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.9	1.1	0.9	1.1	0.9	1.1
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.2	0.9	1.5	1.7	1.8
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	40	65	60	66	66	64	62	59	54
Time to Drain 99% of Inflow Volume (hours) =	**43**	72	67	73	74	72	71	70	68
Maximum Ponding Depth (ft) =	2.82	6.08	5.10	5.90	6.29	6.60	6.83	7.34	7.92
Area at Maximum Ponding Depth (acres) =	0.19	0.39	0.32	0.38	0.40	0.43	0.44	0.47	0.51
Maximum Volume Stored (acre-ft) =	0.261	1.203	0.849	1.130	1.286	1.415	1.510	1.745	2.032

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

<u>Inflow Hydrographs</u>

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

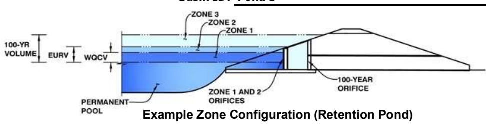
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.03	0.81
	0:15:00	0.00	0.00	2.18	3.58	4.44	2.99	3.69	3.65	5.12
	0:20:00	0.00	0.00	7.39	9.65	11.33	7.12	8.26	8.92	11.54
	0:25:00	0.00	0.00	15.08	20.78	25.34	14.69	17.52	19.02	25.63
	0:30:00	0.00	0.00	16.97	22.35	28.00	36.18	44.08	50.97	71.65
	0:35:00	0.00	0.00	14.30	18.53	22.97	38.86	46.72	57.88	79.11
	0:40:00	0.00	0.00	11.91	15.09	18.56	34.89	41.88	51.33	69.86
	0:45:00	0.00	0.00	9.41	12.12	14.92	28.23	33.98	43.89	59.76
	0:50:00	0.00	0.00	7.68	10.13	12.12	23.17	28.00	35.89	48.93
	0:55:00	0.00	0.00	6.49	8.48	10.20	18.26	21.98	29.01	39.96
	1:00:00	0.00	0.00	5.47	7.06	8.57	14.75	17.68	24.38	33.85
	1:05:00	0.00	0.00	4.58	5.86	7.20	12.06	14.37	20.76	28.95
	1:10:00	0.00	0.00	3.57	4.99	6.24	9.08	10.72	14.84	20.57
	1:15:00	0.00	0.00	3.02	4.41	5.90	6.95	8.19	10.62	14.71
	1:20:00	0.00	0.00	2.76	4.01	5.36	5.52	6.44	7.62	10.47
	1:25:00	0.00	0.00	2.60	3.74	4.68	4.70	5.42	5.78	7.82
	1:30:00	0.00	0.00	2.51	3.57	4.22	4.00	4.57	4.70	6.25
	1:35:00	0.00	0.00	2.45	3.45	3.90	3.52	4.00	3.99	5.20
	1:40:00	0.00	0.00	2.40	3.06	3.68	3.24	3.67	3.53	4.52
	1:45:00	0.00	0.00	2.37	2.78	3.54	3.04	3.43	3.22	4.06
	1:50:00	0.00	0.00	2.36	2.58	3.43	2.91	3.28	3.06	3.83
	1:55:00	0.00	0.00	2.00	2.44	3.24	2.85	3.20	3.02	3.76
	2:00:00	0.00	0.00	1.73	2.27	2.90	2.80	3.15	3.00	3.74
	2:05:00	0.00	0.00	1.19	1.55	1.98	1.91	2.15	2.05	2.55
	2:10:00	0.00	0.00	0.79	1.03	1.33	1.28	1.44	1.37	1.71
	2:15:00	0.00	0.00	0.52	0.67	0.88	0.85	0.95	0.91	1.13
	2:20:00	0.00	0.00	0.33	0.42	0.55	0.54	0.60	0.57	0.71
	2:25:00	0.00	0.00	0.20	0.27	0.34	0.34	0.38	0.37	0.45
	2:30:00	0.00	0.00	0.10	0.15	0.19	0.20	0.22	0.21	0.26
	2:35:00	0.00	0.00	0.04	0.07	0.09	0.09	0.10	0.10	0.12
	2:40:00	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.03	0.03
	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

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Westgate Apartments - South Pond**

Basin ID: **Pond S**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**			
Watershed Area =	7.66	acres		
Watershed Length =	750	ft		
Watershed Length to Centroid =	375	ft		
Watershed Slope =	0.030	ft/ft		
Watershed Imperviousness =	50.00%	percent		
Percentage Hydrologic Soil Group A =	75.0%	percent		
Percentage Hydrologic Soil Group B =	25.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.132	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.434	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.327	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.432	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.534	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.704	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.840	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.023	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	1.399	acre-feet		inches
Approximate 2-yr Detention Volume =	0.290	acre-feet		
Approximate 5-yr Detention Volume =	0.386	acre-feet		
Approximate 10-yr Detention Volume =	0.482	acre-feet		
Approximate 25-yr Detention Volume =	0.572	acre-feet		
Approximate 50-yr Detention Volume =	0.628	acre-feet		
Approximate 100-yr Detention Volume =	0.706	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.132	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.302	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.272	acre-feet
Total Detention Basin Volume =	0.706	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	24	0.001		
6117.0	--	0.83	--	--	--	492	0.011	214	0.005
6117.5	--	1.33	--	--	--	1,695	0.039	761	0.017
6118.0	--	1.83	--	--	--	4,095	0.094	2,208	0.051
6118.5	--	2.33	--	--	--	5,715	0.131	4,661	0.107
6119.0	--	2.83	--	--	--	6,553	0.150	7,727	0.177
6119.5	--	3.33	--	--	--	7,405	0.170	11,217	0.258
6120.0	--	3.83	--	--	--	8,293	0.190	15,141	0.348
6120.5	--	4.33	--	--	--	9,224	0.212	19,520	0.448
6121.0	--	4.83	--	--	--	10,209	0.234	24,379	0.560
6121.5	--	5.33	--	--	--	11,245	0.258	29,742	0.683
6122.0	--	5.83	--	--	--	12,343	0.283	35,639	0.818
6122.5	--	6.33	--	--	--	13,515	0.310	42,104	0.967
6123	--	6.83	--	--	--	14,773	0.339	49,176	1.129
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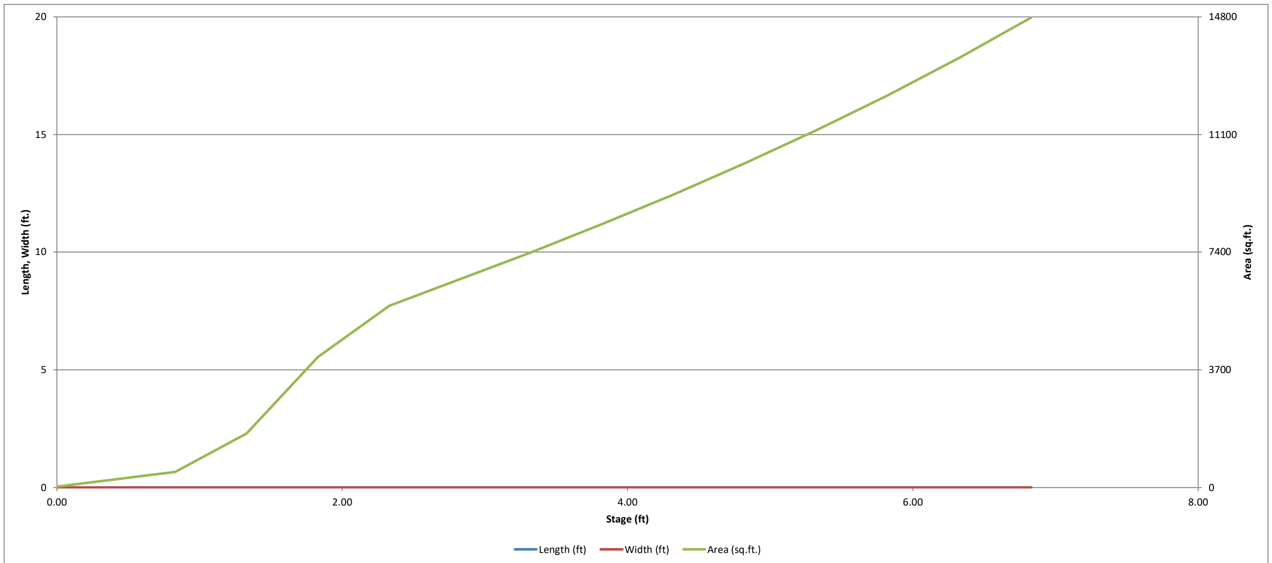
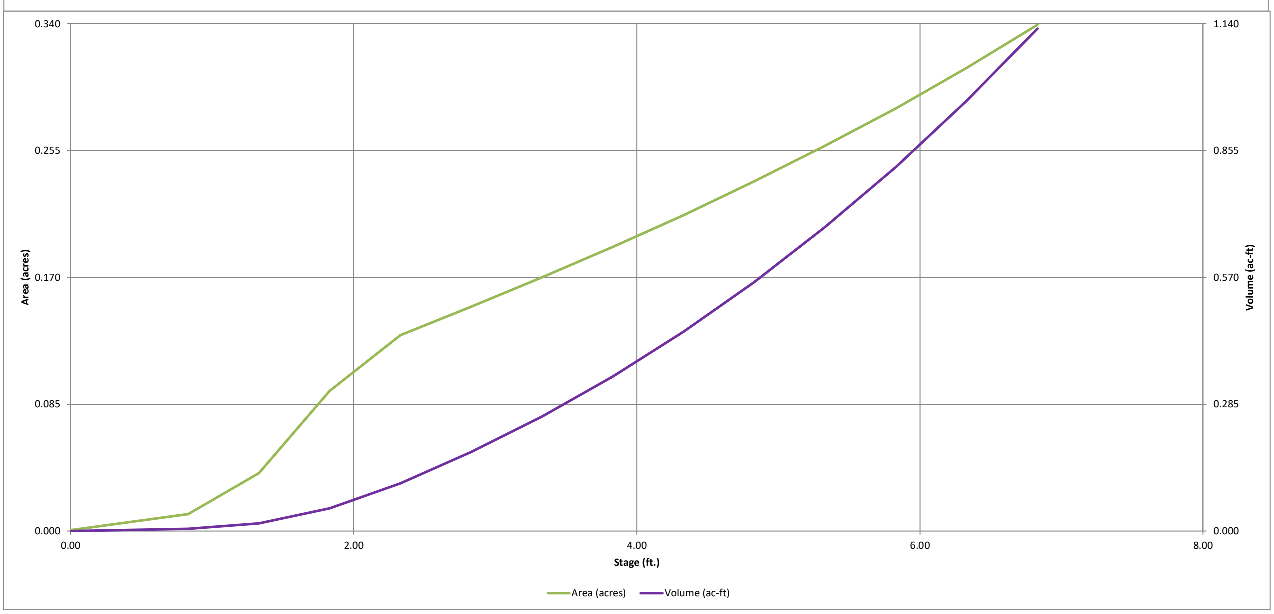
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



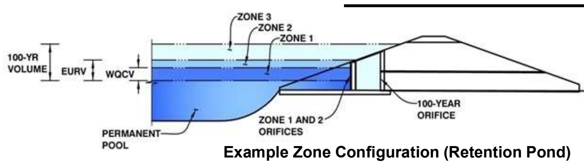


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Westgate Apartments - South Pond**

Basin ID: **Pond S**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.52	0.132	Orifice Plate
Zone 2 (EURV)	4.27	0.302	Orifice Plate
Zone 3 (100-year)	5.42	0.272	Weir&Pipe (Restrict)
Total (all zones)		0.706	

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

			Calculated Parameters for Underdrain		
Underdrain Orifice Invert Depth =		ft (distance below the filtration media surface)	Underdrain Orifice Area =		ft^2
Underdrain Orifice Diameter =		inches	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)

			Calculated Parameters for Plate		
Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	4.00	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	sq. inches	Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	2.00	2.50	0.00	0.00	0.00	0.00	0.00
Orifice Area (sq. inches)	0.78	0.78	1.23					

	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)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected		Calculated Parameters for Vertical Orifice	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

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

	Zone 3 Weir	Not Selected		Calculated Parameters for Overflow Weir	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.00	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.00	N/A	feet
Overflow Weir Front Edge Length =	3.42	N/A	feet	Overflow Weir Slope Length =	2.92	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	13.48	N/A	
Horiz. Length of Weir Sides =	2.92	N/A	feet	Overflow Grate Open Area w/o Debris =	6.95	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	3.48	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

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

	Zone 3 Restrictor	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.52	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.29	N/A	feet
Restrictor Plate Height Above Pipe Invert =	6.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.23	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

			Calculated Parameters for Spillway		
Spillway Invert Stage=	5.33	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.44	feet
Spillway Crest Length =	20.00	feet	Stage at Top of Freeboard =	6.77	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.34	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.11	acre-ft

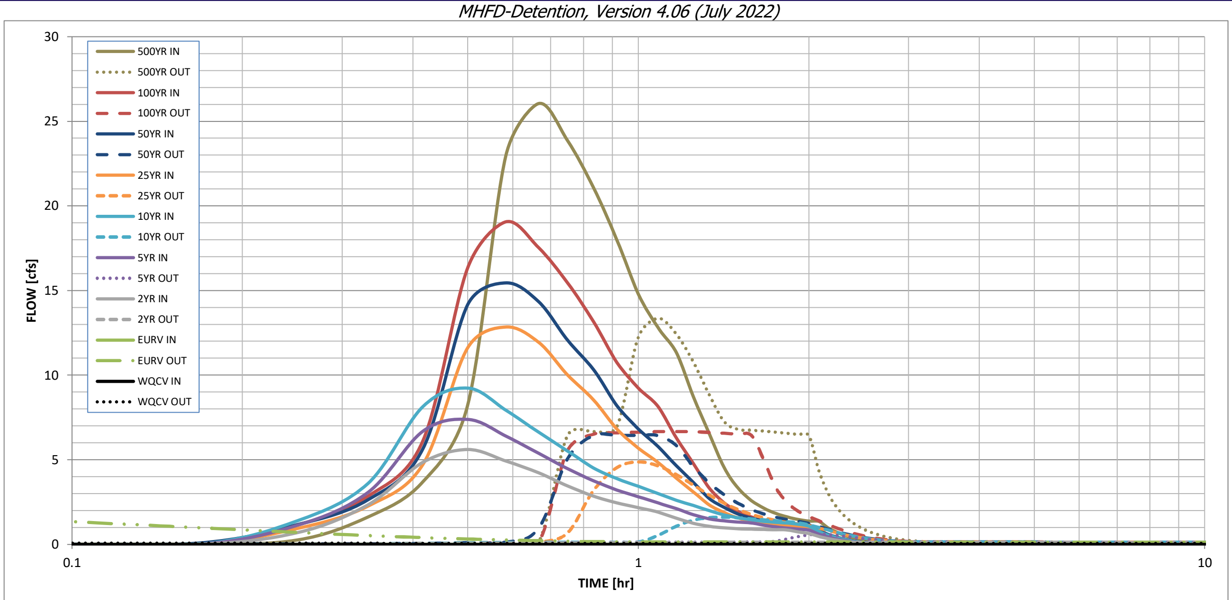
Routed Hydrograph Results

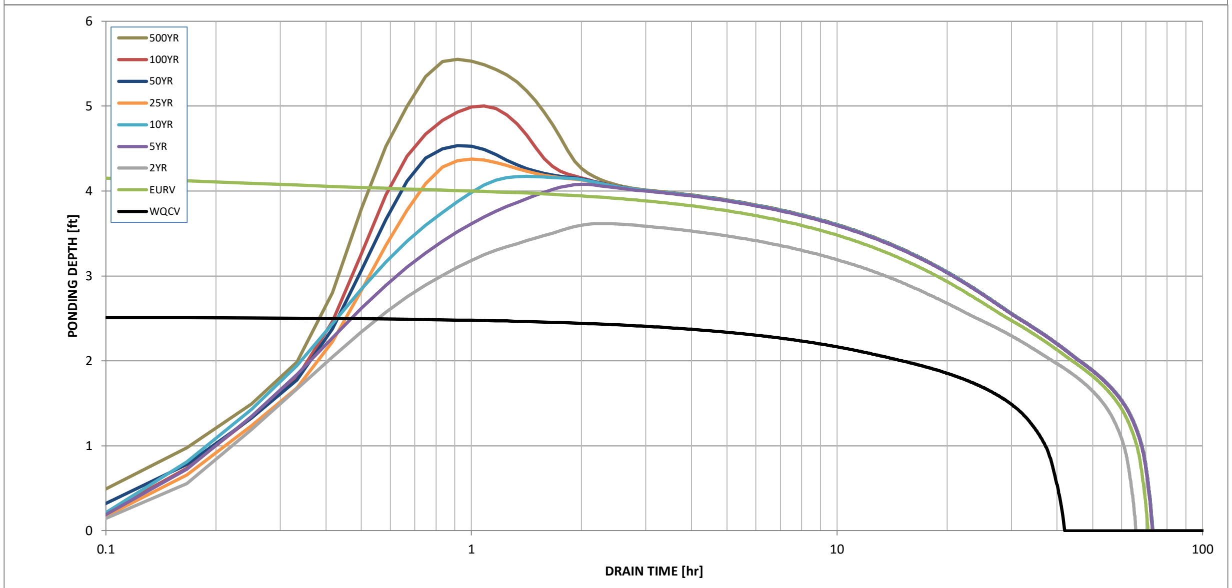
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

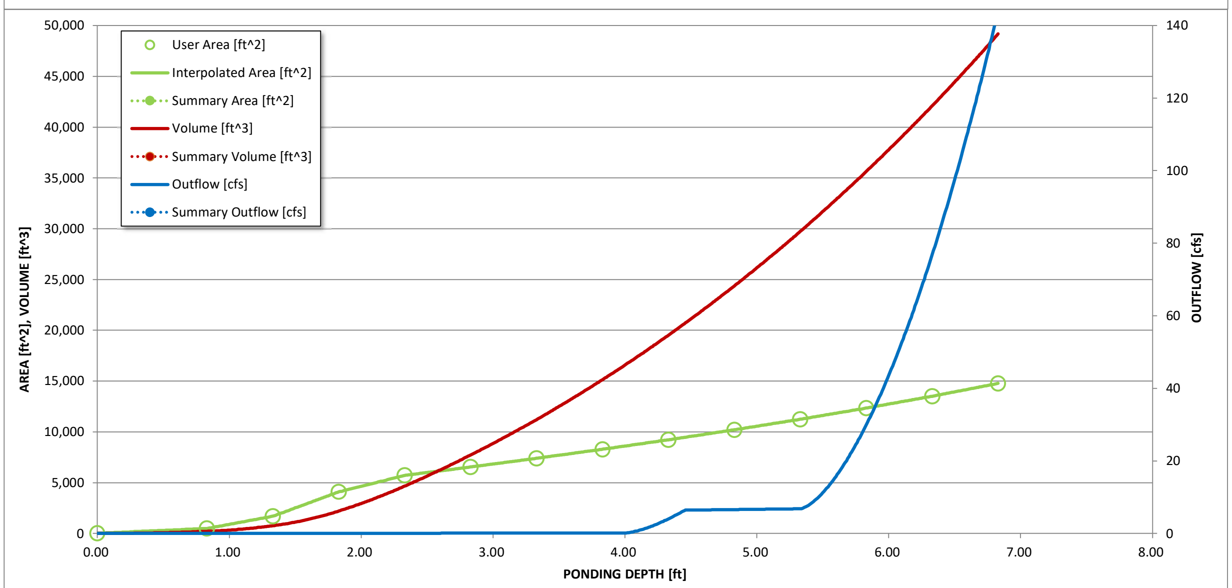
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.132	0.434	0.327	0.432	0.534	0.704	0.840	1.023	1.399
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.327	0.432	0.534	0.704	0.840	1.023	1.399
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.9	3.6	5.3	7.5	12.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.12	0.47	0.69	0.97	1.58
Peak Inflow Q (cfs) =	N/A	N/A	5.6	7.4	9.2	12.8	15.5	19.1	26.1
Peak Outflow Q (cfs) =	0.1	2.3	0.1	0.6	1.6	4.9	6.4	6.7	13.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	3.5	1.8	1.3	1.2	0.9	1.1
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	0.41	N/A	0.1	0.2	0.7	0.9	0.9	1.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	64	60	66	65	63	61	59	55
Time to Drain 99% of Inflow Volume (hours) =	**41**	68	63	70	69	69	68	67	66
Maximum Ponding Depth (ft) =	2.52	4.27	3.62	4.08	4.17	4.38	4.53	5.00	5.55
Area at Maximum Ponding Depth (acres) =	0.14	0.21	0.18	0.20	0.20	0.21	0.22	0.24	0.27
Maximum Volume Stored (acre-ft) =	0.133	0.436	0.307	0.395	0.415	0.457	0.491	0.600	0.741

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.01	0.25
	0:15:00	0.00	0.00	0.68	1.12	1.40	0.94	1.16	1.15	1.62
	0:20:00	0.00	0.00	2.35	3.07	3.61	2.27	2.64	2.84	3.69
	0:25:00	0.00	0.00	4.85	6.68	8.14	4.73	5.64	6.12	8.24
	0:30:00	0.00	0.00	5.60	7.38	9.23	11.62	14.16	16.34	22.96
	0:35:00	0.00	0.00	4.92	6.40	7.93	12.85	15.45	19.06	26.06
	0:40:00	0.00	0.00	4.23	5.39	6.63	11.94	14.34	17.52	23.87
	0:45:00	0.00	0.00	3.45	4.47	5.52	10.02	12.06	15.46	21.08
	0:50:00	0.00	0.00	2.85	3.75	4.52	8.54	10.33	13.16	17.98
	0:55:00	0.00	0.00	2.45	3.21	3.88	6.81	8.20	10.75	14.79
	1:00:00	0.00	0.00	2.17	2.82	3.43	5.68	6.82	9.23	12.80
	1:05:00	0.00	0.00	1.90	2.44	3.00	4.84	5.78	8.14	11.33
	1:10:00	0.00	0.00	1.54	2.10	2.61	3.91	4.65	6.30	8.73
	1:15:00	0.00	0.00	1.25	1.75	2.30	3.10	3.66	4.77	6.58
	1:20:00	0.00	0.00	1.07	1.51	1.99	2.34	2.72	3.34	4.54
	1:25:00	0.00	0.00	0.97	1.39	1.74	1.88	2.18	2.45	3.32
	1:30:00	0.00	0.00	0.92	1.31	1.57	1.55	1.79	1.93	2.59
	1:35:00	0.00	0.00	0.90	1.26	1.45	1.36	1.55	1.62	2.13
	1:40:00	0.00	0.00	0.88	1.13	1.36	1.23	1.39	1.40	1.82
	1:45:00	0.00	0.00	0.86	1.03	1.30	1.14	1.29	1.26	1.61
	1:50:00	0.00	0.00	0.85	0.96	1.26	1.08	1.22	1.16	1.46
	1:55:00	0.00	0.00	0.73	0.91	1.19	1.04	1.18	1.10	1.38
	2:00:00	0.00	0.00	0.65	0.84	1.08	1.02	1.15	1.08	1.35
	2:05:00	0.00	0.00	0.47	0.60	0.77	0.73	0.82	0.78	0.97
	2:10:00	0.00	0.00	0.33	0.43	0.54	0.52	0.58	0.55	0.69
	2:15:00	0.00	0.00	0.23	0.30	0.38	0.36	0.41	0.39	0.48
	2:20:00	0.00	0.00	0.16	0.20	0.26	0.25	0.28	0.27	0.33
	2:25:00	0.00	0.00	0.11	0.13	0.17	0.17	0.19	0.18	0.22
	2:30:00	0.00	0.00	0.07	0.09	0.11	0.11	0.13	0.12	0.15
	2:35:00	0.00	0.00	0.04	0.05	0.07	0.07	0.08	0.07	0.09
	2:40:00	0.00	0.00	0.02	0.03	0.03	0.04	0.04	0.04	0.04
	2:45:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	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

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	Inlet P1	Inlet P3	Inlet P5
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	In Sump	In Sump	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	3.4	5.5	6.5
Major Q_{Known} (cfs)	6.7	10.4	12.5

Bypass (Carry-Over) Flow from Upstream

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

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

Minor Total Design Peak Flow, Q (cfs)	**3.4**	**5.5**	**6.5**
Major Total Design Peak Flow, Q (cfs)	**6.7**	**10.4**	**12.5**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	Inlet P6	Inlet P9	Inlet P10
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	In Sump	In Sump	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	5.4	4.9	6.1
Major Q_{Known} (cfs)	10.0	11.1	11.7

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	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
Major Bypass Flow Received, Q_b (cfs)	0.0	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)			

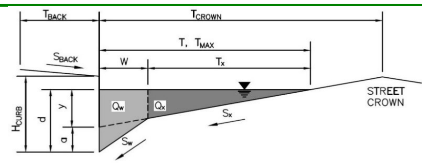
CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**5.4**	**4.9**	**6.1**
Major Total Design Peak Flow, Q (cfs)	**10.0**	**11.1**	**11.7**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A

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

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

Project: Westgate
Inlet ID: Inlet P1



<u>Gutter Geometry:</u>

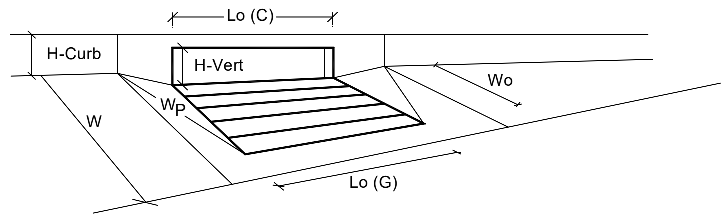
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	18.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input) CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

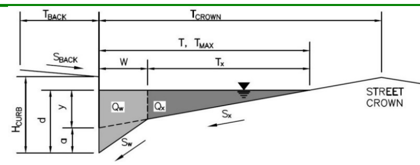
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.33	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	0.93	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**8.3**	**8.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	3.4	6.7	cfs

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

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

Project: Westgate
Inlet ID: Inlet P3



Gutter Geometry:

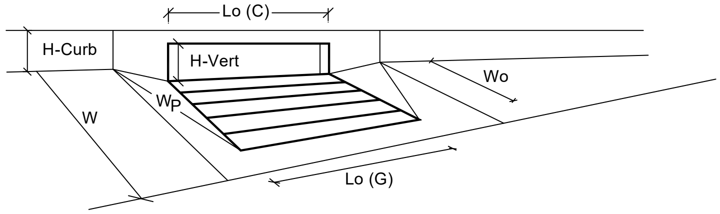
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.025	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)

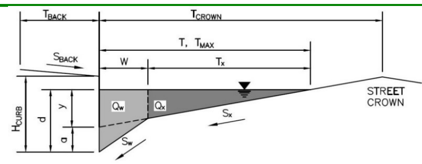


		MINOR	MAJOR	
Design Information (Input) CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	7.0	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.42	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	0.99	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	$\mathbf{Q_a}$ =	**8.3**	**12.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	5.5	10.4	cfs

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

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

Project: Westgate
Inlet ID: Inlet P5



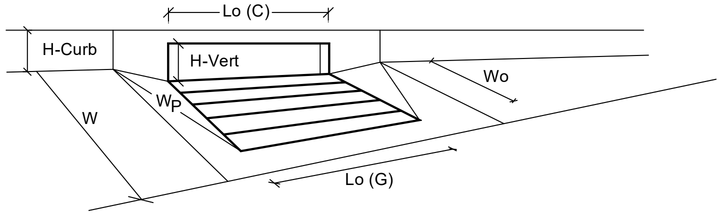
Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	18.0	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} =	24.0	ft		
Gutter Width	W =	2.00	ft		
Street Transverse Slope	S_X =	0.035	ft/ft		
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft		
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft		
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016			
		Minor Storm	Major Storm		
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft	
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.1	inches	
Check boxes are not applicable in SUMP conditions		☐	☐		

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)

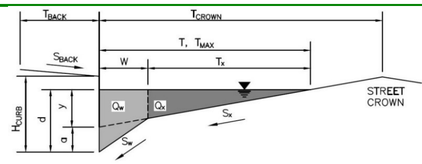


Design Information (Input)	CDOT Type R Curb Opening	MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	7.1	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.43	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	0.99	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**8.3**	**12.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	6.5	12.5	cfs

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

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

Project: Westgate
Inlet ID: Inlet P6

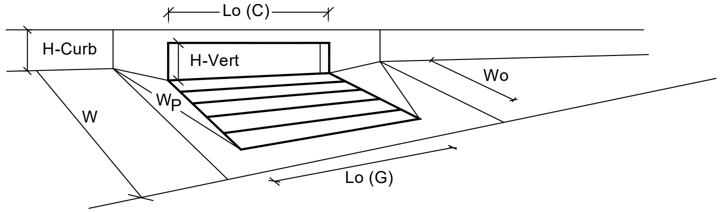


Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	18.0		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} =	24.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.040		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLEET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)

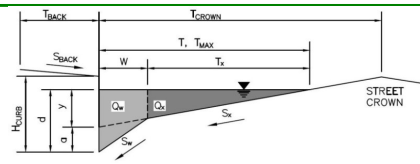


		MINOR	MAJOR	
Design Information (Input) — CDOT Type R Curb Opening				
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	7.0	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.42	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	0.99	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**8.3**	**12.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	5.4	10.0	cfs

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

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

Project: Westgate
Inlet ID: Inlet P9

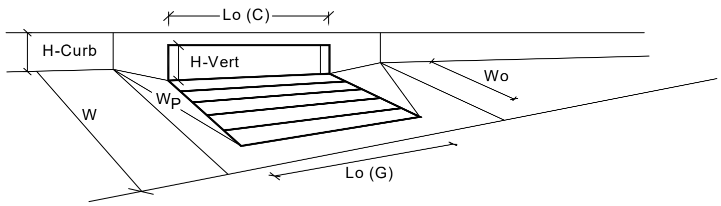


Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =			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} =	24.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.025		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	7.0	inches
Grate Information			MINOR	MAJOR	Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

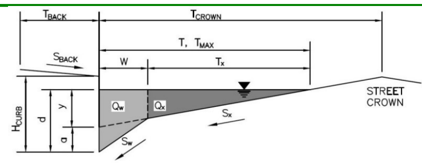
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.42	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	0.99	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**8.3**	**12.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	4.9	11.1	cfs

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

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

Project: Westgate
Inlet ID: Inlet P10

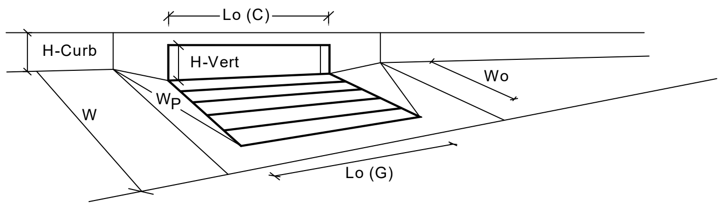


Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =			ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.030		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	7.0	inches
Grate Information			MINOR	MAJOR	Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.33	0.42	ft
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.93	0.99	
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**8.3**	**12.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)		$Q_{PEAK\ REQUIRED}$ =	6.1	11.7	cfs

Nyloplast Inlet Capacity Table

DISCLAIMER: SAFETY FACTORS ARE NOT INCLUDED IN THESE CALCULATIONS. ACTUAL CALCULATIONS SHOULD BE CARRIED OUT AND VERIFIED BY THE DESIGN ENGINEER TAKING INTO ACCOUNT ALL LOCAL CONDITIONS. NYLOPLAST RECOMMENDS USING A MINIMUM SAFETY FACTOR OF 1.25 FOR PAVED AREAS AND 2.0 FOR TURF AREAS. ADS/NYLOPLAST IS NOT RESPONSIBLE FOR MISUSE OF THIS TOOL.

Input

Type of Grate	30" Standard
Head (ft)	0.333333333

Properties

Orifice Flow Area (in)	324.00
Orifice Flow Area (ft)	2.24
Weir Flow Perimeter (in)	93.53
Weir Flow Perimeter (ft)	7.79

Solution

Capacity (cfs)	5.00
Capacity (gpm)	2241.83

Inlet P2
Max 100-Year Flow: 4.40 cfs

Inlet P4
Max 100-Year Flow: 3.84 cfs

Inlet P7
Max 100-Year Flow: 3.35 cfs

Inlet P8
Max 100-Year Flow: 4.03 cfs

Inlet P11
Max 100-Year Flow: 3.56 cfs

Flows include the associated sub-basin + roof drains that splash on grade and flow to the inlet

$$Q_{weir} = CLH^{3/2}$$

$C = 3.33$ *Weir Discharge Coefficient*

$L =$ *Perimeter of Grate Opening (ft)*

$H =$ *Flow Height of Water Surface Above Weir (ft)*

$$Q_{orifice} = CA\sqrt{2gh}$$

$C = 0.60$ *Orifice Discharge Coefficient*

$A =$ *Area of the Orifice* (ft^2)

$g =$ *Gravitational Constant* $\left(32.2\frac{ft}{s^2}\right)$

$H =$ *Depth of Water Above Center of Orifice (ft)*

REV 2.1.21

Kimley»Horn

Date	5/19/2023
Prepared By	JWM
Checked By	MOH

Forebay Sizing Calculations - Forebay A

Contributing Sub-Basins: P2-P4, P9, R3, R4, R6, R7, R14-R16

		Forebay A	
	Required	Flow: Q_{100} = (cfs)	Release Rate
Forebay Release and Configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch or berm/pipe configuration	30.99	0.62

			Required (CF)	Provided (CF)
Minimum Forebay Volume Required	2% of the WQCV	40hr drain time a = 1 I = 0.64 A = 5.56 AC	100.59	116.00

	Required	Provided	
Maximum Forebay Depth	18" Max	18"	Concrete Forebay Structure

Forebay Notch Calculations			
$Q = C_o A_o (2gH_o)^{0.5}$			
Q_a	0.62	cfs	2% of Peak 100 YR Discharge for contributing Sub-Basins
C_o	0.6		
H_o	0.5	ft	
g	32.2	ft/s^2	
A_a	0.18	ft^2	
L_a	0.12	ft	
	1.46	**in**	3" Minimum per Criteria

$$WQCV = a(0.91I^3 - 1.19I^2 + 0.78I)$$ Equation 3-1

Where:

WQCV = Water Quality Capture Volume (watershed inches)

a = Coefficient corresponding to WQCV drain time (Table 3-2)

I = Imperviousness (%/100) (see Figures 3-3 through 3-5 [single family land use] and /or the *Runoff* chapter of Volume 1[other typical land uses])

Table 3-2. Drain Time Coefficients for WQCV Calculations

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

Kimley»Horn

Forebay Sizing Calculations - Forebay B

Contributing Sub-Basins: P5-P8, R1, R2, R5, R8-R13

Date 5/19/2023
Prepared By JWM
Checked By MOH

		Forebay A	
	Required	Flow: Q_{100} = (cfs)	Release Rate
Forebay Release and Configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch or berm/pipe configuration	33.62	0.67

			Required (CF)	Provided (CF)
Minimum Forebay Volume Required	2% of the WQCV	40hr drain time a = 1 I = 0.66 A = 5.68 AC	106.07	116.00

	Required	Provided	
Maximum Forebay Depth	18" Max	18"	Concrete Forebay Structure

Forebay Notch Calculations			
$Q = C_o A_o (2gH_o)^{0.5}$			
Q_a	0.67	cfs	2% of Peak 100 YR Discharge for contributing Sub-Basins
C_o	0.6		
H_o	0.5	ft	
g	32.2	ft/s^2	
A_a	0.20	ft^2	
L_a	0.13	ft	
	1.58	**in**	3" Minimum per Criteria

$$\text{WQCV} = a(0.91I^3 - 1.19I^2 + 0.78I) \quad \text{Equation 3-1}$$

Where:

WQCV = Water Quality Capture Volume (watershed inches)

a = Coefficient corresponding to WQCV drain time (Table 3-2)

I = Imperviousness (%/100) (see Figures 3-3 through 3-5 [single family land use] and /or the *Runoff* chapter of Volume 1[other typical land uses])

Table 3-2. Drain Time Coefficients for WQCV Calculations

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

Kimley»Horn

Date	5/19/2023
Prepared By	JWM
Checked By	MOH

Forebay Sizing Calculations - Forebay C

Contributing Sub-Basins: P10, P11, P12, P13, R17-R21

		Forebay A	
	Required	Flow: Q_{100} = (cfs)	Release Rate
Forebay Release and Configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch or berm/pipe configuration	30.69	0.61

			Required (CF)	Provided (CF)
Minimum Forebay Volume Required	2% of the WQCV	40hr drain time a = 1 I = 0.58 A = 5.5 AC	99.72	116.00

	Required	Provided	
Maximum Forebay Depth	18" Max	18"	Concrete Forebay Structure

Forebay Notch Calculations			
$Q = C_o A_o (2gH_o)^{0.5}$			
Q_a	0.61	cfs	2% of Peak 100 YR Discharge for contributing Sub-Basins
C_o	0.6		
H_o	0.5	ft	
g	32.2	ft/s^2	
A_a	0.18	ft^2	
L_a	0.12	ft	
	1.44	**in**	3" Minimum per Criteria

$$WQCV = a(0.91I^3 - 1.19I^2 + 0.78I)$$ Equation 3-1

Where:

WQCV = Water Quality Capture Volume (watershed inches)

a = Coefficient corresponding to WQCV drain time (Table 3-2)

I = Imperviousness (%/100) (see Figures 3-3 through 3-5 [single family land use] and /or the *Runoff* chapter of Volume 1[other typical land uses])

Table 3-2. Drain Time Coefficients for WQCV Calculations

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

Kimley»Horn

Forebay Sizing Calculations - Forebay C

Contributing Sub-Basins: P10, P11, P12, P13, R17-R21

Date	5/19/2023
Prepared By	JWM
Checked By	MOH

		Forebay A	
	Required	Flow: Q_{100} = (cfs)	Release Rate
Forebay Release and Configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch or berm/pipe configuration	27.79	0.56

			Required (CF)	Provided (CF)
Minimum Forebay Volume Required	2% of the WQCV	40hr drain time a = 1 I = 0.58 A = 5.5 AC	91.32	116.00

	Required	Provided	
Maximum Forebay Depth	18" Max	18"	Concrete Forebay Structure

Forebay Notch Calculations			
$Q = C_o A_o (2gH_o)^{0.5}$			
Q_a	0.56	cfs	2% of Peak 100 YR Discharge for contributing Sub-Basins
C_o	0.6		
H_o	0.5	ft	
g	32.2	ft/s^2	
A_a	0.16	ft^2	
L_a	0.11	ft	
	1.31	**in**	3" Minimum per Criteria

$$\text{WQCV} = a(0.91I^3 - 1.19I^2 + 0.78I)$$ Equation 3-1

Where:

WQCV = Water Quality Capture Volume (watershed inches)

a = Coefficient corresponding to WQCV drain time (Table 3-2)

I = Imperviousness (%/100) (see Figures 3-3 through 3-5 [single family land use] and /or the *Runoff* chapter of Volume 1[other typical land uses])

Table 3-2. Drain Time Coefficients for WQCV Calculations

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

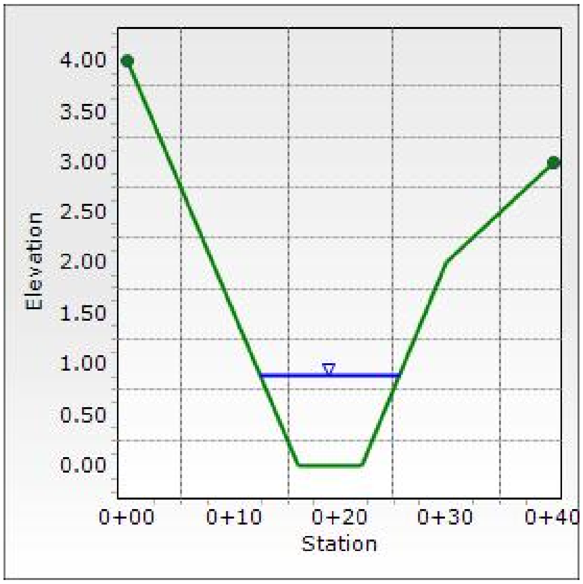
Cross Section for Pond N Swale

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.005 ft/ft
Normal Depth	10.6 in
Discharge	21.93 cfs



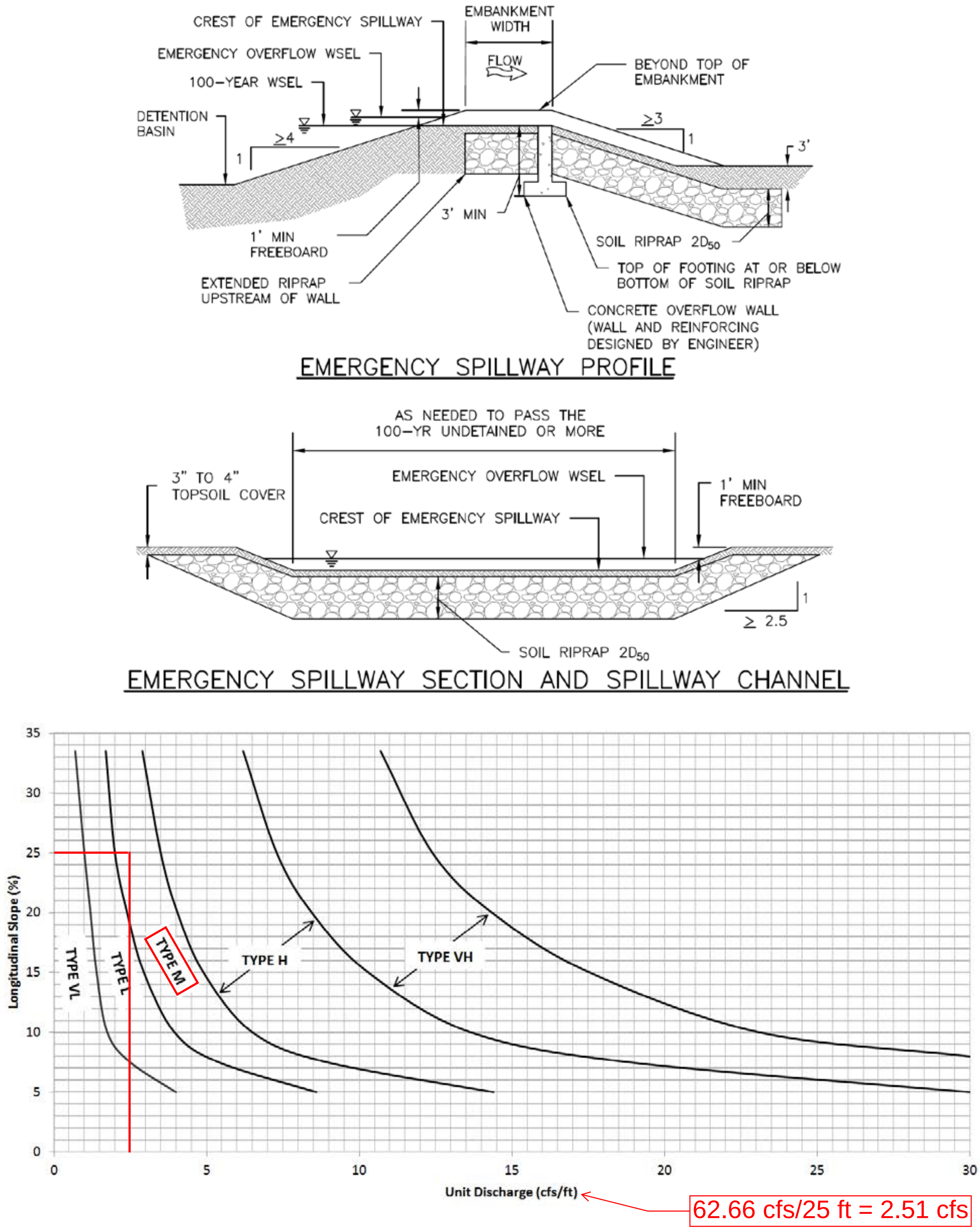


Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

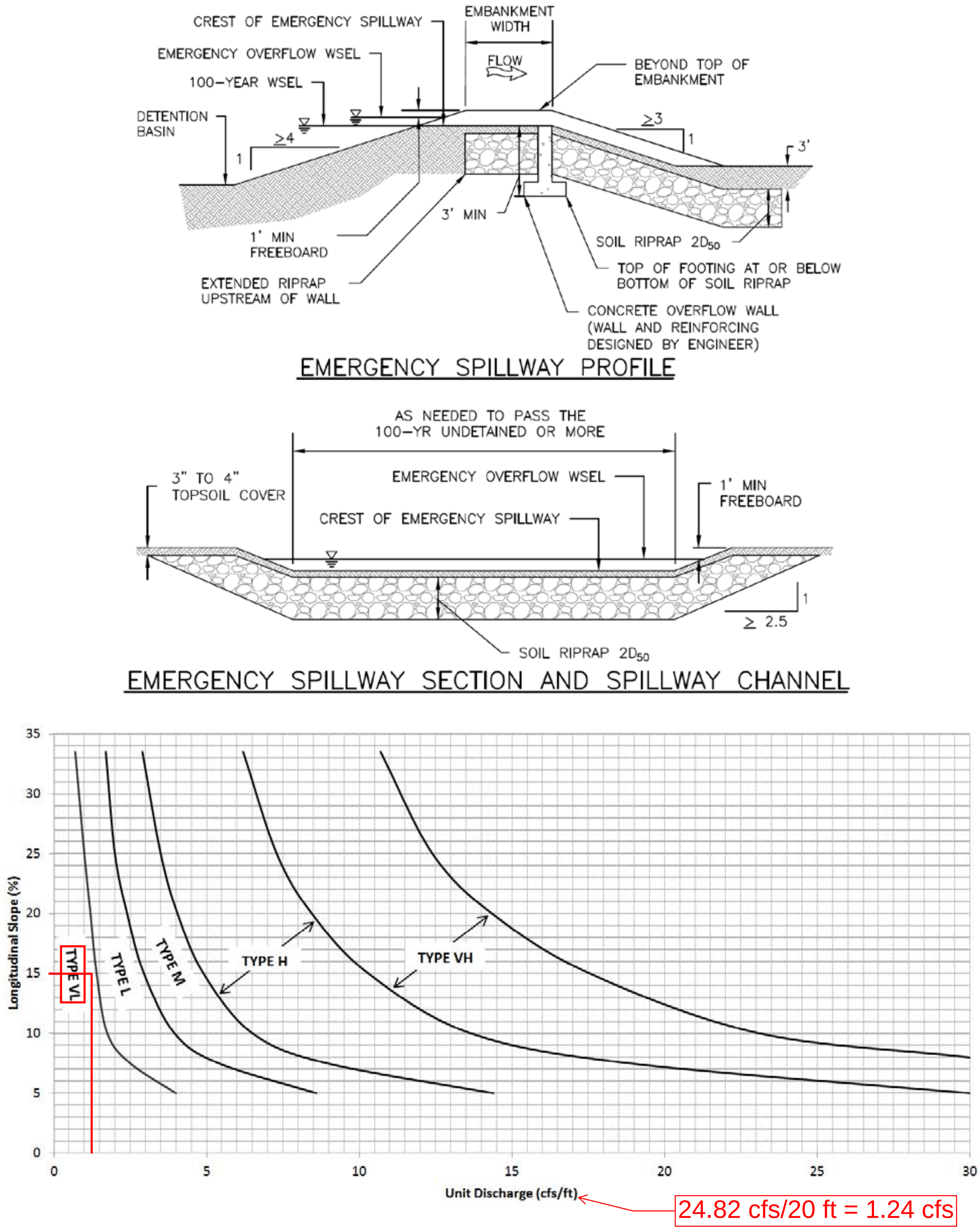


Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

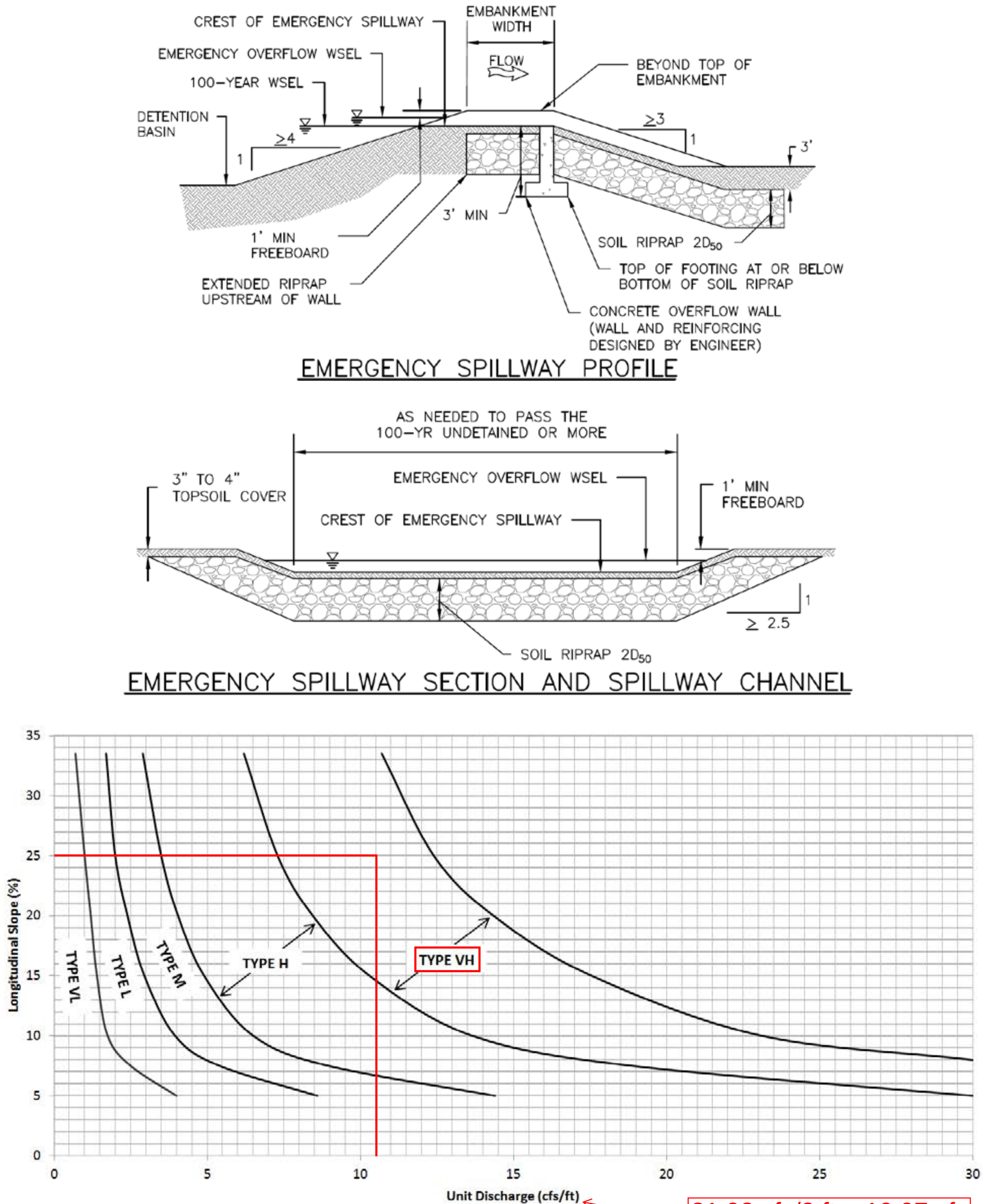


Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

Rip-Rap Calculation

Culvert 100-Year Outflow

Riprap Apron E1

Applicable Equations:

$L_p = (1/2\tan\Theta)(A_t/Y_t\text{-}D)$	Equation 9-11 per USCDM
$A_t = Q/V$	Equation 9-12 per USDCM
$\Theta = \tan^{-1}(1/(2^*\text{ExpansionFactor}))$	Equation 9-13 per USDCM
$W = 2(L_p\tan\Theta)+D$	Equation 9-14 per USDCM
$T = 2D_{50}$	Equation 9-15 per USDCM

Assumptions

Acceptable major event velocity is 5 ft/s due to HSG B soils

Input parameters:

Description		Variable	Input	Unit
Width of the conduit (use diameter for circular conduits),		D:	2.00	ft
HGL Elevation			6111.11	ft
Invert Elevation			6109.70	ft
Tailwater depth (ft),		Y_t:	1.41	ft
Expansion angle of the culvert flow		Θ:	0.07	radians
Design discharge (cfs)*		Q:	20.00	cfs
Froude Number		F_r	0.94	Subcritical
Unitless Variables for Tables:				
	For Figure 9-35	$Q/D^{2.5}$	3.54	
	For Figure 9-35	Y_t/D	0.70	
	For Figure 9-38	$Q/D^{1.5}$	7.07	
	For Figure 9-38	Y_t/D	0.70	
Allowable non-eroding velocity in the downstream channel (ft/sec)		V:	5	ft/sec
Expansion Factor (Figure 9-35), 1/(2tan(θ))			6.75	

Solve for:

Description	Variable	Output	Unit
1. Required area of flow at allowable velocity (ft^2)	A_t:	4.00	ft^2
2. Length of Protection	L_p:	5.65	ft
	L_p < 3D?	Yes	
	L_p > 10D?	No	
	L_p > 10D & F_r > 6?	No	
	L_{pmin}:	6.00	ft
3. Width of downstream riprap protection	W:	3.00	ft
4. Rip Rap Type (Figure 9-38)	-	L	
5. Rip Rap Size (Figure 8-34)	D_{50}:	9	inches

Rip Rap Summary

Length	L_p	6.00	ft
Width	W_{min}	3.00	ft
Size	D_{50}	9	inches
Type	-	L	-
Thickness	T	18	inches

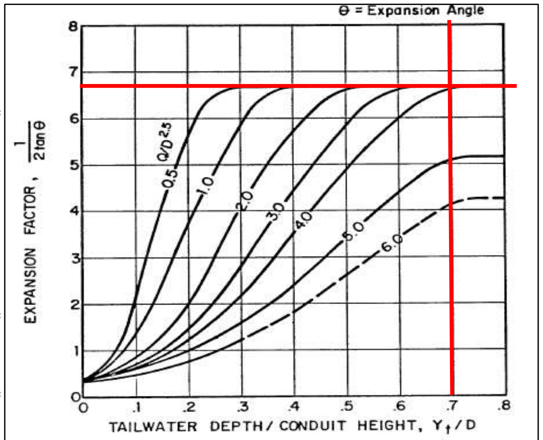
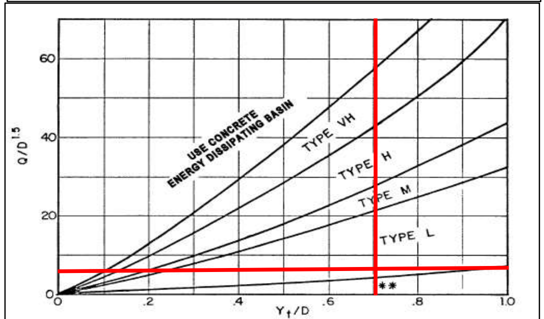


Figure 9-35. Expansion factor for circular conduits



Use D_a instead of D whenever flow is supercritical in the barrel.
** Use Type L for a distance of 3D downstream.

Figure 9-38. Riprap erosion protection at circular conduit outlet (valid for $Q/D_{2.5} \le 6.0$)

RIPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSION (INCHES)	D_{50}* (INCHES)
TYPE VL	70 – 100 50 – 70 35 – 50 2 – 10	12 9 6 2	6
TYPE L	70 – 100 50 – 70 35 – 50 2 – 10	15 12 9 3	9
TYPE M	70 – 100 50 – 70 35 – 50 2 – 10	21 18 12 4	12
TYPE H	70 – 100 50 – 70 35 – 50 2 – 10	30 24 18 6	18

*D_{50} = MEAN ROCK SIZE

Figure 8-34. Riprap and soil riprap placement and gradation (part 1 of 3)

Cross Section for 2-FT Concrete Trickle Channel

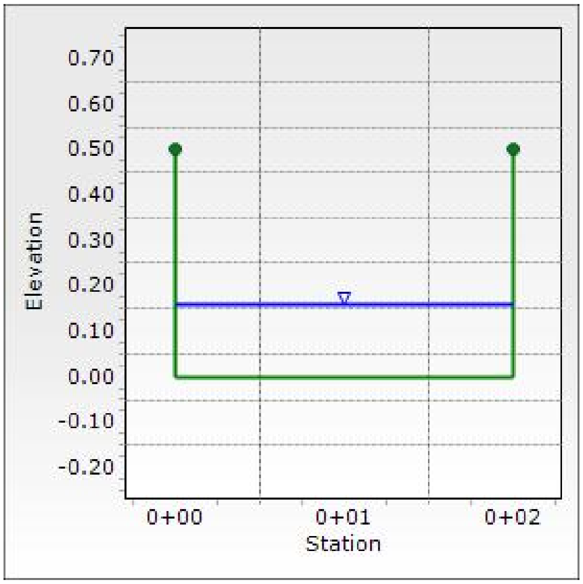
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.005 ft/ft
Normal Depth	1.9 in
Discharge	0.67 cfs

Each forebay is the same size (116 CF volume), the maximum flow exiting a forebay is at Forebay B and is .67cfs. Therefore a 2' wide x 6" tall concrete trickle channel will have capacity to convey the maximum released flows from each forebay on site



Offsite Analysis for low flow channel east of Sand Creek

Low Flow Channel Worksheet

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.009 ft/ft
Discharge	52.09 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	2.50
0+30	2.00
0+34	0.00
0+40	0.00
0+44	2.00
0+54	3.00
0+64	4.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2.50)	(0+64, 4.00)	0.060

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	22.9 in
Roughness Coefficient	0.060
Elevation	1.91 ft
Elevation Range	0.0 to 4.0 ft
Flow Area	18.7 ft²
Wetted Perimeter	14.5 ft
Hydraulic Radius	15.5 in
Top Width	13.63 ft
Normal Depth	22.9 in
Critical Depth	13.9 in
Critical Slope	0.058 ft/ft
Velocity	2.78 ft/s
Velocity Head	0.12 ft
Specific Energy	2.03 ft
Froude Number	0.419

Offsite Analysis for low flow channel east of Sand Creek

Low Flow Channel Worksheet

Results	
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	22.9 in
Critical Depth	13.9 in
Channel Slope	0.009 ft/ft
Critical Slope	0.058 ft/ft

Offsite Analysis for low flow channel east of Sand Creek

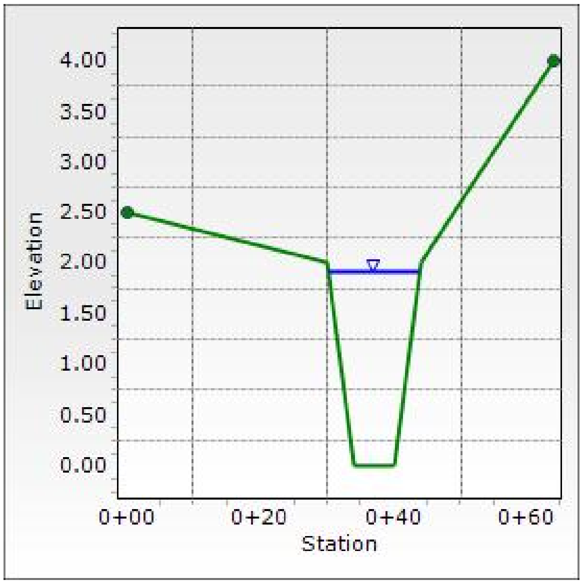
Low Flow Channel Section

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.009 ft/ft
Normal Depth	22.9 in
Discharge	52.09 cfs



APPENDIX D – OPINION OF PROBABLE CONSTRUCTION COST

Kimley»Horn

Kimley-Horn & Associates, Inc. **Opinion of Probable Construction Cost**

Client:	**Realsource Properties, LLC**	**Date:**	**2/7/2023**
Project:	**Westgate Apartments**	**Prepared By:**	**JWM**
KHA No.:	**1962170000**	**Checked By:**	**MOH**

No: **Sheet:** **1 of 2**

This OPC is not intended for basing financial decisions, or securing funding. Review all notes and assumptions. Since Kimley-Horn & Associates, Inc. has no control over the cost of labor, materials, equipment, or services furnished by others, or over methods of determining price, or over competitive bidding or market conditions, any and all opinions as to the cost herein, including but not limited to opinions as to the costs of construction materials, shall be made on the basis of experience and best available data. Kimley-Horn & Associates, Inc. cannot and does not guarantee that proposals, bids, or actual costs will not vary from the opinions on costs shown herein. The total costs and other numbers in this Opinion of Probable Cost have been rounded.

Item No.	Item Description	Quantity	Unit	Unit Price	Item Cost
	Private Storm Sewer (Non-Reimbursable)				
1	10' Type R Storm Sewer Inlet	3	EA	$8,000.00	$24,000
2	15' Type R Storm Sewer Inlet	3	EA	$12,000.00	$36,000
3	30" Nyloplast Standard Grate Inlet - Circular	5	EA	$1,800.00	$9,000
4	5' Type II Manhole	10	EA	$4,500.00	$45,000
5	18" PVC Storm Sewer	738	LF	$40.00	$29,520
6	24" PVC Storm Sewer	1,047	LF	$60.00	$62,820
7	30" PVC Storm Sewer	1,247	LF	$75.00	$93,525
		Subtotal:			$299,865
		Contingency (%,+/-)		10%	$29,987
		Project Total:			**$329,852**

Basis for Cost Projection:

- ☐ No Design Completed
- ☐ Preliminary Design
- ☑ Final Design

Design Engineer:

Mitchell O. Hess
Registered Professional Engineer, State of Colorado No. 53916

Kimley-Horn & Associates, Inc. — Opinion of Probable Construction Cost

Client:	Realsource Properties, LLC	Date:	2/7/2023
Project:	Westgate Apartments	Prepared By:	JWM
KHA No.:	1962170000	Checked By:	MOH

No: **Sheet:** **2 of 2**

This OPC is not intended for basing financial decisions, or securing funding. Review all notes and assumptions. Since Kimley-Horn & Associates, Inc. has no control over the cost of labor, materials, equipment, or services furnished by others, or over methods of determining price, or over competitive bidding or market conditions, any and all opinions as to the cost herein, including but not limited to opinions as to the costs of construction materials, shall be made on the basis of experience and best available data. Kimley-Horn & Associates, Inc. cannot and does not guarantee that proposals, bids, or actual costs will not vary from the opinions on costs shown herein. The total costs and other numbers in this Opinion of Probable Cost have been rounded.

Item No.	Item Description	Quantity	Unit	Unit Price	Item Cost
	Private Permanent Control Measures (Non-Reimbursable)				
1	3/4" Fractured Face Granite Mixed w/Class 5 Roadbase	7,000	CF	$12.00	$84,000
2	Concrete Trickle Channel	611	SF	$15.00	$9,165
3	24" RCP outlet pipe	460	LF	$75.00	$34,500
4	5' Type II Manhole	1	EA	$4,500.00	$4,500
5	Outlet Structure	1	EA	$5,000.00	$5,000
6	Type L Riprap - Emergency Overflow	14	Ton	$2,500.00	$33,750
7	Concrete Forebay	3	EA	$3,000.00	$9,000
8	24" Flared End Section	2	EA	$2,500.00	$5,000
		Subtotal:			$184,915
		Contingency (%,+/-)		10%	$18,492
		Project Total:			**$203,407**

Basis for Cost Projection:

- ☐ No Design Completed
- ☐ Preliminary Design
- ☑ Final Design

Design Engineer:

Mitchell O. Hess
Registered Professional Engineer, State of Colorado No. 53916

APPENDIX E – DRAINAGE MAPS

WESTGATE APARTMENTS

PROPOSED DRAINAGE EXHIBIT

NORTH

GRAPHIC SCALE IN FEET
0 30 60 120

Kimley»Horn
2 NORTH NEVADA AVENUE, SUITE 900
COLORADO SPRINGS, COLORADO 80903 (719) 453-0180

LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = 100-YR DESIGN STORM RUNOFF (CFS)
D = 100-YR RUNOFF COEFFICIENT

\# = DESIGN POINT

DRAINAGE SUB-BASIN BOUNDARY
EXISTING MAJOR CONTOUR
EXISTING MINOR CONTOUR
EXISTING MAJOR CONTOUR
EXISTING MINOR CONTOUR
PROPERTY LINE
BUILDING SETBACK
LANDSCAPE SETBACK
LIMITS OF DISTURBANCE
PROPOSED STORM SEWER
EXISTING 8" WATER LINE
EXISTING 8" SANITARY SEWER LINE
EXISTING UNDERGROUND ELECTRIC LINE
EXISTING OVERHEAD ELECTRIC LINE
EXISTING FIBER OPTIC LINE
EXISTING GAS LINE
EXISTING UTILITY ESMT
EXISTING STORM SEWER
PROPOSED DRAINAGE ARROW
EXISTING DRAINAGE ARROW
PROPOSED LANDSCAPING
PROPOSED CONCRETE
PROPOSED ASPHALT PAVING
PROPOSED SLOTTED CURB AND GUTTER

KEYNOTE LEGEND

1. PROPOSED TYPE 2 CURB AND GUTTER PER COLORADO SPRINGS STANDARD DRAWING 6B
2. PROPOSED ACCESS WITH CROSSPAN PER COLORADO SPRINGS STANDARD DRAWING D-7
3. PROPOSED 4' WIDE CONCRETE V-GUTTER
4. PROPOSED RETAINING WALL
5. PROP. ROOF DRAIN CONNECTION (PER NOTE 4)
6. PROPOSED 5' CONCRETE SIDEWALK
7. PROPOSED 6' CONCRETE SIDEWALK

STRUCTURE TABLE

NAME:	DETAILS
INLET P1	PR. PRIVATE 10' TYPE R INLET
INLET P2	PR. PRIVATE NYLOPLAST 30" STANDARD GRATE INLET
INLET P3	PR. PRIVATE 10' TYPE R INLET
INLET P4	PR. PRIVATE NYLOPLAST 30" STANDARD GRATE INLET
INLET P5	PR. PRIVATE 10' TYPE R INLET
INLET P6	PR. PRIVATE 15' TYPE R INLET
INLET P7	PR. PRIVATE NYLOPLAST 30" STANDARD GRATE INLET
INLET P8	PR. PRIVATE NYLOPLAST 30" STANDARD GRATE INLET
INLET P9	PR. PRIVATE 15' TYPE R INLET
INLET P10	PR. PRIVATE 15' TYPE R INLET
INLET P11	PR. PRIVATE NYLOPLAST 30" STANDARD GRATE INLET
STMH-W1	PR. PRIVATE 5' STORM SEWER MANHOLE
STMH-W2	PR. PRIVATE 5' STORM SEWER MANHOLE
STMH-W3	PR. PRIVATE 5' STORM SEWER MANHOLE
STMH-W4	PR. PRIVATE 5' STORM SEWER MANHOLE
STMH-W5	PR. PRIVATE 5' STORM SEWER MANHOLE
STMH-W6	PR. PRIVATE 5' STORM SEWER MANHOLE
STMH-W7	PR. PRIVATE 5' STORM SEWER MANHOLE
STMH-W8	PR. PRIVATE 5' STORM SEWER MANHOLE
STMH-W9	PR. PRIVATE 5' STORM SEWER MANHOLE
STMH-W10	PR. PRIVATE 5' STORM SEWER MANHOLE
STMH-W11	PR. PRIVATE 5' STORM SEWER MANHOLE

COLORADO SPRINGS GENERAL NOTES

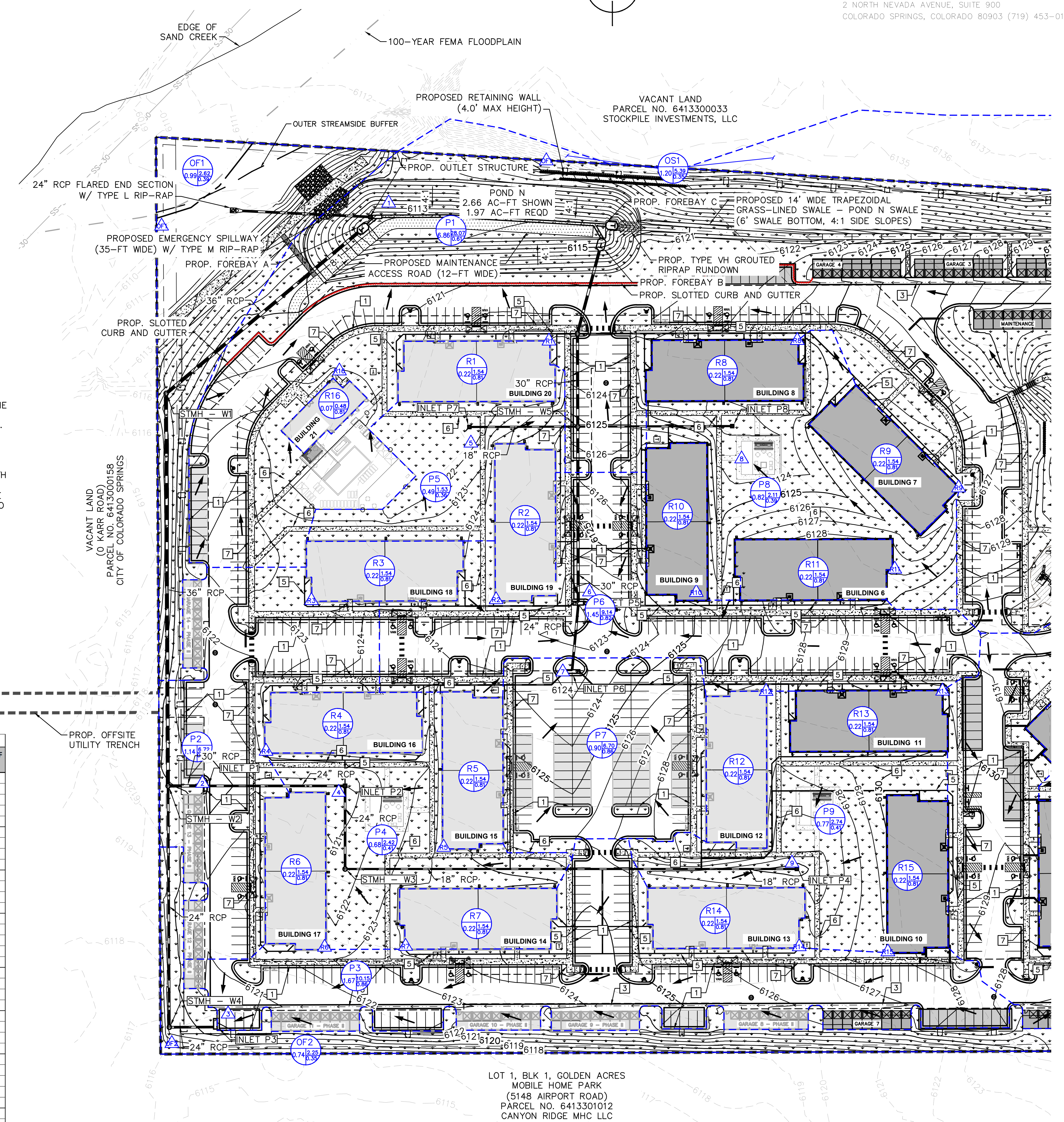
1. THESE DETAILED PLANS AND SPECIFICATIONS WERE PREPARED UNDER MY DIRECTION AND SUPERVISION. SAID DETAILED PLANS AND SPECIFICATIONS HAVE BEEN PREPARED ACCORDING TO THE ESTABLISHED CRITERIA FOR DETAILED DRAINAGE PLANS AND SPECIFICATIONS, AND SAID DETAILED PLANS AND SPECIFICATIONS ARE IN CONFORMITY WITH THE MASTER PLAN OF THE DRAINAGE BASIN. SAID DETAILED DRAINAGE PLANS AND SPECIFICATIONS MEET THE PURPOSES FOR WHICH THE PARTICULAR DRAINAGE FACILITY(S) IS DESIGNED. I ACCEPT RESPONSIBILITY FOR ANY LIABILITY CAUSED BY ANY NEGLIGENT ACTS, ERRORS OR OMMISSIONS ON MY PART IN PREPARATION OF THE DETAILED DRAINAGE PLANS AND SPECIFICATIONS.
2. PLAN REVIEW BY CITY OF COLORADO SPRINGS IS PROVIDED ONLY FOR GENERAL CONFORMANCE WITH DESIGN CRITERIA. THE CITY OF COLORADO SPRINGS IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND/OR ELEVATIONS WHICH SHALL BE CONFIRMED AT THE JOB SITE. THE CITY OF COLORADO SPRINGS, THROUGH APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

NOTES

1. ALL PR. STORMWATER INFRASTRUCTURE DEPICTED ON THESE PLANS IS TO BE PRIVATELY OWNED AND MAINTAINED UNLESS OTHERWISE NOTED.
2. ALL PR. CURB & GUTTER IS TYPE 2 PER COLORADO SPRINGS STANDARD DETAIL 6B UNLESS OTHERWISE NOTED.
3. ALL PROPOSED STORM SEWER IS PRIVATE RCP UNLESS NOTED OTHERWISE NOTED.
4. ROOF DRAIN CONNECTION SIZING AS FOLLOWS:
   - 4.1. 1-4 ROOF DRAIN DOWNSPOUTS – 6" PVC
   - 4.2. 5-8 ROOF DRAIN DOWNSPOUTS – 8" PVC
   - 4.3. 8+ ROOF DRAIN DOWNSPOUTS – 12" PVC

SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	CUM. 5-YR RUNOFF (CFS)	CUM. 100-YR RUNOFF (CFS)	BASIN IMP. (%)	100-YR RUNOFF COEF.
1	P1	6.86	11.78	28.07	0.00	0.00	42.9%	0.61
2	P2	1.14	3.39	6.72	0.00	0.00	71.9%	0.78
3	P3	1.67	5.39	10.15	0.00	0.00	84.7%	0.86
4	P4	0.68	0.55	2.42	0.00	0.00	9.4%	0.41
5	P5	0.49	0.23	1.53	0.00	0.00	1.1%	0.36
6	P6	1.45	4.71	9.14	0.00	0.00	76.4%	0.82
7	P7	0.90	3.55	6.70	0.00	0.00	83.7%	0.86
8	P8	0.82	0.43	2.11	0.00	0.00	6.3%	0.39
9	P9	0.77	0.63	2.74	0.00	0.00	9.3%	0.41
R1	R1	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R2	R2	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R3	R3	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R4	R4	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R5	R5	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R6	R6	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R7	R7	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R8	R8	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R9	R9	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R10	R10	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R11	R11	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R12	R12	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R13	R13	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R14	R14	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R15	R15	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R16	R16	0.07	0.26	0.48	0.00	0.00	90.0%	0.81
R17	R17	0.17	0.63	1.18	0.00	0.00	90.0%	0.81
OF1	OF1	0.99	0.52	2.62	0.00	0.00	5.8%	0.39
OF2	OF2	0.74	0.31	2.25	0.00	0.00	0.1%	0.35
OS1	OS1	1.20	0.41	5.39	0.00	0.00	0.0%	0.35
Pond N Total		21.25	45.17	104.56	0.00	0.00	49.2%	0.63
10	P10	1.52	1.23	4.52	0.00	0.00	14.7%	0.44
11	P11	2.58	4.82	11.02	0.00	0.00	47.5%	0.64
12	P12	1.41	4.50	8.73	0.00	0.00	76.5%	0.81
13	P13	0.60	0.45	1.88	0.00	0.00	10.4%	0.41
R18	R18	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R19	R19	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R20	R20	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R21	R21	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
OF3	OF3	0.40	1.12	2.40	0.00	0.00	57.0%	0.70
OF4	OF4	0.29	0.10	0.71	0.00	0.00	0.0%	0.35
Pond S Total		7.66	15.51	35.40	0.00	0.00	47.0%	0.63



WESTGATE APARTMENTS

PROPOSED DRAINAGE EXHIBIT

NORTH

GRAPHIC SCALE IN FEET
0 30 60 120

Kimley»Horn

2 NORTH NEVADA AVENUE, SUITE 900
COLORADO SPRINGS, COLORADO 80903 (719) 453-0180

LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = 100-YR DESIGN STORM RUNOFF (CFS)
D = 100-YR RUNOFF COEFFICIENT

= DESIGN POINT

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- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPERTY LINE
- BUILDING SETBACK
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- LIMITS OF DISTURBANCE
- PROPOSED STORM SEWER
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KEYNOTE LEGEND

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INLET P1	PR. PRIVATE 10' TYPE R INLET
INLET P2	PR. PRIVATE NYLOPLAST 30" STANDARD GRATE INLET
INLET P3	PR. PRIVATE 10' TYPE R INLET
INLET P4	PR. PRIVATE NYLOPLAST 30" STANDARD GRATE INLET
INLET P5	PR. PRIVATE 10' TYPE R INLET
INLET P6	PR. PRIVATE 15' TYPE R INLET
INLET P7	PR. PRIVATE NYLOPLAST 30" STANDARD GRATE INLET
INLET P8	PR. PRIVATE NYLOPLAST 30" STANDARD GRATE INLET
INLET P9	PR. PRIVATE 15' TYPE R INLET
INLET P10	PR. PRIVATE 15' TYPE R INLET
INLET P11	PR. PRIVATE NYLOPLAST 30" STANDARD GRATE INLET
STMH-W1	PR. PRIVATE 5' STORM SEWER MANHOLE
STMH-W2	PR. PRIVATE 5' STORM SEWER MANHOLE
STMH-W3	PR. PRIVATE 5' STORM SEWER MANHOLE
STMH-W4	PR. PRIVATE 5' STORM SEWER MANHOLE
STMH-W5	PR. PRIVATE 5' STORM SEWER MANHOLE
STMH-W6	PR. PRIVATE 5' STORM SEWER MANHOLE
STMH-W7	PR. PRIVATE 5' STORM SEWER MANHOLE
STMH-W8	PR. PRIVATE 5' STORM SEWER MANHOLE
STMH-W9	PR. PRIVATE 5' STORM SEWER MANHOLE
STMH-W10	PR. PRIVATE 5' STORM SEWER MANHOLE
STMH-W11	PR. PRIVATE 5' STORM SEWER MANHOLE

COLORADO SPRINGS GENERAL NOTES

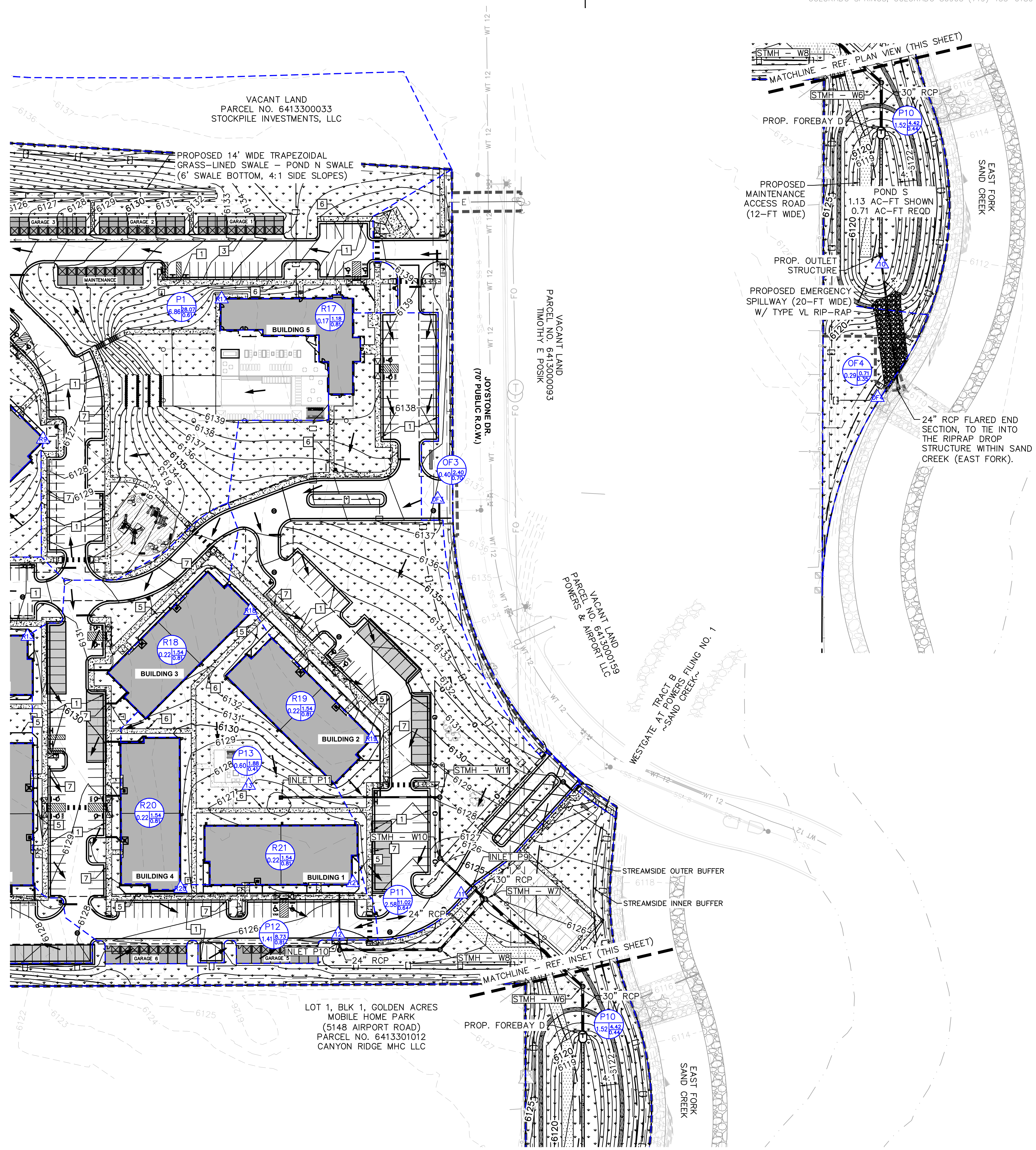
1. THESE DETAILED PLANS AND SPECIFICATIONS WERE PREPARED UNDER MY DIRECTION AND SUPERVISION. SAID DETAILED PLANS AND SPECIFICATIONS HAVE BEEN PREPARED ACCORDING TO THE ESTABLISHED CRITERIA FOR DETAILED DRAINAGE PLANS AND SPECIFICATIONS, AND SAID DETAILED PLANS AND SPECIFICATIONS ARE IN CONFORMITY WITH THE MASTER PLAN OF THE DRAINAGE BASIN. SAID DETAILED DRAINAGE PLANS AND SPECIFICATIONS MEET THE PURPOSES FOR WHICH THE PARTICULAR DRAINAGE FACILITY(S) IS DESIGNED. I ACCEPT RESPONSIBILITY FOR ANY LIABILITY CAUSED BY ANY NEGLIGENT ACTS, ERRORS OR OMMISSIONS ON MY PART IN PREPARATION OF THE DETAILED DRAINAGE PLANS AND SPECIFICATIONS.
2. PLAN REVIEW BY CITY OF COLORADO SPRINGS IS PROVIDED ONLY FOR GENERAL CONFORMANCE WITH DESIGN CRITERIA. THE CITY OF COLORADO SPRINGS IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND/OR ELEVATIONS WHICH SHALL BE CONFIRMED AT THE JOB SITE. THE CITY OF COLORADO SPRINGS, THROUGH APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

NOTES

1. ALL PR. STORMWATER INFRASTRUCTURE DEPICTED ON THESE PLANS IS TO BE PRIVATELY OWNED AND MAINTAINED UNLESS OTHERWISE NOTED.
2. ALL PR. CURB & GUTTER IS TYPE 2 PER COLORADO SPRINGS STANDARD DETAIL 6B UNLESS OTHERWISE NOTED.
3. ALL PROPOSED STORM SEWER IS PRIVATE RCP UNLESS NOTED OTHERWISE NOTED.
4. ROOF DRAIN CONNECTION SIZING AS FOLLOWS:
   - 4.1. 1-4 ROOF DRAIN DOWNSPOUTS – 6" PVC
   - 4.2. 5-8 ROOF DRAIN DOWNSPOUTS – 8" PVC
   - 4.3. 8+ ROOF DRAIN DOWNSPOUTS – 12" PVC

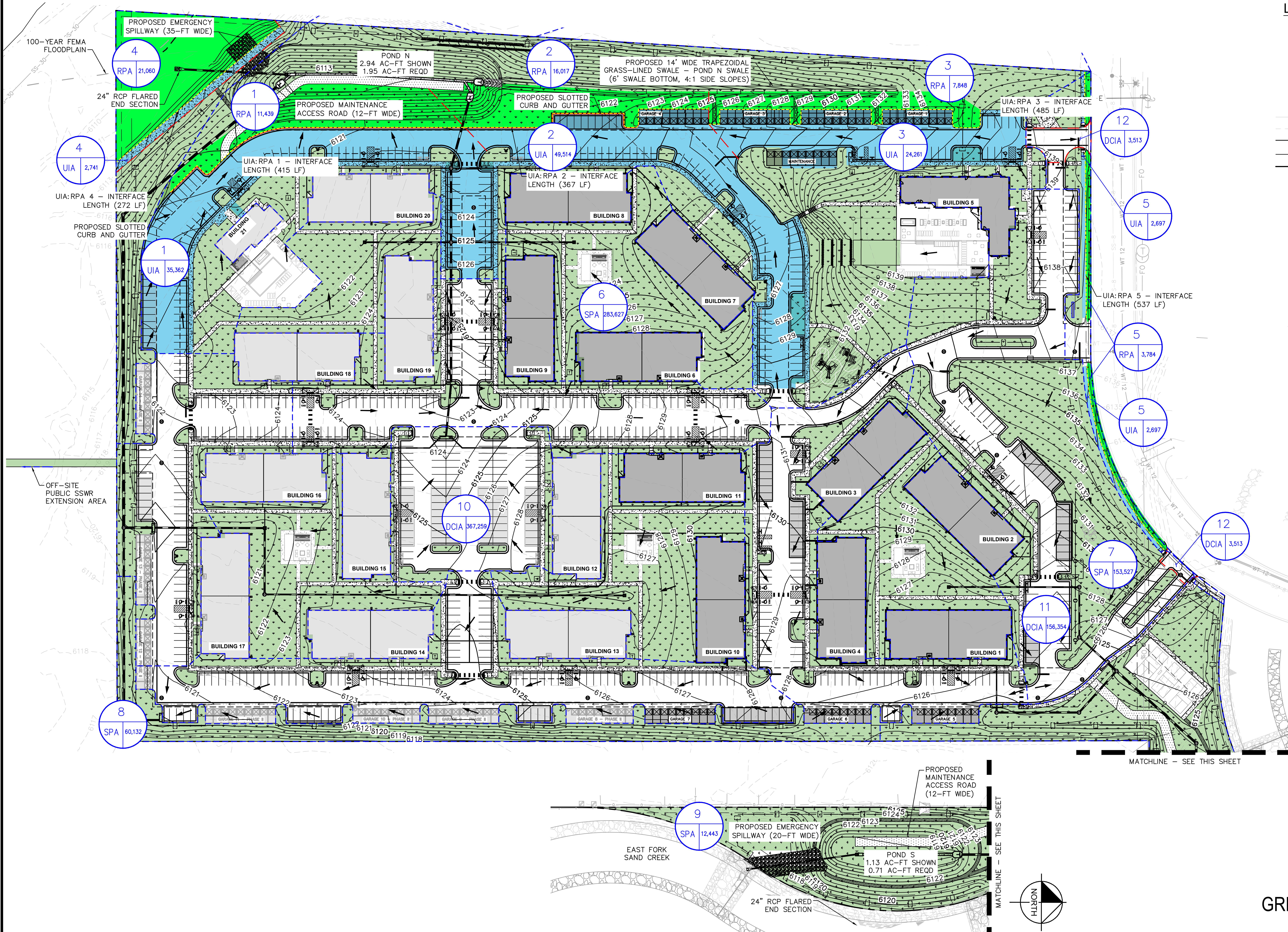
SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	CUM. 5-YR RUNOFF (CFS)	CUM. 100-YR RUNOFF (CFS)	BASIN IMP. (%)	100-YR RUNOFF COEF.
1	P1	6.86	11.78	28.07	0.00	0.00	42.9%	0.61
2	P2	1.14	3.39	6.72	0.00	0.00	71.9%	0.78
3	P3	1.67	5.39	10.15	0.00	0.00	84.7%	0.86
4	P4	0.68	0.55	2.42	0.00	0.00	9.4%	0.41
5	P5	0.49	0.23	1.53	0.00	0.00	1.1%	0.36
6	P6	1.45	4.71	9.14	0.00	0.00	76.4%	0.82
7	P7	0.90	3.55	6.70	0.00	0.00	83.7%	0.86
8	P8	0.82	0.43	2.11	0.00	0.00	6.3%	0.39
9	P9	0.77	0.63	2.74	0.00	0.00	9.3%	0.41
R1	R1	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R2	R2	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R3	R3	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R4	R4	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R5	R5	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R6	R6	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R7	R7	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R8	R8	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R9	R9	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R10	R10	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R11	R11	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R12	R12	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R13	R13	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R14	R14	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R15	R15	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R16	R16	0.07	0.26	0.48	0.00	0.00	90.0%	0.81
R17	R17	0.17	0.63	1.18	0.00	0.00	90.0%	0.81
OF1	OF1	0.99	0.52	2.62	0.00	0.00	5.8%	0.39
OF2	OF2	0.74	0.31	2.25	0.00	0.00	0.1%	0.35
OS1	OS1	1.20	0.41	5.39	0.00	0.00	0.0%	0.35
Pond N Total		21.25	45.17	104.56	0.00	0.00	49.2%	0.63
10	P10	1.52	1.23	4.52	0.00	0.00	14.7%	0.44
11	P11	2.58	4.82	11.02	0.00	0.00	47.5%	0.64
12	P12	1.41	4.50	8.73	0.00	0.00	76.5%	0.81
13	P13	0.60	0.45	1.88	0.00	0.00	10.4%	0.41
R18	R18	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R19	R19	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R20	R20	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
R21	R21	0.22	0.83	1.54	0.00	0.00	90.0%	0.81
OF3	OF3	0.40	1.12	2.40	0.00	0.00	57.0%	0.70
OF4	OF4	0.29	0.10	0.71	0.00	0.00	0.0%	0.35
Pond S Total		7.66	15.51	35.40	0.00	0.00	47.0%	0.63



2 NORTH NEVADA AVENUE, SUITE 900
COLORADO SPRINGS, COLORADO 80903 (719) 453-0180

WESTGATE APARTMENTS
GREEN INFRASTRUCTURE EXHIBIT



LEGEND

1 / TYPE / SF	GREEN INFRASTRUCTURE REGION
XXXX	EXISTING MAJOR CONTOUR
XXXX	EXISTING MINOR CONTOUR
XXXX	EXISTING MAJOR CONTOUR
XXXX	EXISTING MINOR CONTOUR
	PROPERTY LINE
	PROPOSED DRAINAGE ARROW
	DIRECTLY CONNECTED IMPERVIOUS AREA (DCIA) (UNHIGHLIGHTED AREAS / ROOFTOPS)
	UNCONNECTED IMPERVIOUS AREA (UIA)
	RECEIVING PERVIOUS AREA (RPA)
	SEPARATE PERVIOUS AREA (SPA)
	GREEN INFRASTRUCTURE AREA DELINEATION
	SUB-BASIN DELINEATION
	UIA:RPA INTERFACE
	SLOTTED CURB AND GUTTER

CALCULATED SITE RESULTS (sums results from all columns in worksheet)

Total Area (ft^2)	1,211,578
Total Impervious Area (ft^2)	641,701
WQCV (ft^3)	26,738
WQCV Reduction (ft^3)	4,774
WQCV Reduction (%)	18%
Untreated WQCV (ft^3)	21,964

NORTH

GRAPHIC SCALE IN FEET
0 30 60 120

CITY APPROVAL:

GREEN INFRASTRUCTURE EXHIBIT
SHEET 9

APPENDIX F – EXCERPTS FROM PREVIOUS DRAINAGE STUDIES

Master Development Drainage Plan (MDDP) – April 30, 2012

Final Drainage Report for Westgate at Powers Phase 1 – March 28, 2018

MASTER DEVELOPMENT DRAINAGE PLAN

for

WESTGATE AT POWERS

Prepared for:

Dr. Martin List
c/o Signature Realty Capital Corp.
2082 Michelson Drive, Suite 212
Irvine, CA 92612

February 16, 2012
Revised April 30, 2012

Prepared by:

JPS ENGINEERING

19 E. Willamette Avenue
Colorado Springs, CO 80903
(719)-477-9429
(719)-471-0766 FAX

JPS Project No. 020501

Based on the limited drainage capacity downstream of the southwest corner of the property, developed drainage within Basin C will be routed northwesterly through EDB #C4 prior to discharge to the main channel of Sand Creek. As such, developed flows exiting the property at Design Point #2 will be negligible. Runoff from Basins C1-C4 will combine at Design Point #3, with developed peak flows calculated as Q_5 = 48.8 cfs and Q_{100} = 94.0 cfs.

A drainage channel will be constructed along the north boundary of Basin C3 to intercept and convey historic off-site flows from Basin OC1 westerly to the Sand Creek main channel.

C. Comparison of Developed to Historic Discharges

Based on the hydrologic calculations in Appendix C, the total developed flows from the site will exceed historic flows from the parcel. Due to the increased impervious areas in the developed site, the total undetained flow from the site would be significantly higher than the historic flow. In accordance with the Sand Creek DBPS, the increase in developed flows for the overall basin will be mitigated by regional stormwater detention ponds. The comparison of developed to historic discharges at key design points is summarized as follows:

Design Point	Historic Flow			Developed Flow			Comparison of Developed to Historic Flow (Q_5%/Q_{100}%)
	Area (ac)	Q_5 (cfs)	Q_{100} (cfs)	Area (ac)	Q_5 (cfs)	Q_{100} (cfs)	
1	40.4	22.7	55.9	41.0	60.9	117.7	268% / 211% (increase)
2	13.0	5.5	14.1				(decrease / re-directed to DP3)
3	26.6	20.9	46.7	23.4	48.8	94.0	233% / 201% (increase)

D. Stormwater Quality

According to Colorado Springs drainage criteria, a combination of stormwater quality detention facilities, including extended detention basins (EDB), retention ponds (RP), and porous landscape detention (PLD) areas, will be provided within the site for stormwater quality enhancement purposes. The proposed extended detention basins and landscape detention areas will be sized to slowly release the "water quality capture volume," and these facilities will be designed to meet City of Colorado Springs Volume 2 stormwater quality criteria. Preliminary sizing parameters for the proposed detention basins are detailed in Appendix E. The preliminary program of permanent stormwater quality BMP"s is summarized as follows:

The proposed development will include construction of the following regional drainage facilities identified in the approved DBPS:

- Riprap Bank Lining along Sand Creek Center Tributary Channel
- Drop Structures within Sand Creek Center Tributary Channel
- Multiple box culvert crossing Sand Creek Center Tributary Channel at Westgate Road (to be proposed for consideration as regional drainage improvement)

Costs for these regional drainage facilities should be eligible for reimbursement through the City of Colorado Springs drainage basin fee system. According to the preliminary cost estimate in Appendix F, the costs for regional drainage improvements are anticipated to exceed the drainage basin fee obligation for the project. As a result, the developer should be eligible for reimbursement of actual drainage improvement costs in excess of the drainage fee requirements.

In conjunction with development of this site, the 2-acre parcel located at the northwest corner of the property (EPC Parcel No. 64133-00-022, as shown on Figure EX1) within the main channel of Sand Creek will be dedicated to the City. Additionally, the adjoining area at the northwest corner of the Phase 2 apartment site will also be dedicated to the City as a drainage, trail, and utility tract.

VII. PHASING PLAN

The proposed phasing plan will depend on market conditions, but is generally anticipated to begin with development of the proposed multi-family and retail areas in the southeastern part of the master plan area, along the west side of the re-aligned Troy Hill Road alignment. Phase 1 will also include the east side of the proposed apartment complex in the northwest part of the site. Phase 2 will include development of the balance of the apartment complex area on the west side of the northwest part of the property.

Future phases are anticipated to include the proposed retail development areas along the east side of the re-aligned Troy Hill Road, as well as the proposed office areas on the north side of the roundabout.

The proposed re-alignment of the Sand Creek Center Tributary Channel will be completed with the initial phase of development, in conjunction with processing of a FEMA Letter of Map Revision to revise floodplain limits in this area. Phase 1 will also include the proposed re-alignment of Troy Hill Road, new roundabout, and re-configuration of the Airport Road intersection to align with Airport Creek Point.

Phase 1 will also include construction of the proposed box culvert crossing the Sand Creek Center Tributary Channel and extension of the new northwest collector roadway to the northern property boundary, providing access to the northwesterly apartment complex.

Based on the anticipated development-phasing plan, the proposed phasing plan for major infrastructure improvements is summarized as follows:

Phase	Major Infrastructure Improvements
1	Sand Creek Center Tributary Channel Re-Alignment & LOMR (Airport Road northeast to Phase 1 channel limit) Troy Hill Road Re-Alignment and Roundabout Storm Sewer A1, A2 EDB #A1 NW Collector Road (from roundabout NW to north boundary) Box Culvert A8 crossing Sand Creek Center Tributary Channel RP #A7 EDB #C4 (with temporary drainage channels from apt. site to EDB)
2	Storm Sewer C1, C2, C3
3	Sand Creek Center Tributary Channel (from Phase 1 limit to Troy Hill Road) EDB #A2, EDB #A3 PLD #A4, PLD #A5, PLD #A6 Storm Sewer A4

VIII. MAINTENANCE

All proposed road and drainage construction within the Westgate at Powers development will be performed to City of Colorado Springs Standards and Specifications. Roads and major drainage facilities within the public right-of-way will be maintained by the City of Colorado Springs upon final acceptance of these facilities after the warranty period. The Property Owners Association will maintain private storm sewer facilities and stormwater detention ponds within the private commercial development sites and proposed open space areas.

IX. SUMMARY

The Westgate at Powers is a proposed master plan consisting of a mix of commercial, retail, office, and multi-family apartment land uses at the northwest corner of Airport Road and Troy Hill Road. The proposed drainage patterns for the project will remain consistent with historic conditions and the overall drainage plan for this area. New drainage facilities constructed to City of Colorado Springs standards will safely convey developed runoff to adequate outfalls.

The development will include public street and drainage improvements within the site, re-alignment of the Sand Creek Center Tributary drainage channel, re-alignment of Troy Hill Road, and extension of Westgate Road through the site. Developed flows from the proposed site will be routed through on-site extended detention basins and porous landscape detention areas for stormwater quality purposes. Construction of the proposed stormwater facilities, in conjunction with proper erosion control practices during construction, will ensure that this developed site will not adversely affect downstream or surrounding areas.

The following table provides a comparison of channel design parameters for the existing upstream and downstream reaches of the Sand Creek Center Tributary Channel, along with the proposed channel design parameters:

Design Parameter	**Upstream Reach (East of Troy Hill Road)**	**Proposed Project Reach (Troy Hill Rd. to Airport Rd.)**	**Downstream Reach (South of Airport Road)**
Channel Section	Natural sand bottom w/ 100-yr RR sides	Natural sand bottom w/ 100-yr RR sides	Natural sand bottom w/ 100-yr RR sides
Longitudinal Slope	0.668%	0.6%	0.91-1.0%
Bottom Width	50'	50'	25-30'
Side Slope	2.5:1	3:1	<3:1

E. Major Drop Structure Components / Attributes

The project will include a series of drop structures for channel bed stabilization. The Sand Creek DBPS recommended a series of drop structures to stabilize this segment of the Sand Creek Center Tributary Channel, with a recommended longitudinal slope of 0.6 percent. The proposed channel profile has been designed to maintain the recommended maximum design slope of 0.6 percent, which is consistent with the DBPS as well as DCM Table 12-6.

The channel improvements both upstream and downstream of this reach were designed with vertical drop structure details, and the existing structures are in stable condition and appear to be functioning properly.

Drop structures for this project have been designed as "Grouted Sloping Boulder (GSB)" drops per current drainage criteria, with design parameters summarized as follows:

- Drop Structures provided to maintain a maximum longitudinal slope of 0.6 percent (5 drop structures provided between Airport Road and Troy Hill Road)
- Cutoff walls provided at crest of each drop structure
- Riprap aprons upstream and downstream of GSB per UDFCD guidelines (Table 9-1)
- Unit Discharge Calculation:
    - Bottom Width = 50'
    - 100-Yr Flow = 1,960 cfs
    - 100-Yr Flow Depth = 4.0'
    - 100-Yr Flow Area = 251.2 sf
    - Calculated Flow in Rectangular Section over BW = (50'W * 4.0'D) = 200.0 SF
    - Percentage of Flow over BW = (200.0 sf / 251.2 sf) = 79.6%
    - Unit Flow over BW = (79.6% * 1,960 cfs) = 1,560.2 cfs
    - Unit Discharge = (1,560.2 cfs / 50 ft) = <u>31.2 cfs/ft</u>
- Basin Length (Lb) = 20' per USDCM Figure 9-1
- Boulder Size = B30 per USDCM Figure 9-1

FINAL DRAINAGE REPORT

for

WESTGATE AT POWERS
PHASE 1

Prepared for:

Powers and Airport, LLC
9891 Irvine Center Drive, Suite 200
Irvine, CA 92618

December 20, 2017
Revised February 20, 2018
Revised March 9, 2018
Revised March 28, 2018

Prepared by:

JPS ENGINEERING

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JPS Project No. 020501

Basin A7 (1.2 acres) comprises the proposed office/retail area lying on the north side of the proposed Sand Creek Center Tributary Channel, east of the proposed Joystone Drive extension. The developed drainage plan for Basin A7 includes a porous landscape detention area (PLD #A7) for stormwater quality treatment within this development area. Flows from these PLD facilities will discharge into the adjoining drainage channel. Developed flows from Basin A7 flow to Design Point #A7, with peak flows calculated as Q_5 = 3.6 cfs and Q_{100} = 7.2 cfs.

On the north side of Basin A7, Off-site Basin OA2 flows southerly to the Sand Creek Center Tributary Channel, with peak flows at Design Point OA2 calculated as Q_5 = 6.0 cfs and Q_{100} = 15.7 cfs.

Basin A8 (2.0 acres) comprises the public roadway area along Joystone Drive extending northwest of the Sand Creek Center Tributary Channel. The roadway drainage will be conveyed by curb and gutter to Inlets A8.1 and A8.2 (Public 5' Type D10R) located at the sump in the road profile, and Storm Sewer A8.1-A8.2 will convey these flows into Detention Pond A6. Developed flows from Basin A8 drain to Design Point #A8, with peak flows calculated as Q_5 = 6.4 cfs and Q_{100} = 12.2 cfs.

Developed on-site flows from Basins A6-A8 and Basin OA2 combine at Design Point #A6a, with peak flows calculated as Q_5 = 45.3 cfs and Q_{100} = 94.0 cfs. Detention Pond A6 will provide full-spectrum stormwater detention for the combined flow from Basins A6-A8.

Basin A9 (Pond A9)

Basin A9 (6.3 acres) comprises the eastern fringe of the proposed apartment area planned for the northwest part of the Westgate at Powers site. Surface runoff from Basin A9 will be conveyed southeasterly by sheet flow and curb and gutter to storm inlets in the local street system serving this area. The storm sewer system will intercept surface flows and convey developed runoff to the proposed Detention Basin A9, which will discharge into the Sand Creek Center Tributary Channel. Developed flows from Basin A9 flow to Design Point #A9 (see Sh. D1.1, Appendix G), with peak flows calculated as Q_5 = 11.7 cfs and Q_{100} = 24.8 cfs.

Basin A10 has been delineated as the re-aligned Sand Creek Center Tributary Channel and adjoining undeveloped areas. Developed peak flows from Basin A10 are calculated as Q_5 = 1.3 cfs and Q_{100} = 9.2 cfs.

Basin B

Basin B (6.6 acres) comprises the additional area purchased by the Westgate at Powers developer on the east side of Troy Hill Road in the time following the 2012 Development Plan approval. Detailed plans for this area will be included in a future Development Plan and Final Drainage Report, but preliminary drainage planning has been included in this report.

Basin OB1 (2.3 acres) comprises the off-site area in the CDOT right-of-way east of Basin B, which sheet flows westerly across Basin B. Surface runoff from Basins OB1 and B sheet flows northwesterly across Basin B to Design Point #2, with peak flows calculated as $Q_5 = 12.1$ cfs and $Q_{100} = 28.6$ cfs. An on-site storm sewer system will intercept surface drainage from Basin B and convey developed flows northerly to the proposed Detention Basin B1 at the northwest corner of the site, which will mitigate developed drainage impacts from this area and discharge into the existing Sand Creek Center Tributary channel.

Developed on-site flows from Basins OA1, OA2, A1-A10, OB1, and B1 combine at Design Point #1, with peak flows calculated as $Q_5 = 75.2$ cfs and $Q_{100} = 177.9$ cfs.

Basin C

Basin C (23.4 acres) comprises the northwest part of the Westgate at Powers site, which is beyond the limits of Phase 1. Surface runoff from Basins C1-C4 will be conveyed westerly by sheet flow and curb and gutter to storm inlets in the local street system serving this area. The storm sewer system will intercept surface flows and convey developed runoff to the proposed Detention Basin C, which will discharge into the Sand Creek drainage channel at the northwest corner of the property.

Developed on-site flows from Basins C1-C4 combine at Design Point #3, with peak flows calculated as $Q_5 = 28.0$ cfs and $Q_{100} = 62.7$ cfs.

Detailed drainage planning for Basin C will be provided in a future Final Drainage Report.

Drainage Facility Design:

Hydrologic calculations are detailed in Appendix A, and hydraulic calculations for proposed drainage improvements are enclosed in Appendix B.

As detailed in the “Storm Inlet Sizing Summary” table in Appendix B, inlet flows have been calculated based on the proportional basin area draining to each individual inlet, and the selected inlets have been sized to provide Inlet Capacity exceeding the calculated 100-year flow entering each inlet. As such, no bypass flow is anticipated from any of the inlets.

Allowable street capacities have been evaluated in the “Street Capacity Analysis” table in Appendix B, and storm inlets have been designed along Joystone Drive and Troy Hill Road such that street flows will remain below the allowable street capacities.

As detailed in the “Storm Sewer Sizing Summary” table in Appendix B, the selected storm drain pipes have been sized to provide pipe capacity exceeding the calculated 100-year flow entering each pipe.

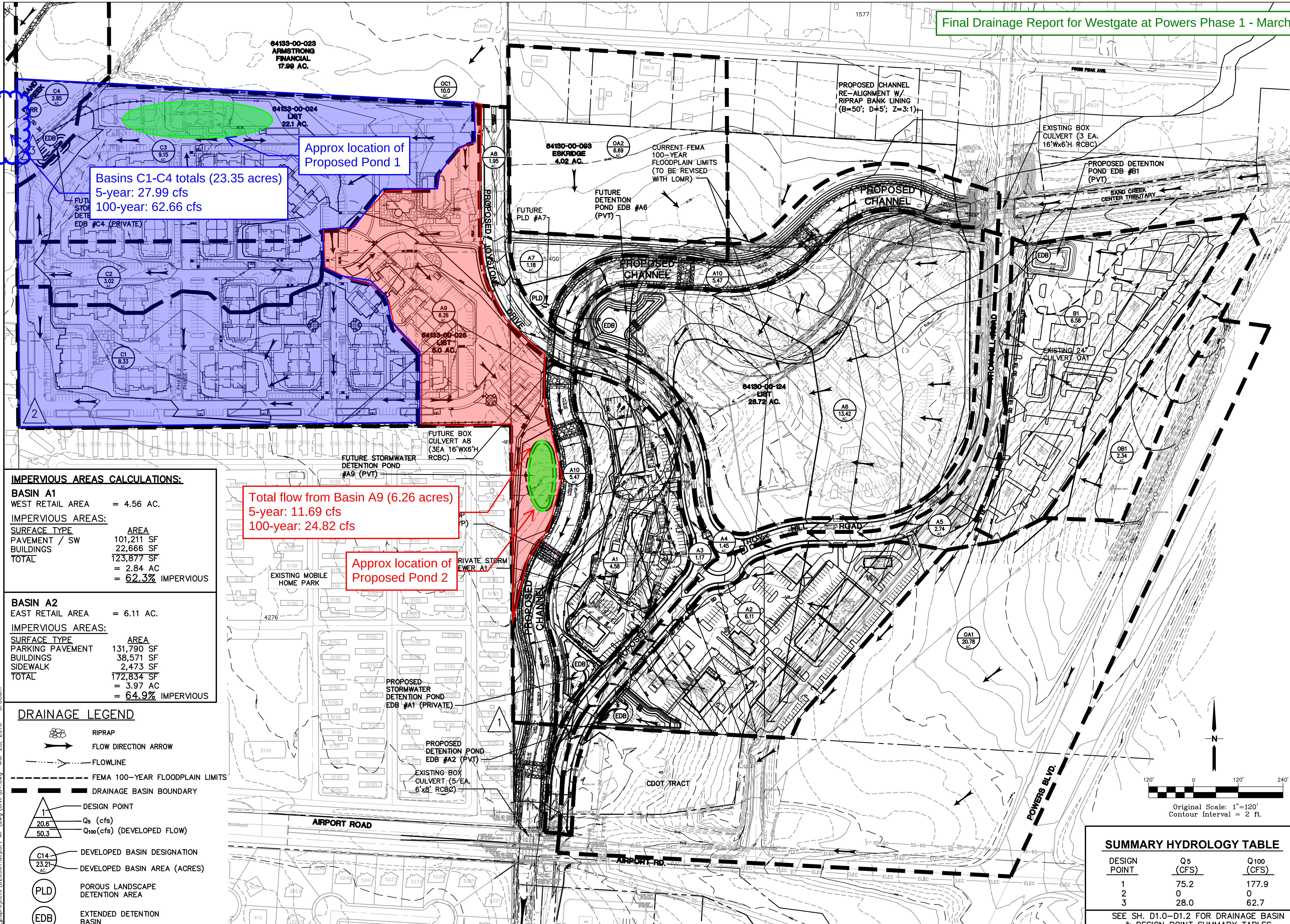
WESTGATE AT POWERS
RATIONAL METHOD

DEVELOPED FLOWS

					Overland Flow			Channel flow										
			C										TOTAL	TOTAL	INTENSITY (5)		PEAK FLOW	
BASIN	DESIGN POINT	AREA (AC)	5-YEAR (7)	100-YEAR (7)	LENGTH (FT)	SLOPE (FT/FT)	Tco (1) (MIN)	CHANNEL LENGTH (FT)	CONVEYANCE COEFFICIENT C	SLOPE (FT/FT)	SCS (2) VELOCITY (FT/S)	Tt (3) (MIN)	Tc (4) (MIN)	Tc (4) (MIN)	5-YR (IN/HR)	100-YR (IN/HR)	Q5 (6) (CFS)	Q100 (6) (CFS)
A1	A1	4.56	0.591	0.779	100	0.03	6.5	780	20	0.0218	2.95	4.4	10.9	10.9	4.00	6.72	10.79	23.88
A3	A3	1.17	0.756	0.853	28	0.02	2.6	1180	20	0.0169	2.60	7.6	10.2	10.2	4.10	6.88	3.62	6.87
A1,A3	A1a	5.73	0.625	0.794									10.9	10.9	4.00	6.72	14.34	30.59
A2	A2	6.11	0.613	0.746	100	0.02	7.1	980	20	0.0276	3.32	4.9	12.0	12.0	3.86	6.47	14.44	29.51
A4	A4	1.45	0.756	0.853	12	0.02	1.7	1310	20	0.0179	2.68	8.2	9.9	9.9	4.15	6.96	4.54	8.61
A5	A5	2.74	0.756	0.853	12	0.02	1.7	1890	20	0.0228	3.02	10.4	12.2	12.2	3.84	6.44	7.94	15.05
Tt A4-A2							0.0	680	20	0.0287	3.39	3.3	3.3					
A2,A4,A5	A2a	10.30	0.671	0.790									13.2	13.2	3.71	6.23	25.63	50.66
OA1	OA1	20.78	0.190	0.432	100	0.02	13.2	2680	15	0.0175	1.98	22.5	35.7	35.7	2.22	3.72	8.76	33.42
A2,A4,A5,OA1	A5a	31.08	0.350	0.551									35.7	35.7	2.22	3.72	24.14	63.76
A1-A5,OA1	A3a	36.81	0.393	0.589									35.7	35.7	2.22	3.72	32.10	80.72
A6	A6	13.42	0.590	0.700	100	0.08	4.7	1150	20	0.0148	2.43	7.9	12.5	12.5	3.79	6.36	30.00	59.75
OA2	OA2	6.69	0.278	0.434	100	0.01	15.0	400	15	0.0175	1.98	3.4	18.4	18.4	3.21	5.39	5.98	15.66
A7	A7	1.18	0.590	0.700	20	0.02	3.2	100	20	0.01	2.00	0.8	4.0	5.0	5.17	8.68	3.60	7.17
A8	A8	1.95	0.757	0.853	28	0.02	2.6	720	20	0.01	2.00	6.0	8.6	8.6	4.35	7.30	6.42	12.15
OA2,A6-A8	A6a	23.24	0.514	0.636									12.5	12.5	3.79	6.36	45.26	94.01
A9	A9	6.26	0.490	0.620	100	0.02	8.9	480	20	0.013	2.28	3.5	12.4	12.4	3.81	6.40	11.69	24.82
A10	A10	5.47	0.080	0.350			0.0	2276	15	0.012	1.64	23.1	23.1	23.1	2.87	4.82	1.26	9.24
OB1	OB1	2.34	0.080	0.350	100	0.01	17.0	110	15	0.01	1.50	1.2	18.2	18.2	3.23	5.42	0.60	4.44
B1		6.58	0.573	0.717			0.0	420	20	0.0333	3.65	1.9	1.9	5.0	5.17	8.68	19.49	40.95
OB1,B1	B1	8.92	0.444	0.621									20.1	20.1	3.08	5.17	12.20	28.64
OA1,OA2,OB1,A,B	1	80.70	0.420	0.592									35.7	35.7	2.22	3.72	75.20	177.87
OC1	OC1	10.00	0.590	0.700	300	0.01	14.8	400	15	0.015	1.84	3.6	18.4	18.4	3.21	5.39	18.94	37.73
C1	C1	8.33	0.490	0.620	50	0.02	6.3	1040	20	0.0115	2.14	8.1	14.4	14.4	3.59	6.02	14.64	31.10
C2	C2	3.02	0.490	0.620	70	0.02	7.4	1100	20	0.025	3.16	5.8	13.2	13.2	3.71	6.23	5.49	11.67
C1,C2	C2.1	11.35	0.490	0.620									14.4	14.4	3.59	6.02	19.95	42.38
C3	C3.1	9.15	0.490	0.620	0		0.0	120	20	0.005	1.41	1.4	1.4	5.0	5.17	8.68	23.17	49.24
Tt C1-C3							0.0	670	20	0.01	2.00	5.6	5.6	5.6				
C1-C3	C3.1	20.50	0.490	0.620									19.9	19.9	3.09	5.19	31.08	66.02
C4		2.85	0.080	0.350	0		0.0	215	20	0.005	1.41	2.5	2.5	5.0	5.17	8.68	1.18	8.66
C1-C4	3	23.35	0.440	0.587									25.5	25.5	2.72	4.57	27.99	62.66

1) OVERLAND FLOW Tco = (0.395*(1.1-RUNOFF COEFFICIENT)*(OVERLAND FLOW LENGTH^(0.5)/(SLOPE^(0.333))
2) SCS VELOCITY = C * ((SLOPE(FT/FT)^0.5)
C = 2.5 FOR HEAVY MEADOW
C = 5 FOR TILLAGE/FIELD
C = 7 FOR SHORT PASTURE AND LAWNS
C = 10 FOR NEARLY BARE GROUND
C = 15 FOR GRASSED WATERWAY
C = 20 FOR PAVED AREAS AND SHALLOW PAVED SWALES
3) MANNING'S CHANNEL TRAVEL TIME = L/V (WHEN CHANNEL VELOCITY IS KNOWN)
4) Tc = Tco + Tt
*** IF TOTAL TIME OF CONCENTRATION IS LESS THAN 5 MINUTES, THEN 5 MINUTES IS USED
5) INTENSITY BASED ON I-D-F EQUATIONS IN CITY OF COLORADO SPRINGS DRAINAGE CRITERIA MANUAL
$I_5 = -1.5 * \ln(Tc) + 7.583$
$I_{100} = -2.52 * \ln(Tc) + 12.735$
6) Q = CiA

Final Drainage Report for Westgate at Powers Phase 1 - March 28, 2018



IMPERVIOUS AREAS CALCULATIONS:

BASIN A1

WEST RETAIL AREA = 4.56 AC.

IMPERVIOUS AREAS:

SURFACE TYPE	AREA
PAVEMENT / SW	101,211 SF
BUILDINGS	22,666 SF
TOTAL	123,877 SF
	= 2.84 AC
	= 62.3% IMPERVIOUS

BASIN A2

EAST RETAIL AREA = 6.11 AC.

IMPERVIOUS AREAS:

SURFACE TYPE	AREA
PARKING PAVEMENT	131,790 SF
BUILDINGS	38,571 SF
SIDEWALK	2,473 SF
TOTAL	172,834 SF
	= 3.97 AC
	= 64.9% IMPERVIOUS

DRAINAGE LEGEND

- RIPRAP
- FLOW DIRECTION ARROW
- FLOWLINE
- FEMA 100-YEAR FLOODPLAIN LIMITS
- DRAINAGE BASIN BOUNDARY
- DESIGN POINT (1; 20.6 = Q_5 (cfs); 50.3 = Q_{100} (cfs) (DEVELOPED FLOW))
- DEVELOPED BASIN DESIGNATION (C14); DEVELOPED BASIN AREA (ACRES) (23.21 AC)
- PLD — POROUS LANDSCAPE DETENTION AREA
- EDB — EXTENDED DETENTION BASIN

SUMMARY HYDROLOGY TABLE

DESIGN POINT	Q_5 (CFS)	Q_{100} (CFS)
1	75.2	177.9
2	0	0
3	28.0	62.7

SEE SH. D1.0–D1.2 FOR DRAINAGE BASIN & DESIGN POINT SUMMARY TABLES

JPS ENGINEERING
19 E. Willamette Ave.
Colorado Springs, CO 80903
PH: 719-477-9429
FAX: 719-471-0766
www.jpsengr.com

CALL UTILITY NOTIFICATION CENTER OF COLORADO 1-800-922-1987
CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

WESTGATE AT POWERS

MASTER DEVELOPMENT DRAINAGE PLAN

No.	REVISION	BY	DATE

HORZ. SCALE:	1"=120'	DRAWN:	BJJ
VERT. SCALE:	N/A	DESIGNED:	JPS
SURVEYED:	LDC	CHECKED:	JPS
CREATED:	2/2/05	LAST MODIFIED:	3/28/18
PROJECT NO:	020501	MODIFIED BY:	BJJ
SHEET:	D1		

J:\jpsprojects\020501.airport MP\dwg\Civil\D1.dwg Mar 28, 2018 - 8:08am

APPENDIX G – APPROVED VARIANCE

Kimley»Horn

6/06/2023

Jonathan Scherer
Colorado Springs Public Works
30 S. Nevada Ave #401
Colorado Springs, CO 80903

Subject: ***MDDP Amendment / Final Drainage Report for Westgate at Powers Filing No. 3 Variance Request***
Master Project Number: STM-MP21-0474
Final Drainage Report: STM-REV23-0162

This letter, submitted on behalf of the applicant RealSource Properties, LLC (the Applicant), for the Westgate Apartments (Project), provides a summary of the project requirements, the design considerations, and the subsequent request for a variance to the City of Colorado Springs Drainage Criteria Manual (the "Criteria") for the following:

1. Pipe velocities less than 3 fps
2. Pipe slope less than 0.5% for pipes 30 inches diameter and smaller

Location and Project Description

The Project is located within the Sand Creek Drainage Basin and is part of the subject area of the Master Development Drainage Plan for Westgate at Powers dated April 30, 2012 prepared by JPS Engineering (the "MDDP"). Additionally, the subject area is analyzed in the Final Drainage Report for Westgate at Powers Phase 1 dated March 28, 2018 prepared by JPS Engineering. Furthermore, the East Fork Sand Creek Drainage Channel was recently realigned and stabilized as outlined within the Channel Design Report for Westgate at Powers Sand Creek Center Tributary Channel (the "Channel Study") dated March 28, 2018 and prepared by JPS Engineering.

The Project is located on Joystone Drive, northwest of the intersection Airport Rd and S Powers Blvd. The Project is bound by Joystone Drive to the east, Sand Creek to the West, vacant land to the north, and a residential development to the south. The site will be accessed by three proposed driveways, each connecting to Joystone Drive. More specifically, the Project is within a portion of the south half of section 13, township 14 south, range 66 west of the 6th P.M., City of Colorado Springs, County of El Paso, State of Colorado.

The proposed development involves the construction of 19 apartment buildings totaling 456 units. The proposed development also includes the construction of two clubhouses, pool deck areas, surface parking, utilities to service the buildings, detached garages, and an open amenity area. Water quality and detention is provided on-site at two different extended detention basins.

As part of the utility infrastructure improvements, a proposed storm sewer system will be constructed to collect runoff. Stormwater will be conveyed via overland flow across the lots, within the curb and gutter of the proposed streets before being captured in proposed storm inlets. The storm sewer system will then convey runoff into the private full-spectrum extended detention basins before being discharged offsite into existing drainage channels. The site is bound by two separate streamside zones, as both the eastern and western boundaries of the site are included in the Streamside Zone, and carries the 'SS' zoning tag. Refer to the Streamside and Land Suitability Plans included as a part of the Development Plan for additional information.

Variance 1: Pipe velocities less than 3 fps

DCM, Volume 1, Chapter 9, Section 7.2, *"A minimum velocity of 3 ft/sec is required when the storm sewer conveys runoff from flow equal to the minor design storm flow rate."*

Variance 2: Pipe slope less than 0.5% for pipes 30 inches diameter and smaller

DCM, Volume 1, Chapter 9, Section 7.3, *"The minimum allowable longitudinal slope shall be 0.005 ft/ft (0.50 percent) for pipes 30 inches in diameter and smaller."*

Justification

A variance is requested to allow velocities less than 3 ft/sec in three different segments of pipes during the minor storm event. The three segments are each identified on the overall map view of the storm network in the appendix. Pipe segments 1 and 3 are the outfall pipes from each of the extended detention basins' outlet structures and do not meet the minimum velocity requirement as a result of meeting the necessary release rate requirements for the outlet structures. Pipe segment 3 meets the minimum slope requirement with a proposed slope of 1.4% but cannot be increased in order to increase the velocity due to downstream tie-in elevation constraints. Pipe segment 2, which outfalls into Pond N at Forebay A is 36" RCP and designed at the minimum allowable slope of 0.3% for pipes 36" or greater in order to meet cover requirements at the upstream end of this storm alignment at Inlet P3. The hydraulic calculations in the MDDP Amendment/FDR also show that this pipe segment meets the minimum slope criteria in a free outfall condition, but not with the tailwater defined condition from the minor storm event.

For pipe segment 1, a variance is also being requested to allow the 24" RCP outlet pipe to lay at 0.34% slope, which is less than then 0.5% minimum required slope for pipes of this size. The pipes' tie-in elevation above the channel is required to minimally impact the already stabilized drainageway. The slope of the pipe was then determined after all on-site flows were captured in Pond N and the outlet structure was set at the highest allowable elevation per the Criteria, resulting in a 0.34% slope in pipe segment 1.

Conclusion

Due to site constraints, a variance to allow velocities less than 3ft/s and pipe slope less than 0.5% in pipes 30" or less are being requested. This variance has no impact on peak flows and water quality within the Sand Creek Drainage Basin. The requested variance will not result in any increase in peak flows in Fountain Creek. The requested variance will not result in any decrease in water quality in Fountain Creek. We hereby request that this variance from the Criteria be granted due to the challenges associated with the site constraints noted above. Should you have any questions or concerns, please do not hesitate to contact me at (719) 284-7310.

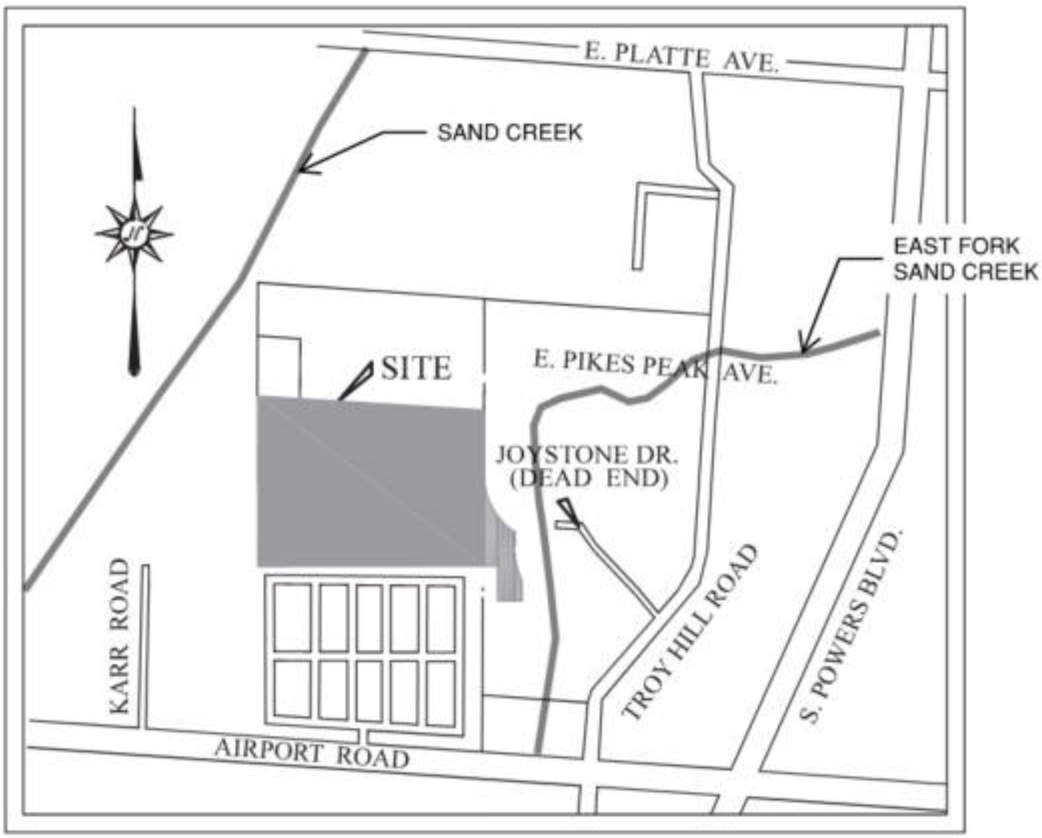
Sincerely,

KIMLEY-HORN AND ASSOCIATES, INC.

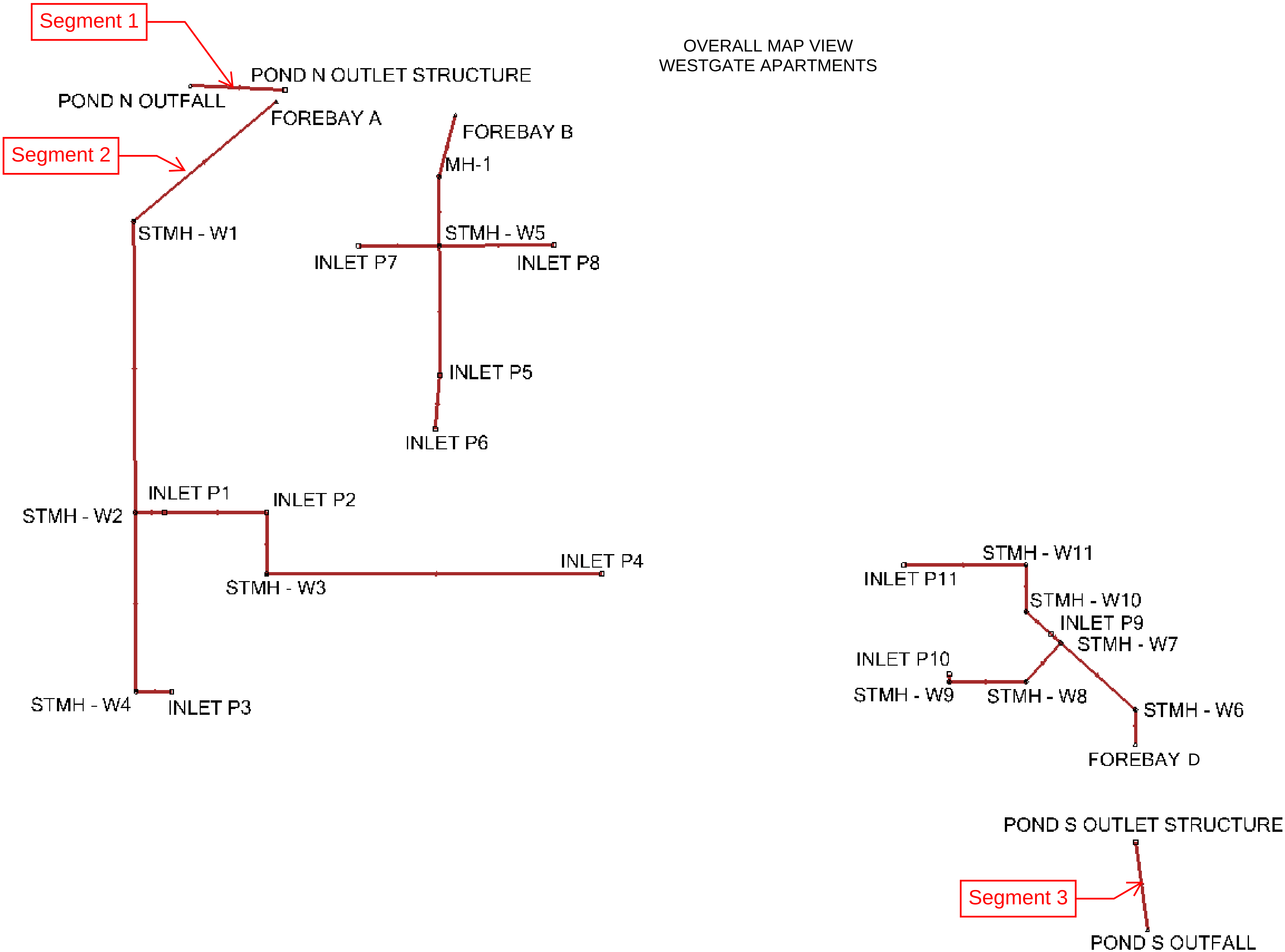
COLORADO LICENSED
MITCHELL O. HESS
53916
6/06/2023
PROFESSIONAL ENGINEER

Mitchell Hess, P.E. No. 53916
Project Engineer

Vicinity Map



VICINITY MAP
(NOT TO SCALE)


OVERALL MAP VIEW
WESTGATE APARTMENTS
Segment 1
POND N OUTLET STRUCTURE
POND N OUTFALL
FOREBAY A
Segment 2
FOREBAY B
MH-1
STMH - W1
STMH - W5
INLET P7
INLET P8
INLET P5
INLET P6
INLET P1
INLET P2
STMH - W2
INLET P4
STMH - W3
STMH - W4
INLET P3
STMH - W11
INLET P11
STMH - W10
INLET P9
STMH - W7
INLET P10
STMH - W9
STMH - W8
STMH - W6
FOREBAY D
POND S OUTLET STRUCTURE
Segment 3
POND S OUTFALL

Westgate Apartments

5-YEAR TAILWATER MODEL

Conduit Table - Time: 0.00 hours

Start Node	Stop Node	Invert (Start) (ft)	Invert (Stop) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Flow (cfs)	Velocity (ft/s)	Capacity (Design) (cfs)	Flow / Capacity (Design) (%)	Manning's n	Headloss (ft)	Froude Number (Normal)
INLET P11	STMH - W11	6,122.20	6,121.37	167.0	0.005	18.0	2.24	3.67	7.40	30.3	0.013	0.82	0.999
STMH - W11	STMH - W10	6,121.17	6,120.85	64.2	0.005	18.0	2.24	3.68	7.41	30.2	0.013	0.32	1.001
STMH - W10	INLET P9	6,120.65	6,120.42	45.7	0.005	18.0	2.24	3.69	7.45	30.1	0.013	0.23	1.006
INLET P5	STMH - W5	6,115.15	6,113.81	178.0	0.007	30.0	11.84	6.51	35.52	33.3	0.013	0.23	1.331
INLET P7	STMH - W5	6,116.76	6,114.90	110.5	0.020	18.0	1.12	4.95	14.87	7.5	0.013	1.09	1.981
INLET P8	STMH - W5	6,118.50	6,117.71	157.5	0.005	18.0	1.85	3.49	7.43	24.9	0.013	0.79	1.008
INLET P4	STMH - W3	6,119.79	6,117.49	460.7	0.005	18.0	3.46	4.13	7.43	46.6	0.013	2.31	0.974
INLET P10	STMH - W9	6,120.66	6,120.61	10.7	0.005	24.0	5.99	4.61	15.49	38.7	0.013	0.00	1.005
STMH - W9	STMH - W8	6,120.41	6,119.88	105.6	0.005	24.0	5.99	4.73	16.03	37.4	0.013	0.37	1.043
INLET P9	STMH - W7	6,119.42	6,119.32	18.6	0.005	30.0	7.06	5.00	30.07	23.5	0.013	0.00	1.139
STMH - W7	STMH - W6	6,119.12	6,118.44	137.6	0.005	30.0	13.05	5.73	28.84	45.3	0.013	0.02	1.057
STMH - W8	STMH - W7	6,119.68	6,119.32	71.6	0.005	24.0	5.99	4.74	16.04	37.3	0.013	0.02	1.044
STMH - W6	FOREBAY D	6,118.24	6,118.00	47.2	0.005	30.0	13.05	5.79	29.24	44.6	0.013	0.02	1.073
INLET P6	INLET P5	6,117.88	6,115.65	74.3	0.030	24.0	5.34	8.73	39.18	13.6	0.013	2.55	2.587
STMH - W3	INLET P2	6,116.99	6,116.56	84.8	0.005	24.0	3.46	4.06	16.00	21.6	0.013	0.20	1.059
INLET P2	INLET P1	6,116.26	6,115.56	140.1	0.005	24.0	5.72	4.67	15.99	35.8	0.013	0.72	1.043
INLET P3	STMH - W4	6,116.04	6,115.80	49.1	0.005	24.0	5.61	4.64	16.00	35.1	0.013	0.22	1.044
INLET P1	STMH - W2	6,115.06	6,113.77	40.3	0.032	30.0	9.11	10.18	73.41	12.4	0.013	0.23	2.769
STMH - W2	STMH - W1	6,113.27	6,112.07	400.3	0.003	36.0	14.72	4.89	36.53	40.3	0.013	0.17	0.858
STMH - W4	STMH - W2	6,115.50	6,114.27	246.0	0.005	24.0	5.61	4.64	15.99	35.1	0.013	0.50	1.044
POND S OUTLET STRUCTURE	POND S OUTFALL	6,114.00	6,112.00	121.7	0.014	18.0	0.20	2.61	12.46	1.6	0.013	2.03	1.538
STMH - W1	FOREBAY A	6,111.87	6,111.10	255.3	0.003	36.0	14.72	2.08	36.53	40.3	0.013	0.12	0.858
POND N OUTLET STRUCTURE	POND N OUTFALL	6,110.17	6,109.70	129.8	0.003	24.0	0.70	2.23	13.21	5.3	0.013	0.49	0.845
STMH - W5	STMH-W12	6,113.61	6,113.14	94.7	0.005	30.0	16.45	6.09	28.97	56.8	0.013	0.10	1.031
STMH-W12	FOREBAY B	6,112.94	6,112.50	87.9	0.005	30.0	16.45	3.35	29.02	56.7	0.013	0.14	1.033

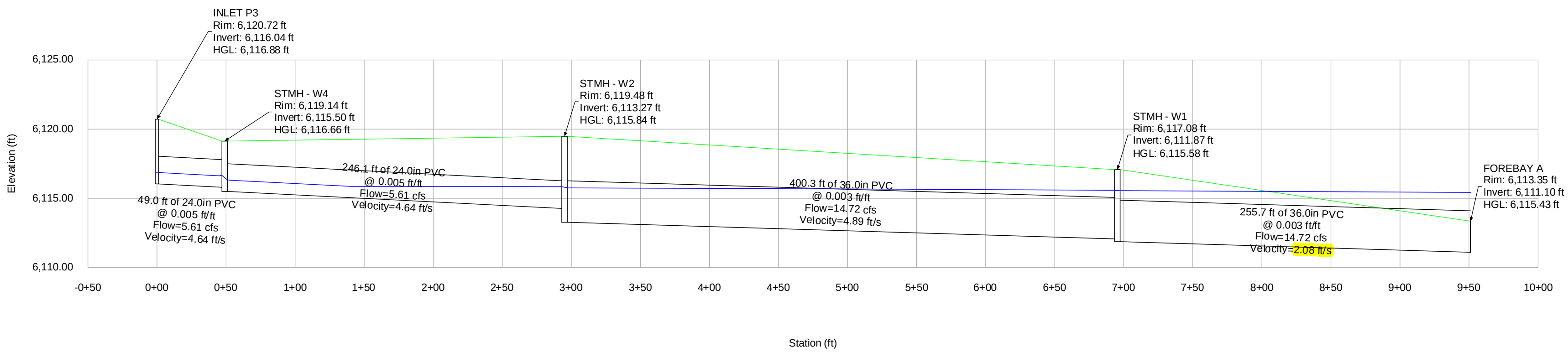
Segments 1, 2, & 3

Westgate Apartments

Profile Report

Engineering Profile - Storm A (Westgate.stsw)

Active Scenario: 5 - YEAR TAILWATER MODEL

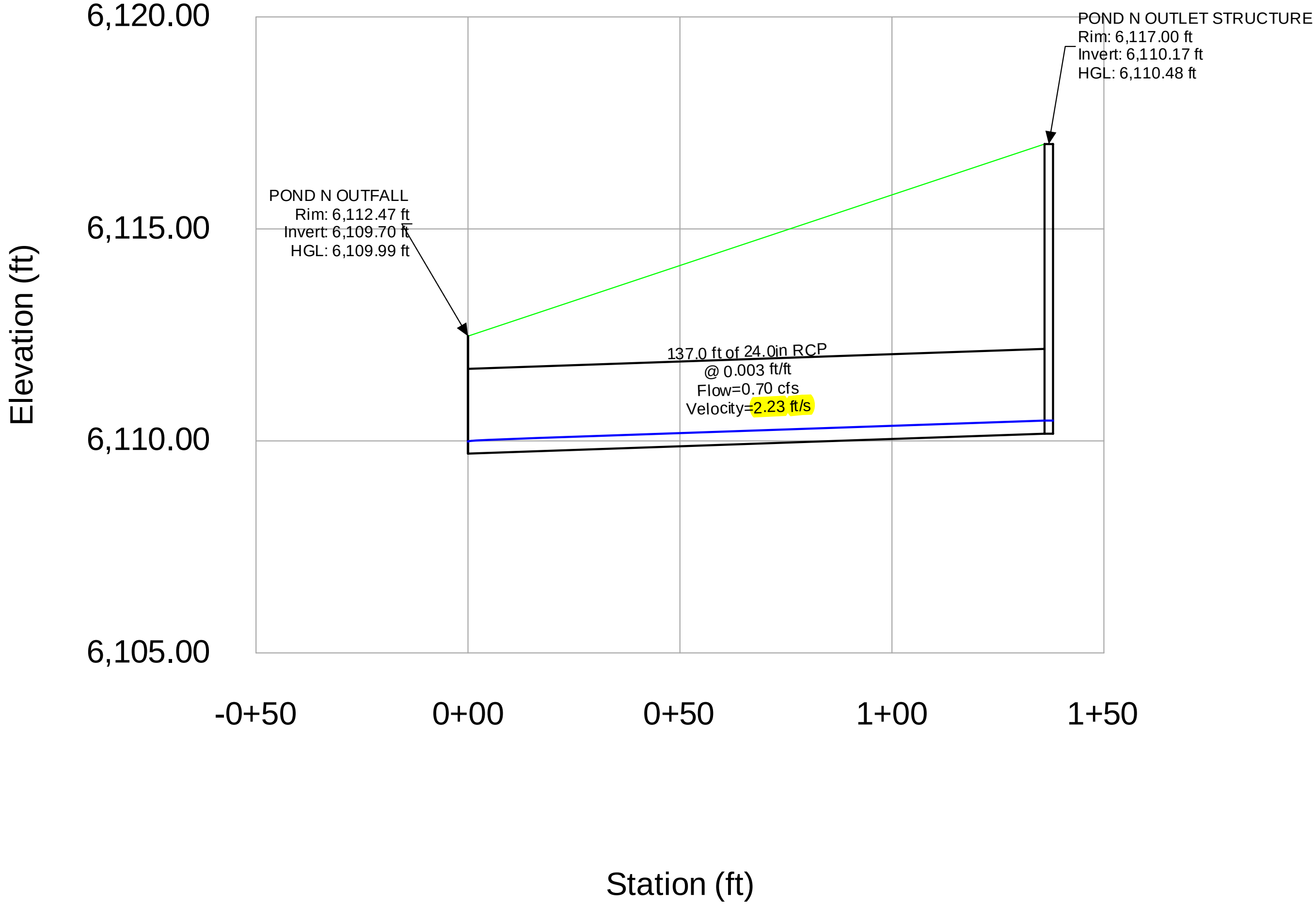


Westgate Apartments

Profile Report

Engineering Profile - Pond N Outfall (Westgate.stsw)

Active Scenario: 5 - YEAR TAILWATER MODEL

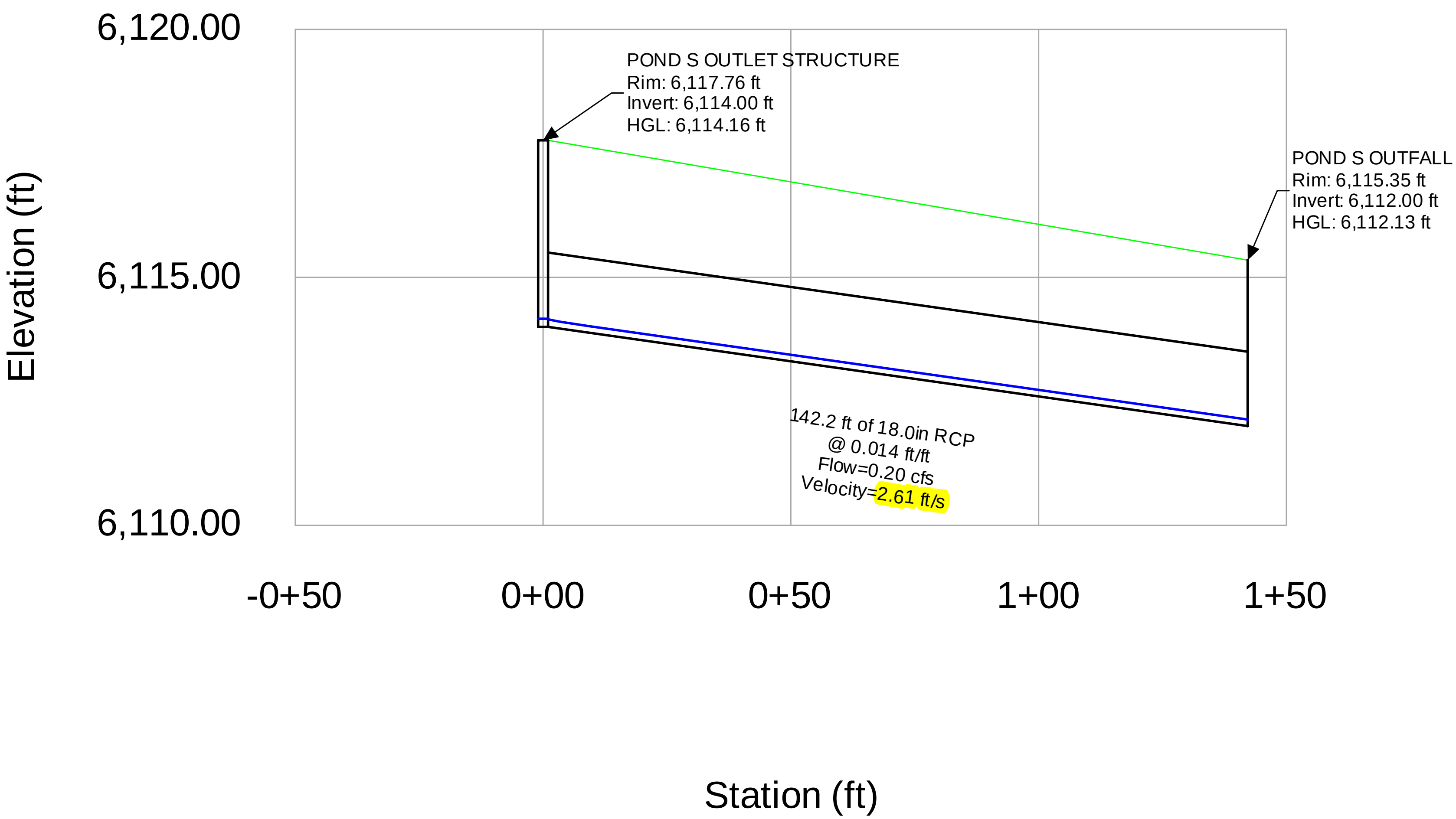


Westgate Apartments

Profile Report

Engineering Profile - Pond S Outfall (Westgate.stsw)

Active Scenario: 5 - YEAR TAILWATER MODEL



Westgate Apartments

5 - YEAR FREE OUTFALL

Conduit Table

Start Node	Stop Node	Invert (Start) (ft)	Invert (Stop) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Flow (cfs)	Velocity (ft/s)	Capacity (Design) (cfs)	Flow / Capacity (Design) (%)	Manning's n	Headloss (ft)	Froude Number (Normal)
INLET P11	STMH - W11	6,122.20	6,121.37	167.0	0.005	18.0	2.24	3.67	7.40	30.3	0.013	0.82	0.999
STMH - W11	STMH - W10	6,121.17	6,120.85	64.2	0.005	18.0	2.24	3.68	7.41	30.2	0.013	0.32	1.001
STMH - W10	INLET P9	6,120.65	6,120.42	45.7	0.005	18.0	2.24	3.69	7.45	30.1	0.013	0.23	1.006
INLET P5	STMH - W5	6,115.15	6,113.81	178.0	0.007	30.0	11.84	6.51	35.52	33.3	0.013	0.48	1.331
INLET P7	STMH - W5	6,116.76	6,114.90	110.5	0.020	18.0	1.12	4.95	14.87	7.5	0.013	1.33	1.981
INLET P8	STMH - W5	6,118.50	6,117.71	157.5	0.005	18.0	1.85	3.49	7.43	24.9	0.013	0.79	1.008
INLET P4	STMH - W3	6,119.79	6,117.49	460.7	0.005	18.0	3.46	4.13	7.43	46.6	0.013	2.31	0.974
INLET P10	STMH - W9	6,120.66	6,120.61	10.7	0.005	24.0	5.99	4.61	15.49	38.7	0.013	0.00	1.005
STMH - W9	STMH - W8	6,120.41	6,119.88	105.6	0.005	24.0	5.99	4.73	16.03	37.4	0.013	0.38	1.043
INLET P9	STMH - W7	6,119.42	6,119.32	18.6	0.005	30.0	7.06	5.00	30.07	23.5	0.013	0.00	1.139
STMH - W7	STMH - W6	6,119.12	6,118.44	137.6	0.005	30.0	13.05	5.73	28.84	45.3	0.013	0.71	1.057
STMH - W8	STMH - W7	6,119.68	6,119.32	71.6	0.005	24.0	5.99	4.74	16.04	37.3	0.013	0.02	1.044
STMH - W6	FOREBAY D	6,118.24	6,118.00	47.2	0.005	30.0	13.05	5.79	29.24	44.6	0.013	0.28	1.073
INLET P6	INLET P5	6,117.88	6,115.65	74.3	0.030	24.0	5.34	8.73	39.18	13.6	0.013	2.55	2.587
STMH - W3	INLET P2	6,116.99	6,116.56	84.8	0.005	24.0	3.46	4.06	16.00	21.6	0.013	0.20	1.059
INLET P2	INLET P1	6,116.26	6,115.56	140.1	0.005	24.0	5.72	4.67	15.99	35.8	0.013	0.72	1.043
INLET P3	STMH - W4	6,116.04	6,115.80	49.1	0.005	24.0	5.61	4.64	16.00	35.1	0.013	0.22	1.044
INLET P1	STMH - W2	6,115.06	6,113.77	40.3	0.032	30.0	9.11	10.18	73.41	12.4	0.013	1.09	2.769
STMH - W2	STMH - W1	6,113.27	6,112.07	400.3	0.003	36.0	14.72	4.89	36.53	40.3	0.013	1.25	0.858
STMH - W4	STMH - W2	6,115.50	6,114.27	246.0	0.005	24.0	5.61	4.64	15.99	35.1	0.013	1.25	1.044
POND S OUTLET STRUCTURE	POND S OUTFALL	6,114.00	6,112.00	121.7	0.014	18.0	0.20	2.61	12.46	1.6	0.013	2.03	1.538
STMH - W1	FOREBAY A	6,111.87	6,111.10	255.3	0.003	36.0	14.72	4.89	36.53	40.3	0.013	0.87	0.858
POND N OUTLET STRUCTURE	POND N OUTFALL	6,110.17	6,109.70	129.8	0.003	24.0	0.70	2.23	13.21	5.3	0.013	0.49	0.845
STMH - W5	STMH-W12	6,113.61	6,113.14	94.7	0.005	30.0	16.45	6.09	28.97	56.8	0.013	0.45	1.031
STMH-W12	FOREBAY B	6,112.94	6,112.50	87.9	0.005	30.0	16.45	6.10	29.02	56.7	0.013	0.46	1.033

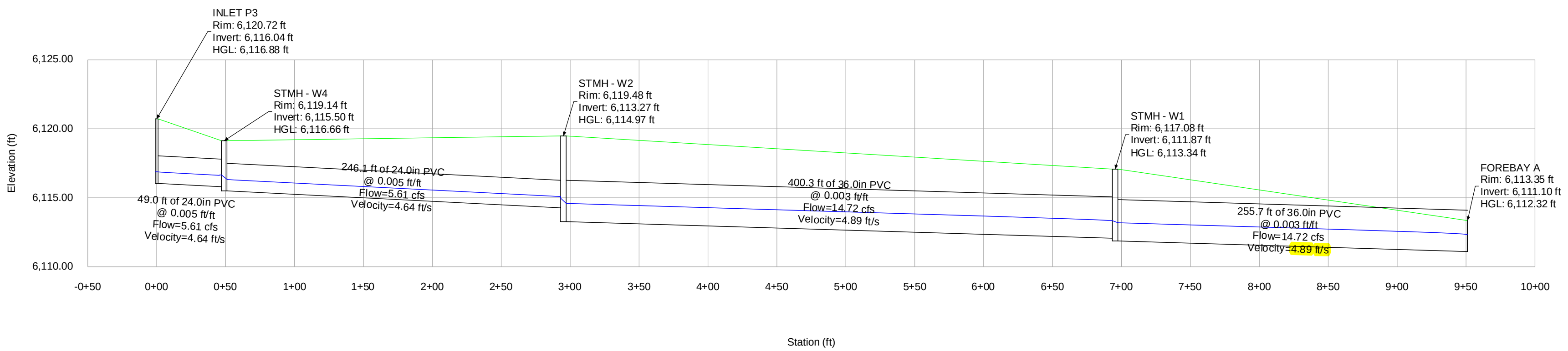
Segments 1, 2, & 3

Westgate Apartments

Profile Report

Engineering Profile - Storm A (Westgate.stsw)

Active Scenario: 5 - YEAR FREE OUTFALL

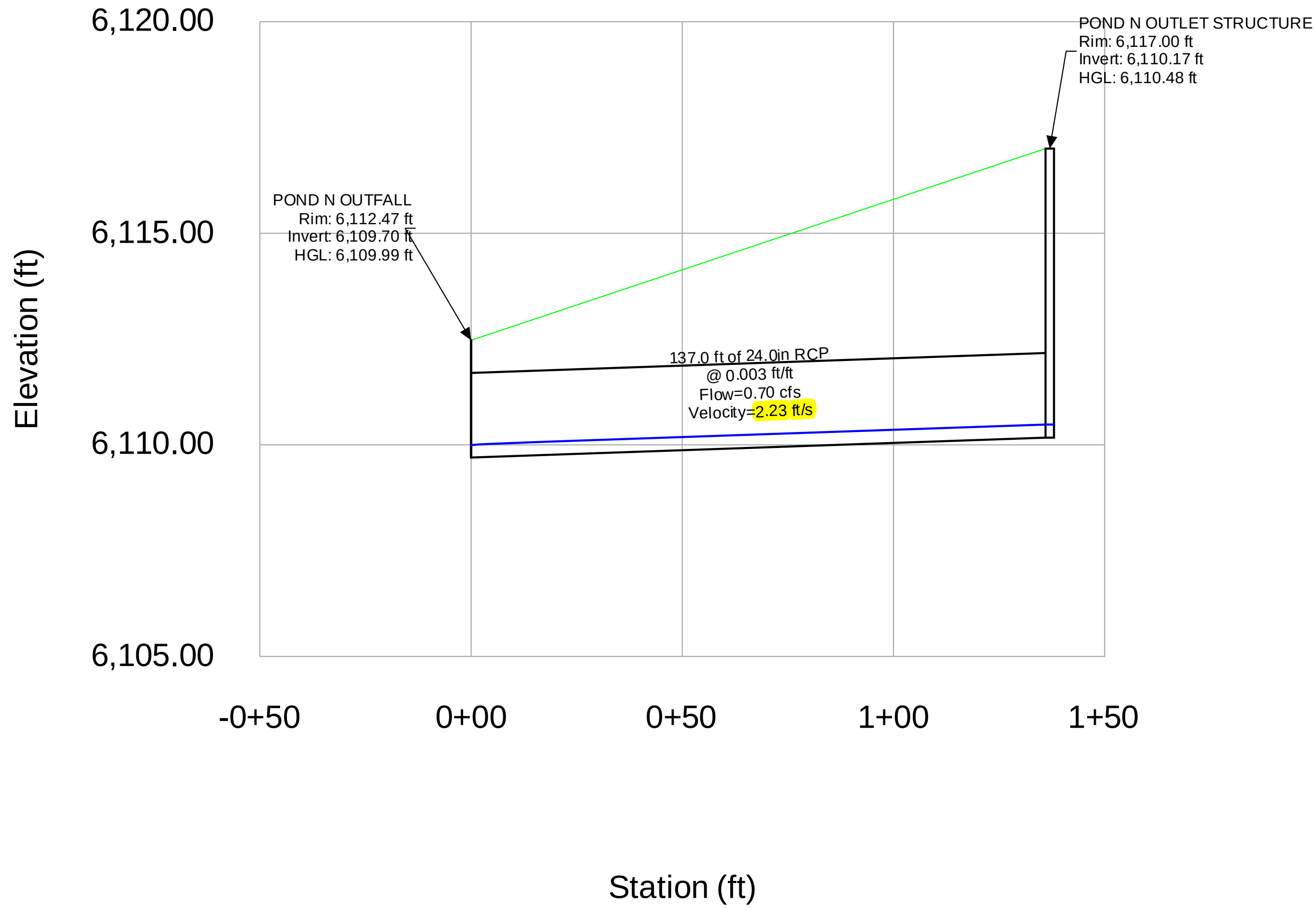


Westgate Apartments

Profile Report

Engineering Profile - Pond N Outfall (Westgate.stsw)

Active Scenario: 5 - YEAR FREE OUTFALL



Westgate Apartments

Profile Report

Engineering Profile - Pond S Outfall (Westgate.stsw)

Active Scenario: 5 - YEAR FREE OUTFALL