MASTER DEVELOPMENT DRAINAGE PLAN
FOR
WILLOWIND COMMERCIAL FILING NO. 4
AND THE
FINAL DRAINAGE REPORT FOR WILLOWIND COMMERICAL FILING NO. 4 INITIAL INFRASTRUCTURE

October 2023

Prepared for:

CD Marksheffel & Barnes LLC
106 S. Kyrene Rd, Ste 2
Chandler, AZ 85226

Prepared by:

CIVIL CONSULTANTS,INC.

212 N Wahsatch Ave, Ste 305
Colorado Springs, CO 80903
(719) 955-5485

Project #10-021

MASTER DEVELOPMENT DRAINAGE PLAN FOR WILLOWIND COMMERCIAL FILING NO. 4 AND THE FINAL DRAINAGE REPORT FOR WILLLOWIND COMMERCIAL FILING NO. 4 INITIAL INFRASTRUCTURE

DRAINAGE REPORT STATEMENTS

ENGINEER'S STATEMENT

This report and plan for the drainage design of Willowind Commercial Filing No. 4 was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said drainage report and plan has been prepared in accordance with the City of Colorado Springs Drainage Criteria Manual and is in conformity with the master plan of the drainage basin. I understand that the City of Colorado Springs does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.



Virgil A. Sanchez, P.E. #37160
For and on Behalf of M&S Civil Consultants, Inc

DEVELOPER'S STATEMENT

CD Marksheffel & Barnes LLC., hereby certifies that the drainage facilities for Willowind Commercial Filing No. 4 shall be constructed according to the design presented in this report. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to the City of Colorado Springs pursuant to Section 7.7.906 of the City Code; and cannot, on behalf of the Willowind Commercial Filing No. 4, guarantee that final drainage design review will absolve CD Marksheffel & Barnes 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.

BY: _____ DATE: 10/26/23

TITLE: Developer

ADDRESS: CD Marksheffel & Barnes LLC
106 S. Kyrene Rd., Ste 2
Chandler, AZ 85226

CITY OF COLORADO SPRINGS

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

BY: _____ DATE: 11/14/23

For the City Engineer Heidi McMacken

CONDITIONS:

MASTER DEVELOPMENT DRAINAGE PLAN FOR WILLOWIND COMMERCIAL FILING NO. 4 AND THE FINAL DRAINAGE REPORT FOR WILLLOWIND COMMERCIAL FILING NO. 4 INITIAL INFRASTRUCTURE

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MASTER DEVELOPMENT DRAINAGE PLAN FOR WILLOWIND COMMERCIAL FILING NO. 4 AND THE FINAL DRAINAGE REPORT FOR WILLLOWIND COMMERCIAL FILING NO. 4 INITIAL INFRASTRUCTURE

PURPOSE

The purpose of this master development drainage plan and final drainage report is to identify the runoff patterns associated with the existing subdivision and its proposed re-platted configuration and recommend "initial" large-scale storm sewer infrastructure improvements to support the development. In addition, this report will conceptually size water quality and detention facilities that will be required as development progresses. The proposed drainage patterns and recommended improvements are to be in compliance with the City of Colorado Springs Drainage Criteria Manual (DCM) Volumes 1 and 2 and the previously approved drainage reports for the area, including the Sand Creek Drainage Basin Planning Study.

The 'initial' infrastructure constructed and approved by this FDR will only includes the construction of the subsurface utilities; which includes the water, wastewater and portions of the proposed storm sewer mains. No additional grading beyond what is required to excavate place and backfill the proposed utilities back to existing grade will be a portion of the final drainage report. It should be noted that no additional imperviousness will be created by the installation of the aforementioned 'initial' infrastructure. As the specific site plans for the undeveloped lots are not known at this time, individual drainage reports shall be required for all future lots and ensure compliance with this master development drainage plan.

GENERAL LOCATION AND DESCRIPTION

The Willowind Commercial Filing No. 4 (WWCF4) is a proposed commercial development. The site is located in the southeast one-quarter of Section 20, Township 13 South, Range 65 West of the Sixth Principal Meridian, Colorado Springs, El Paso County, Colorado. (Refer to the Vicinity map in the appendix for additional details).

The 8.74 AC site is currently divided into eight (8) separate lots and zoned PBC AO. Two (2) of the existing lots; Lot 1 Willowind Commercial Filing No. 3 (currently 7-11 convenience store) and Lot 1 Willowind Commercial Filing No. 2 (currently a mixed-use commercial building) have been developed in accordance with the approved 2007 development plan. The concept plan has since expired.

The proposed concept plan will redevelop the seven (7) lots, of which six (6) are vacant. No proposed changes to the existing commercial buildings are associated with this concept plan. A final plat is proposed alongside the concept plan, incorporating utility easements and lot area changes.

All remaining seven (7) vacant lots and the existing mixed-use commercial building are proposed as a commercial center. All lots will benefit from a shared access and parking agreement, which will be implemented through the Property Owners Association convents. Site specific details for the redevelopment of the seven (7) lots will be provided in future development plans.

The site is bounded by an existing public roadway of Antelope Ridge Drive and Willowind at Stetson Hills Filing No. 1 to the west, an existing public street of Barnes Road and Chateau at Antelope Ridge Filing No. 1 to the south, an existing public roadway of Marksheffel Road to the east and Willowind at Stetson Hills Filing No. 4 to the north. The County records indicate that BLH No. 2, LLC owns the property to the east.

The subject property is located within the Tributary to East Fork Sand Creek Basin Drainage flows from this site are tributary East Fork Sand Creek Sub-tributary (EFSCST) which discharges into Sand Creek. Site vegetation for the undeveloped areas is sparse, consisting primarily of native grasses. Existing site terrain generally slopes from north to south, with existing slopes varying between 1 and 10%. Per the Colorado Springs Streamside Overlay Map, no portion of the site lies within a streamside overlay area.

It should be noted that at the time of the preparation of this report, specific site plans for each lot are unknown; as such, the total disturbance by future development is unknown. The total area of the undeveloped lots (1-5, and 7) is approximately 7.3 acres. The total disturbance anticipated based upon the installation of gas, water sanitary and storm sewer (initial infrastructure) totals approximately 70,500 square feet or 1.62 acres. The proposed disturbed areas for future lot development will be discussed in the individual final drainage reports.

SOILS

Soils in the study area were delineated using the "Web Soil Survey" (WSS), a web-based soil database provided by the U.S. Department of Agriculture (USDA)'s Natural Resources Conservation Service (NRCS). Per the site, soils for the analyzed watershed were determined to be Truckton Sandy Loam (97), a deep, well-drained soil formed in an alluvial residuum derived from arkosic sedimentary rock. This soil type is characterized as a Hydrologic Soil Type "A." The HGS information was found using the Hydrologic Soils Group sub-tab under the Soils Properties and Qualities Tab of the USDA, NRCS, and WSS websites. An exhibit within the appendix has been provided which illustrates these descriptions and classifications.

DRAINAGE CRITERIA

This drainage analysis has been prepared in accordance with the current City of Colorado Springs Drainage Criteria Manual (last revised January 2021). Calculations were performed to determine runoff for developed conditions using the Rational Method as required for basins having areas less than 100 acres. An additional large-scale hydrologic modeling was performed using the United States Army Corps of Engineers HEC-HMS program, which aided in determining the stormwater conveyed through the site from the large offsite areas, which totaled greater than 100 acres. Both forms of Hydrologic calculations were performed to estimate stormwater runoff anticipated from design storms with 5-year and 100-year recurrence intervals. Additional drainage criteria discussion regarding the proposed condition analysis is discussed in subsequent related paragraphs. Refer to the Appendix for calculations.

RATIONAL METHOD HYDROLOGIC CALCULATIONS

The rational method was used to calculate peak flows from small on and offsite watersheds. The resultant calculations provided a comparison to the provided existing onsite conditions analysis. In addition, the rational analysis provided runoff rates that could be directly compared against those in the larger HEC-HMS model to ensure its validity further.

Where: $Q = C*i*A$

Q = Maximum runoff rate in cubic feet per second (cfs)

C = Runoff coefficient

i = Average rainfall intensity (inches per hour)

A = Area of drainage sub-basin (acres)

Runoff Coefficient

Rational Method coefficients from Table 6-6 of the City of Colorado Springs Drainage Criteria Manual for developed land were utilized in the Rational Method calculations. Composite percent impervious and C values were calculated using land use or surface characteristics such as (but not limited to): roofs, commercial areas, residential development, paved streets, gravel, landscaped areas, parks, and pastures found within the aforementioned table. A copy of Table 6-6 has been included in the appendix.

Time of Concentration

For urban areas, the time of concentration (tc) consists of an initial time or overland flow time (ti) plus the travel time (tt) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. The travel portion (tt) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainage way. Tc = ti + tt (CS DCM Eq. 6-7) in mins. The overland flow time, (ti), was calculated using CS DCM Equation 6-8. A 300 ft maximum was utilized for non-urban land uses, and a 100 ft maximum for urban land uses.

Rainfall Intensity

The rainfall intensity equation for the Rational Method was taken from Drainage Criteria Manual Volume 1 Figure 6-5. A copy of the Rainfall Intensity Duration Frequency graph and IDF equations are provided in the appendix.

LARGE SCALE HYDROLOGIC CALCULATIONS

The NRCS curve number loss and dimensionless unit hydrograph method have been used to determine the impacts of sizeable offsite runoff reaching the site. The offsite runoff is primarily conveyed via a large-diameter storm sewer system that crosses under the subject site. Per the City of Colorado Springs Drainage Criteria Manual, this method applies to drainage basins as small as 10 acres. It is the only method that should be applied for drainage basins larger than 640 acres. This method can be used to estimate peak flows or to produce a runoff hydrograph and also provides estimates of volumetric runoff.

Hydrologic Modeling

A hydrologic model was utilized to simulate stormwater runoff within the developed watersheds to determine peak discharges and runoff volume for the proposed condition. The models were created using the U.S. Army Corps of Engineers HEC-HMS hydrologic modeling program version 4.10. The NRCS curve number loss and dimensionless unit hydrograph method were applied with HEC-HMS in accordance with the drainage criteria manual.

Project Mapping

Project mapping for the hydrologic analysis located outside the subject site consisted of several clipped images obtained from the City of Colorado Springs Spring View graphic information systems (GIS) website.

Onsite topographic and planimetric data was provided from a site survey conducted by Olson & Associated. Contour information provided by that survey was in 1’ increments. Layers included within the background images included 2’ contour data and 2020 aerial imagery.

Times of Concentration Calculations

Topographic contour data collected from the mapping and onsite surveys were used to determine overland flow paths and reach slopes and geometry. Times of concentration calculation were analyzed in accordance with guidance provided in Chapter 6, Section 3.2 of the Colorado Springs Drainage Criteria Manual. Typically, overland sheet flow was limited to a maximum of 100 feet for urban development, while sheet flow for rural development was limited to 300 feet.

Lag Times

Equation 6-13 from the DCM, T(lag) = 0.6 *Tc, was utilized to convert times of concentration to lag time. The existing conditions and developed conditions' times of concentration and resultant lag times are provided in spreadsheets located in the appendix.

Reach Routing

Reach Routing for stream and pipe conveyance was performed within HEC HMS using the Kinematic Wave method. The Kinematic Wave method requires input parameters of channel or pipe length, channel or pipe slope, Manning's N value, channel shape, bottom width and side slope, and/or pipe diameter. Spreadsheets in the appendix list the reach data that has been entered into the proposed HEC-HMS hydrologic model. Most typically, a roughness factor of 0.050 was assumed for channels assuming a narrow grass-lined channel with mild to steep earthen side slopes, while a roughness value of 0.013 was utilized in modeling concrete-lined conveyance structures and pipes. Labeling of the channel reaches within this HMS model has been designated by R-X and is shown on the model schematics and the HEC-HMS proposed conditions maps included in the appendix.

Runoff Curve Numbers/Impervious Percentage

The curve numbers for the developed condition watersheds within the model have been assigned based on land use and a soil type. An area-weighted composite curve number for each sub-basin was calculated when multiple land uses were encountered within a basin. Spreadsheets (which immediately follows the basin schematic) summarizes theses various curve numbers and associated impervious percentage values for the given land use and soil types. Table 6-10 of the City of Colorado Springs Drainage Criteria Manual, Volume I was utilized to assign CN values based upon land use.

It should be noted, that despite that the subject site and the offsite watershed falling within an area defined to possess Hydrologic Soil Group “Type A” soils, many of the selected CN values (where applicable) were chosen based upon HGS “Type B” soils. This is generally due the engineer’s belief that as a result of construction and other disturbances the soil profile has largely been altered from its natural state and thus the extremely well drained characteristics of the soils do not apply to their initial extent. This protocol generally results in the selection of a higher CN coefficient and subsequently results in larger runoff values for a given area, which in turn generally leads to a conservative approach when analyzing and designing existing and proposed infrastructure. This assumption also aligns with section City of Colorado Springs Drainage Criteria Manual (rev 2021) Chapter 6, Section 4.3 which states that “soils within a development project are usually disturbed and covered with top soil, sod or landscaping and irrigated, Type A soils must be represented as Type B soils for post development curve number calculations”.

Initial Abstraction

In accordance with the City of Colorado Springs Drainage Criteria Manual, Initial Abstraction (IA) was calculated for each sub-basin using equation 6-12, Ia = 0.1 {(100/CN)-10]. The calculated values were input into the various HEC-HMS models. A table summarizing the proposed condition initial abstraction values is included in the appendix.

Design Rainfall/Storm Type

The 24-hr storm events for the 5, 10, and 100-year recurrence intervals were evaluated. Rainfall precipitation values of 2.6 inches for the 5-year event, 3.2 inches for the 10-year event, and 4.6 inches for the 100-year event were derived from NOAA Atlas 2 Isopluvial Tables, which are contained within the appendix of this report. The 24-Hr Type II Storm with an Antecedent Moisture Condition (AMC) of II was selected in hydrologic modeling for long-duration "frontal storms." No Depth-Area-Reduction Factor was considered in the modeling of the storm events.

HYDRAULIC CALCULATIONS

Hydraulic calculations were estimated using the methods described in the City of Colorado Springs Storm Drainage Design Criteria Manual (DCM) (last revised January 2021). Manning's Equation was used for the hydraulic analysis of diversion swales and the preliminary sizing of storm sewer facilities. The MFHD-Inlet v5.02 worksheet was utilized to calculate both the street capacities and evaluate inlet capacities. The pertinent data sheets are included in the appendix of this report. It should be noted that bypass flows determined by the MFHD-Inlet sheets are converted back to a CA values and reanalyzed using the rational method at the next downstream design point in lieu of the bypass flow being added to the downsteam inlet via the worksheet.

StormCAD was utilized to analyze the proposed storm sewer system and determine the Hydraulic Grade Line (HGL) profiles for the major and minor storms. The standard method was used to calculate the head loss in the systems using K coefficients provided within Table 9-4 of the Colorado Springs DCM. The flows reported in the HEC-HMS model at the various junctions, basins, and ponds were input into the StormCAD model (the reach flow rates were not used in the model but are reflected on the storm sewer plan sheets.

The Mile High Flood District BMP Sizing (UD-BMPv.3.07) and Detention Design (MHFD Detention v4.06) worksheets were utilized to conceptually size the Full Spectrum Detention Facilities anticipated to be required for the site.

FLOODPLAIN STATEMENT

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel No. 08041C0543G, revised December 7, 2018, the subject site is NOT located within the 100 year floodplain. However, the subject site is located within the Other Areas Zone 'X' which is defined as an area determined to be outside the 0.2 annual chance floodplain and/or Other Areas Zone 'D' in which flood hazards are undetermined but possible. An annotated FIRM Panel is included in the Appendix with an outline of the project site.

PREVIOUS REPORTS

Several studies and reports were reviewed during the preparation of the current study. Below is a brief synopsis of the recommendations and/or key assumptions for the site and the relevant study. The outline also provides a timeline for the changes in assumptions or developments that impact the subject site. Please refer to each study for specific references to design points, pond and basin identifiers, etc. Copies of portions of the referenced documents, including drainage maps, are included in this report's appendix.

Master Development Drainage Plan for Stetson Hills Enclave, by Leigh Whitehead & Associates, Inc. dated September 2000.

The report evaluated the 58 acres located north of Barnes Road, including the subject site. The site is planned to construct single-family, multifamily, and commercial neighborhood business areas, including the subject site.

- Existing conditions show the Ex. 6'x8' Reinforced concrete box culvert (RCBC) under Barnes Road and is shown, but it does not evaluate the culvert that runs under Marksheffel Road. It states additional investigation regarding the culvert will need to be performed with the PDR/FDR stage.

- States that in accordance with the Sand Creek Drainage Basin Planning Study (SCDBPS), runoff from this area (Basin 38) is to be directed to the existing RCBC.

- Estimates Sub-Basin OS-A1, located north of the property (34.8 acres), generates a peak flow of 69.5 cfs and 150.4 cfs in the 50 and 100-year events, respectively.

- Estimates the existing box culvert to have a maximum capacity of 1040 cfs. The planned flow to Structure 23 is estimated to be 305.1cfs for the 10-year event and 903.2 cfs for the 100-year event (per the SCDBPS).

- The combined offsite and onsite areas produced 205.0 and 450 cfs at the beginning of the box culvert (DP-12) and 228 cfs for the 5-year event, and 499 cfs for the 100-year event (DP-15).

- Indicates that wing walls and inlet project at the top of RCBC are planned to be removed and a 6'x10' proposed junction box constructed.

- Proposes a large 48" RCP is planned to convey collected runoff from the single-family and multifamily areas located north through the planned commercial area (subject site) while collecting a portion of the commercial drainage.

- Similarly, a proposed 30/36" will collect flows from a portion of onsite commercial and offsite runoff from Marksheffel (3.34 acres) and offsite areas east of Marksheffel Road. (27.55 acres).

Final Drainage Report and Plan for Willowind at Stetson Hills Filing No. 1, 2, and 3, by Leigh Whitehead & Associates, Inc. dated March 2001.

The project divided the 38.64 acres located to the north and west of the subject site to construct 160 residential lots (Filing 1: 14.64 acres, Filing 2: 14.17 acres, and Filing 3: 9.83 acres). The report discusses assumptions for the commercial area and offsite flows reaching the subject site.

- Estimates the development to the north (of Stetson 1, 2, & 3) to be 39.56 acres, generating an estimated Peak flow of 68.9 cfs and 153.6 cfs for the 5 and 100-year events, respectively. Constructs the pipe to collect the flow and convey it south to the RCBC. (Q100=143.0 cfs to pipe, 10.6 cfs as surface flow, Sub-basin OS-B12)

- The report states that a total of 140.44 acres contributed to the existing 6'x8' reinforced concrete box culvert located onsite. The combined offsite and onsite areas produced 228 cfs for the 5-year event and 499 cfs for the 100-year event, indicating less than the 620 cfs and 903 cfs calculated at Design Point 23 in the SCDBPS, by Kiowa Engineering in 1995.

- Assumes that all onsite and offsite flows affecting the subject site will eventually be directed to the existing 6'x8' RBC.

- Analyzes runoff and sizes inlets and provides flow-by rates for Barnes Road

- The report analyzes a fully developed 6.95-acre offsite basin for Marksheffel Road, producing flows of 27.0 and 50.6 cfs in the 5 and 100-year events, respectively. Indicates Barnes Road sump inlet was sized assuming a future 15' inlet will be placed on Marksheffel Road upstream of Barnes Road and that this inlet will be tied to the 6'x8' RCBC that travels under Barnes. Assumes that bypass flows of 10.5 and 26.5 cfs will be conveyed to the sump inlet in Barnes.
- Assumes maximum flow reaching 20' sump inlet in the north side of Barnes to be 25.5 and 63.3 cfs resulting in corresponding ponding depths of 0.55' and 1.29' in the 5 and 100-year storm events, respectively.

- Assume the existing culvert under Marksheffel Road accepts flows from a large area to the east and is conveyed south instead.

Willowind at Stetson Hills Box Culvert Conversion Exhibit, by Leigh Whitehead & Associates, Inc. dated April 2003.

City of Colorado Springs Design Index #0106-11.

- Construction plan provides connection details of 60" RCP and 24" RCP (from Barnes Sump Inlet) to existing wingwalls of 6'x 8.25' RCBC.

- Construction closes upstream end of RCBC by constructed a new wall/front face and roof/top slab.

- Constructed a manhole access atop structure.

Final Drainage Report and Plan for Willowind Commercial Filing No. 1, by Leigh Whitehead & Associates, Inc. dated April 2003.

This report covers the same area as the subject site. The project divided the 9.63-acre parcel into five (5) lots known as Willowind Commercial Filing No. 1. The report discusses assumptions for the commercial area and offsite flows reaching the subject site. Drainage analysis uses the rational method to calculate onsite runoff while using HEC-1 to analyze total runoff directed to the box culvert.

- Also, an estimated 140.44 acres contributed to the existing 6'x8' reinforced concrete box culvert onsite. The combined offsite and onsite areas produced 228 cfs for the 5-year event and 499 cfs for the 100-year event, indicating less than the 620 cfs and 903 cfs calculated at Design Point 23 in the SCDBPS, by Kiowa Engineering in 1995.

- Assumes all onsite and offsite flows affecting the subject site are to be directed to the existing 6'x8' RBC eventually

- Identifies that the Chateau at Antelope Ridge at Marksheffel Channel was not designed for flows over 420 cfs but indicates that the additional 79 cfs will not significantly impact the channel but lessen the freeboard.

- 18" CMP that crosses under Marksheffel Road is responsible for conveying 27.55 acres at peak flow rates of 19.9 cfs and 49.3 cfs in the 5 and 100-year events, respectively. Per the report, without overtopping, the capacity of the existing 18" CMP is 9.6 cfs. The remaining 39.8 cfs in the 100-year event overtops the road and continues into the Willowind commercial area.

- The total flow reaching the site's eastern side, from 34.50 acres (5.95 Acre OS-B1 and 27.5 acre OS-B2), totals 24.7 cfs and 60.4 cfs at Design Point 1 in the 5 and 100-year events.

- It recommended three options for the culvert. 1) straight grade Marksheffel Road when it is fully developed and incorporate an underground storm sewer system with some runoff being conveyed in the curbs, 2) allow the low spot to remain and construct a storm drainage system to convey the fully developed flows, direct interior runoff easterly and southerly away from Marksheffel Road, or 3) construct a detention facility which would eliminate road overtopping.

- The drainage map indicates that runoff from a portion of the east half of Antelope Ridge Drive (located west of Lot 5) was anticipated to be conveyed into the Willowind Commercial site.
- Per the Kiowa DBPS, no major drainage facilities for this area.

- No onsite facilities were required at the time of the writing of this report, either for water quality or detention storage.

Final Drainage Report and Plan for Willowind at Stetson Hills Filing No. 4, by Leigh Whitehead & Associates, Inc. dated September 2004.

Project constructed 68 single-family residential lots located immediately north of the subject site. The report discusses assumptions for the commercial area and offsite flows reaching the subject site.

- An excerpt address raised concerns about the inadequacy of the existing 24” culvert located 0.5 miles south of the site, on Marksheffel Road (below the existing 6’x 8’ RBC and channel associated with Chateau at Antelope Ridge); the report made recommendations for the placement of signage at the crossing on Marksheffel until El Paso County improves the roadway.

- Estimates Flow in the pipe that enters the subject site (DP6) at 121.1 cfs and 271.1 cfs. In the 5-year and 100-year, respectively, from 71.65 acres.

Preliminary/Final Drainage Report for Eastview Estates Filing No. 2, by JR Engineering, LLC, April 2005.

The subdivision is located upstream (north) of the subject site. The report discusses assumptions about offsite Marksheffel drainage patterns and contributing runoff to the storm sewer crossing through the subject site.

- Indicates that 23.42 acres basin WW-13, located north and east of Marksheffel Road and Tamlin Road, is diverted to the west under Marksheffel to a proposed 30" storm sewer constructed with Eastview Estates Filing No. 3, which ties to RCBC system.

- States that anticipated runoff from fully developed Marksheffel Road is to be contained within the Roadway Corridor (Basin WW-A6) per the FDR and plan for Willowind at Stetson Hills Filings No. 1, 2, and 3.

- Flows discharged to the storm sewer in Antelope Ridge are 66 cfs and 138 cfs in the 5 and 100-year, respectively; allowable for the 5 and 100-year events were 68.9 cfs and 143.0 cfs per the FDR Willowind at Stetson Hills Filing No. 1 10.6 cfs as surface flow.

Final Drainage Letter for Willowind Commercial Subdivision Filing No. 2, a Replat of Lot 4, Willowind Commercial Filing No. 1, Colorado Springs, Colorado, by Kiowa Engineering Corporation, April 2005.

The subdivided Lot 4 (within the subject site) into two lots so that each lot may have its own separate structure of roughly the same total square footage and similar site parking and drainage characteristics. Per the report, no increase in runoff was anticipated.

Preliminary/Final Drainage Report for Eastview Estates Filing No. 3, by JR Engineering, LLC, November 2005.

This subdivision is located upstream (north) of the subject site. The report discusses assumptions about offsite Marksheffel drainage patterns and contributing runoff to the storm sewer crossing through the subject site.

- Based upon site grading, approximately 0.68 acres (Basins F-3(Q5=1.0 cfs, Q100=2.2 cfs), F-4 (Q5=0.8 cfs, Q100=1.7 cfs)) discharged as surface flow to Stetson Ridge filing No. 4, instead of being conveyed to the street.

Small Subdivision Drainage Report for 7-Eleven (Willowind Commercial Filing No.3, Lot 1, Barnes Road, Colorado Springs, CO, by Harrison French & Associates, LTD, April 2012.

The project constructs a convenience store with fueling services within Lot 5 of the Willowind Commercial Filing No.1. Constructs a Porous landscape Detention Pond. The report assumes future developed flows from Area 2 (Lot 2, west of 7-11) will combine with those from Area 1 (Lat 1, 7-11).

- Per the grading plan, flows behind the building are to be directed south, then east (around the south side of the building).

- Lot 1 and future Lot 2 flows will be collected by the inlet at the southeast corner of the subject site (Q10=6.72 cfs, Q100=12.17 cfs).
- Both lots' WQ flows are to be treated by the proposed PLD.

- Treated flows and large event storms discharged to an existing 24" RCP that ties into the existing 60" storm in the roadway west of WW Commercial Lot 3.

Sand Creek Drainage Basin Planning Study Final Report, by Stantec, Dewberry and FDR, April 2021.

- The drainage is routed to existing facilities and outfalls to locations shown in the prepared study.
- There are no deficiencies are noted for the subject site.
- The SCDBPSFR is not currently valid due to issues with Hydrology.

Drainage Letter for Willowind Commercial Filing No. 4, by M&S Civil Consultants, August 2023.

- Supports the re-platting of the subdivision to match the proposed development further analyzed by this study.

EXISTING DRAINAGE CONDITIONS

Existing Site Conditions and General Drainage Discussion

The 8.74 AC site is currently divided into eight (8) separate lots and zoned PBC AO. As previously discussed, two of the existing lots, Lot 1 Willowind Commercial Filing No. 3 (currently 7-11 convenience store) and Lot 1 Willowind Commercial Filing No. 2 (currently a mixed-use commercial building), were developed under the approved 2007 development plan. The concept plan has since expired, and the remaining six (6) approved lots have remained vacant. The following paragraphs provide a general overview of the existing onsite conditions and drainage patterns. Please refer to the as-platted and existing drainage maps in the appendix to accompany the discussion.

An existing private un-named road, located within a public access and utility easement extends from Barnes Road to Antelope Ridge Drive, henceforth referred to as the "spine road". This roadway bisects the site placing three (3) lots (2 vacant, 1 developed) west of the roadway while the remaining five (5) lots (4 vacant, 1 developed) are located to the east side of the road.

The lots located to the west of the street (and including the west half of the street) are Willowind Commercial Filing No. 3, Lots 1-3, and the lots located to the east of the street (including the east half of the street) are Willowind Commercial Filing No. 2, Lots 1 and 2, as well as Willowind Commercial Filing No. 3, Lots 1-3.

Paved parking and existing drive isles constructed with the mixed-use commercial building (WWCF2, Lot 1) extend into WWCF1 Lots 2 and 3, while existing gravel/dirt parking associated with the building extends into portions of WWCF1, Lot 1, and WWCF2 Lots 2. A small paved strip of asphalt (approximately 8-10' wide) and curb and gutter extending west from the commercial parking area behind the building west into the northern part of Filing 2, Lot 2.

Runoff from the existing building rooftop and the rear of WWCF2, Lot 1, as well as runoff from a portion of the northern half of WWCF2, Lot 2, is collected by an existing private 5' Type R sump inlet located at the northeast corner of the lot. These flows are directed west underground via a private 24" RCP storm sewer, which runs westerly along the north edge of the site before intersecting a public 60" RCP which runs south under the existing spine road toward Barnes Road.

The public 60" RCP that crosses thru the subject site is responsible for conveying much of the runoff that develops to the north and east of the subject site. Runoff reaching this system is produced within portions of Eastview Estates Filing No. 1, 2, and 3, and Willowind at Stetson Hills Filings 2, 3, and 4, Canty Subdivisions (Filing No. 2 and 3) as well as portions Tamlin Road and portions of undeveloped Banning Lewis Ranch.

Before reaching Barnes Road, the public 60" RCP turns east and runs through the southern portion of WWCF1, Lot 3, where it connects with an existing public 6'x8.25' RCBC that runs south under Barnes Road. An analysis of the flow reaching this system has been provided as a portion of the proposed conditions section of this report.

Runoff from WWCF3 Lots 1 and 2, a small portion of WWCF2, Lot 1, and a segment of the existing 7-11 private drive aisle are collected and conveyed south within the existing private spine roadway to Barnes Road. This runoff combines with up-gradient runoff produced within portions of Stetson Hills Subdivision Filings No. 9 and portions of Willowind at Stetson Hills Filings No. 1 and 2. These combined flows conveyed within the northern half of Barnes Road is collected by an existing public 20' Type D-10R sump inlet, located south of the subject site. An existing 24" RCP public storm sewer conveys the captured runoff from the inlet and directs it northward into the site, where it connects to the existing 6.25'x8' RCBC within WWCF1, Lot 2, within an established drainage 120'x150' public drainage easement.

An existing culvert located approximately 300' north of the Barnes Road and Marksheffel intersection conveys offsite runoff from portions of primarily undeveloped BLH No. 2 LLC lands located east of Marksheffel and directs them west under the roadway. Runoff conveyed by the existing culvert combines with runoff produced within a portion of the Marksheffel roadway corridor located north and east of the site. These flows enter the site along the site's eastern boundary between WWCF1, Lot 1, and WWCF2, Lot 2. The offsite runoff combines with onsite runoff produced within the site, which collects at an existing depression located within Lots 2 and 3 of WWCF1.

Flows from the remainder of internal lots immediately adjacent to the north side of Barnes are conveyed to a second depression which coincides with the top of the beginning of the public 6.25'x 8' RCBC that crosses under Barnes Road. At this location, an existing beehive inlet is situated atop the box, which collects runoff reaching the depression.

Existing Conditions Detailed Drainage Discussion

See the appendix for hydrologic and hydraulic calculations. Rational calculations were used to analyze the existing drainage basin conditions; refer to the appendix for additional information. Refer to the appendix for existing MHFD Inlet calculation sheets. The following paragraphs detail the existing drainage patterns.

Basin OS1

Offsite 0.04 acre **Basin OS1** (Q5=0.02 cfs, Q100=0.1 cfs) consists of unimproved Antelope Ridge ROW portions. Flows discharge as sheet flow along undeveloped **Basin A** (Willowind Commercial Filing No. 3, Lot 3). The cumulative flows from **Basin OS1** and **Basin A** will sheet flow east to **DP1** (Q5=0.3 cfs, Q100=2.0 cfs).

Basin OS2

Offsite 0.05 acre **Basin OS2** (Q5=0.02 cfs, Q100=0.2 cfs) consists of existing unimproved Antelope Ridge ROW. Flows discharge as sheet flow along undeveloped **Basin C** (Willowind Commercial Filing No. 3, Lot 2 & 3). The cumulative flows from **Basin OS2** and **Basin C** will sheet flow east to **DP2** (Q5=0.3 cfs, Q100=2.4 cfs).

Basin OS3

Offsite 3.75 acre **Basin OS3** (Q5=7.3 cfs, Q100=15.0 cfs) consists of several lots within the residential parcel of Stetson Hills Subdivision Filing No.13 and a southern portion of Barnes Road. Flows discharge as sheet flow along residential streets to the east and continue to flow east along the south half of Barnes Road until the flows reach **DP5** (Q5=7.3 cfs, Q100=15.0 cfs) and enter an existing public 10' D10R at grade inlet. The captured flows (Q5=1.1 cfs, Q100=6.0 cfs) are carried east via an existing public 18" RCP storm pipe and will eventually be tied into the onsite existing public 60" RCP storm system.

Basin OS4

Offsite 4.96 acre **Basin OS4** (Q5=8.9 cfs, Q100=20.1 cfs) consists of several lots within the residential parcel of Willowind at Stetson Hills Filing No.1, a northern portion of Barnes Road, and a drainage tract to the west. Flows generally discharge as sheet flow east along existing residential streets and south to Barnes Road. The flows continue to flow east along Barnes Road curb and gutter into **Basin OS5**.

Basin OS5

Offsite 2.84 acre **Basin OS5** (Q5=5.9 cfs, Q100=12.3 cfs) consists of a portion of several lots within the residential Willowind at Stetson Hills Filing No.1 and a northern portion of Barnes Road. Flows generally discharge as sheet flow to the south and combine on Barnes Road with flows from **Basin OS4**. All flows travel east along a portion of the northern half of Barnes Road curb and gutter until the flows reach **DP6** (Q5=14.2 cfs, Q100=31.0 cfs) and enter an existing public 15' D10R at grade inlet. The captured flows (Q5=2.2 cfs, Q100=12.0 cfs) are carried east via an existing public 18" RCP storm pipe which, ties into the existing public 60" RCP storm system.

Basin OS6

Offsite 1.48 acre **Basin OS6** (Q5=2.1 cfs, Q100=5.1 cfs) consists of a portion of several lots within the residential Willowind at Stetson Hills Filing No.1 and a southern portion of Willowind Drive. Flows generally discharge as sheet flow to the north and are routed on Willowind Drive curb and gutter east into **Basin OS8**.

Basin OS7

Offsite 0.02 acre **Basin OS7** (Q5=0.01 cfs, Q100=0.1 cfs) consists of existing unimproved Antelope Ridge ROW. Flows generally discharge as sheet flow to the south into **Basin OS8.**

Basin OS8

Offsite 1.46 acre **Basin OS8** (Q5=4.6 cfs, Q100=8.9 cfs) consists of a portion of several lots within the residential Willowind at Stetson Hills Filing No.1, a portion of Antelope Ridge Drive and a northern portion of Barnes Road. Flows generally discharge as sheet flow to the southeast onto Antelope Ridge Drive. The cumulative flows from **Basin OS8**, **Basin OS7**, **Basin OS6, Basin F, Basin D, DP3** (Q5=2.6 cfs, Q100=8.4 cfs) and flow-by from the existing public 15' at grade inlet at **DP6** (Q5=2.2 cfs, Q100=12.9 cfs) are routed via curb and gutter to **DP7** (Q5=9.8 cfs, Q100=27.0 cfs).

Basin OS9

Offsite 15.45 acre **Basin OS9** (Q5=7.0 cfs, Q100=36.1 cfs) is a native grassed undeveloped land located northeast of the Willowind Commercial parcels. Flows discharge as sheet flow to an existing public 24" CMP culvert along the east side of Marksheffel Road at **DP9** (Q5=7.0 cfs, Q100=36.1 cfs). Flows carried through the pipe are routed west under the existing Marksheffel Road, to a swale on the west side of the road and continue to flow south and west to **DP10** (Q5=10.6 cfs, Q100=46.4 cfs).

Basin OS10

Offsite 3.45 acre **Basin OS10** (Q5=3.8 cfs, Q100=11.1 cfs) consists of Marksheffel Road and a native grass roadside ditch (called out on map) located west of the roadway. Flows from **Basin OS9** and **OS10** combine along the west of Marksheffel Road to **DP10** (Q5=10.6 cfs, Q100=46.4 cfs).

Basin OS11

Offsite 0.95 acre **Basin OS11** (Q5=3.2 cfs, Q100=6.3 cfs) consists of a portion of Marksheffel Road and a portion of the north half of Barnes Road. The cumulative flows from **Basin OS11** and **DP7** (Q5=9.8 cfs, Q100=27.0 cfs) are routed via existing curb and gutter to an existing public 20' sump inlet at **DP14** (Q5=11.8 cfs, Q100=30.7 cfs). Flows are routed north via an existing public 24" RCP storm pipe (Q5=11.8 cfs, Q100=30.7 cfs) where they tie to an existing public 8.25'W x 6.0'H reinforced concrete box culvert that conveys the intercepted runoff south under Barnes Road.

Basin A

Onsite 0.93 acre **Basin A** (Q5=0.3 cfs, Q100=2.0 cfs) consists of undeveloped native grass Willowind Commercial Filing No. 3, Lot 3. The cumulative flows from **Basin OS1** and **Basin A** will sheet flow east to **DP1**(Q5=0.3 cfs, Q100=2.0 cfs).

Basin B

Onsite 0.86 acre **Basin B** (Q5=2.6 cfs, Q100=5.0 cfs) consists of onsite existing Desert Varnish Drive and a portion of existing developed Willowind Commercial Filing No. 2, Lot 1. The cumulative flows from **Basin B, DP1** and **DP2** (Q5=0.3 cfs, Q100=2.4 cfs) are routed via existing private street curb and gutter to **DP3** (Q5=2.6 cfs, Q100=8.4 cfs).

Basin C

Onsite 1.14 acre **Basin C** (Q5=0.3 cfs, Q100=2.3 cfs) consists of undeveloped native grass Willowind Commercial Filing No. 3, Lot 2 & 3. The cumulative flows from **Basin OS2** and **Basin C** will sheet flow east to **DP2** (Q5=0.3 cfs, Q100=2.4 cfs).

Basin D

Onsite 0.10 acre **Basin D** (Q5=0.1 cfs, Q100=0.3 cfs) consists of undeveloped native grass Willowind Commercial Filing No. 3, Lot 2. Flows discharge as sheet flow along **Basin OS 8.** The cumulative flows from **Basin OS8**, **Basin OS7**, **Basin OS6, Basin F, Basin D, DP3** (Q5=2.6 cfs, Q100=8.4 cfs) and flow-by from the existing public 15' at grade inlet at **DP6** (Q5=2.2 cfs, Q100=12.9 cfs), are routed via curb and gutter to **DP7** (Q5=9.8 cfs, Q100=27.0 cfs).

Basin E

Onsite 1.09 acre **Basin E** (Q5=2.8 cfs, Q100=5.9 cfs) consists of existing developed Willowind Commercial Filing No. 3, Lot 2. Flows are routed via existing curb and gutter to an existing Water Quality Pond to **DP4** (Q5=2.8 cfs, Q100=5.9 cfs). Flows are routed east via an existing private 24" RCP storm sewer and will tie into an existing public 60" RCP storm system.

Basin F

Onsite 0.27 acre **Basin F** (Q5=1.1 cfs, Q100=2.0 cfs) consists of onsite existing Desert Varnish Drive and a portion of existing developed Willowind Commercial Filing No. 3, Lot 2. The cumulative flows from **Basin F** and **DP3** (Q5=2.6 cfs, Q100=8.4 cfs) are routed via existing private street curb and gutter to **DP7** (Q5=9.8 cfs, Q100=27.0 cfs).

Basin G

Onsite 1.40 acre **Basin G** (Q5=2.5 cfs, Q100=6.1 cfs) consists of developed Willowind Commercial Filing No. 2, Lot 1. Flows from **Basin G** are routed to an existing public 5' sump inlet at **DP8** (Q5=9.8 cfs, Q100=27.0 cfs). Flows are routed west via an existing public 24" RCP storm pipe which will tie into an existing public 60" RCP storm system. In the case that the existing system were to become clogged, runoff would overtop the existing high point in the parking lot and continue west to the spine road.

Basin H

Onsite 1.39 acre **Basin H** (Q5=1.6 cfs, Q100=4.6 cfs) consists of developed gravel parking and undeveloped native grass Willowind Commercial Filing No. 2, Lot 2. The cumulative flows from **Basin H** and **DP10** (Q5=10.6 cfs, Q100=46.4 cfs) will sheet flow to **DP11** (Q5=10.6 cfs, Q100=44.4 cfs).

Basin I

Onsite 1.25 acre **Basin I** (Q5=3.9 cfs, Q100=7.9 cfs) consists of developed Willowind Commercial Filing No. 2, Lot 2 parking and undeveloped native grass Willowind Commercial Filing No. 1 & 2, Lot 1 & 3. The flows from **Basin I** will sheet flow to **DP12** (Q5=3.9 cfs, Q100=7.9 cfs).

Basin J

Onsite 1.21 acre **Basin J** (Q5=0.3 cfs, Q100=2.4 cfs) consists of undeveloped Willowind Commercial Filing No. 1 & 2, Lot 1 & 3. The cumulative flows from **DP11** (Q5=10.6 cfs, Q100=44.4 cfs) and **DP12** (Q5=3.9 cfs, Q100=7.9 cfs) will flow to **DP13** (Q5=12.5 cfs, Q100=48.4 cfs) to an existing Beehive grate area drain atop a box culvert. Flows are routed south via an existing public 8.25'W x 6.0' H storm system.

FOUR STEP PROCESS (MDDP)

Step 1 Employ Runoff Reduction Practices. Whenever possible, roof drains can be directed to vegetated landscaping buffer areas and islands before release to streets aiding in minimizing direct connection of impervious surfaces. Parking lot drainage, whenever possible, can be routed through grass swales and collected by the area inlet or routed directly into the FSD facilities. The lots, upon development, will be required to provide a minimum stormwater reduction of 10% as a percentage of the Water Quality Capture Volume (WQCV).

Step 2 Implement PCMs that provide a water quality capture volume with slow release. Stormwater from the lot's stormwater will be conveyed to private full-spectrum detention and water quality ponds. The ponds shall be designed and will be constructed based upon the current City of Colorado Springs Criteria and will function to store and slowly release developed runoff at predevelopment rates with the WQCV released over 12-40 hours while the EURV will be released over 72 hours. At a minimum, 95% of the total disturbed area must be treated for water quality. The remaining 5% not treated cannot exceed 1 acre.

Step 3 Stabilize streams. All new and re-development project are required to construction or participate in the funding of channel stabilization measures. Drainage fees paid at the time of platting go towards channel stabilization within the drainage basin. The drainage fees for this site have been previous paid at the time of the initial platting. The downstream outlet of the box culvert, located 250' below the site (along the south side of Barnes Road) has sufficient stabilization. A minor amount of frequent discharge to the downstream tributaries provided by this site should be of benefit by providing water to existing vegetation which provides habitat and functions to stabilize the existing channel banks and channel bed.

Step 4 Implement site specific and other source control PCMs. The proposed development will implement a Stormwater Management Plan, including property housekeeping practices and spill containment procedures. Material storage (such as backfill stockpiles or landscape materials), designated fueling areas, and trash

enclosures during construction are to be located away from drainage facilities. Source control measures (CM's) such as covering storage/handling areas and implementing containment measures should be utilized to prevent containments from entering the City's storm sewer systems.

FOUR STEP PROCESS (FDR-INITIAL INFRASTRUCTURE)

The "initial infrastructure" project covered by this Final Drainage Report consists entirely of utility installations, and therefore falls under the 4 Step Process exclusion for Aboveground and Underground Utilities (I.E.4.a.i.A of COS000004). The ultimate development covered by the Master Development Drainage Report will comply with all applicable 4 Step Process and detention criteria in place at the time of development.

PROPOSED DRAINAGE CONDITIONS

General Concept Plan and Proposed Drainage Discussion

The Concept Plan includes 7 of the 8 existing commercial lots to create a commercial center development. Currently, a 7-11 convenience store, an Amazon hub, and a gas station occupy Lot 1 Willowind Commercial Filing No. 3. This lot was developed under the previously approved development plan (AR DP 02-500-A1MN07) and has been excluded from this concept plan. All six (6) remaining vacant lots and the existing mixed-use commercial building are proposed as a commercial center. All lots will benefit from a shared access and parking agreement, which will be implemented through the Property Owners Association convents. The details of the remaining vacant lots will be provided in the future development plan(s).

Each of the seven (7) parcels are currently zoned PBC-AO and are proposed to develop for commercial use. Building setbacks for this site are consistent with the PBC zone with a 25'-0" front, side, and rear setback. A 15' landscape buffer is proposed along the northern boundary and Antelope Ridge Drive to separate the single-family residential from the proposed commercial.

Since site-specific plans for each lot are unknown at this time, the proposed drainage patterns for the site are generally assumed to closely mimic those of the existing site grading and drainage patterns. A short discussion on the general concept drainage improvements is as follows; refer to the Proposed Conditions Detailed Drainage Discussion for additional details regarding the proposed site improvements which will include size and materials anticipated to be utilized in construction.

Upon development runoff from WWCF4 Lot 1 is anticipated to be conveyed northeast to a proposed private FSD Pond (#1). This is primarily due to the existing grading established along the western edge of the existing 7-11 building, which generally directs runoff in that direction (north).

Upon development runoff from WWCF4 Lot 7 is to be conveyed to the southeast corner of the lot to a proposed private FSD Pond (#0).

No changes to the rear of Lot 6 are anticipated as a portion of the development, as such, flow will continue to be collected by the existing private sump inlet.

No changes in drainage patterns are assumed to occur within the private spine road; as such, runoff reaching and produced within the street will continue to discharge to the north half of Barnes Road as in the historic condition.

No changes to the existing WWCF3, Lot 1 are anticipated to occur due to the development of the remaining lots. As in the existing condition runoff from the 7-11 building and fueling station will continue to use the existing systems in place to collect and treat runoff, which consist of a private water quality pond and associated private outlet works and storm drain.

Upon development runoff from the southwest corner of Lot 6 will combine with runoff from the northwest corner of Lot 2 in a proposed private FSD Detention Pond (#2). Runoff from the west half of Lot 5, the north half of Lot 6, and a portion of the periphery of Lots 2 and 3 will be directed to a proposed private FSD Pond (#4). The remaining runoff produced within WWCF4, Lot 2 will be directed to the southwest to a proposed private FSD Pond (#3).

Upon development runoff from portions of Lots 2, 4, and 6 will drain to a proposed private FSD located in the middle of the site. While runoff from the east half of Lot 5 is anticipated to be conveyed to the east to a proposed private FSD Pond (#4A). Upon development lots 3 and 4 will drain to the south, where a proposed private FSD Ponds (#5 and #6) can accept and treat runoff.

Upon development of Lot 5 and the construction of the anticipated future entrance, a public culvert will likely be required to convey the existing runoff conveyed along the west half of Marksheffel Road to continue south as in the historical condition. The culvert will likely require slope and inlet and outlet protection and a proposed earthern swale/berm will be needed along the site's eastern edge protect lots 4 and 5 and convey runoff from the culvert to a collection/low point. A proposed public Type 'D' CDOT sump inlet is recommended to collect the runoff. These improvements will be likely be triggered with the development of Lots 4 and/or 5.

It should be noted that the anticipated that the flows reaching the proposed sump inlet may likely be decreased with the construction of the future Marksheffel roadway improvements. The 'draft' construction drawings, (provided in the appendix) indicate that the roadway will be curb and guttered and will have its own storm sewer to collect runoff produced within the roadway, however to what extent isn't fully clear at the time of the writing of this report. The existing condition (prior to the roadway improvements) appears to produce the highest potential offsite drainage impacts on the site and thus has been chosen to govern this sizing of the conveyance system. All of the aforementioned improvements are not a part of the 'initial' infrastructure and will need to be evaluated and fully designed with each lots grading and erosion control plan and final drainage report. These facilities are listed as 'by others' on the proposed drainage maps.

An 'initial' storm sewer system, (shown in dark purple on the proposed drainage maps) will be housed within private and public storm sewer easements. The system will be extended throughout the subdivision and provide suitable storm outfalls for all the aforementioned private FSD ponds and provide adequate outfalls for the existing Marksheffel corridor. In addition the more commonly private storm system the 'initial' infrastructure drainage improvements will also include the re-routing of the public 60" RCP storm sewer system and construct a public junction box connection to the existing public 6.25' x 8' RCBC. **The only grading to occur with the 'initial' infrastructure will what is required to install and remove storm sewer, gas, water and sanitary sewer mains for future development.**

All the anticipated runoff released by these future private drainage facilities will be available to be collected by the "initial" proposed storm sewer infrastructure system that will ultimately discharge to the existing public 6.25'x8' RCBC where it will continue to downstream facilities and ultimately the East Fork Sand Creek Sub-tributary.

Proposed Conditions Detailed Drainage Discussion

Two sets of proposed drainage calculations have been provided to support this Master Development Drainage Plan and Final Drainage Report.

An HEC-HMS model was prepared to evaluate the proposed overall watershed (which exceeded 100 acres) and determine the peak flow rates within the large storm sewer system that crosses the subject site from which hydraulic grade line analysis and conveyance sufficiency could be conducted on the existing and proposed systems.

Rational method calculations were provided for the subject site that closely aligns with the existing condition analysis. The purpose of the rational analysis was threefold. 1) the analysis provides onsite surface runoff rates that can be compared directly to the existing conditions' rational calculations; 2) the analysis provides runoff rates for basins that were also in the HEC-HMS model, which allowed for evaluating the validity of the larger HEC-HMS model. Finally, the data gathered for the rational model for the onsite watersheds was the basis for the concept sizing of the proposed FSD Ponds (DCM Table 6-6).

See the appendix for the proposed MHFD Inlet and MHFD Detention Pond calculation sheets. See the subsequent **Detention Facility Design** section of the report for the discussion of the anticipated required water quality treatment and detention volumes for each full spectrum detention facility. The following paragraphs detail the proposed drainage patterns.

HEC-HMS Proposed Conditions Model and Initial Infrastructure Discussion

Please reference the Willowind Filing No. 4 HEC-HMS Developed Conditions Drainage Map in the appendix for the location of the Basins, Diversions, Junctions, and Reaches. It should be noted that although the 10-year storm event was modeled, the data is not included in the subsequent paragraphs or report on the drainage map. Refer to the appendix for input and output data.

Offsite **Basin A** (Q5 = 29.3 cfs, Q100 = 72.0 cfs) is 27.4-acres in size and consists of portions of a RV storage facility, a residential site with a few out-buildings, portions of a church and parking lot as well a large area of undeveloped grass covered fields associated with Lot 2 of Canty Subdivision and Lot 3 of Canty Subdivision Filing No. 2 and portions of Marksheffel Road. Runoff produced within **Basin A** is conveyed under Marksheffel and thru Eastview Estates via a 36" RCP public storms sewer system (**Reach 1**) which extends into Antelope Ridge Drive.

Offsite **Basin B** (Q5 = 78.7 cfs, Q100 = 153.7 cfs) consists of 37.2 acres of single-family residential development associated with portions of Eastview Estates Filing Nos. 1, 2 and 3. **Junction 1** (Q5 = 106.7 cfs, Q100 = 233.3 cfs) includes the total runoff generated from **Basin A** and 37.2-acre **Basin B**. The combined runoff is routed south underground via a public 48" RCP storm sewer (**Reach 2**) at peak flow rates of Q5 = 104.4 cfs, Q100 = 219.1 cfs.

Offsite **Basin C** (Q5 = 38.0 cfs, Q100 = 80.2 cfs) consists of 24.8 acres of single-family residential development associated with portions of Willowind at Stetson Hills Filing Nos.1 and 4, Stetson Hills Subdivision No. 9, Eastview Estates Filing 3 and Laura Gilpin Park. **Junction 2** (Q5 = 143.0 cfs, Q100 = 299.1 cfs) includes the total runoff generated from offsite 24.8-acre **Basin C** and runoff conveyed within **Reach 2**. The combined runoff continues southeast underground via a public 54" RCP storm sewer (**Reach 3**) at peak flow rates of Q5 = 140.9 cfs, Q100 = 295.4 cfs.

Offsite **Basin D** (Q5 = 18.7 cfs, Q100 = 35.3 cfs) consists of 7.7 acres of single-family residential development associated with portions of Stetson Hills Filing No. 4. **Junction 3** (Q5 = 159.6 cfs, Q100 = 330.7 cfs) includes total runoff generated from offsite **Basin D** and runoff conveyed within **Reach 3**. The combined runoff continues south and enters the subject site via a public 54" RCP storm sewer (**Reach 4**) at peak flow rates of Q5 = 158.8 cfs, Q100 = 329.2 cfs.

Offsite **Basin F** (Q5 = 8.1 cfs, Q100 = 15.3 cfs) consists of 3.7 acres of single-family residential development associated with portions of Willowind at Stetson Hills Filing No.13 and westbound Barnes Road. **Diversion 1** is located at an existing 15' D10 R at grade inlet (**Inlet 1**) located within the south side of existing Barnes Road, to the east of Desert Varnish Road. The runoff generated from offsite 3.7-acre **Basin F** was entered into MHFD-Inlet, Version 5.02 spreadsheet, where it was determined that the inlet could intercept flows of Q5 = 7.4 cfs, Q100 = 9.1 cfs) which are conveyed underground via an existing public 18" RCP (**Reach 6**). By-pass (non-diverted) flows of Q5 = 1.5 cfs, Q100 = 6.2 cfs continue east within the south half of Barnes Road (to **Junction 16**).

Offsite **Basin G** (Q5 = 16.1 cfs, Q100 = 30.7 cfs) consists of 7.8 acres of single-family residential development associated with portions of Willowind at Stetson Hills Filing Nos.1 & 9 as well as a portion of eastbound Barnes Road. **Diversion 2** is located at an existing 15' D10 R at grade inlet (**Inlet 2**) located within the north side of existing Barnes Road, west of Antelope Ridge Drive. The runoff generated from offsite **Basin G** was entered into MHFD-Inlet, Version 5.02 spreadsheet, where it was determined that the inlet had the potential to intercept flows of Q5 = 12.9 cfs, Q100 = 18.0 cfs) however, due to hydraulic constraints determined by StormCAD modeling, it was determined that about the maximum flow combined flow of **Reach 7**, (an existing public 18" RCP) was limited to approximately 19.5 cfs (aka **Junction 4**). Given this, **Diversion 2** in the model was set to Divert flows in excess of 12.9 cfs and 10.4 cfs in the 5 and 100-year models, respectively. Resulting in By-pass flows of Q5 = 6.2 cfs, Q100 = 20.3 cfs which continue east within the south half of Barnes Road (to **Junction 19**).

Offsite **Basin E** (Q5 = 28.8 cfs, Q100 = 57.3 cfs) consists of 14.9 acres of single-family residential development associated with portions of Willowind at Stetson Hills Filing No.2 and eastbound Barnes Road.
Reach 5 (Q5 = 28.4 cfs, Q100 = 56.6 cfs) an existing public 36" RCP conveys the runoff generated from offsite 14.9-acre **Basin E**. The runoff conveyed within **Reaches 4** and **5** combine an existing public manhole **Junction 5** at peak flow rates of Q5 = 159.6 cfs, Q100 = 330.7 cfs. The combined runoff continues south via an existing public 54" RCP storm sewer (**Reach 8**) at peak flow rates of Q5 = 186.6 cfs, Q100 = 384.7 cfs.
Onsite **Basin L** (Q5 = 1.6 cfs, Q100 = 3.2 cfs) consists of 0.6 acres of existing commercial development associated with portions of Willowind Commercial Filing No. 4, Lot 6. **Junction 6** (Q5 = 188.0 cfs, Q100 = 387.5 cfs) includes the total runoff generated from **Basin L** and runoff conveyed within **Reach 8**. The combined runoff continues south via an existing public 60" RCP storm sewer (**Reach 9**) at peak flow rates of Q5 = 185.5 cfs, Q100 = 383.1 cfs.

Onsite **Basin K** (Q5 = 1.6 cfs, Q100 = 3.2 cfs) consists of 0.8 acres of existing commercial development associated with portions of Willowind Commercial Filing No. 3, Lot 1 (7-11 store and fueling station).

Junction 7 (Q5 = 206.7 cfs, Q100 = 402.6 cfs) includes runoff conveyed within **Reach 7** (Q5 = 19.5 cfs, Q100 = 19.5 cfs) and **Reach 9** (Q5 = 185.5 cfs, Q100 = 295.4 cfs) as well as the total runoff generated from onsite **Basin K**. In the 100-year event the 60" RCP storm sewer system was significantly pressurized, thus it is anticipated that runoff from **Basin K** will be directed to the street via the existing spillway which in larger event storms will contributes directly to **Junction 16**. The runoff (at **Junction 7**) conveyed underground continues east via the existing public and proposed public 60" RCP storm sewer system (**Reach 10**) at peak flow rates of Q5 = 205.5 cfs, Q100 = 400.6 cfs. It should be noted that the existing 60" RCP storm system in

this area is to be partially rerouted as a portion of the box culvert and associated wing walls are being removed to maximize the developable area. A custom 45-degree Type I manhole will constructed to redirect flows thru the proposed pipe.

Basin Q (Q5 = 3.6 cfs, Q100 = 7.8 cfs) includes runoff from portions of the existing Marksheffel and adjacent borrow ditch. The runoff from **Basin Q** is collected and directed under the future proposed entrance at the northeast corner of the site via a future public 24" RCP with D50=12" 24" deep riprap slope and outlet protection. Depending upon the grading associated with the culverts final design additional slope protection maybe required. Runoff from the culvert, outfalls into **Reach 11** where a proposed trapezoidal earthen swale with a min. 7.5' BW graded at 1% will convey the collected drainage south. The proposed entrance, culvert, slope projection and swale, shall be designed in future site specific drainage report. The swales (A-A, B-B) should provide a minimum of 12" of freeboard. Refer to appendix for concept sizing of these facilities.

Offsite 15.4-acre **Basin P** (Q5 = 14.2 cfs, Q100 = 39.1 cfs) consists of undeveloped portions of un-platted grasslands under the BLH No. 2 LLC, ownership. a portion of a water storage tank owned by the Cherokee Metropolitan District, and portion of the Marksheffel Road Rights-of-Way. Offsite 1.2-acre **Basin Q2** (Q5 = 2.1 cfs, Q100 = 4.5 cfs) consists of undeveloped portions of un-platted grasslands under the ownership of BLH No. 2 LLC., as well as portions of Marksheffel Road Right of Way. **Junction 8** (Q5 = 19.6 cfs, Q100 = 51.2 cfs) includes the total runoff generated from offsite 15.4-acre **Basin P**, **Reach 11** (Q5 = 3.6 cfs, Q100 = 7.8 cfs) and 1.2-acre **Basin Q2.** The combined runoff at **J8** is conveyed underground via a Type 'D' sump inlet (Inlet 3) which connects to a private 36" PP storm sewer (**Reach 12**) at peak flow rates of Q5 = 19.6 cfs, Q100 = 51.2 cfs. A d50=12" 24" deep riprap apron will be placed adjacent to the inlet as slope protection. The extension of the storm sewer, inlet, slope projection and grading will be designed and analyzed in future site specific drainage reports.

Onsite **Basin O2** (Q5 = 2.6 cfs, Q100 = 4.6 cfs) consists of 0.8 acres of proposed commercial development located in the eastern half of Willowind Commercial Filing No. 4, Lot 5. **Pond 4a** was conceptually sized using the MHFD-Detention, Version 4.06 worksheet to collect runoff produced within **Basin O2**. When modeled as a Sand Filter Detention Basin with the WQCV and EURV draining via filtration media and the 100-year draining via a Weir (box) and Pipe with a Restrictor plan, the Outlet Structure hydrograph indicates discharge flow rates of 0.0 and 0.5 cfs in the 5 and 100-year events, respectively. A proposed private 15" PP (Reach 13 - Q5 = 0.0 cfs, Q100 = 0.5 cfs) is to be extended along the eastern property line within a private drainage easement. When constructed **Pond 4a** should have a safe overflow/spillway path that outfalls to the Marksheffel roadway corridor; overflow from the pond can be collected by the newly constructed inlet adjacent to Lot 4.

Junction 9 (Q5 = 19.5 cfs, Q100 = 51.3 cfs) is at a proposed private 5.33'x6.33' Type I manhole, which conveys the runoff within **Reach 12** (Q5 = 19.5 cfs, Q100 = 51.0 cfs) and **Reach 13** (Q5 = 0.0 cfs, Q100 = 0.3 cfs). The combined runoff continues south and west via a 36" PP storm sewer (**Reach 14**) at peak flow rates of Q5 = 19.2 cfs, Q100 = 50.6 cfs.

Onsite **Basin R** (Q5 = 2.1 cfs, Q100 = 4.5 cfs) consists of 0.8 acres of proposed commercial development located in Willowind Commercial Filing No. 4, Lot 4. **Pond 6** was conceptually sized using the MHFD-Detention, Version 4.06 worksheet to collect runoff produced within **Basin R**. When modeled as a Sand Filter Detention Basin with the WQCV and EURV draining via filtration media and the 100-year draining via a Weir (box) and Pipe with a Restrictor plan the Outlet Structure hydrograph indicates discharge flow rates of 0.0 and 0.5 cfs in the 5 and 100-year events, respectively. A proposed private 15" PP is to be extended along the eastern property line within a private drainage easement. When constructed **Pond 6** should have a safe overflow/spillway path that outfalls to the Barnes Roadway corridor.

Junction 10 (Q5 = 19.5 cfs, Q100 = 51.1 cfs) is at a proposed private 5.33'x6.33' Type I manhole, which conveys the runoff within **Reach 14** (Q5 = 19.2 cfs, Q100 = 50.6 cfs) and **Pond 6** (Q5 = 0.0 cfs, Q100 = 0.5 cfs). The combined runoff continues west via a 36" PP storm sewer (**Reach 15**) at peak flow rates of Q5 = 18.9 cfs, Q100 = 50.6 cfs.

Onsite **Basin S** (Q5 = 2.7 cfs, Q100 = 4.8 cfs) consists of 0.9 acres of proposed commercial development located in Willowind Commercial Filing No. 4, Lot 4. **Pond 5** was conceptually sized using the MHFD-Detention, Version 4.06 worksheet to collect runoff produced within **Basin S**. When modeled as a Sand Filter Detention Basin with the WQCV and EURV draining via filtration media and the 100-year draining via a Weir (box) and Pipe with a Restrictor plan the Outlet Structure hydrograph indicates discharge flow rates of 0.0 and 0.6 cfs in the 5 and 100-year events, respectively. A proposed private 15" PP is to be extended along the eastern property line within a private drainage easement. When constructed, **Pond 5** should have a safe overflow/spillway path that outfalls to the access roadway.

Junction 11 (Q5 = 18.9 cfs, Q100 = 51.2 cfs) is at a proposed private 5.33'x6.33' Type I manhole, which conveys the within **Reach 15** (Q5 = 19.2 cfs, Q100 = 50.6 cfs) and **Pond 5** (Q5 = 0.0 cfs, Q100 = 0.6 cfs). The combined runoff continues west via a 36" PP storm sewer (**Reach 16**) at peak flow rates of Q5 = 18.8 cfs, Q100 = 51.0 cfs.

Onsite **Basin J** (Q5 = 2.5 cfs, Q100 = 4.4 cfs) consists of 0.8 acres of proposed commercial development located in Willowind Commercial Filing No. 4, Lot 1. **Pond 1** was conceptually sized using the MHFD-Detention, Version 4.06 worksheet to collect runoff produced within **Basin J**. When modeled as a Sand Filter Detention Basin with the WQCV and EURV draining via filtration media and the 100-year draining via a Weir (box) and Pipe with a Restrictor plan the Outlet Structure hydrograph indicates discharge flow rates of 0.0 and 0.6 cfs in the 5 and 100-year events, respectively. A proposed private 15" PP (**Reach 17**) located within a private drainage easement conveys runoff underground to the east. When constructed, **Pond 1** should have a safe overflow/spillway path that outfalls to the access roadway.

Junction 12 (Q5 = 0.1 cfs, Q100 = 1.7 cfs) is at a proposed private 5' type II manhole, which conveys the runoff within **Reach 17** (Q5 = 19.2 cfs, Q100 = 50.6 cfs) and **Pond 0** (Q5 = 0.0 cfs, Q100 = 0.6 cfs). The combined runoff continues east via a private 15" PP storm sewer (**Reach 18**) at peak flow rates of Q5 = 18.8 cfs, Q100 = 51.0 cfs.

Onsite **Basin N** (Q5 = 0.5 cfs, Q100 = 1.0 cfs) consists of 0.2 acres of proposed commercial development located within portions of Willowind Commercial Filing No. 4, Lots 2 and 6. **Pond 2** was conceptually sized using the MHFD-Detention, Version 4.06 worksheet to collect runoff produced within **Basin N**. When modeled as a Sand Filter Detention Basin with the WQCV and EURV draining via filtration media and the 100-year draining via a Weir (box) and Pipe with a Restrictor plan the Outlet Structure hydrograph indicates discharge flow rates of 0.0 and 0.1 cfs in the 5 and 100-year events, respectively. A proposed private 15" PP located within a private drainage easement conveys runoff underground to the south. When constructed, **Pond 2** should have a safe overflow/spillway path the adjacent street.

Onsite **Basin N2** (Q5 = 3.1 cfs, Q100 = 5.6 cfs) consists of 1.0 acres of proposed commercial development located within portions of Willowind Commercial Filing No. 4, Lots 2. **Pond 3** was conceptually sized using the MHFD-Detention, Version 4.06 worksheet to collect runoff produced within **Basin N2**. When modeled as a Sand Filter Detention Basin with the WQCV and EURV draining via filtration media and the 100-year draining via a Weir (box) and Pipe with a Restrictor plan the Outlet Structure hydrograph indicates discharge flow rates of 0.0 and 0.6 cfs in the 5 and 100-year events, respectively. A proposed private 15" PP located

within a private drainage easement conveys runoff underground to the north. When constructed **Pond 3** should have a safe overflow/spillway path the adjacent street.

Junction 13 (Q5 = 0.1 cfs, Q100 = 1.7 cfs) a proposed private 5' dia. Type II manhole includes the runoff conveyed within **Reach 18** (Q5 = 0.1 cfs, Q100 = 1.7 cfs) and **Pond 2** (Q5 = 0.0 cfs, Q100 = 0.1 cfs) **and Pond 3** (Q5 = 0.0 cfs, Q100 = 0.6 cfs). The combined runoff continues east via a private 15" PP storm sewer (**Reach 19**) at peak flow rates of Q5 = 0.1 cfs, Q100 = 2.6 cfs.

Onsite **Basin O** (Q5 = 3.4 cfs, Q100 = 6.1 cfs) consists of 1.1 acres of proposed commercial development located within portions of Willowind Commercial Filing No. 4, Lots 2, 5, and 6. **Pond 4** was conceptually sized using the MHFD-Detention, Version 4.06 worksheet to collect runoff produced within **Basin O.** When modeled as a Sand Filter Detention Basin with the WQCV and EURV draining via filtration media and the 100-year draining via a Weir (box) and Pipe with a Restrictor plan the Outlet Structure hydrograph indicates discharge flow rates of 0.0 and 0.6 cfs in the 5 and 100-year events, respectively. A proposed private 15" PP located within a private drainage easement conveys runoff underground to the north. When constructed **Pond 4** should have a safe overflow/spillway path to Barnes Road.

Junction 14 (Q5 = 0.1 cfs, Q100 = 2.6 cfs) is at a proposed private 5' dia. Type II manhole which conveys the runoff within **Reach 19** (Q5 = 0.1 cfs, Q100 = 2.6 cfs) and the discharges from **Pond 4** (Q5 = 0.0 cfs, Q100 = 0.1 cfs). The combined runoff continues south via a private 15" PP storm sewer (**Reach 20**) at peak flow rates of Q5 = 0.1 cfs, Q100 = 3.5 cfs.

Junction 15 (Q5 = 18.9 cfs, Q100 = 54.5 cfs) is at a proposed private 5.33'x6.33' Type I manhole, which conveys the within **Reach 16** (Q5 = 18.8 cfs, Q100 = 51.0 cfs) and **Reach 20** (Q5 = 0.1 cfs, Q100 = 3.5 cfs). The combined runoff continues west via a private 36" PP storm sewer (**Reach 20**) at peak flow rates of Q5 = 0.1 cfs, Q100 = 3.5 cfs.

Offsite **Basin H** (Q5 = 28.8 cfs, Q100 = 57.3 cfs) consists of 2.4 acres of single-family residential development associated with portions of Willowind at Stetson Hills Filing No.1 and portions of eastbound Barnes Road and Antelope Ridge Drive. Onsite **Basin M** (Q5 = 3.0 cfs, Q100 = 5.5 cfs) consists of 1.1 acres of the subject site, which includes portions of the existing spine roadway and existing developed portions of WWCF3 Lot 1 and WWCF4, Lots 2 and 6. Onsite Basin K consists 0.8 acres of the existing WWCF3 Lot 1 development.
Junction 16 (Q5 = 12.7 cfs, Q100 = 41.0 cfs) an existing 20' D10-R sump inlet which includes the runoff conveyed within the street from **Basin OS11** and diverted flows from **Inlet 2** (**D2**) (Q5 = 3.2 cfs, Q100 = 12.7 cfs) as well as runoff from **Basin M** and **Basin K** in the 100-year event (Q100 = 4.4 cfs). The collected runoff continues north via the existing public 24" RCP storm sewer (**Reach 22**) at peak flow rates of Q5 = 0.1 cfs, Q100 = 3.5 cfs.

Junction 17 (Q5 = 31.5 cfs, Q100 = 95.2 cfs) is at a proposed private 5.33'x6.33' Type I manhole, which conveys the within **Reach 21** (Q5 = 18.8 cfs, Q100 = 54.3 cfs) and **Reach 22** (Q5 = 12.6 cfs, Q100 = 40.9 cfs). The combined runoff continues west via a private 36" PP storm sewer (**Reach 23**) at peak flow rates of Q5 = 31.3 cfs, Q100 = 95.0 cfs.

Junction 18 (Q5 = 31.5 cfs, Q100 = 95.2 cfs) a proposed public 6.33'x10' Junction Box includes the runoff conveyed within **Reach 10** (Q5 = 18.8 cfs, Q100 = 54.3 cfs) and **Reach 23** (Q5 = 12.6 cfs, Q100 = 40.9 cfs). The combined runoff continues south via the existing public 6'x8.25' CBC storm sewer (**Reach 24**) at peak low rates of Q5 = 31.3 cfs, Q100 = 95.0 cfs.

Offsite **Basin T** (Q5 = 9.0 cfs, Q100 = 17.0 cfs) consists of 3.9 acres of open space and right of way associated with portions of eastbound Barnes Road and an electrical substation. **Junction 19** (Q5 = 10.6 cfs, Q100 = 23.1 cfs) an existing public 20' D10-R sump includes the runoff conveyed within the street from **Basin T** and diverted flows from **Inlet 1** (**D1**) (Q5 = 1.5 cfs, Q100 = 6.2 cfs). The collected runoff continues east via an existing public 18" RCP storm sewer at peak flow rates of Q5 = 10.6 cfs, Q100 = 23.1 cfs.

Junction 20 (Q5 = 246.1 cfs, Q100 = 95.2 cfs) an existing public 18" RCP conveying runoff from **Junction 19** (Q5 = 10.6 cfs, Q100 = 23.1 cfs) ties to the existing 6'x8.25' CBC storm sewer **Reach 24** (Q5 = 235.5 cfs, Q100 = 493.6 cfs). The combined runoff continues southeast within the box culvert at peak flow rates of Q5 = 246.1 cfs, Q100 = 516.7 cfs.

As previously discussed a secondary hydrologic analysis was performed using the rational method. The purpose of the analysis was threefold. The analysis provided onsite surface runoff rates versus that can be compared directly to the existing conditions rational calculations. Secondly, the rational analysis provided runoff rates for basins, which were also modeled in the HEC HMS analysis which can be directly compared to further evaluate the validity of the larger HEC-HMS model. Finally, the data gathered for the rational model for the onsite watersheds was the basis for the concept sizing of the proposed FSD Ponds.

As the drainage patterns and proposed infrastructure was previously discussed in the HEC HMS section, the output from the model will simply be provided. Please refer to the appendix for supporting calculation and the Proposed Conditions Map in the appendix.

Basin Summary (basin, acreage, runoff and contributing summary)
Basin A - 1.71 acres (Q5=7.1 cfs, Q100=12.9 cfs) – portions of WWCF4 Lot 7 (Pond 0)
Basin B – 0.76 acres (Q5=2.4 cfs, Q100=4.6 cfs) – existing spine road and portions of WWCF4 Lots 2, 4 & 6
Basin C – 0.75 acres (Q5=3.2 cfs, Q100=5.7 cfs) – portions of WWCF4 Lot 1(Pond 1)
Basin D – 0.80 acres (Q5=2.9 cfs, Q100=5.6 cfs) – portions of existing commercial WWCF4 Lot 1
Basin E – 0.29 acres (Q5=1.2 cfs, Q100=2.3 cfs) – ex spine rd, portions WWCF3 Lot1 and WWCF4 Lot 2 &7
Basin F – 0.64 acres (Q5=1.8 cfs, Q100=3.8 cfs) – portions WWCF4 Lot 6
Basin F1 – 1.11 acres (Q5=4.7 cfs, Q100=8.5 cfs) – portions WWCF4 Lot 3, 5 & 6 (Pond 4)
Basin F2 – 0.67 acres (Q5=2.8 cfs, Q100=5.1 cfs) – portions WWCF4 Lot 3, 5 & 6 (Pond 4A)
Basin G – 0.18 acres (Q5=0.7 cfs, Q100=1.4 cfs) – portions WWCF4 Lot 2 & 6 (Pond 2)
Basin H – 1.03 acres (Q5=4.3 cfs, Q100=6.1 cfs) – portions WWCF4 Lot 2 (Pond 3)
Basin I – 0.87 acres (Q5=3.7 cfs, Q100=6.7 cfs) – portions WWCF4 Lot 3 (Pond 5)
Basin J – 0.82 acres (Q5=3.4 cfs, Q100=6.2 cfs) – portions WWCF4 Lot 3 (Pond 6)
Basin OS1 – 0.06 acres (Q5=0.1 cfs, Q100=0.3 cfs) – portions of Antelope Ridge Drive E ROW
Basin OS2 – 0.05 acres (Q5=0.1 cfs, Q100=0.2 cfs) – portions of Antelope Ridge Drive E ROW
Basin OS3 – 3.75 acres (Q5=7.3 cfs, Q100=15.0 cfs) – portions of Barnes Road/S ROW, Stetson Hills Sub F13
Basin OS4 – 4.96 acres (Q5=8.9 cfs, Q100=20.1 cfs) – portions of Barnes Road/N ROW, WWStetson Hills F1
Basin OS5 – 2.84 acres (Q5=5.9 cfs, Q100=12.3 cfs) – portions of Barnes Road/N ROW, WWStetson Hills F1
Basin OS6 – 1.48 acres (Q5=2.1 cfs, Q100=5.1 cfs) – portions of WW Stetson Hills F1
Basin OS7 – not used
Basin OS8 – 1.46 acres (Q5=4.6 cfs, Q100=8.9 cfs) – portions of Barnes Road/N ROW, WWStetson Hills F1
Basin OS9 – 15.45 acres (Q5=7.0 cfs, Q100=36.1 cfs) – portion of undeveloped land under BLR 2
Basin OS10 – 2.09 acres (Q5=2.3 cfs, Q100=6.9 cfs) – portions of Marksheffel Road /W ROW
Basin OS10A – 0.16 acres (Q5=0.7 cfs, Q100=1.3 cfs) – portions of Marksheffel Road and NE entrance
Basin OS10B – 1.20 acres (Q5=1.8 cfs, Q100=3.3 cfs) – portions of Marksheffel Road /W ROW
Basin OS11– 0.95 acres (Q5=3.2 cfs, Q100=6.3 cfs) – portions of Barnes Road/N ROW

Design Points (DP/JP, runoff and contributing summary, structure)
Pond 0 - (Q5=7.2 cfs, Q100=13.2 cfs) – OS1, A, SF Pond O
Pond 1 - (Q5=3.2 cfs, Q100=6.0 cfs) – OS2, C, SF Pond 1
EX Pond - (Q5=2.9 cfs, Q100=5.6 cfs) – D, SF Pond O
X - (Q5=3.3 cfs, Q100=6.3 cfs) – B, E, Barnes Road
I1 - (Q5=7.3 cfs, Q100=15.0 cfs) – OS3, Ex 10' D10R At-Grade Inlet
I2 - (Q5=14.2 cfs, Q100=31.0 cfs) – OS4, OS5, Ex 10' D10R At-Grade Inlet
Y - (Q5=10.2 cfs, Q100=28.8 cfs) – OS2, OS6, OS8, DPX, FB12, Barnes Road
EXIN – (Q5=1.8 cfs, Q100=3.8 cfs) – F, Ex 5' D10R Sump Inlet
Pond 4 – (Q5=4.7 cfs, Q100=8.5 cfs) – F1, SF Pond 4
Pond 4A – (Q5=3.5 cfs, Q100=6.4 cfs) – 10A, F2, SF Pond 4A
Pond 2 - (Q5=0.7 cfs, Q100=1.4 cfs) – G, SF Pond 2
Pond 3 – (Q5=4.3 cfs, Q100=7.9 cfs) – H, SF Pond 3
Cul – (Q5=2.3 cfs, Q100=6.9 cfs) – OS10, Prop 24" Culvert
EXCul – (Q5=7.0 cfs, Q100=36.1 cfs) – OS10, EX FES
Pond 6 – (Q5=3.4 cfs, Q100=6.2 cfs) – J, SF Pond 6
Pond 5 – (Q5=3.7 cfs, Q100=6.7 cfs) – I, SF Pond 5
Z - (Q5=12.1 cfs, Q100=32.1 cfs) – OS11, DPY, Ex 20' D10R Sump Inlet

A comparison chart of common design points between the proposed conditions rational method and proposed conditions HEC-HMS analysis has been provided in the appendix to show that the two mythologies provide similar but not like results as such limited comparisons were made to the existing conditions flow rates.

DRAINAGE FACILITY DESIGNS

Seven Concept drainage facilities have been sized utilizing MHFD Detention Worksheet Version 4.06 from the Mile High Flood District. These conceptual sand filter ponds are anticipated to be constructed with an underdrain system and outlet control structure, which limits the pond's release rate through weirs and a restricted outlet pipe. The ponds will be required to store the WCQV, EURV, and flood control volumes for the 2, 5, 10, 25, 50, and 100-year storm events while discharging at the Pre-development peak flow rates for each event. The WQCV from each pond shall be slowly released over 12-40 hours, while the EURV is to be released over 72 hours. An overflow emergency weir/spillway shall be constructed for each facility to safely convey flows to the nearby street section in the event that the outlet structure becomes clogged. The spillways are required to provide 1' of freeboard across the crest during operation.

The tables below summarize the peak inflows, outflows, storage volumes, and water surface elevations for the water quality, 5-year, EURV, and 100-year event storms. All proposed (future) ponds are private and are to be maintained by the Willowind Filing No. 4 Metropolitan District. Refer to the Proposed Conditions Drainage Map to reference the assumed contributing basins and approximate pond locations. The various ponds' exact type, layout, and location shall be determined and analyzed with the subsequent site/lot-specific drainage reports. Due to geographic constraints of the site, it is anticipated/recommended that multiple lots will share single or multiple ponds.

FSD Pond 0
Assumed Type: Sand Filter
Assumed Contributing Area = 1.77 Acres (Rational Analysis **Basins, OS1, A**)
Assumed % Imperviousness = 93.1%
Assumed Detention & Water Quality Treatment for: WWCF4 Lot 7 & portion of Antelope Ridge ROW

Anticipated Volumes (MHFD-Det.Ver. 4.06 -Basin)	**WQCV**	**EURV**	**100 Year**	**Total**
Maximum Volume Stored (acre-ft) (Req'd)	0.051	0.175	0.087	0.313

Routed Output (MHFD-Det.Ver.4.06 - Outlet Struct)	**WQCV**	**EURV**	**5 Year**	**100 Year**
Maximum Volume Stored (acre-ft) (Req'd)	0.051	0.227	0.184	0.267
Maximum WS Ponding Depth (ft)	0.71	2.29	1.98	2.58
Peak Inflow (cfs)	N/A	N/A	3.8	6.6
Peak Outflow (cfs)	0.1	0.1	0.1	1.1

FSD Pond 1

Assumed Type: Sand Filter
Assumed Contributing Area = 0.80 Acres, (Rational Analysis **Basins OS2, C**)
Assumed % Imperviousness = 91.7%
Detention & Water Quality Treatment for: WWCF4 Lot 1 & portion of WWCF4 Lot 7, and portion of Antelope Ridge ROW

Anticipated Volumes (MHFD-Det Ver. 4.06 -Basin)	**WQCV**	**EURV**	**100 Year**	**Total**
Maximum Volume Stored (acre-ft) (Req'd)	0.022	0.079	0.039	0.139

Routed Output (MHFD-Det.Ver.4.06 - Outlet Struct)	**WQCV**	**EURV**	**5 Year**	**100 Year**
Maximum Volume Stored (acre-ft) (Req'd)	0.022	0.101	0.079	0.112
Maximum WS Ponding Depth (ft)	0.81	2.36	2.03	2.51
Peak Inflow (cfs)	N/A	N/A	1.9	3.3
Peak Outflow (cfs)	0.0	0.0	0.0	0.6

FSD Pond 2

Assumed Type: Sand Filter
Assumed Contributing Area = 0.18 Acres, (Rational Analysis **Basin G**)
Assumed % Imperviousness = 95.0%
Detention & Water Quality Treatment for: portion of WWCF4 Lots 2 & 6

Anticipated Volumes (MHFD-Det Ver. 4.06 -Basin)	**WQCV**	**EURV**	**100 Year**	**Total**
Maximum Volume Stored (acre-ft) (Req'd)	0.005	0.018	0.009	0.033

Routed Output (MHFD-Det.Ver.4.06 - Outlet Struct)	**WQCV**	**EURV**	**5 Year**	**100 Year**
Maximum Volume Stored (acre-ft) (Req'd)	0.005	0.024	0.02	0.029
Maximum WS Ponding Depth (ft)	0.36	1.26	1.09	1.45
Peak Inflow (cfs)	N/A	N/A	0.3	0.6
Peak Outflow (cfs)	0.0	0.0	0.0	0.1

FSD Pond 3

Assumed Type: Sand Filter
Assumed Contributing Area = 1.03 Acres, (Rational Analysis **Basin H**)
Assumed % Imperviousness = 95.0%
Detention & Water Quality Treatment for: portion of WWCF4 Lots 2 & 6

Anticipated Volumes (MHFD-Det Ver. 4.06 -Basin)	**WQCV**	**EURV**	**100 Year**	**Total**
Maximum Volume Stored (acre-ft) (Req'd)	0.031	0.104	0.051	0.186

Routed Output (MHFD-Det.Ver.4.06 - Outlet Struct)	**WQCV**	**EURV**	**5 Year**	**100 Year**
Maximum Volume Stored (acre-ft) (Req'd)	0.032	0.136	0.105	0.148

Maximum WS Ponding Depth (ft)	0.53	1.79	1.48	1.92
Peak Inflow (cfs)	N/A	N/A	2.5	4.3
Peak Outflow (cfs)	0.0	0.0	0.0	0.8

FSD Pond 4

Assumed Type: Sand Filter
Assumed Contributing Area = 1.11 Acres, (Rational Analysis **Basin F1**)
Assumed % Imperviousness = 95.0%
Detention & Water Quality Treatment for: portions of WWCF4 Lots 2, 3, 5 & 6

Anticipated Volumes (MHFD-Det Ver. 4.06 -Basin)	**WQCV**	**EURV**	**100 Year**	**Total**
Maximum Volume Stored (acre-ft) (Req'd)	0.033	0.112	0.055	0.201

Routed Output (MHFD-Det.Ver.4.06 - Outlet Struct)	**WQCV**	**EURV**	**5 Year**	**100 Year**
Maximum Volume Stored (acre-ft) (Req'd)	0.033	0.146	0.116	0.164
Maximum WS Ponding Depth (ft)	0.53	1.68	1.42	1.83
Peak Inflow (cfs)	N/A	N/A	2.6	4.4
Peak Outflow (cfs)	0.0	0.0	0.0	0.7

FSD Pond 4A

Assumed Type: Sand Filter
Assumed Contributing Area = 0.83 Acres, (Rational Analysis **Basins F2, OS10A**)
Assumed % Imperviousness = 95.0%
Detention & Water Quality Treatment for: portion of WWCF4 Lot 5

Anticipated Volumes (MHFD-Det Ver. 4.06 -Basin)	**WQCV**	**EURV**	**100 Year**	**Total**
Maximum Volume Stored (acre-ft) (Req'd)	0.025	0.085	0.042	0.152

Routed Output (MHFD-Det.Ver.4.06 - Outlet Struct)	**WQCV**	**EURV**	**5 Year**	**100 Year**
Maximum Volume Stored (acre-ft) (Req'd)	0.026	0.110	0.087	0.131
Maximum WS Ponding Depth (ft)	0.42	1.37	1.15	1.56
Peak Inflow (cfs)	N/A	N/A	2.0	3.3
Peak Outflow (cfs)	0.0	0.0	0.0	0.3

FSD Pond 5

Assumed Type: Sand Filter
Assumed Contributing Area = 0.87 Acres, (Rational Analysis Basin **I**)
Assumed % Imperviousness = 95.0%
Detention & Water Quality Treatment for: portion of WWCF4 Lot 3

Anticipated Volumes (MHFD-Det Ver. 4.06 -Basin)	**WQCV**	**EURV**	**100 Year**	**Total**
Maximum Volume Stored (acre-ft) (Req'd)	0.026	0.088	0.043	0.157

Routed Output (MHFD-Det.Ver.4.06 - Outlet Struct)	**WQCV**	**EURV**	**5 Year**	**100 Year**
Maximum Volume Stored (acre-ft) (Req'd)	0.026	0.114	0.090	0.126
Maximum WS Ponding Depth (ft)	0.69	2.05	1.75	2.19
Peak Inflow (cfs)	N/A	N/A	2.0	3.5
Peak Outflow (cfs)	0.0	0.0	0.0	0.6

FSD Pond 6
Assumed Type: Sand Filter
Assumed Contributing Area = 0.82 Acres, (Rational Analysis **Basin J**)
Assumed % Imperviousness = 95.0%
Detention & Water Quality Treatment for: portion of WWCF4 Lot 4

Anticipated Volumes (MHFD-Det Ver. 4.06 -Basin)	WQCV	EURV	100 Year	Total
Maximum Volume Stored (acre-ft) (Req'd)	0.024	0.083	0.041	0.148

Routed Output (MHFD-Det.Ver.4.06 - Outlet Struct)	WQCV	EURV	5 Year	100 Year
Maximum Volume Stored (acre-ft) (Req'd)	0.024	0.108	0.088	0.132
Maximum WS Ponding Depth (ft)	0.68	2.05	1.79	2.34
Peak Inflow (cfs)	N/A	N/A	1.7	3.0
Peak Outflow (cfs)	0.0	0.0	0.0	0.5

Rational Analysis Basins B, E, F, and G were previously developed and are not disturbed as a portion of this project as such no additional treatment or detention is being provided.

Rational Analysis Basin D was previously developed and are not disturbed as a portion of this project. Runoff from this basin currently drains to an existing water quality pond and outlet works.

Rational Analysis Basins OS3-OS6, OS8-OS9. are not disturbed as a portion of this project.

The future disturbances anticipated disturbances within Rational Analysis Basins OS10 and OS10B are not directed to onsite treatment facilities, but are anticipated to be less than 0.5 acre.

EROSION CONTROL

It is the policy of the City of Colorado Springs that we submit an erosion control plan with the drainage report. We respectfully request that the erosion control plan be submitted in conjunction with the final grading plan. Proposed straw bale check dams, silt fences, inlet protection, vehicle traffic control, and reseeding are proposed as erosion control measures. The Grading and Erosion Control Plans will be submitted as a separate document.

DRAINAGE, BRIDGE, AND POND FEES

The project is located within the Sand Creek Drainage Basin. The site has been previously platted and therefore no fees are due.

CONSTRUCTION COST ESTIMATE

(Private Storm Sewer System, Non-Reimbursable)

Item	Description	Quantity	Unit Cost	Cost
1.	15" PP Storm Drain	998 LF	$100/LF	$ 99,800.00
2.	36" PP Storm Drain	279 LF	$225/LF	$ 62,775.00
3.	36" RCP Storm Drain	90 LF	$275/LF	$ 24,750.00
4.	42" RCP Storm Drain	15 LF	$300/LF	$ 4,500.00
5	5.33x6.33' Type I MH	6 EA	$7,500/EA	$ 45,000.00
6.	5' Type II MH	4 EA	$5,500/EA	$ 22,000.00

Subtotal		$ 258,825.00
Engineering and Contingency (15%)		$ 38,823.75
Total	**=**	**$ 297,648.80**

(Private, Detention Storage, Non-Reimbursable)

Pond 0-7 (Facilities to be maintained by the Willowind Filing No. 4 Metropolitan District)

Item	Description	Quantity	Unit Cost	Cost
1.	Pond 0	1 LS	$40,000/LS	$ 40,000.00
2.	Pond 1	1 LS	$25,000/LS	$ 25,000.00
3.	Pond 2	1 LS	$15,000/LS	$ 15,000.00
4.	Pond 3	1 LS	$25,000/LS	$ 25,000.00
5.	Pond 4	1 LS	$30,000/LS	$ 30,000.00
6.	Pond 4a	1 LS	$25,000/LS	$ 25,000.00
7.	Pond 5	1 LS	$25,000/LS	$ 25,000.00
8.	Pond 6	1 LS	$25,000/LS	$ 25,000.00

Subtotal		$ 210,000.00
Engineering and Contingency (15%)		$ 31,500.00
Total	**=**	**$ 241,500.00***

***Based upon concepts shown. The actual types of water quality/detention facilities, their associated components, and their estimated costs will be provided in future site specific Final Drainage Reports**

(Public Storm Sewer System, Non-Reimbursable)

Item	Description	Quantity	Unit Cost	Cost
1.	R&R 24" RCP Storm Drain	15 LF	$120/LF	$ 1,800.00
2.	60" RCP Storm Drain	56 LF	$580/LF	$ 32,480.00
3.	R&R 60" RCP Storm Drain	8 LF	$460/LF	$ 3,680.00
4.	Custom Type I MH	1 EA	$12,000/LF	$ 12,500.00
5.	6.33'x10'Junction Box	1 EA	$20,000/EA	$ 20,500.00
6.	D50=12" Riprap	16 CY	$75/CY	$ 1,200.00
7.	NAG Erosion Control Bkt	50 SY	$15/SY	$ 750.00

Subtotal		$ 72,910.00
Engineering and Contingency (10%)		$ 7,291.00
Total	**=**	**$ 80,201.00**

M & S Civil Consultants, Inc. (M & S) cannot and does not guarantee the construction cost will not vary from these opinions of probable costs. These opinions represent our best judgment as design professionals familiar with the construction industry and this development. The above is only an estimate of the facility cost and drainage basin fee amounts in 2023. Upon completion of the aforementioned improvements, M & S shall submit the actual construction costs to the City of Colorado Springs/City Drainage Board for reimbursement. Drainage fees must be paid before plat recordation.

FINDINGS, CONSIDERATIONS, AND RECOMMENDATIONS

- Per the HEC-HMS analysis, the total runoff existing in the outfall of the 6'x8' box culvert per this analysis was calculated at Q5 = 246.1 cfs, Q100 = 516.7 cfs; this closely aligns with the discharge of Q5

= 228.0 cfs and Q100= 499.0 cfs estimated in the *Master Development Drainage Plan for Stetson Hills Enclave*. The runoff calculated by this study produces runoff significantly less than the 620 cfs, and 903 cfs calculated at Design Point 23 in the *Sand Creek Drainage Basin Planning Study* prepared by Kiowa in 1995, for which the box culvert was initially designed.

- Hydraulic evaluation of the existing public 60" trunk main indicates it becomes pressurized in events exceeding the 10-year storm event. Given this, the proposed system should not directly connect to this portion of the system. The connection of the proposed system at the box culvert (via the proposed junction box) significantly aids in reduce the hydraulic constraints to the proposed system. It should be noted that this statement assumes that all upstream-produced runoff reaching the system is intercepted and is not conveyed within the adjacent streets and disregards the effects of ponding at sump inlets or offsite collections points, which would result in greater lag times and lower flow rates within the modeled system.

- Any additional decrease in runoff to occur as a result of the future widening of Marksheffel Road was not accounted for by this study for two reasons; the first being that the offsite and roadway drainage in the existing condition will still need to be dealt with if the subject site develops before the roadway improvements. Secondly, at the time of the writing of this report, updated plans and drainage studies for the future project were being developed and unavailable. Thus, it was unclear how the runoff would be collected and where it would be directed and treated. It should be noted that the previous plans, Marksheffel Roadway Plans (2007), which are included in the appendix, illustrated that the runoff produced by the road would be retained within the roadway. The proposed storm sewer system would collect said runoff, intercept offsite runoff located east of the roadway, and direct it south of Barnes Road.

- An excerpt within the *Final Drainage Report and Plan for Willowind at Stetson Hills Filing No. 4* addresses concerns about the inadequacy of the existing 24" culvert located 0.5 miles south of site Marksheffel Road (below existing 6'x 8' RBC and channel associated with Chateau at Antelope Ridge). The report recommended the placement of signage at the crossing on Marksheffel until El Paso County improves the roadway. This should still be considered until its clear if this condition is alleviated by the Marksheffel Improvement Project(s).

- Due to the low discharge from the proposed concept ponds some portions of the proposed infrastructure will have velocities that are less than 3 feet per second in the minor event storm. A variance letter has been submitted to the City for approval that discusses this. A copy of the letter is included within the appendix of this report.

- All runoff produced by the site is directed to the existing box culvert and therefore is in general accordance with the *Sand Creek Drainage Basin Planning Study* and previously submitted and approved Master Development and Drainage Plans and Final Drainage Reports for the area.

SUMMARY

The runoff and storm drain, and appurtenances of Willowind Commercial Filing No. 4 will not adversely affect the downstream and surrounding developments. The proposed concept drainage facilities will adequately convey, detain and route runoff from the onsite & offsite flows to existing facilities, as well as provide water quality treatment. Runoff, storm drains, and appurtenances will not adversely affect the existing downstream infrastructure and surrounding developments. This Master Development Drainage Plan

and Final Drainage Report are in general compliance with prior hydrologic studies affecting the site. All drainage facilities described herein and shown on the included Proposed Drainage Map (See Appendix) are subject to change depending on individual lot development. This MDDP/FDR should be used as a guideline for releasing flows offsite and final Full Spectrum & Water Quality Detention Pond sizing. Care shall be taken to accommodate overland emergency flow routes on site and temporary drainage conditions with the continued development of the subject site.

REFERENCES

1.) City of Colorado Springs Drainage Criteria Manual, Volumes 1 & 2, revised 2020 and 2021.

2.) Urban Drainage and Flood Control District, Urban Storm Drainage Criteria Manual Volume 1 & 2 dated January 2016.

3.) Web Soil Survey, USDA NRCS Soils Map
https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

4.) FEMA flood Map Service Center, Federal Emergency Management Agency
https://msc.fema.gov/portal/home

3.) Sand Creek Drainage Basin Planning Study Preliminary Design Report, dated January 1993, Revised March 1996, by Kiowa Engineering Corporation.

4.) Master Development Drainage Plan for Stetson Hills Enclave, by Leigh Whitehead & Associates, Inc. dated September 2000.

5.) Final Drainage Report and Plan for Willowind at Stetson Hills Filing No. 1, 2, and 3, by Leigh Whitehead & Associates, Inc. dated March 2001.

6.) Final Drainage Report and Plan for Willowind Commercial Filing No. 1 by Leigh Whitehead & Associates, Inc. dated April 2003.

7.) Willowind at Stetson Hills Box Culvert Conversion Exhibit, by Leigh Whitehead & Associates, Inc. dated April 2003.

8.) Preliminary/Final Drainage Report for Eastview Estates Filing No. 2, by JR Engineering, LLC, April 2005.

9.) Final Drainage Report and Plan for Willowind at Stetson Hills Filing No. 4, by Leigh Whitehead & Associates, Inc. dated September 2004.

10.) Final Drainage Letter for Willowind Commercial Subdivision Filing No. 2, a Replat of Lot 4, Willowind Commercial Filing No. 1, Colorado Springs, Colorado, by Kiowa Engineering Corporation, April 2005.

11.) Preliminary/Final Drainage Report for Eastview Estates Filing No. 3, by JR Engineering, LLC, November 2005.

12.) Small Subdivision Drainage Report for 7-Eleven (Willowind Commercial Filing No.3, Lot 1, Barnes Road, Colorado Springs, CO, by Harrison French & Associates, LTD, April 2012.

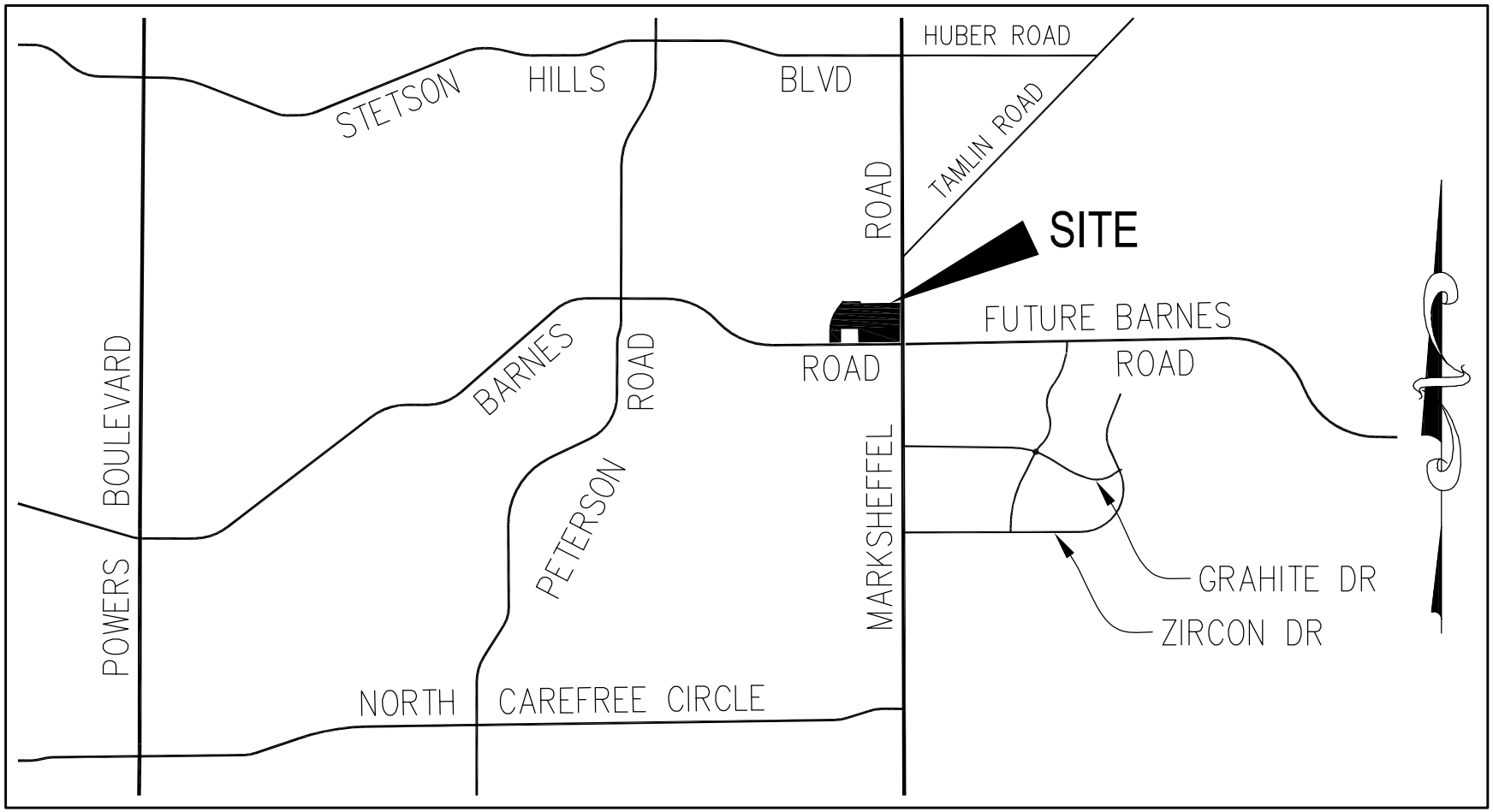
13.) Sand Creek Drainage Basin Planning Study Final Report, dated 2021, by Stantec and HDR Dewberry.

14.) Drainage Letter for Willowind Commercial Filing No. 4, prepared by M&S Civil Consultants, August 2023.

.

APPENDIX

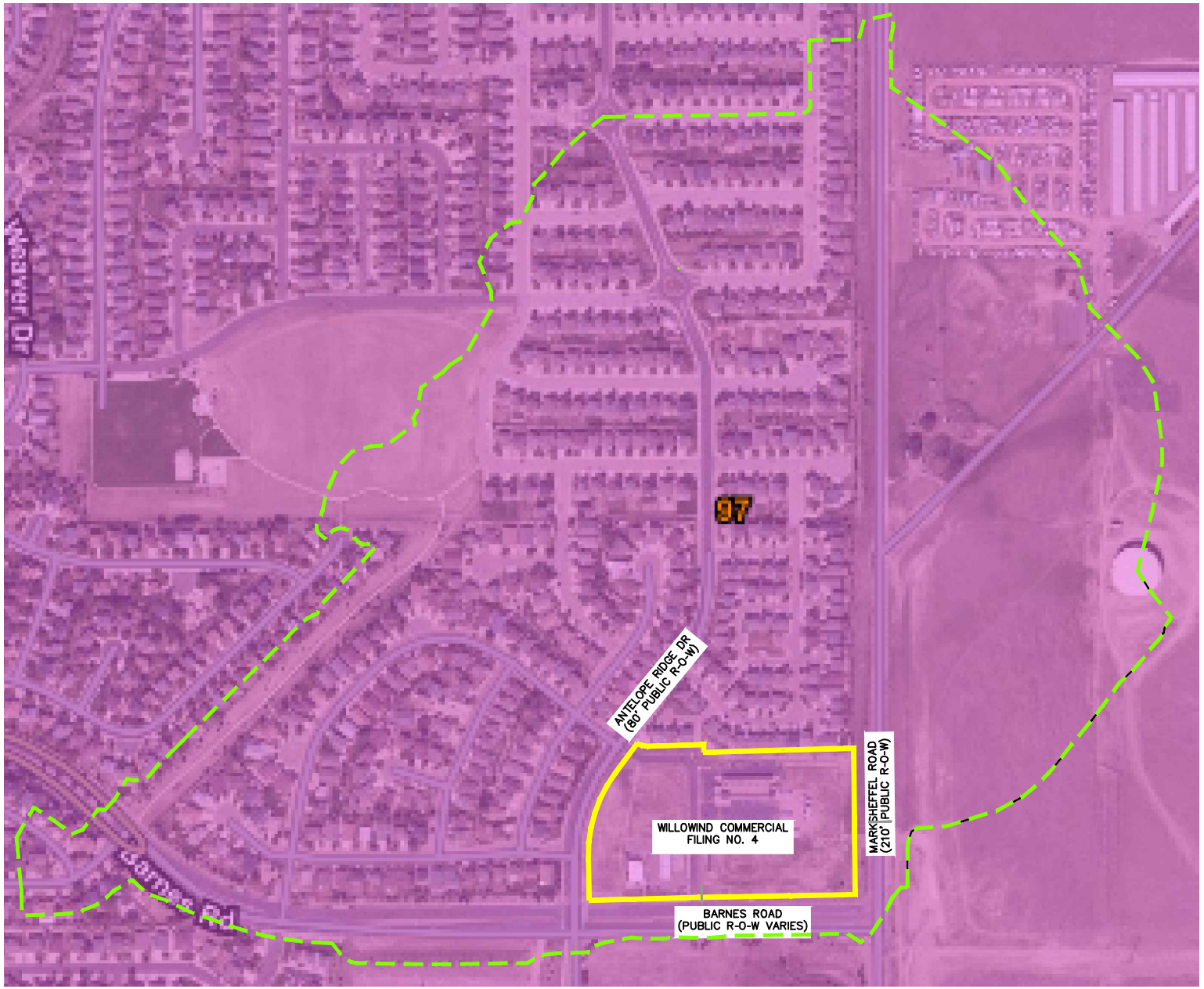
VICINITY MAP



VICINITY MAP

N.T.S.

SOILS MAP



1" = 500'

0 250 500 1000

Scale in Feet

WILLOWWIND COMMERCIAL FILING NO. 4

SOILS MAP

HYDROLOGIC TYPE A SOILS

WATERSHED BOUNDARY

SITE BOUNDARY

CIVIL CONSULTANTS, INC.

212 N. WAHSATCH AVE., STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

File: O:\10021A-Willowwind-Dunkin Donuts\Dunkin Donuts\Drainage\PDfs\10-021 SOILS MAP.dwg Plotstamp: 3/6/2023 1:23 PM

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10	Blendon sandy loam, 0 to 3 percent slopes	B	0.1	0.0%
97	Truckton sandy loam, 3 to 9 percent slopes	A	790.9	100.0%
Totals for Area of Interest			**791.0**	**100.0%**

Description

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

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

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

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

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

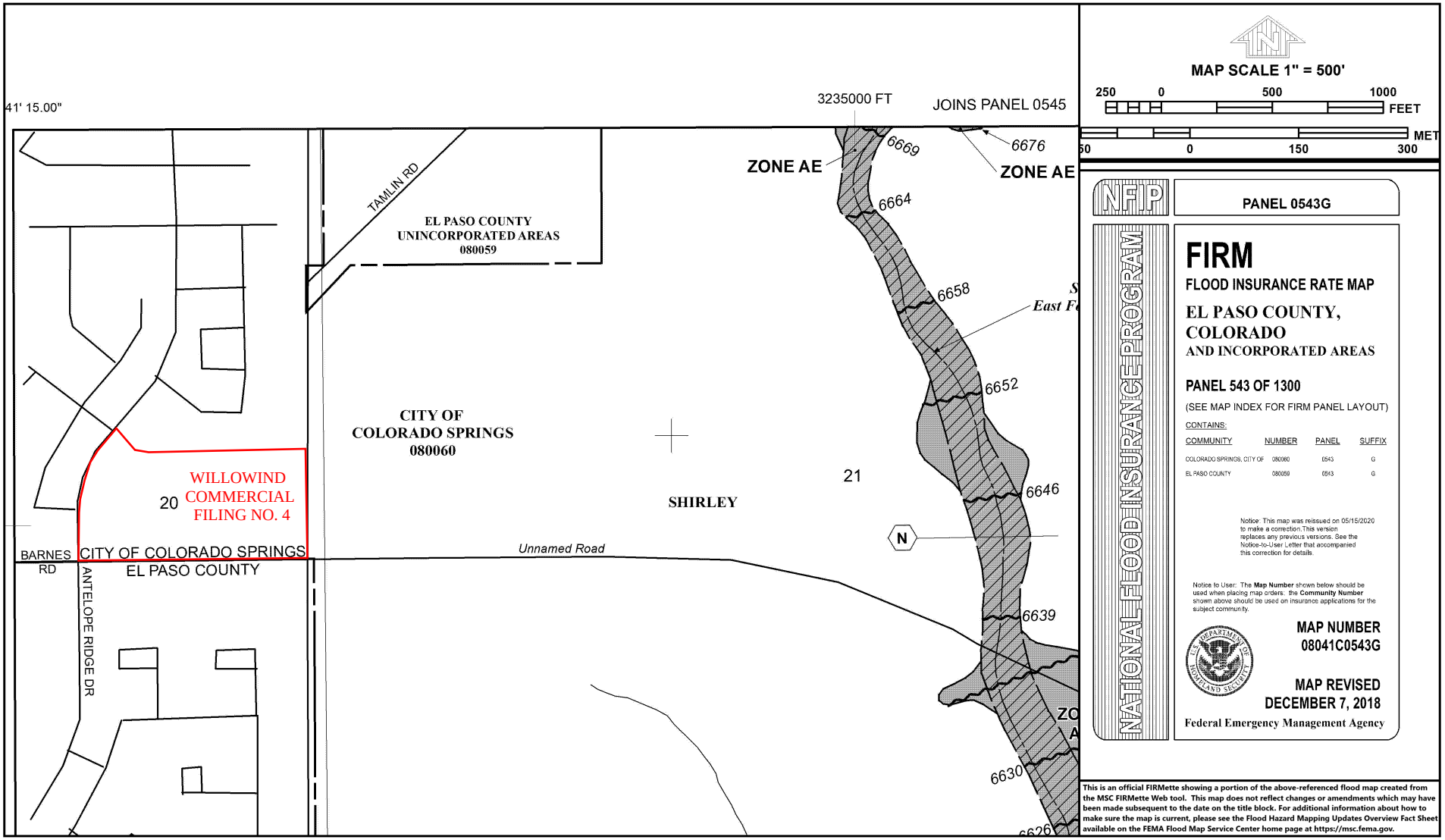
Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over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

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

Rating Options

Aggregation Method: Dominant Condition

FIRM PANELS


41' 15.00"
3235000 FT
JOINS PANEL 0545
TAMLIN RD
EL PASO COUNTY
UNINCORPORATED AREAS
080059
CITY OF
COLORADO SPRINGS
080060
WILLOWIND
COMMERCIAL
FILING NO. 4
20
21
SHIRLEY
BARNES
RD
CITY OF COLORADO SPRINGS
EL PASO COUNTY
ANTELOPE RIDGE DR
Unnamed Road
ZONE AE
ZONE AE
6669
6676
6664
6658
6652
6646
6639
6630
6626
East Fe
N
MAP SCALE 1" = 500'
250 0 500 1000
FEET
50 0 150 300
MET
NFIP
NATIONAL FLOOD INSURANCE PROGRAM
PANEL 0543G
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY,
COLORADO
AND INCORPORATED AREAS
PANEL 543 OF 1300
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
COLORADO SPRINGS, CITY OF 080060 0543 G
EL PASO COUNTY 080059 0543 G
Notice: This map was reissued on 05/15/2020 to make a correction.This version replaces any previous versions. See the Notice-to-User Letter that accompanied this correction for details.
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.
MAP NUMBER
08041C0543G
MAP REVISED
DECEMBER 7, 2018
Federal Emergency Management Agency
This is an official FIRMette showing a portion of the above-referenced flood map created from the MSC FIRMette Web tool. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For additional information about how to make sure the map is current, please see the Flood Hazard Mapping Updates Overview Fact Sheet available on the FEMA Flood Map Service Center home page at https://msc.fema.gov.

HYDROLOGIC CALCULATIONS

EXISTING CONDITIONS
RATIONAL METHOD ANALYSIS

PRELIMINARY/FINAL DRAINAGE REPORT
WILLOWIND COMMERICAL FILING NO.4
(Existing Conditions - Area Runoff Coefficient Summary)

			STREETS/DEVELOPED			*COMMERICAL/RESIDENTIAL*			*LANDSCAPED/UNDEVELOPED*			*OTHER*			*WEIGHTED*	
BASIN	**TOTAL AREA** *(SF)*	**TOTAL AREA** *(Acres)*	**AREA** *(Acres)*	**C_5**	**C_{100}**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**C_5**	**C_{100}**
A	***40341.0***	0.93	0.00	0.90	0.96	0.00	0.00	0.00	0.93	0.08	0.35	0.00	0.08	0.35	***0.08***	***0.35***
B	***37554.4***	0.86	0.63	0.90	0.96	0.00	0.33	0.52	0.23	0.08	0.35	0.00	0.08	0.35	***0.68***	***0.80***
C	***49607.1***	1.14	0.00	0.90	0.96	0.00	0.33	0.52	1.14	0.08	0.35	0.00	0.08	0.35	***0.08***	***0.35***
D	***4477.2***	0.10	0.01	0.90	0.96	0.00	0.33	0.52	0.09	0.08	0.35	0.00	0.08	0.35	***0.15***	***0.40***
E	***47296.0***	1.09	0.49	0.90	0.96	0.15	0.73	0.81	0.45	0.08	0.35	0.00	0.08	0.35	***0.54***	***0.69***
F	***11630.6***	0.27	0.24	0.90	0.96	0.00	0.33	0.52	0.03	0.08	0.35	0.00	0.08	0.35	***0.82***	***0.90***
G	***60946.2***	1.40	0.32	0.90	0.96	0.20	0.73	0.81	0.75	0.08	0.35	0.13	0.59	0.70	***0.41***	***0.59***
H	***60646.3***	1.39	0.37	0.90	0.96	0.00	0.33	0.52	1.02	0.08	0.35	0.00	0.59	0.70	***0.30***	***0.51***
I	***54373.0***	1.25	0.77	0.90	0.96	0.04	0.73	0.81	0.45	0.08	0.35	0.00	0.08	0.35	***0.61***	***0.74***
J	***52744.3***	1.21	0.00	0.90	0.96	0.00	0.33	0.52	1.21	0.08	0.35	0.00	0.08	0.35	***0.08***	***0.35***
OS1	***1750.6***	0.04	0.00	0.90	0.96	0.00	0.33	0.52	0.04	0.08	0.35	0.00	0.08	0.35	***0.08***	***0.35***
OS2	***2220.0***	0.05	0.00	0.90	0.96	0.00	0.33	0.52	0.05	0.08	0.35	0.00	0.08	0.35	***0.08***	***0.35***
OS3	***163533.0***	3.75	1.36	0.90	0.96	2.39	0.38	0.55	0.00	0.08	0.35	0.00	0.08	0.35	***0.57***	***0.70***
OS4	***216141.1***	4.96	1.05	0.90	0.96	3.38	0.38	0.55	0.53	0.08	0.35	0.00	0.38	0.55	***0.46***	***0.62***
OS5	***123561.5***	2.84	1.31	0.90	0.96	1.07	0.38	0.55	0.46	0.08	0.35	0.00	0.08	0.35	***0.57***	***0.71***
OS6	***64600.1***	1.48	0.00	0.90	0.96	1.48	0.38	0.55	0.00	0.08	0.35	0.00	0.08	0.35	***0.38***	***0.55***
OS7	***796.1***	0.02	0.00	0.90	0.96	0.00	0.33	0.52	0.02	0.08	0.35	0.00	0.08	0.35	***0.08***	***0.35***
OS8	***63452.2***	1.46	0.99	0.90	0.96	0.35	0.38	0.55	0.12	0.08	0.35	0.00	0.08	0.35	***0.71***	***0.81***
OS9	***673171.7***	15.45	0.72	0.90	0.96	0.00	0.33	0.52	14.56	0.08	0.35	0.17	0.59	0.70	***0.12***	***0.38***
OS10	***150250.1***	3.45	0.90	0.90	0.96	0.00	0.33	0.52	2.48	0.08	0.35	0.07	0.08	0.35	***0.29***	***0.51***
OS11	***41429.0***	0.95	0.71	0.90	0.96	0.00	0.33	0.52	0.23	0.08	0.36	0.01	0.59	0.70	***0.70***	***0.81***

PRELIMINARY/FINAL DRAINAGE REPORT
WILLOWIND COMMERICAL FILING NO.4
(Existing Conditions - Area Drainage Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*STREET / CHANNEL FLOW*				*Time of Travel (T_t)*		*INTENSITY **		*TOTAL FLOWS*	
BASIN	**AREA TOTAL**	**C_5**	**C_{100}**	**C_5**	**Length**	**Height**	**T_C**	**Length**	**Slope**	**Velocity**	**T_t**	**TOTAL**	**CHECK**	**I_5**	**I_{100}**	**Q_5**	**Q_{100}**
	(Acres)	*From DCM Table 5-1*			*(ft)*	*(ft)*	*(min)*	*(ft)*	*(%)*	*(fps)*	*(min)*	*(min)*	*(min)*	*(in/hr)*	*(in/hr)*	*(c.f.s.)*	*(c.f.s.)*
A	0.93	0.08	0.35	0.08	50	2.5	7.7	225	0.7%	0.6	6.6	14.2	11.5	3.6	6.0	***0.3***	***2.0***
B	0.86	0.68	0.80	0.68	60	1.0	5.0	375	0.8%	1.8	3.5	8.5	12.4	4.4	7.4	***2.6***	***5.0***
C	1.14	0.08	0.35	0.08	50	2.0	8.2	252	0.7%	0.6	7.2	15.4	11.7	3.5	5.8	***0.3***	***2.3***
D	0.10	0.15	0.40	0.15	50	2.0	7.7	46	6.5%	1.8	0.4	8.1	10.5	4.4	7.4	***0.1***	***0.3***
E	1.09	0.54	0.69	0.54	40	0.7	5.4	225	1.9%	2.8	1.4	6.8	11.5	4.7	7.9	***2.8***	***5.9***
F	0.27	0.82	0.90	0.82	20	0.1	2.9	355	1.3%	2.3	2.6	5.5	12.1	5.0	8.5	***1.1***	***2.0***
G	1.40	0.41	0.59	0.41	45	1.0	6.4	190	0.9%	1.9	1.6	8.1	11.3	4.5	7.5	***2.5***	***6.1***
H	1.39	0.30	0.51	0.30	60	1.0	9.5	300	1.3%	0.8	6.3	15.7	12.0	3.9	6.5	***1.6***	***4.6***
I	1.25	0.61	0.74	0.61	50	1.5	4.4	180	2.9%	3.4	0.9	5.3	11.3	5.1	8.6	***3.9***	***7.9***
J	1.21	0.08	0.35	0.08	60	0.7	13.6	140	1.7%	0.9	2.5	16.1	11.1	3.4	5.7	***0.3***	***2.4***
OS1	0.04	0.08	0.35	0.08	10	1.0	2.7	0	0.0%	0.0	0.0	5.0	10.1	5.2	8.7	***0.02***	***0.1***
OS2	0.05	0.08	0.35	0.08	10	1.0	2.7	0	0.0%	0.0	0.0	5.0	10.1	5.2	8.7	***0.02***	***0.2***
OS3	3.75	0.57	0.70	0.57	65	1.3	6.2	1225	1.1%	2.1	9.9	16.1	17.2	3.4	5.7	***7.3***	***15.0***
OS4	4.96	0.46	0.62	0.46	100	2.0	9.2	460	2.8%	3.4	2.3	11.5	13.1	3.9	6.6	***8.9***	***20.1***
OS5	2.84	0.57	0.71	0.57	100	2.0	7.6	783	1.1%	2.1	6.2	13.8	14.9	3.6	6.1	***5.9***	***12.3***
OS6	1.48	0.38	0.55	0.38	60	1.3	7.9	820	1.6%	2.5	5.4	13.3	14.9	3.7	6.2	***2.1***	***5.1***
OS7	0.02	0.08	0.35	0.08	10	1.0	2.7	0	0.0%	0.0	0.0	5.0	10.1	5.2	8.7	***0.01***	***0.1***
OS8	1.46	0.71	0.81	0.71	100	2.0	5.6	481	2.7%	3.3	2.4	8.0	13.2	4.5	7.5	***4.6***	***8.9***
OS9	15.45	0.12	0.38	0.12	100	10.0	8.2	1165	5.3%	3.5	5.6	13.9	17.0	3.6	6.1	***7.0***	***36.1***
OS10	3.45	0.29	0.51	0.29	50	1.0	8.2	893	4.8%	3.3	4.5	12.7	15.2	3.8	6.3	***3.8***	***11.1***
OS11	0.95	0.70	0.81	0.70	50	1.0	4.1	350	2.3%	3.0	1.9	6.0	12.2	4.9	8.2	***3.2***	***6.3***

* Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: DLM
Date: 11/10/2022
Checked by: VAS

PRELIMINARY/FINAL DRAINAGE REPORT
WILLOWIND COMMERICAL FILING NO.4
(Existing Conditions - Basin Routing Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*PIPE / CHANNEL FLOW*				*Time of Travel (T_t)*	*INTENSITY **		*TOTAL FLOWS*		
DESIGN POINT	**CONTRIBUTING BASINS**	**CA_5**	**CA_{100}**	**C_5**	**Length** *(ft)*	**Height** *(ft)*	**T_C** *(min)*	**Length** *(ft)*	**Slope** *(%)*	**Velocity** *(fps)*	**T_t** *(min)*	**TOTAL** *(min)*	**I_5** *(in/hr)*	**I_{100}** *(in/hr)*	**Q_5** *(c.f.s.)*	**Q_{100}** *(c.f.s.)*	COMMENTS
1	**OS1, A**	0.08	0.34	Assumes Basin A Tt =								14.2	3.6	6.0	***0.3***	***2.0***	Existing Desert Varnish Drive
2	**OS2, C**	0.10	0.42	Assumes Basin C Tt =								15.4	3.5	5.8	***0.3***	***2.4***	Existing Desert Varnish Drive
3	**DP1, DP2, B**	0.76	1.44	Assumes Basin C Tt =								15.4	3.5	5.8	***2.6***	***8.4***	Existing Desert Varnish Drive
4	**E**	0.59	0.75	Assumes Basin E Tt =								6.8	4.7	7.9	***2.8***	***5.9***	Existing Area Drain/WQ Pond
5	**OS3**	2.13	2.62	Assumes Basin OS3 Tt =								16.1	3.4	5.7	***7.3***	***15.0***	Existing 10' at Grade Inlet
6	**OS4, OS5**	3.89	5.06	Assumes Basin OS5 Tt =								13.8	3.6	6.1	***14.2***	***31.0***	Existing 15' D10R At Grade Inlet
7	**OS6, OS8, OS7, D FBPD6, DP3, F**	2.91	4.78	Assumes DP3 Tt =				160	1.3%	2.3	1.2	16.6	3.4	5.7	***9.8***	***27.0***	Existing Barnes Road
8	**G**	0.57	0.82	Assumes Basin G Tt =								8.1	4.5	7.5	***2.5***	***6.1***	Existing 5' Sump Inlet
9	**OS9**	1.92	5.91	Assumes Basin OS9 Tt =								13.9	3.6	6.1	***7.0***	***36.1***	Existing 24" CMP
10	**DP9, OS10**	2.93	7.67	Assumes Basin OS9 Tt =				60	9.2%	3.5	0.3	14.1	3.6	6.1	***10.6***	***46.4***	Sheet Flow to Offsite Area West of Marksheffel
11	**DP10, H**	3.34	8.38	Assumes DP10 Tt =				237	1.3%	0.8	4.9	19.1	3.2	5.3	***10.6***	***44.4***	Sheet Flow to Offsite Area West of Marksheffel
12	**I**	0.76	0.93	Assumes Basin I Tt =								5.3	5.1	8.6	***3.9***	***7.9***	Sheet Flow to Offsite Low Point West of Marksheffel
13	**DP11, DP12 J**	4.20	9.73	Assumes DP10 Tt =				143	1.4%	0.9	2.6	21.7	3.0	5.0	***12.5***	***48.4***	Existing Grated Area Drain Atop Box Culvert
14	**DP7, OS11**	3.57	5.55	Assumes DP7 Tt =				155	2.3%	3.0	0.9	17.4	3.3	5.5	***11.8***	***30.7***	Existing 20' D10R Sump Inlet

Calculated by: DLM
Date: 9/12/2022
Checked by: VAS

PROPOSED CONDITIONS
RATIONAL METHOD ANALYSIS

MASTER DEVELOPMENT DRAINAGE PLAN
WILLOWIND COMMERICAL FILING NO.4
(Proposed Conditions - Area Runoff Coefficient Summary)

			STREETS/DEVELOPED			*COMMERICAL/RESIDENTIAL*			*LANDSCAPED/UNDEVELOPED*			*OTHER*			*WEIGHTED*	
BASIN	**TOTAL AREA** *(SF)*	**TOTAL AREA** *(Acres)*	**AREA** *(Acres)*	**C_5**	**C_{100}**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**C_5**	**C_{100}**
A	***74278.0***	1.71	0.00	0.90	0.96	1.71	0.81	0.88	0.00	0.08	0.35	0.00	0.08	0.35	***0.81***	***0.88***
B	***33229.2***	0.76	0.56	0.90	0.96	0.00	0.81	0.88	0.20	0.12	0.39	0.00	0.08	0.35	***0.69***	***0.81***
C	***32786.5***	0.75	0.00	0.90	0.96	0.75	0.81	0.88	0.00	0.08	0.35	0.00	0.08	0.35	***0.81***	***0.88***
D	***34634.3***	0.80	0.49	0.90	0.96	0.15	0.73	0.81	0.16	0.12	0.39	0.00	0.08	0.35	***0.71***	***0.82***
E	***12848.0***	0.29	0.27	0.90	0.96	0.00	0.81	0.88	0.03	0.12	0.39	0.00	0.08	0.35	***0.83***	***0.91***
F	***27786.2***	0.64	0.21	0.90	0.96	0.20	0.73	0.81	0.23	0.12	0.39	0.00	0.08	0.35	***0.57***	***0.71***
F1	***48534.7***	1.11	0.00	0.90	0.96	1.11	0.81	0.88	0.00	0.12	0.39	0.00	0.08	0.35	***0.81***	***0.88***
F2	***29269.3***	0.67	0.00	0.90	0.96	0.67	0.81	0.88	0.00	0.12	0.39	0.00	0.08	0.35	***0.81***	***0.88***
G	***7732.4***	0.18	0.00	0.90	0.96	0.18	0.81	0.88	0.00	0.08	0.35	0.00	0.59	0.70	***0.81***	***0.88***
H	***44771.2***	1.03	0.00	0.90	0.96	1.03	0.81	0.88	0.00	0.08	0.35	0.00	0.59	0.70	***0.81***	***0.88***
I	***38093.8***	0.87	0.00	0.90	0.96	0.87	0.81	0.88	0.00	0.08	0.35	0.00	0.08	0.35	***0.81***	***0.88***
J	***35642.8***	0.82	0.00	0.90	0.96	0.82	0.81	0.88	0.00	0.08	0.35	0.00	0.08	0.35	***0.81***	***0.88***
OS1	***2606.9***	0.06	0.01	0.90	0.96	0.00	0.33	0.52	0.05	0.12	0.39	0.00	0.08	0.35	***0.30***	***0.52***
OS2	***2153.3***	0.05	0.01	0.90	0.96	0.00	0.33	0.52	0.04	0.12	0.39	0.00	0.08	0.35	***0.31***	***0.53***
OS3	***163533.0***	3.75	1.36	0.90	0.96	2.39	0.38	0.55	0.00	0.08	0.35	0.00	0.08	0.35	***0.57***	***0.70***
OS4	***216141.1***	4.96	1.05	0.90	0.96	3.38	0.38	0.55	0.53	0.08	0.35	0.00	0.38	0.55	***0.46***	***0.62***
OS5	***123561.5***	2.84	1.31	0.90	0.96	1.07	0.38	0.55	0.46	0.08	0.35	0.00	0.08	0.35	***0.57***	***0.71***
OS6	***64600.1***	1.48	0.00	0.90	0.96	1.48	0.38	0.55	0.00	0.08	0.35	0.00	0.08	0.35	***0.38***	***0.55***
OS7						NOT				USED						
OS8	***63452.2***	1.46	0.99	0.90	0.96	0.35	0.38	0.55	0.12	0.08	0.35	0.00	0.08	0.35	***0.71***	***0.81***
OS9	***673171.7***	15.45	0.72	0.90	0.96	0.00	0.33	0.52	14.56	0.08	0.35	0.17	0.59	0.70	***0.12***	***0.38***
OS10	***91005.2***	2.09	0.46	0.90	0.96	0.00	0.33	0.52	1.57	0.08	0.35	0.06	0.59	0.70	***0.27***	***0.49***
OS10A	***6856.2***	0.16	0.16	0.90	0.96	0.00	0.33	0.52	0.00	0.08	0.35	0.00	0.59	0.70	***0.90***	***0.96***
OS10B	***52407.4***	1.20	0.37	0.90	0.96	0.00	0.33	0.52	0.00	0.08	0.35	0.03	0.59	0.70	***0.29***	***0.31***
OS11	***41429.0***	0.95	0.71	0.90	0.96	0.00	0.33	0.52	0.23	0.08	0.36	0.01	0.59	0.70	***0.70***	***0.81***

MASTER DEVELOPMENT DRAINAGE PLAN
WILLOWIND COMMERICAL FILING NO.4
(Proposed Conditions - Area Drainage Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*STREET / CHANNEL FLOW*				*Time of Travel (T_t)*		*INTENSITY **		*TOTAL FLOWS*	
BASIN	**AREA TOTAL**	**C_5**	**C_{100}**	**C_5**	**Length**	**Height**	**T_C**	**Length**	**Slope**	**Velocity**	**T_t**	**TOTAL**	**CHECK**	**I_5**	**I_{100}**	**Q_5**	**Q_{100}**
	(Acres)	*From DCM Table 5-1*			*(ft)*	*(ft)*	*(min)*	*(ft)*	*(%)*	*(fps)*	*(min)*	*(min)*	*(min)*	*(in/hr)*	*(in/hr)*	*(c.f.s.)*	*(c.f.s.)*
A	1.71	0.81	0.88	0.81	50	2.5	2.2	268	0.6%	1.5	3.0	5.2	11.8	5.1	8.6	***7.1***	***12.9***
B	0.76	0.69	0.81	0.69	50	1.0	4.1	430	0.9%	1.9	3.8	7.9	12.7	4.5	7.5	***2.4***	***4.6***
C	0.75	0.81	0.88	0.81	50	10.0	1.4	175	2.5%	3.1	0.9	5.0	11.3	5.2	8.7	***3.2***	***5.7***
D	0.80	0.71	0.82	0.71	50	1.0	3.9	196	2.3%	3.0	1.1	5.0	11.4	5.2	8.7	***2.9***	***5.6***
E	0.29	0.83	0.91	0.83	20	0.1	2.7	369	1.2%	2.2	2.8	5.6	12.2	5.0	8.4	***1.2***	***2.3***
F	0.64	0.57	0.71	0.57	55	2.0	4.7	183	2.5%	3.2	1.0	5.6	11.3	5.0	8.4	***1.8***	***3.8***
F1	1.11	0.81	0.88	0.81	45	4.5	1.6	200	2.3%	3.0	1.1	5.0	11.4	5.2	8.7	***4.7***	***8.5***
F2	0.67	0.81	0.88	0.81	45	4.5	1.6	260	0.8%	1.8	2.5	5.0	11.7	5.2	8.7	***2.8***	***5.1***
G	0.18	0.81	0.88	0.81	20	0.5	1.7	197	0.9%	1.9	1.7	5.0	11.2	5.2	8.7	***0.7***	***1.4***
H	1.03	0.81	0.88	0.81	50	1.0	2.9	80	4.9%	4.4	0.3	5.0	10.7	5.2	6.8	***4.3***	***6.1***
I	0.87	0.81	0.88	0.81	50	1.0	2.9	148	3.6%	3.8	0.7	5.0	11.1	5.2	8.7	***3.7***	***6.7***
J	0.82	0.81	0.88	0.81	50	1.0	2.9	145	1.7%	2.6	0.9	5.0	11.1	5.2	8.7	***3.4***	***6.2***
OS1	0.06	0.30	0.52	0.30	10	1.0	2.1	0	0.0%	0.0	0.0	5.0	10.1	5.2	8.7	***0.1***	***0.3***
OS2	0.05	0.31	0.53	0.31	10	1.0	2.1	0	0.0%	0.0	0.0	5.0	10.1	5.2	8.7	***0.1***	***0.2***
OS3	3.75	0.57	0.70	0.57	65	1.3	6.2	1225	1.1%	2.1	9.9	16.2	17.2	3.4	5.7	***7.3***	***15.0***
OS4	4.96	0.46	0.62	0.46	100	2.0	9.2	460	2.8%	3.4	2.3	11.5	13.1	3.9	6.6	***8.9***	***20.1***
OS5	2.84	0.57	0.71	0.57	100	2.0	7.6	783	1.1%	2.1	6.2	13.8	14.9	3.6	6.1	***5.9***	***12.3***
OS6	1.48	0.38	0.55	0.38	60	1.3	7.9	820	1.6%	2.5	5.4	13.3	14.9	3.7	6.2	***2.1***	***5.1***
OS7					NOT					USED							
OS8	1.46	0.71	0.81	0.71	100	2.0	5.6	481	2.7%	3.3	2.4	8.0	13.2	4.5	7.5	***4.6***	***8.9***
OS9	15.45	0.12	0.38	0.12	100	10.0	8.2	1165	5.3%	3.5	5.6	13.9	17.0	3.6	6.1	***7.0***	***36.1***
OS10	2.09	0.27	0.49	0.27	50	1.0	8.4	585	5.5%	3.5	2.8	11.2	13.5	4.0	6.7	***2.3***	***6.9***
OS10A	0.16	0.90	0.96	0.90	50	1.0	2.0	135	5.9%	4.9	0.5	5.0	11.0	5.2	8.7	***0.7***	***1.3***
OS10B	1.20	0.29	0.31	0.29	50	1.0	8.2	380	2.6%	3.2	2.0	5.0	12.4	5.2	8.7	***1.8***	***3.3***
OS11	0.95	0.70	0.81	0.70	50	1.0	4.1	350	2.3%	3.0	1.9	6.0	12.2	4.9	8.2	***3.2***	***6.3***

* Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: DLM
Date: 5/8/2023
Checked by: VAS

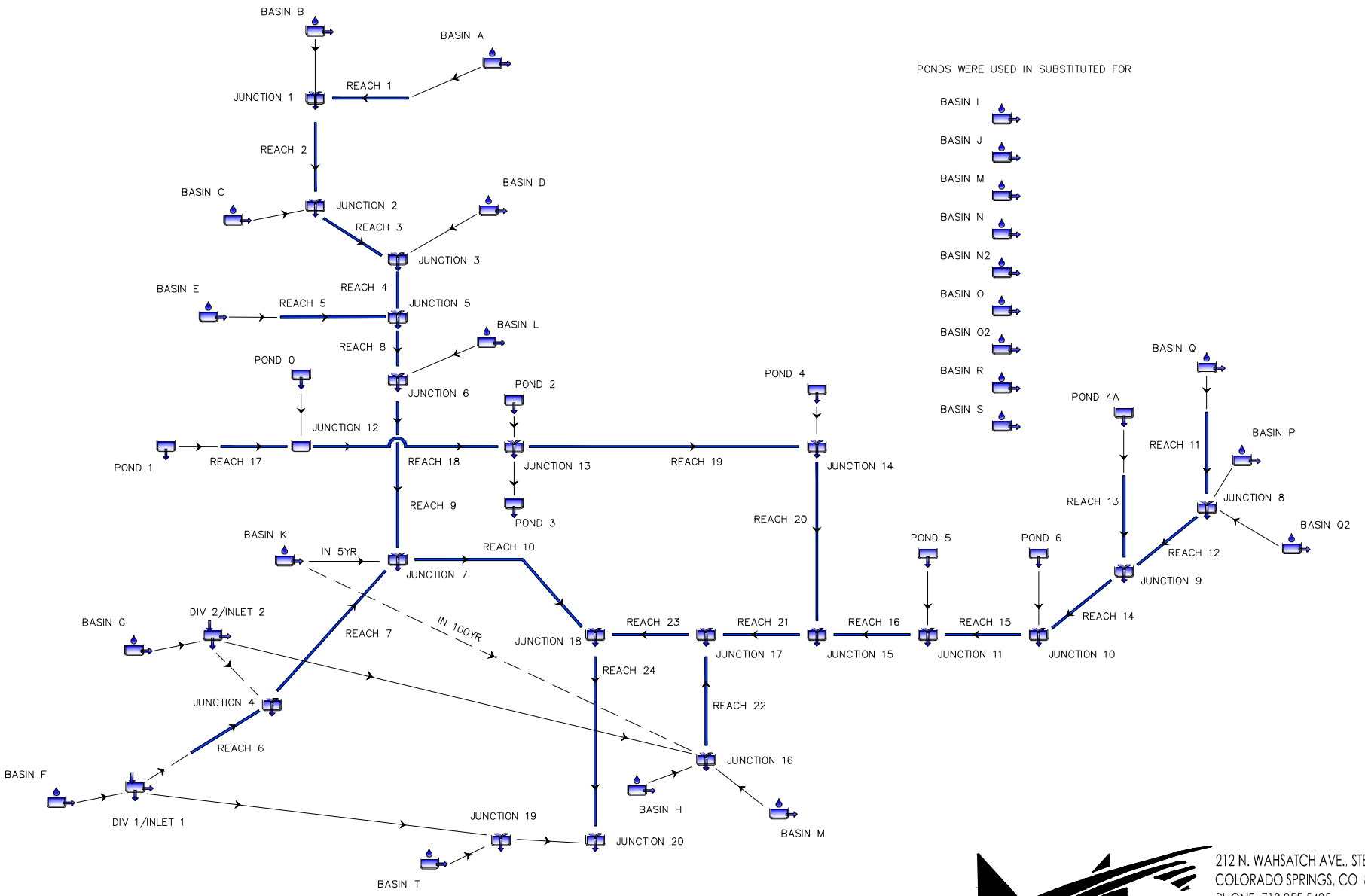
MASTER DEVELOPMENT DRAINAGE PLAN
WILLOWIND COMMERICAL FILING NO.4
(Proposed Conditions - Basin Routing Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*PIPE / CHANNEL FLOW*				*Time of Travel (T_t)*	*INTENSITY **		*TOTAL FLOWS*		
DESIGN POINT	**CONTRIBUTING BASINS**	**CA_5**	**CA_{100}**	**C_5**	**Length** *(ft)*	**Height** *(ft)*	**T_C** *(min)*	**Length** *(ft)*	**Slope** *(%)*	**Velocity** *(fps)*	**T_t** *(min)*	**TOTAL** *(min)*	**I_5** *(in/hr)*	**I_{100}** *(in/hr)*	**Q_5** *(c.f.s.)*	**Q_{100}** *(c.f.s.)*	COMMENTS
POND 0	**OS1, A**	1.40	1.53	Assumes Bason A Tt =								5.2	5.1	8.6	***7.2***	***13.2***	SF Pond 0
POND 1	**OS2, C**	0.62	0.69	Assumes Basin C Tt =								5.0	5.2	8.7	***3.2***	***6.0***	SF Pond 1
EX POND	**D**	0.57	0.65	Assumes Basin D Tt =								5.0	5.2	8.7	***2.9***	***5.6***	Existing Area Drain/WQ Pond
X	**B, E**	0.78	0.89	Assumes Basin B Tt =								9.2	4.2	7.1	***3.3***	***6.3***	Barnes Road
							7.9	161	1.0%	2.0	1.3						
I1	**OS3**	2.13	2.62	Assumes Basin OS3 Tt =								16.2	3.4	5.7	***7.3***	***15.0***	Ex. 10' D-10R At-grade Inlet
I2	**OS4, OS5**	3.89	5.06	Assumes Basin OS5 Tt =								13.8	3.6	6.1	***14.2***	***31.0***	Ex. 15' D-10R At-grade Inlet
Y	**OS2,OS6 OS8 DPX, FB I2**	2.99	5.01	Assumes Basin OS6 Tt =								16.1	3.4	5.7	***10.2***	***28.8***	Existing Barnes Road
							13.3	596	3.3%	3.6	2.7						
EX IN	**F**	0.36	0.45	Assumes Basin F Tt =								5.6	5.0	8.4	***1.8***	***3.8***	Ex, 5' Sump Inlet
POND 4	**F1**	0.90	0.98	Assumes Basin F1 Tt =								5.0	5.2	8.7	***4.7***	***8.5***	SF Pond 4
POND 4A	**10A, F2**	0.69	0.74	Assumes Basin F2 Tt =								5.0	5.2	8.7	***3.5***	***6.4***	SF Pond 4a
POND 2	**G**	0.14	0.16	Assumes G Tt =								5.0	5.2	8.7	***0.7***	***1.4***	SF Pond 2
POND 3	**H**	0.83	0.90	Assumes Basin H Tt =								5.0	5.2	8.7	***4.3***	***7.9***	SF Pond 3
CUL	**OS10**	0.57	1.03	Assumes Basin OS10 Tt =								11.2	4.0	6.7	***2.3***	***6.9***	Proposed 24" Culvert
EX CUL	**OS9**	1.92	5.91	Assumes Basin OS9 Tt =								13.9	3.6	6.1	***7.0***	***36.1***	EX FES
POND 6	**J**	0.66	0.72	Assumes Basin J Tt =								5.0	5.2	8.7	***3.4***	***6.2***	SF Pond 6
POND 5	**I**	0.71	0.77	Assumes Basin I Tt =								5.0	5.2	8.7	***3.7***	***6.7***	SF Pond 5
Z	**OS11, DPY**	3.65	5.79	Assumes DPY Tt =								17.3	3.3	5.5	***12.1***	***32.1***	Existing 20' D10R Sump Inlet
							16.1	150	1.0%	2.0	1.3						

For information only to be used to compare against HEC-HMS model

Calculated by: DLM
Date: 5/8/2023
Checked by: VAS

HEC-HMS SCHEMATIC



CIVIL CONSULTANTS, INC.
212 N. WAHSATCH AVE., STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

File: O:\10021A-Willowwind-Dunkin Donuts\Dunkin Donuts\Dwg\Eng Exhibits\HMS Model Schematic_recover.dwg Plotstamp: 5/11/2023 3:43 PM

Figure 6-13. 5-Year, 24-Hour Precipitation
Tenths of an Inch (NOAA Atlas 2)

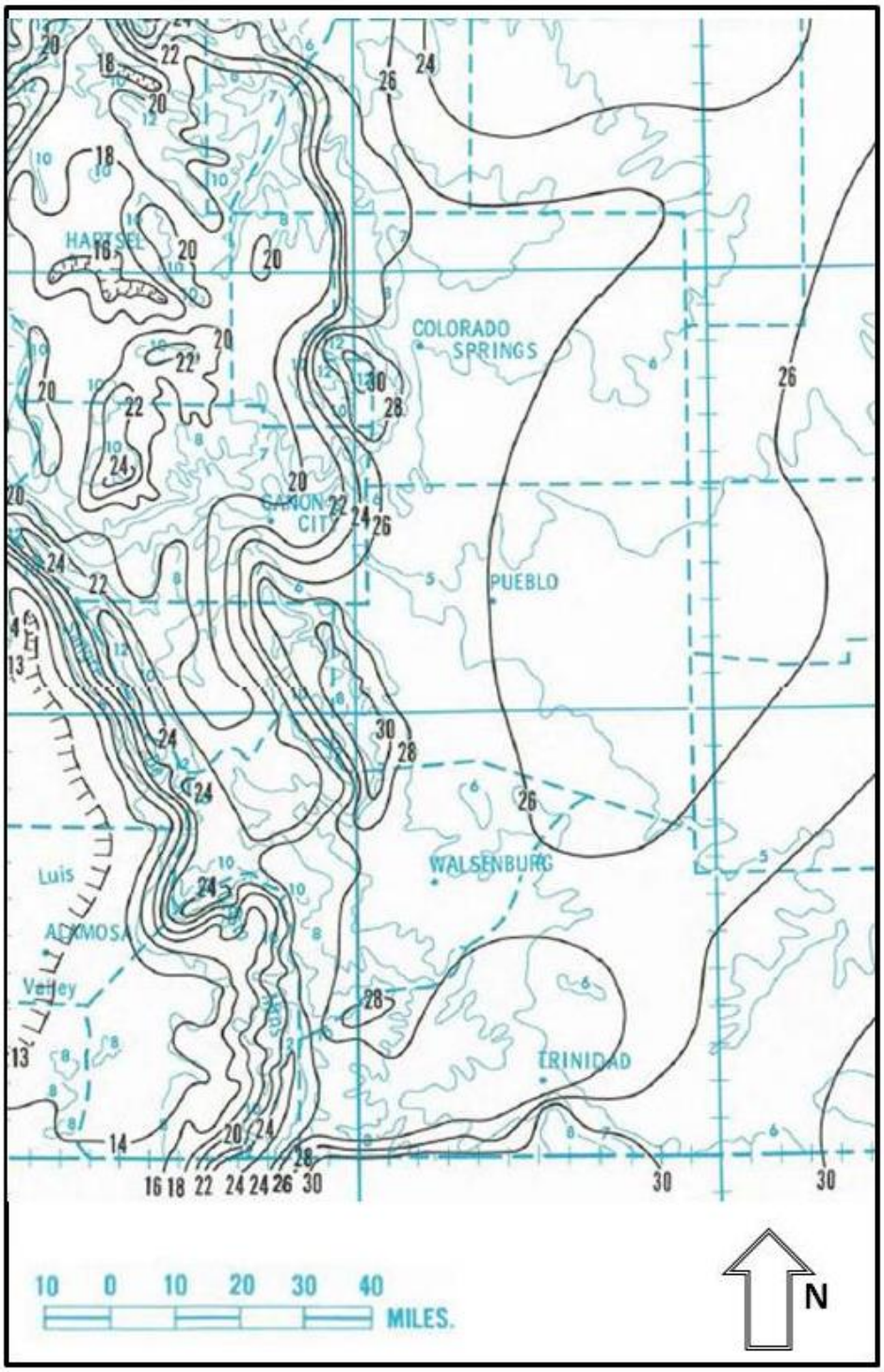


Figure 6-14. 10-Year, 24-Hour Precipitation
Tenths of an Inch (NOAA Atlas 2)

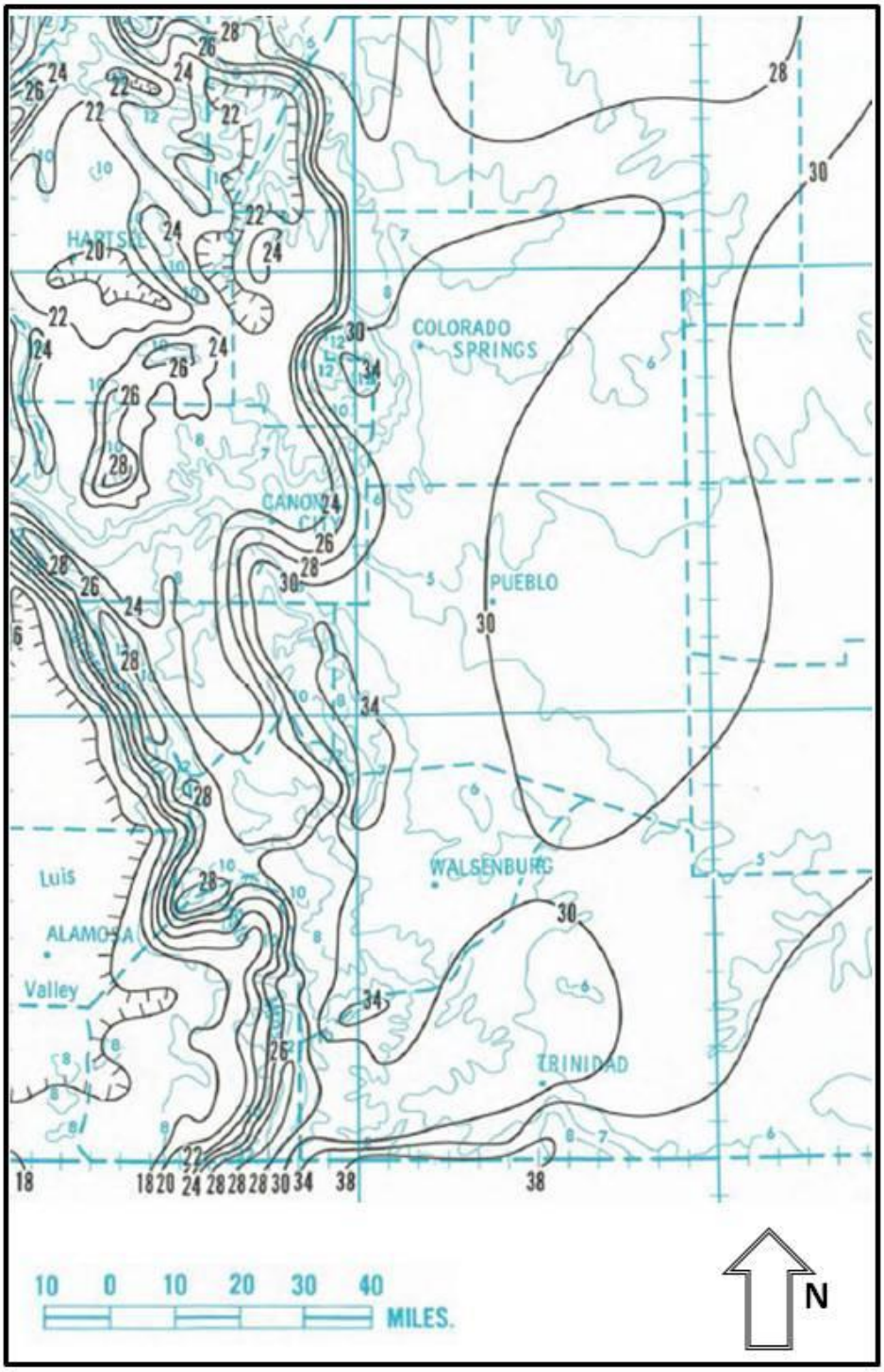
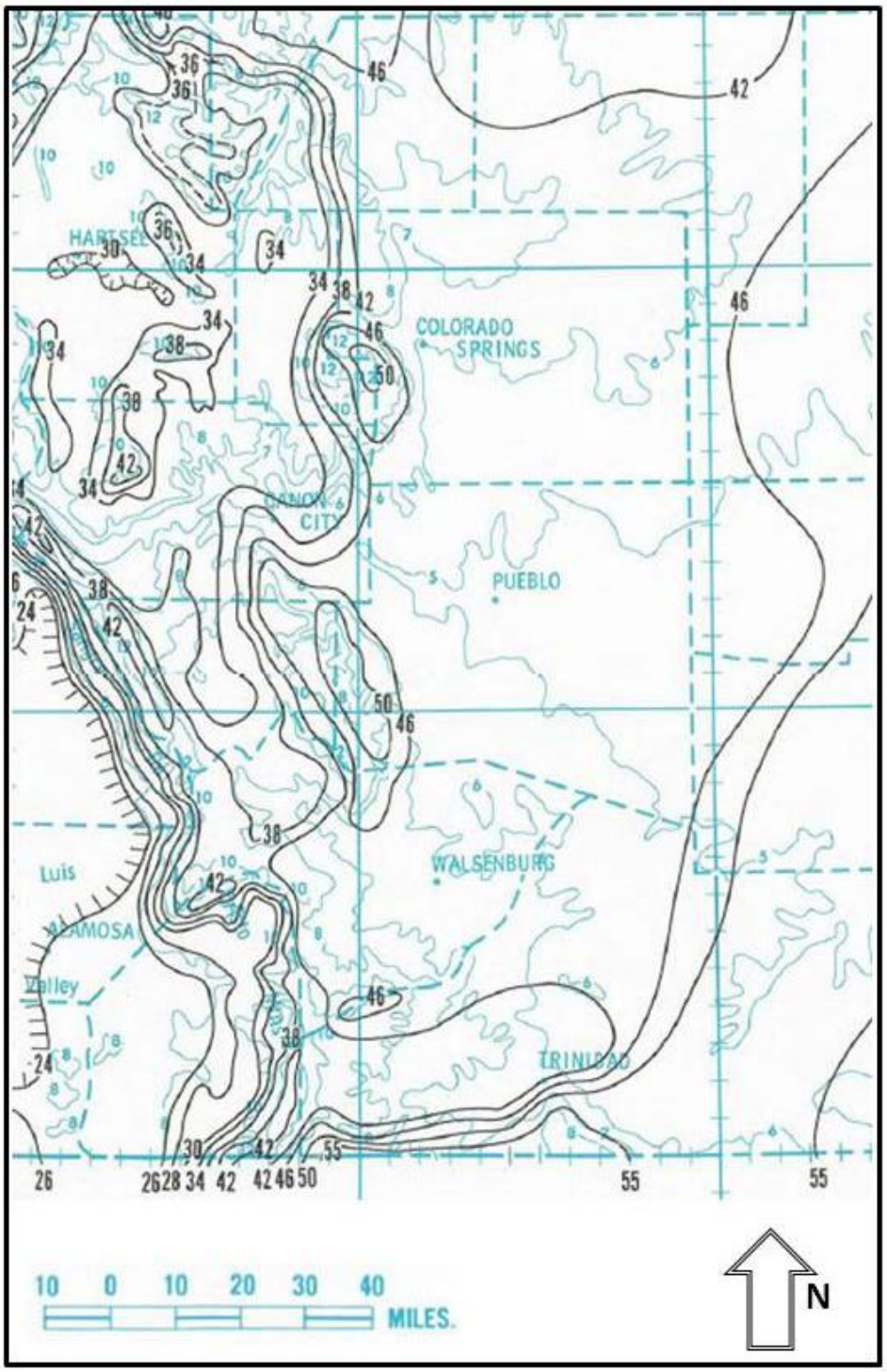


Figure 6-17. 100-Year, 24-Hour Precipitation
Tenths of an Inch (NOAA Atlas 2)



Willowind Commerical Filing No. 4

Developed Condition Composite CN & Impervious % Table

5/9/2023

Basin	Basin	Basin	Basin	Sub-Area 1		HSG	UA CN	CN	Sub-Area 2		HSG	UA CN	CN	Sub-Area 3		HSG	UA CN	CN	Sub-Area 4		HSG	UA CN	CN	Sub-Areas	% HSG	% HSG	Weighted	Weighted
ID	Area	Area	Area	Area	Imp	Type	Value	Value	Area	Imp	Type	Value	Value	Area	Imp	Type	Value	Value	Area	Imp	Type	Value	Value	Total	A	B	Sub Areas Imp	Sub Area CN
	(SF)	(AC)	(SQ MI)	(AC)	(%)			(HSG B)	(AC)	(%)			(HSG B)	(AC)	(%)			(HSG B)	(AC)	(%)			(HSG B)	(Check)	%	%	%	No.
A	1191482	27.4	0.042739	2.2	100	A	98	98	3.2	53	A	73	83	3.6	12	A	46	65	18.3	0	A	49	69	27.4	0	100	15.9	72.5
B	1619063	37.2	0.058076	35.5	58.3	A	73	82.5	1.7	5	A	39	61											37.2	0	100	55.8	81.5
C	1078493	24.8	0.038686	3.4	65	A	77	85	15.5	51.5	A	69	80	5.9	10	B	45	65						24.8	0	100	43.5	77.1
D	333871	7.7	0.011976	7.7	65	A	77	85																7.7	0	100	65.0	85.0
E	646991	14.9	0.023208	14.9	51.5	A	69	80																14.9	0	100	51.5	80.0
F	163292	3.7	0.005857	1.4	100	A	98	98	2.4	44.8	A	65	77.5											3.7	0	100	64.8	84.9
G	339546	7.8	0.012180	2.3	100	A	98	98	4.9	51.5	A	69	80	0.6	10	B	45	65						7.8	0	100	62.7	84.2
H	106651	2.4	0.003826	1.9	100	A	98	98	0.6	51.5	A	69	80											2.4	0	100	88.4	93.7
I	76885	1.8	0.002758	1.8	85	A	89	92																1.8	0	100	85.0	92.0
J	34967	0.8	0.001254	0.8	85	A	89	92																0.8	0	100	85.0	92.0
K	34633	0.8	0.001242	0.6	100	A	98	98	0.1	0	A	49	69											0.8	0	100	81.6	92.7
L	27786	0.6	0.000997	0.4	85	A	89	92	0.2	0	A	49	69											0.6	0	100	54.9	83.9
M	46019	1.1	0.001651	0.8	100	A	98	98	0.2	0	A	49	69											1.1	0	100	78.6	91.8
N	7732	0.2	0.000277	0.2	85	A	89	92																0.2	0	100	85.0	92.0
N2	44771	1.0	0.001606	1.0	85	A	89	92																1.0	0	100	85.0	92.0
O	48535	1.1	0.001741	1.1	85	A	89	92																1.1	0	100	85.0	92.0
O2	36246	0.8	0.001300	0.1	100	A	98	98	0.7	85	A	89	92											0.8	0	100	87.7	93.1
P	670487	15.4	0.024050	0.8	100	A	98	98	14.6	0	A	49	69											15.4	0	100	5.1	70.5
Q	92775	2.1	0.003328	0.6	100	A	98	98	1.6	0	A	49	69											2.1	0	100	26.3	76.6
Q2	53252	1.2	0.001910	0.3	100	A	98	98	0.9	0	A	49	69											1.2	0	100	28.2	77.2
R	35643	0.8	0.001279	0.8	85	A	89	92																0.8	0	100	85.0	92.0
S	38094	0.9	0.001366	0.9	85	A	89	92																0.9	0	100	85.0	92.0
T	168644	3.9	0.006049	2.6	100	A	98	98	1.3	0	A	49	69											3.9	0	100	66.6	88.3

Willowind Commerical Filing No. 4

Developed Condition - Lag Time Calculations

5/9/2023

Basin	OVERLAND FLOW					SHALLOW GUTTER FLOW				SHALLOW CHANNEL FLOW				STORM SEWER FLOW				CHANNELIZED FLOW				Tc	TLag
ID	P2	n	Length	Slope	Tt	Length	Slope	Vel	Tt	Length	Slope	Vel	Tt	Length	Slope	Vel	Tt	Length	Slope	Vel	Tt	Total	0.6*Tc
	(in)		(ft)	(%)	(min)	(ft)	(%)	(fps)	(min)	(ft)	(%)	(fps)	(min)	(ft)	(%)	(fps)	(min)	(ft)	(%)	(fps)	(min)	(min)	(min)
A	2.1	0.15	100	2.0	12.1	0	0.0	0.0	0.0	550	36	6.5	1.4	618	1.1	8.0	1.3	211	6.6	4.0	0.9	15.7	**9.4**
B	2.1	0.1	100	2.0	8.7	705	4.7	4.4	2.7	0	0	0.0	0.0	785	3.9	11.3	1.2	0	0.0	0.0	0.0	12.6	**7.5**
C	2.1	0.1	100	2.0	8.7	1425	2.1	2.9	8.2	0	0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	16.9	**10.2**
D	2.1	0.1	60	2.0	5.8	375	3.5	3.7	1.7	0	0	0.0	0.0	620	2.7	13.7	0.8	0	0.0	0.0	0.0	8.3	**5.0**
E	2.1	0.1	100	2.0	8.7	1090	3.4	3.6	5.0	0	0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	13.8	**8.3**
F	2.1	0.1	100	2.0	8.7	1280	3.0	3.5	6.1	0	0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	14.8	**8.9**
G	2.1	0.1	100	2.0	8.7	1340	2.7	3.3	6.8	0	0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	15.5	**9.3**
H	2.1	0.1	50	4.0	3.8	665	3.2	3.5	3.2	0	0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	7.0	**4.2**
I	2.1	0.015	50	5.0	0.8	270	0.6	1.8	2.5	0	0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	3.3	**2.0**
J	2.1	0.015	50	20.0	0.4	175	2.6	3.2	0.9	0	0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	1.3	**0.8**
K	2.1	0.015	50	1.0	1.5	200	1.5	2.5	1.3	0	0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	2.8	**1.7**
L	2.1	0.015	55	3.6	0.9	180	2.6	3.2	0.9	0	0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	1.9	**1.1**
M	2.1	0.015	50	2.0	1.1	600	1.4	2.0	5.0	0	0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	6.1	**3.7**
N	2.1	0.015	50	2.0	1.1	40	2.0	2.7	0.2	0	0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	1.3	**0.8**
N2	2.1	0.015	50	2.0	1.1	80	5.0	4.5	0.3	0	0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	1.4	**0.8**
O	2.1	0.015	45	10.0	0.5	200	1.4	2.5	1.3	0	0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	1.9	**1.1**
O2	2.1	0.015	50	2.0	1.1	260	0.8	1.8	2.4	0	0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	3.5	**2.1**
P	2.1	0.15	100	10.0	6.4	0	0.0	0.0	0.0	700	50	2.7	4.3	80	1.0	9.4	0.1	435	3.4	3.7	2.0	12.8	**7.7**
Q	2.1	0.1	20	2.5	2.2	200	0.9	1.9	1.8	50	1	1.5	0.6	0	0.0	0.0	0.0	535	4.9	2.4	3.7	8.2	**4.9**
Q2	2.1	0.1	50	2.0	5.0	80	4.9	4.5	1.0	80	4	4.5	0.3	0	0.0	0.0	1.0	300	3.3	1.8	2.8	10.1	**6.1**
R	2.1	0.015	50	2.0	1.1	145	1.7	1.5	1.6	0	0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	2.7	**1.6**
S	2.1	0.015	50	2.0	1.1	150	3.3	3.5	0.7	0	0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	1.8	**1.1**
T	2.1	0.15	60	2.0	8.0	1150	3.4	3.6	5.3	0	0	0.0	0.0	0	0.0	0.0	0.00	0	0.0	0.0	0.0	13.4	**8.0**

Tt for overland flow = 0.007(n*L)^0.8/(P2)^0.5*S^0.4 (Eq 6-15)
DCM TABLE 6-25 WAS USED FOR SHALLOW CONCENTRATED SWALE & GUTTER FLOW
N VALUE FOR OVERLAND FLOW WAS ASSUMED TO BE 0.15, 0.1, OR 0.015 FOR ALL BASINS
A ROUGHNESS COEFFICENT OF 0.050 WAS USED FOR EARTHEN CHANNEL BOTTOMS
A ROUGHNESS COEFFICENT OF 0.013 WAS USED FOR CONCRETE LINED CONVEYANCES

Willowind Commerical Filing No. 4

Developed Conditions - Initial Abstraction Values

9/28/2021

Basin ID	Composite CN Value	Initial Abstraction (in)
A	72.5	0.380
B	81.5	0.227
C	77.1	0.297
D	85.0	0.176
E	80.0	0.250
F	84.9	0.178
G	84.2	0.188
H	93.7	0.067
I	92.0	0.087
J	92.0	0.087
K	92.7	0.079
L	83.9	0.192
M	91.8	0.090
N	92.0	0.087
N2	92.0	0.087
O	92.0	0.087
O2	93.1	0.074
P	70.5	0.419
Q	76.6	0.305
Q2	77.2	0.296
R	92.0	0.087
S	92.0	0.087
T	88.3	0.132

Willowind Commerical Filing No. 4
Hydrologic Study - Proposed Conditions - Reach Data
5/9/2023

Reach ID	Reach Length L1 (ft)	Reach Vert. Drop H1 (ft)	Reach Slope S1 %	Mannings N Value n	Reach Side Slope SS (H/V)	Bottom Width BW (ft)	Diameter D/H (ft)
R1	750	24.0	3.2%	0.013	N/A	N/A	2.5
R2	600	12.5	2.1%	0.013	N/A	N/A	4.0
R3	290	2.9	1.0%	0.013	N/A	N/A	4.5
R4	56	0.5	0.8%	0.013	N/A	N/A	4.5
R5	307	6.9	2.2%	0.013	N/A	N/A	3.0
R6	635	21.0	3.3%	0.013	N/A	N/A	1.5
R7	550	18.0	3.3%	0.013	N/A	N/A	1.5
R8*	14	0.3	2.0%	0.013	N/A	N/A	5.0
R9	404	8.2	2.0%	0.013	N/A	N/A	5.0
R10	169	2.8	1.6%	0.013	N/A	N/A	5.0
R11	420	3.2	0.8%	0.013	3.5:1	7.5	N/A
R12*	26	1.0	4.0%	0.013	N/A	N/A	3.0
R13	200	1.0	0.5%	0.013	N/A	N/A	1.25
R14	167	0.8	0.5%	0.013	N/A	N/A	3.0
R15	119	0.6	0.5%	0.013	N/A	N/A	3.0
R16*	46	1.9	4.0%	0.013	N/A	N/A	3.0
R17	198	1.0	0.5%	0.013	N/A	N/A	1.25
R18*	74	0.4	0.5%	0.013	N/A	N/A	1.25
R19	186	0.9	0.5%	0.013	N/A	N/A	1.25
R20	196	4.0	2.0%	0.013	N/A	N/A	1.25
R21*	42	1.7	4.0%	0.013	N/A	N/A	3.0
R22*	10	1.6	15.9%	0.013	N/A	N/A	2.0
R23*	13	0.5	4.0%	0.013	N/A	N/A	3.5
R24	235	3.1	1.3%	0.013	N/A	8.25	6.0

*a minimum reach length of 100 feet was required to be used for model to process, slope was maintained not anticipated to have a significant impact to modeled flows.

WILLOWIND COMMERICAL FILING NO. 4

MASTER DEVELOPMENT DRAINAGE PLAN AND FINAL DRAINAGE REPORT FOR INITIAL INFRASTRUCTURE

100YR, 10YR, & 5YR HEC-HMS OUTPUT

5yr storm type II		10yr storm type II		100y storm type II	
ID	Q5 (cfs)	ID	Q10 (cfs)	ID	Q100 (cfs)
Basin A	29.3	Basin A	41.1	Basin A	72
Basin B	78.7	Basin B	100.8	Basin B	153.7
Basin C	39	Basin C	50.9	Basin C	80.2
Basin D	18.7	Basin D	23.7	Basin D	35.3
Basin E	28.8	Basin E	37.2	Basin E	57.3
Basin F	8.1	Basin F	10.2	Basin F	15.3
Basin G	16.1	Basin G	20.4	Basin G	30.7
Basin H	6.9	Basin H	8.5	Basin H	12.3
Basin I	5.4	Basin I	6.7	Basin I	9.7
Basin J	2.5	Basin J	3	Basin J	4.4
Basin K	2.4	Basin K	3	Basin K	4.4
Basin L	1.6	Basin L	2.1	Basin L	3.2
Basin M	3	Basin M	3.7	Basin M	5.5
Basin N	0.5	Basin N	0.7	Basin N	1
Basin N2	3.1	Basin N2	3.9	Basin N2	5.6
Basin O	3.4	Basin O	4.2	Basin O	6.1
Basin O2	2.6	Basin O2	3.2	Basin O2	4.6
Basin P	14.2	Basin P	21	Basin P	39.1
Basin Q	3.6	Basin Q	4.8	Basin Q	7.8
Basin Q2	2.1	Basin Q2	2.8	Basin Q2	4.5
Basin R	2.5	Basin R	3.1	Basin R	4.5
Basin S	2.7	Basin S	3.3	Basin S	4.8
Basin T	9.1	Basin T	11.5	Basin T	17
Diversion-1	1.5	Diversion-1	2.8	Diversion-1	6.2
Diversion-2	3.2	Diversion-2	8.3	Diversion-2	20.3
Junction-1	106.7	Junction-1	140.3	Junction-1	223.3
Junction-10	19.2	Junction-10	27.7	Junction-10	51.1
Junction-11	18.9	Junction-11	27.4	Junction-11	51.2
Junction-12	0.1	Junction-12	0.1	Junction-12	1.7
Junction-13	0.1	Junction-13	0.1	Junction-13	2.6
Junction-14	0.1	Junction-14	0.1	Junction-14	3.5
Junction-15	18.9	Junction-15	27.3	Junction-15	54.5
Junction-16	12.7	Junction-16	20	Junction-16	41
Junction-17	31.5	Junction-17	47.2	Junction-17	95.2
Junction-18	236.8	Junction-18	310.2	Junction-18	495.5
Junction-19	10.6	Junction-19	14.3	Junction-19	23.1
Junction-2	143	Junction-2	187.9	Junction-2	299.1
Junction-20	246.1	Junction-20	322.9	Junction-20	516.7
Junction-3	159.6	Junction-3	208.9	Junction-3	330.7
Junction-4	19.5	Junction-4	19.5	Junction-4	19.5
Junction-5	187.2	Junction-5	244.6	Junction-5	385.8

WILLOWIND COMMERICAL FILING NO. 4

MASTER DEVELOPMENT DRAINAGE PLAN AND FINAL DRAINAGE REPORT FOR INITIAL INFRASTRUCTURE

100YR, 10YR, & 5YR HEC-HMS OUTPUT

5yr storm type II		10yr storm type II		100y storm type II	
ID	Q5 (cfs)	ID	Q10 (cfs)	ID	Q100 (cfs)
Junction-6	188	Junction-6	245.6	Junction-6	387.5
Junction-7	206.7	Junction-7	264.6	Junction-7	402.6
Junction-8	19.6	Junction-8	28.3	Junction-8	51.2
Junction-9	19.5	Junction-9	28.2	Junction-9	51.3
Pond 0	0.1	Pond 0	0.1	Pond 0	1.1
Pond 1	0	Pond 1	0	Pond 1	0.6
Pond 2	0	Pond 2	0	Pond 2	0.1
Pond 3	0	Pond 3	0	Pond 3	0.8
Pond 4	0	Pond 4	0	Pond 4	0.9
Pond 4A	0	Pond 4A	0	Pond 4A	0.3
Pond 5	0	Pond 5	0	Pond 5	0.6
Pond 6	0	Pond 6	0	Pond 6	0.5
Reach-1	29.2	Reach-1	40.7	Reach-1	70.5
Reach-10	205.5	Reach-10	263.1	Reach-10	400.6
Reach-11	3.4	Reach-11	4.5	Reach-11	7.5
Reach-12	19.5	Reach-12	28.2	Reach-12	51
Reach-13	0	Reach-13	0	Reach-13	0.3
Reach-14	19.2	Reach-14	27.7	Reach-14	50.6
Reach-15	18.9	Reach-15	27.4	Reach-15	50.6
Reach-16	18.8	Reach-16	27.2	Reach-16	51
Reach-17	0	Reach-17	0	Reach-17	0.6
Reach-18	0.1	Reach-18	0.1	Reach-18	1.7
Reach-19	0.1	Reach-19	0.1	Reach-19	2.6
Reach-2	104.4	Reach-2	137.3	Reach-2	219.1
Reach-20	0.1	Reach-20	0.1	Reach-20	3.5
Reach-21	18.8	Reach-21	27.2	Reach-21	54.3
Reach-22	12.6	Reach-22	20	Reach-22	40.9
Reach-23	31.3	Reach-23	47	Reach-23	95
Reach-24	235.5	Reach-24	308.6	Reach-24	493.6
Reach-3	140.9	Reach-3	185.3	Reach-3	295.4
Reach-4	158.8	Reach-4	208	Reach-4	329.2
Reach-5	28.4	Reach-5	36.6	Reach-5	56.6
Reach-6	6.6	Reach-6	7.4	Reach-6	9.1
Reach-7	19.5	Reach-7	19.5	Reach-7	19.5
Reach-8	186.6	Reach-8	243.8	Reach-8	384.7
Reach-9	185.5	Reach-9	242.6	Reach-9	383.1

WILLOWIND COMMERCIAL FILING NO.4

HEC-HMS vs Rational Comparison

HEC-HMS	FLOW	FLOW	Rational	FLOW	FLOW	Percentage Rational/HEC-HMS	
Basin	5yr	100yr	Basin/Design Pt (DP)	5yr	100yr	5yr	100yr
I	5.4	9.7	DP-POND 0	7.2	13.2	133%	136%
J	2.5	4.4	DP-POND 1	3.2	6	128%	136%
K	2.4	4.4	DP-EX POND	2.9	5.6	121%	127%
M	3	5.5	DP-X	3.3	6.3	110%	115%
L	1.6	3.2	DP-EX IN	1.8	3.8	113%	119%
N	0.5	1	DP-POND 2	0.7	1.4	140%	140%
N2	3.1	5.6	DP-POND 3	4.3	7.9	139%	141%
O	3.4	6.1	DP-POND 4	4.7	8.5	138%	139%
O2	2.6	4.6	DP-POND 4A	3.5	6.4	135%	139%
R	2.5	4.5	DP-POND 6	3.4	6.2	136%	138%
S	2.7	4.8	DP-POND 5	3.7	6.7	137%	140%
Q	3.6	7.8	OS10	2.3	6.9	64%	88%
P	14.2	39.1	OS9	7	36.1	49%	92%
Q2	2.1	4.5	OS10B	1.8	3.3	86%	73%
F	8.1	15.3	OS3	7.3	15	90%	98%
G	16.1	30.7	DP-I2	14.2	31	88%	101%
H	6.9	12.3	DP-Z	12.1	32.1	175%	261%

HYDRAULIC CALCULATIONS / POND CALCULATIONS

Pond 0

Weighted Percent Imperviousness to Pond 0				
Contributing Basins	*Area (Acres)*	C_5	*Impervious % (I)*	*(Acres)*(I)*
A	1.71	0.81	95	161.99
OS1	0.06	0.30	40	2.39
Totals	***1.77***			***164.39***
Imperviousness of WQ Pond 0	***93.1***			

Pond 1

Weighted Percent Imperviousness to Pond 1				
Contributing Basins	*Area (Acres)*	C_5	*Impervious % (I)*	*(Acres)*(I)*
Column1	**Column2**	**Column3**	**Column4**	**Column5**
C	0.75	0.81	95	71.50
OS2	0.05	0.31	41	2.03
Totals	***0.80***			***73.53***
Imperviousness of WQ Pond 1	***91.7***			

Pond 2

Weighted Percent Imperviousness to Pond 2				
Contributing Basins	*Area (Acres)*	C_5	*Impervious % (I)*	*(Acres)*(I)*
Column1	**Column2**	**Column3**	**Column4**	**Column5**
G	0.18	0.81	95	16.86
Totals	***0.18***			***16.86***
Imperviousness of WQ Pond 2	***95.0***			

Pond 3

Weighted Percent Imperviousness to Pond 3				
Contributing Basins	*Area (Acres)*	C_5	*Impervious % (I)*	*(Acres)*(I)*
Column1	**Column2**	**Column3**	**Column4**	**Column5**
H	1.03	0.81	95	97.64
Totals	***1.03***			***97.64***
Imperviousness of WQ Pond 3	***95.0***			

Pond 4

Weighted Percent Imperviousness to Pond 4				
Contributing Basins	*Area (Acres)*	C_5	*Impervious % (I)*	*(Acres)*(I)*
Column1	**Column2**	**Column3**	**Column4**	**Column5**
F1	1.11	0.81	95	105.85
Totals	***1.11***			***105.85***
Imperviousness of WQ Pond 4	***95.0***			

Pond 4A

Weighted Percent Imperviousness to Pond 4A				
Contributing Basins	*Area (Acres)*	C_5	*Impervious % (I)*	*(Acres)*(I)*
Column1	**Column2**	**Column3**	**Column4**	**Column5**
F2	0.67	0.81	95	63.83
OS10A	0.16	0.90	100	15.74
Totals	***0.83***			***79.57***
Imperviousness of WQ Pond 4A	***95.9***			

Pond 5

Weighted Percent Imperviousness to Pond 4A				
Contributing Basins	*Area (Acres)*	C_5	*Impervious % (I)*	*(Acres)*(I)*
Column1	**Column2**	**Column3**	**Column4**	**Column5**
I	0.87	0.81	95	83.08
Totals	***0.87***			***83.08***
Imperviousness of WQ Pond 5	***95.0***			

Pond 6

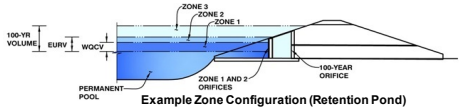
Weighted Percent Imperviousness to Pond 4A				
Contributing Basins	*Area (Acres)*	C_5	*Impervious % (I)*	*(Acres)*(I)*
Column1	**Column2**	**Column3**	**Column4**	**Column5**
J	0.82	0.81	95	77.73
Totals	***0.82***			***77.73***
Imperviousness of WQ Pond 6	***95.0***			

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Willowind Commercial

Basin ID: Pond 0



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	SF	
Watershed Area =	1.77	acres
Watershed Length =	350	ft
Watershed Length to Centroid =	192	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	93.10%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	12.0	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) =	0.051	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.226	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.150	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.52 in.) =	0.196	acre-feet	1.52	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.228	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.264	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.300	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.340	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.431	acre-feet		inches
Approximate 2-yr Detention Volume =	0.149	acre-feet		
Approximate 5-yr Detention Volume =	0.196	acre-feet		
Approximate 10-yr Detention Volume =	0.229	acre-feet		
Approximate 25-yr Detention Volume =	0.270	acre-feet		
Approximate 50-yr Detention Volume =	0.293	acre-feet		
Approximate 100-yr Detention Volume =	0.313	acre-feet		

Define Zones and Basin Geometry

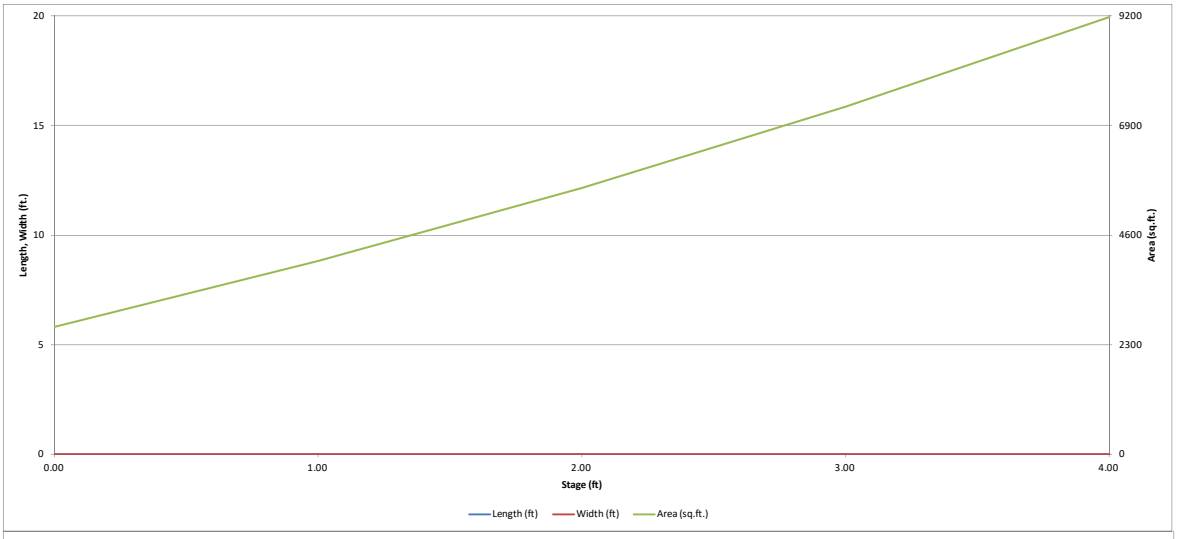
Zone 1 Volume (WQCV) =	0.051	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.175	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.087	acre-feet
Total Detention Basin Volume =	0.313	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	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

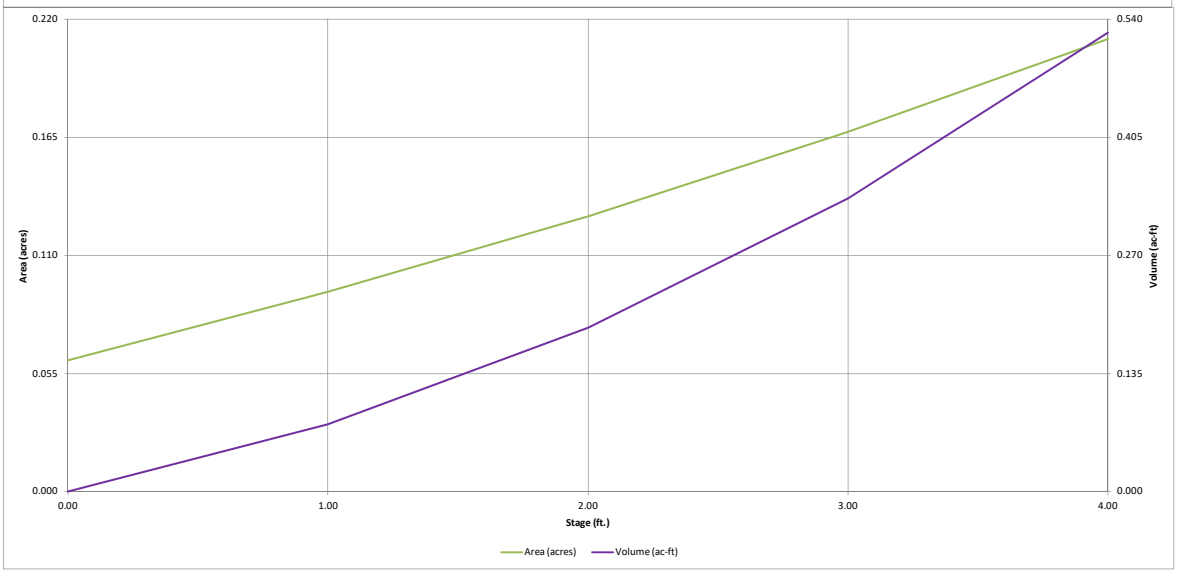
Depth Increment = ft

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)
Media Surface	--	0.00	--	--	--	2,666	0.061		
	--	1.00	--	--	--	4,050	0.093	3,358	0.077
	--	2.00	--	--	--	5,585	0.128	8,175	0.188
	--	3.00	--	--	--	7,296	0.167	14,616	0.336
	--	4.00	--	--	--	9,179	0.211	22,853	0.525

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



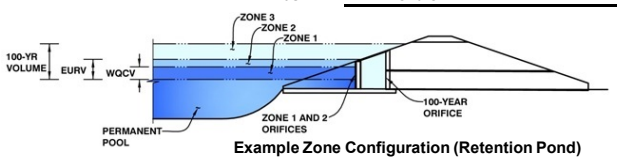


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Willowind Commercial**

Basin ID: **Pond 0**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.71	0.051	Filtration Media
Zone 2 (EURV)	2.29	0.175	Filtration Media
Zone 3 (100-year)	2.87	0.087	Weir&Pipe (Restrict)
Total (all zones)		0.313	

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

Underdrain Orifice Invert Depth =	2.50	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	1.08	inches	Underdrain Orifice Centroid =	0.05	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	N/A	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 =	N/A	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

Calculated Parameters for Plate

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

	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected				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
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
Vertical Orifice Diameter =	N/A	N/A	inches				

Calculated Parameters for Vertical Orif

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			Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	2.40	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	2.40	N/A
Overflow Weir Front Edge Length =	2.91	N/A	feet	Overflow Weir Slope Length =	2.91	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	56.44	N/A
Horiz. Length of Weir Sides =	2.91	N/A	feet	Overflow Grate Open Area w/o Debris =	5.89	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	2.95	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow W

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected
Depth to Invert of Outlet Pipe =	2.75	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.10	N/A
Outlet Pipe Diameter =	15.00	N/A	inches	Outlet Orifice Centroid =	0.10	N/A
Restrictor Plate Height Above Pipe Invert =	2.10		inches	Half-Central Angle of Restrictor Plate on Pipe =	0.77	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.75	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.44 feet
Spillway Crest Length =	6.00	feet	Stage at Top of Freeboard =	4.19 feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.21 acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.52 acre-ft

Calculated Parameters for Spillway

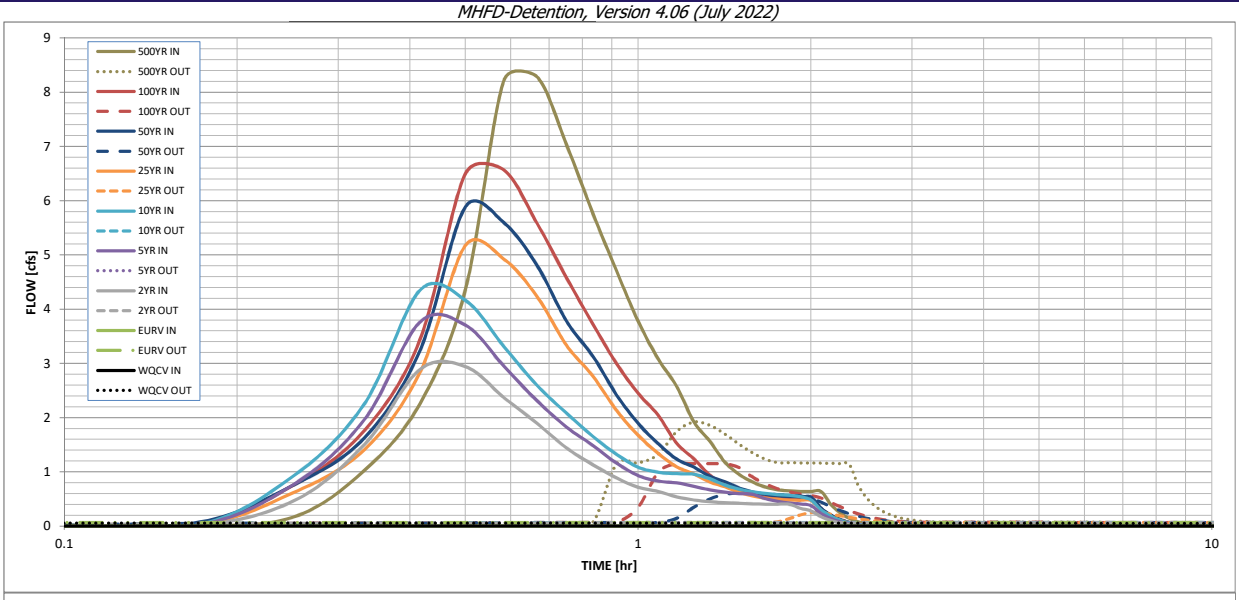
Routed Hydrograph Results

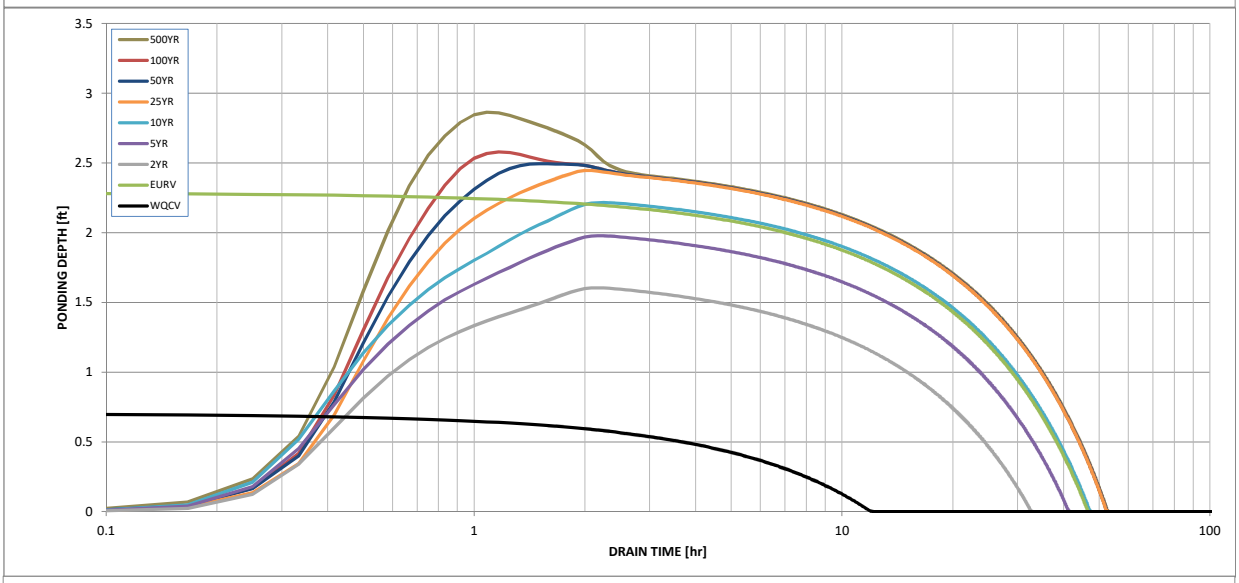
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AI

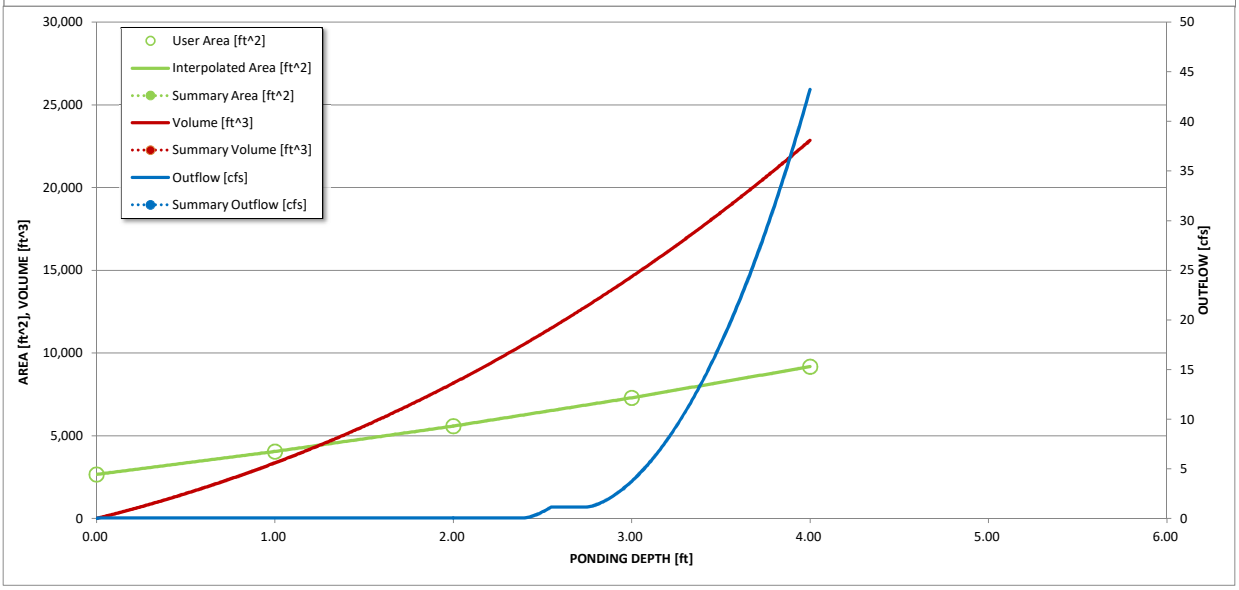
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.52	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.051	0.226	0.150	0.196	0.228	0.264	0.300	0.340
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.150	0.196	0.228	0.264	0.300	0.340
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.4	0.7	1.2
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	0.02	0.20	0.40	0.66
Peak Inflow Q (cfs) =	N/A	N/A	2.9	3.8	4.3	5.2	5.9	6.6
Peak Outflow Q (cfs) =	0.1	0.1	0.1	0.1	0.1	0.2	0.6	1.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.1	1.7	0.7	0.9	1.0
Structure Controlling Flow =	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.1	0.2
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	12	45	32	40	46	51	50	50
Time to Drain 99% of Inflow Volume (hours) =	**12**	46	32	41	47	52	52	52
Maximum Ponding Depth (ft) =	0.71	2.29	1.60	1.98	2.22	2.45	2.49	2.58
Area at Maximum Ponding Depth (acres) =	0.08	0.14	0.11	0.13	0.14	0.15	0.15	0.15
Maximum Volume Stored (acre-ft) =	0.051	0.227	0.139	0.184	0.215	0.248	0.255	0.267

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.

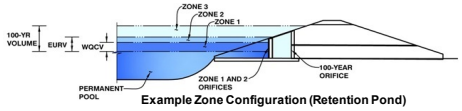
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.01	0.16
	0:15:00	0.00	0.00	0.46	0.76	0.91	0.61	0.75	0.74	1.03
	0:20:00	0.00	0.00	1.50	1.97	2.26	1.41	1.63	1.76	2.26
	0:25:00	0.00	0.00	2.89	3.76	4.35	2.84	3.24	3.44	4.36
	0:30:00	0.00	0.00	2.94	3.70	4.16	5.17	5.88	6.50	8.22
	0:35:00	0.00	0.00	2.37	2.95	3.31	4.92	5.59	6.57	8.28
	0:40:00	0.00	0.00	1.89	2.31	2.59	4.23	4.80	5.58	7.04
	0:45:00	0.00	0.00	1.44	1.83	2.08	3.33	3.78	4.58	5.77
	0:50:00	0.00	0.00	1.13	1.49	1.66	2.77	3.14	3.73	4.71
	0:55:00	0.00	0.00	0.89	1.16	1.32	2.14	2.42	3.00	3.78
	1:00:00	0.00	0.00	0.72	0.93	1.09	1.67	1.89	2.45	3.08
	1:05:00	0.00	0.00	0.64	0.83	0.99	1.34	1.52	2.05	2.58
	1:10:00	0.00	0.00	0.54	0.80	0.97	1.10	1.24	1.53	1.93
	1:15:00	0.00	0.00	0.48	0.74	0.96	0.96	1.09	1.24	1.56
	1:20:00	0.00	0.00	0.45	0.67	0.87	0.81	0.92	0.94	1.18
	1:25:00	0.00	0.00	0.43	0.63	0.76	0.73	0.82	0.76	0.95
	1:30:00	0.00	0.00	0.42	0.60	0.68	0.62	0.70	0.65	0.81
	1:35:00	0.00	0.00	0.41	0.59	0.63	0.56	0.63	0.58	0.72
	1:40:00	0.00	0.00	0.40	0.51	0.60	0.52	0.58	0.54	0.67
	1:45:00	0.00	0.00	0.40	0.46	0.58	0.50	0.56	0.52	0.65
	1:50:00	0.00	0.00	0.40	0.43	0.57	0.48	0.54	0.51	0.64
	1:55:00	0.00	0.00	0.33	0.41	0.54	0.48	0.54	0.51	0.64
	2:00:00	0.00	0.00	0.28	0.38	0.48	0.47	0.53	0.51	0.64
	2:05:00	0.00	0.00	0.17	0.23	0.30	0.30	0.33	0.32	0.40
	2:10:00	0.00	0.00	0.10	0.14	0.18	0.18	0.21	0.20	0.25
	2:15:00	0.00	0.00	0.06	0.08	0.11	0.11	0.12	0.12	0.14
	2:20:00	0.00	0.00	0.03	0.05	0.06	0.06	0.07	0.07	0.08
	2:25:00	0.00	0.00	0.01	0.02	0.03	0.03	0.04	0.03	0.04
	2:30:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	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
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	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Willowind Commercial

Basin ID: Lot 1 Pond1



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	SF	
Watershed Area =	0.80	acres
Watershed Length =	190	ft
Watershed Length to Centroid =	100	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	91.70%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	12.0	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) =	0.022	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.100	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.064	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.52 in.) =	0.083	acre-feet	1.52	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.097	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.113	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.128	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.146	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.185	acre-feet		inches
Approximate 2-yr Detention Volume =	0.066	acre-feet		
Approximate 5-yr Detention Volume =	0.087	acre-feet		
Approximate 10-yr Detention Volume =	0.102	acre-feet		
Approximate 25-yr Detention Volume =	0.120	acre-feet		
Approximate 50-yr Detention Volume =	0.130	acre-feet		
Approximate 100-yr Detention Volume =	0.139	acre-feet		

Define Zones and Basin Geometry

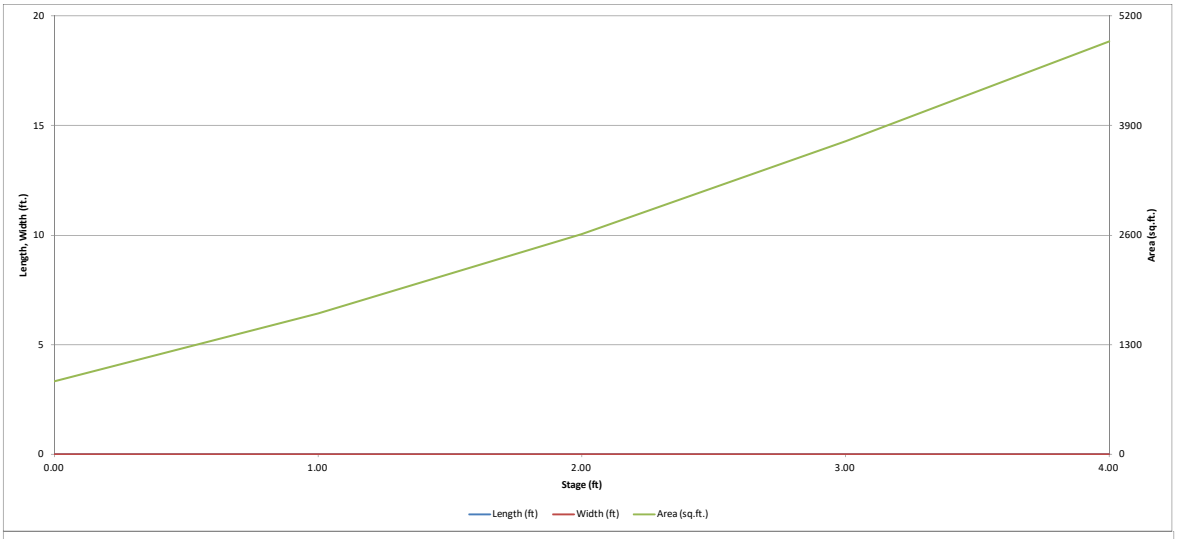
Zone 1 Volume (WQCV) =	0.022	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.078	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.039	acre-feet
Total Detention Basin Volume =	0.139	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	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

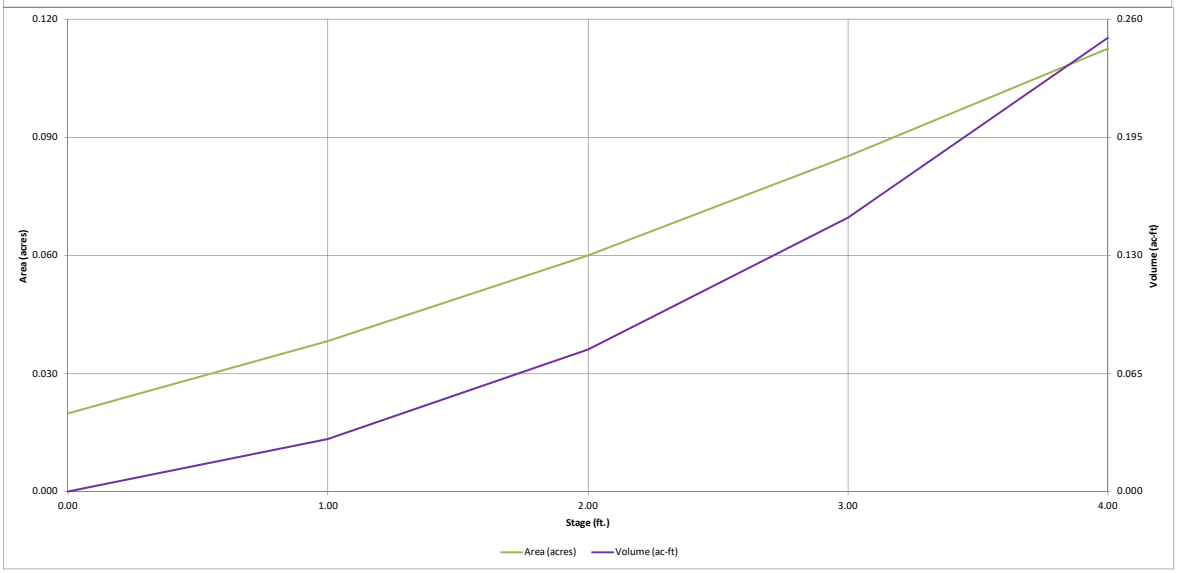
Depth Increment = ft

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)
Media Surface	--	0.00	--	--	--	865	0.020		
	--	1.00	--	--	--	1,668	0.038	1,266	0.029
	--	2.00	--	--	--	2,614	0.060	3,407	0.078
	--	3.00	--	--	--	3,716	0.085	6,572	0.151
	--	4.00	--	--	--	4,900	0.112	10,880	0.250

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



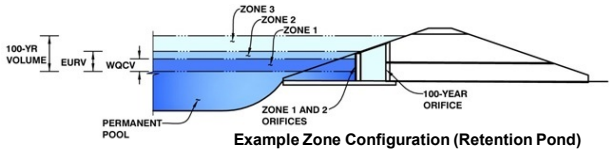


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Willowind Commercial**

Basin ID: **Pond1**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.82	0.022	Filtration Media
Zone 2 (EURV)	2.37	0.079	Filtration Media
Zone 3 (100-year)	2.89	0.040	Weir&Pipe (Restrict)
Total (all zones)		0.141	

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

Underdrain Orifice Invert Depth =	2.50	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.70	inches	Underdrain Orifice Centroid =	0.03	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	N/A	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 =	N/A	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

Calculated Parameters for Plate

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

	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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)	Vertical Orifice Area =	N/A	N/A
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
Vertical Orifice Diameter =	N/A	N/A	inches			

Calculated Parameters for Vertical Orif

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 =	2.37	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	2.37	N/A
Overflow Weir Front Edge Length =	2.91	N/A	feet	Overflow Weir Slope Length =	2.91	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	113.89	N/A
Horiz. Length of Weir Sides =	2.91	N/A	feet	Overflow Grate Open Area w/o Debris =	5.89	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	2.95	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow W

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 =	2.75	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.05	N/A
Outlet Pipe Diameter =	15.00	N/A	inches	Outlet Orifice Centroid =	0.06	N/A
Restrictor Plate Height Above Pipe Invert =	1.30		inches	Half-Central Angle of Restrictor Plate on Pipe =	0.60	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.65	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.16	feet
Spillway Crest Length =	15.00	feet	Stage at Top of Freeboard =	3.81	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.11	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.23	acre-ft

Calculated Parameters for Spillway

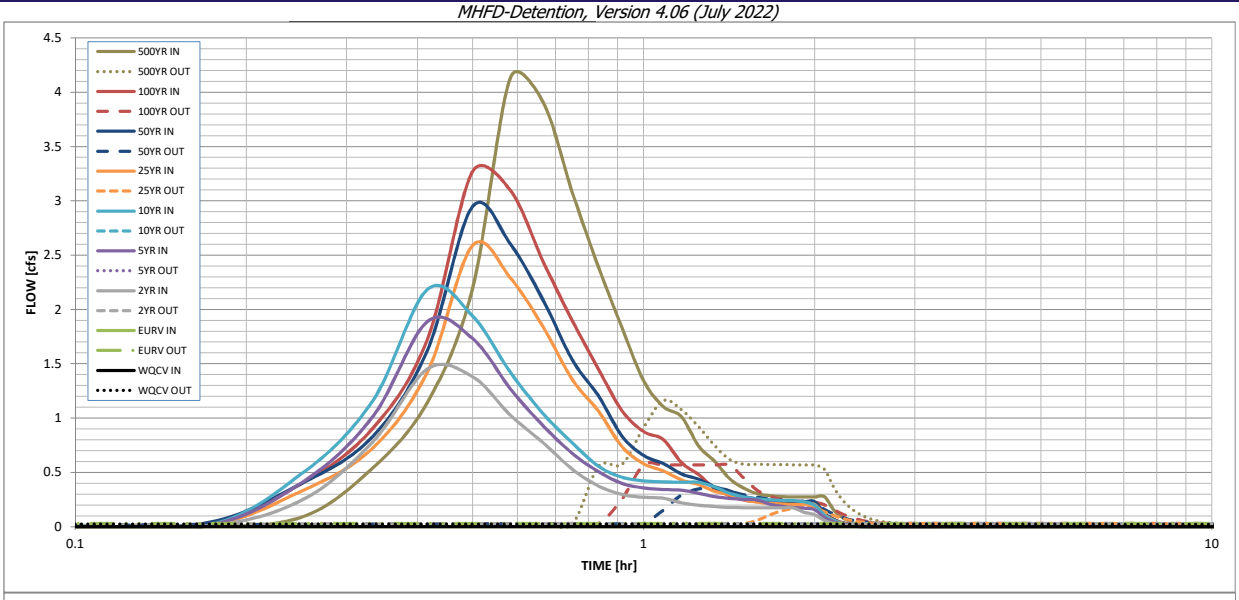
Routed Hydrograph Results

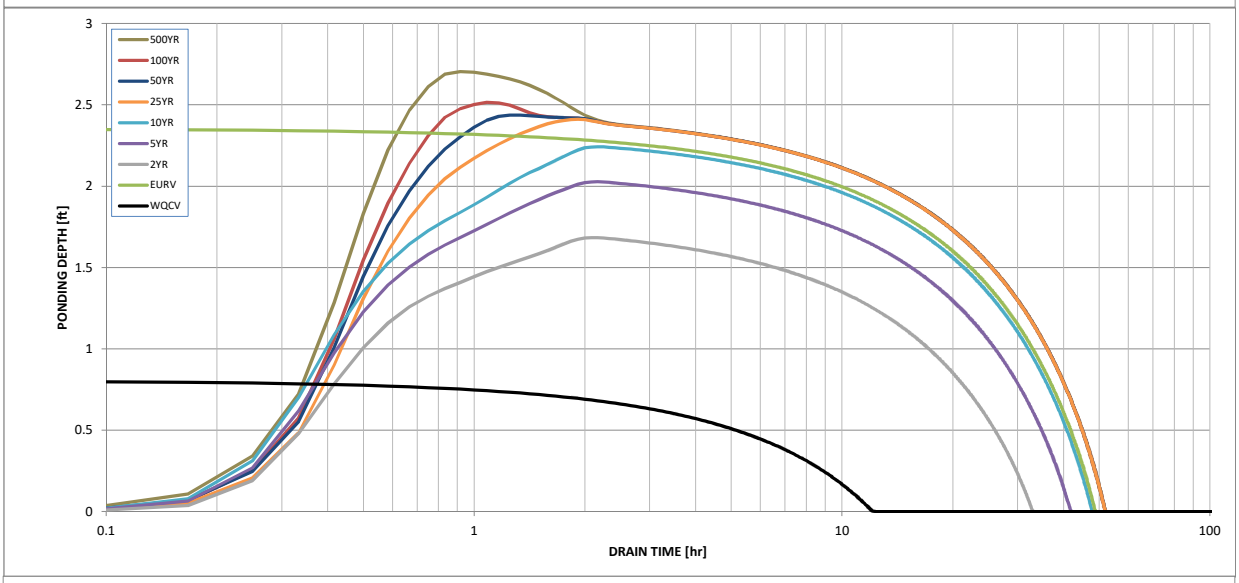
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AI

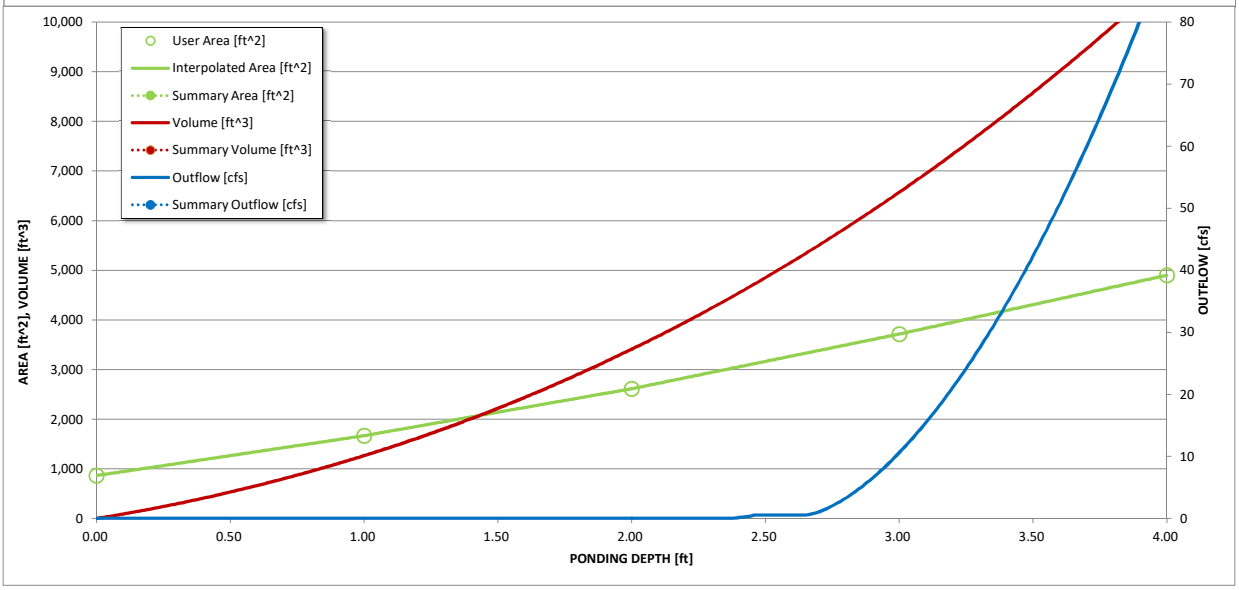
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.52	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.022	0.101	0.065	0.084	0.098	0.114	0.130	0.147
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.065	0.084	0.098	0.114	0.130	0.147
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.2	0.4	0.6
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	0.03	0.25	0.48	0.79
Peak Inflow Q (cfs) =	N/A	N/A	1.5	1.9	2.2	2.6	2.9	3.3
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.6	1.2	0.9	0.9	0.9
Structure Controlling Flow =	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.1	0.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	12	47	32	40	46	50	50	49
Time to Drain 99% of Inflow Volume (hours) =	**12**	48	33	41	47	51	51	51
Maximum Ponding Depth (ft) =	0.81	2.36	1.68	2.03	2.24	2.41	2.44	2.51
Area at Maximum Ponding Depth (acres) =	0.03	0.07	0.05	0.06	0.07	0.07	0.07	0.07
Maximum Volume Stored (acre-ft) =	0.022	0.101	0.060	0.079	0.093	0.105	0.106	0.112

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.

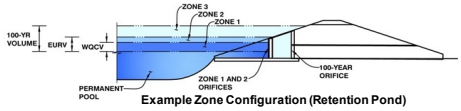
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.09
	0:15:00	0.00	0.00	0.24	0.40	0.49	0.33	0.40	0.40	0.54
	0:20:00	0.00	0.00	0.78	1.01	1.15	0.72	0.83	0.90	1.15
	0:25:00	0.00	0.00	1.45	1.89	2.19	1.42	1.62	1.72	2.19
	0:30:00	0.00	0.00	1.38	1.73	1.94	2.59	2.95	3.26	4.14
	0:35:00	0.00	0.00	1.03	1.27	1.42	2.29	2.60	3.09	3.90
	0:40:00	0.00	0.00	0.77	0.93	1.04	1.83	2.08	2.44	3.07
	0:45:00	0.00	0.00	0.53	0.67	0.77	1.35	1.53	1.89	2.39
	0:50:00	0.00	0.00	0.37	0.51	0.56	1.06	1.20	1.45	1.83
	0:55:00	0.00	0.00	0.30	0.40	0.46	0.74	0.83	1.07	1.35
	1:00:00	0.00	0.00	0.27	0.36	0.42	0.58	0.66	0.88	1.11
	1:05:00	0.00	0.00	0.26	0.34	0.41	0.51	0.58	0.80	1.01
	1:10:00	0.00	0.00	0.22	0.34	0.41	0.43	0.49	0.59	0.74
	1:15:00	0.00	0.00	0.20	0.31	0.41	0.39	0.44	0.48	0.60
	1:20:00	0.00	0.00	0.19	0.28	0.37	0.33	0.37	0.35	0.44
	1:25:00	0.00	0.00	0.18	0.26	0.31	0.29	0.33	0.28	0.36
	1:30:00	0.00	0.00	0.17	0.25	0.28	0.25	0.28	0.24	0.31
	1:35:00	0.00	0.00	0.17	0.25	0.26	0.23	0.25	0.23	0.29
	1:40:00	0.00	0.00	0.17	0.21	0.25	0.21	0.24	0.22	0.28
	1:45:00	0.00	0.00	0.17	0.19	0.24	0.21	0.23	0.22	0.27
	1:50:00	0.00	0.00	0.17	0.18	0.24	0.20	0.23	0.22	0.27
	1:55:00	0.00	0.00	0.13	0.17	0.23	0.20	0.23	0.22	0.27
	2:00:00	0.00	0.00	0.11	0.16	0.20	0.20	0.23	0.22	0.27
	2:05:00	0.00	0.00	0.06	0.08	0.11	0.11	0.12	0.12	0.15
	2:10:00	0.00	0.00	0.03	0.04	0.06	0.06	0.06	0.06	0.08
	2:15:00	0.00	0.00	0.01	0.02	0.03	0.03	0.03	0.03	0.04
	2:20:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02
	2:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	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
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	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Willowind Commercial

Basin ID: Pond 2



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	SF	
Watershed Area =	0.18	acres
Watershed Length =	175	ft
Watershed Length to Centroid =	90	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	95.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	12.0	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) =	0.005	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.024	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.016	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.52 in.) =	0.021	acre-feet	1.52	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.024	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.028	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.032	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.036	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.045	acre-feet		inches
Approximate 2-yr Detention Volume =	0.016	acre-feet		
Approximate 5-yr Detention Volume =	0.020	acre-feet		
Approximate 10-yr Detention Volume =	0.024	acre-feet		
Approximate 25-yr Detention Volume =	0.028	acre-feet		
Approximate 50-yr Detention Volume =	0.031	acre-feet		
Approximate 100-yr Detention Volume =	0.033	acre-feet		

Define Zones and Basin Geometry

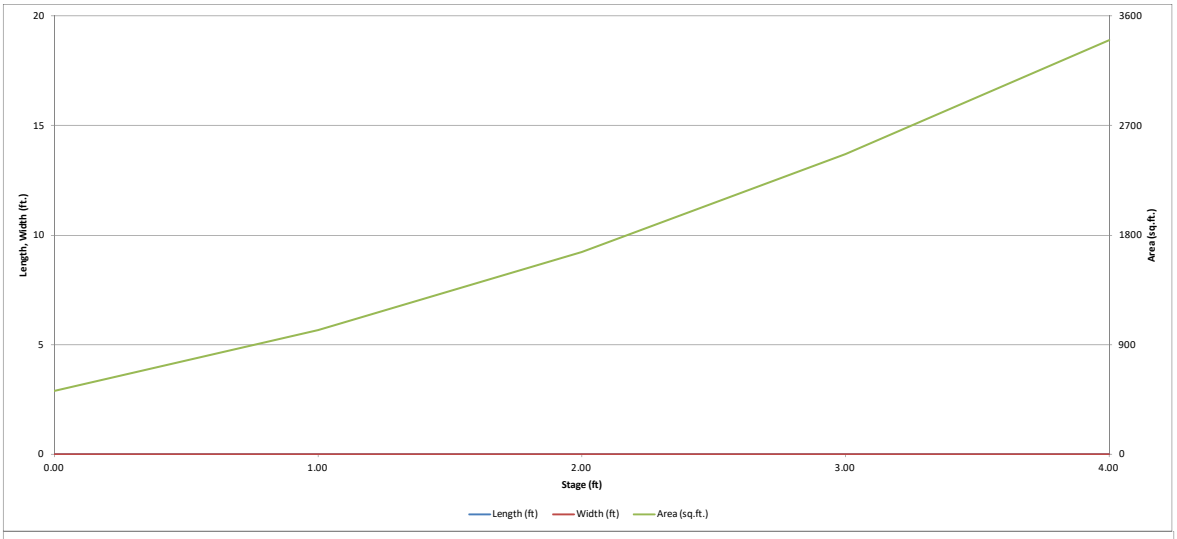
Zone 1 Volume (WQCV) =	0.005	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.018	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.009	acre-feet
Total Detention Basin Volume =	0.033	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	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

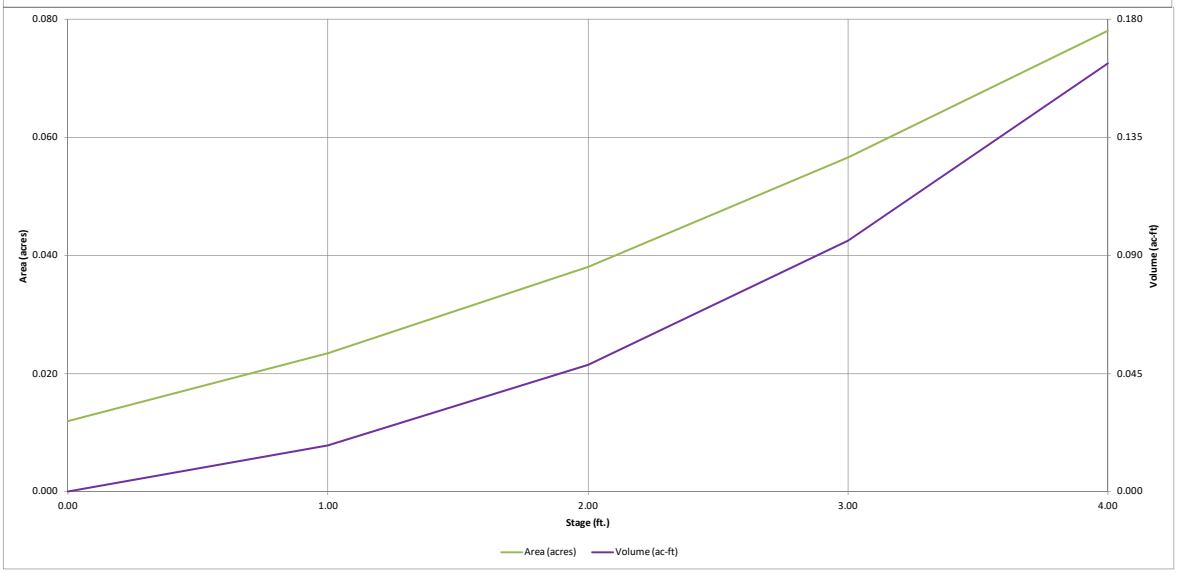
Depth Increment = ft

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)
Media Surface	--	0.00	--	--	--	522	0.012		
	--	1.00	--	--	--	1,019	0.023	770	0.018
	--	2.00	--	--	--	1,660	0.038	2,110	0.048
	--	3.00	--	--	--	2,465	0.057	4,172	0.096
	--	4.00	--	--	--	3,400	0.078	7,105	0.163

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



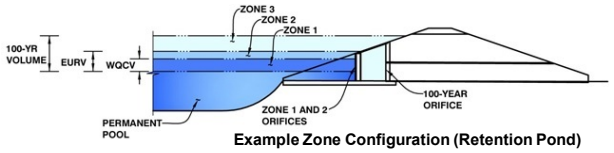


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Willowind Commercial**

Basin ID: **Pond 2**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.38	0.005	Filtration Media
Zone 2 (EURV)	1.24	0.018	Filtration Media
Zone 3 (100-year)	1.55	0.009	Circular Orifice
Total (all zones)		0.033	

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

Underdrain Orifice Invert Depth =	2.50	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.34	inches	Underdrain Orifice Centroid =	0.01	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	N/A	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 =	N/A	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

Calculated Parameters for Plate

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

	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 3 Circular	Not Selected				Zone 3 Circular	Not Selected
Invert of Vertical Orifice =	1.24	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =		0.09	N/A
Depth at top of Zone using Vertical Orifice =	2.00	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =		0.17	N/A
Vertical Orifice Diameter =	4.00	N/A	inches				

Calculated Parameters for Vertical Orif

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

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

Calculated Parameters for Overflow W

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

	Not Selected	Not Selected				Not Selected	Not Selected
Depth to Invert of Outlet Pipe =	N/A	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =		N/A	N/A
Circular Orifice Diameter =	N/A	N/A	inches	Outlet Orifice Centroid =		N/A	N/A
				Half-Central Angle of Restrictor Plate on Pipe =		N/A	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	1.60	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.07	feet
Spillway Crest Length =	10.00	feet	Stage at Top of Freeboard =	2.67	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.05	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.08	acre-ft

Calculated Parameters for Spillway

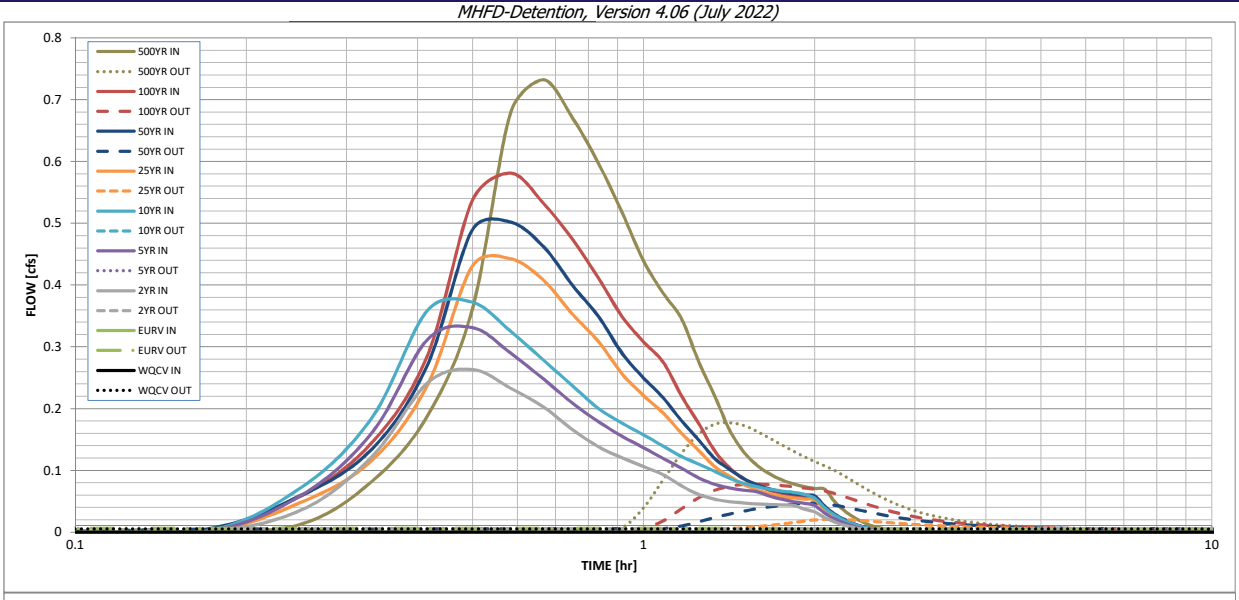
Routed Hydrograph Results

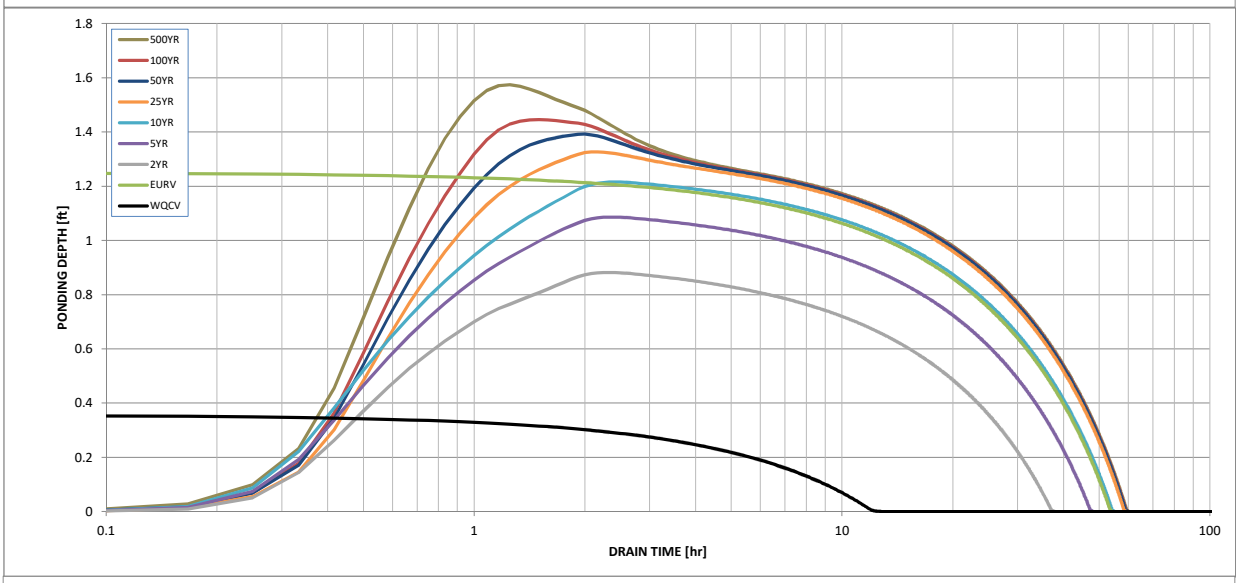
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AI

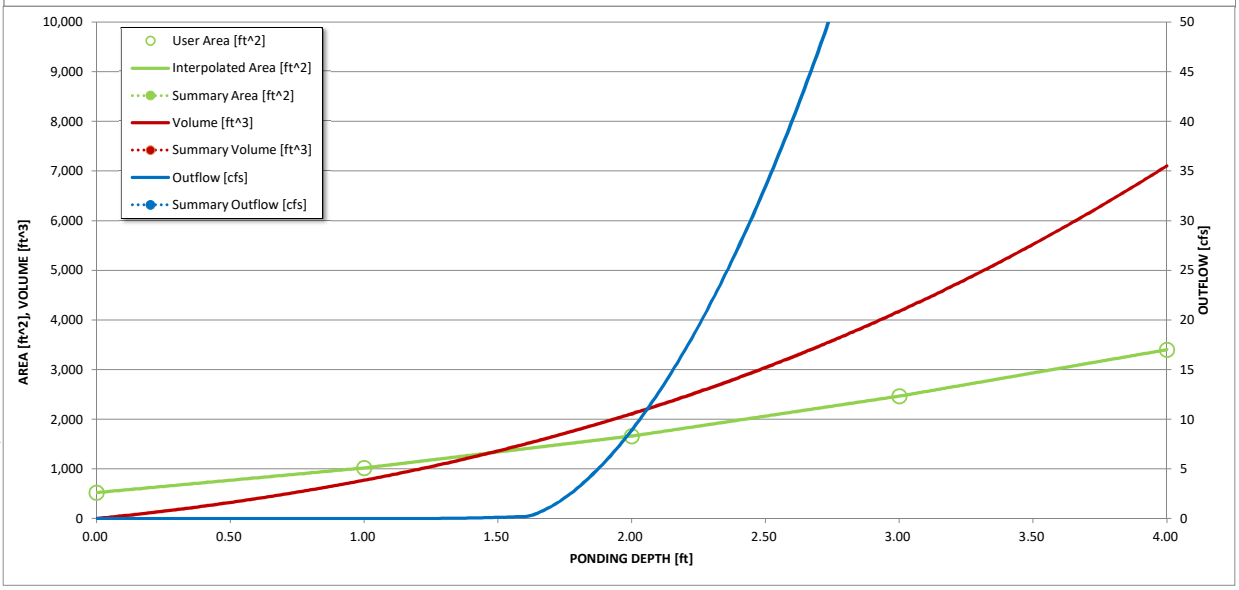
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.52	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.005	0.024	0.016	0.021	0.024	0.028	0.032	0.036
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.016	0.021	0.024	0.028	0.032	0.036
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.0	0.0	0.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.00	0.00	0.13	0.27	0.46
Peak Inflow Q (cfs) =	N/A	N/A	0.3	0.3	0.4	0.4	0.5	0.6
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	#DIV/0!	#DIV/0!	0.9	1.0	0.9
Structure Controlling Flow =	Filtration Media	Vertical Orifice 1	Filtration Media	Filtration Media	Filtration Media	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	12	52	36	46	53	57	57	57
Time to Drain 99% of Inflow Volume (hours) =	**12**	53	37	47	54	58	58	59
Maximum Ponding Depth (ft) =	0.36	1.26	0.88	1.09	1.22	1.33	1.39	1.45
Area at Maximum Ponding Depth (acres) =	0.02	0.03	0.02	0.02	0.03	0.03	0.03	0.03
Maximum Volume Stored (acre-ft) =	0.005	0.024	0.015	0.020	0.023	0.026	0.028	0.029

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







1

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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

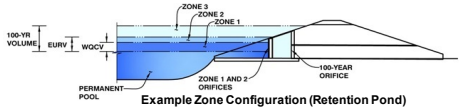
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	0:15:00	0.00	0.00	0.04	0.06	0.07	0.05	0.06	0.06	0.08
	0:20:00	0.00	0.00	0.12	0.16	0.19	0.12	0.14	0.15	0.19
	0:25:00	0.00	0.00	0.24	0.31	0.36	0.24	0.27	0.29	0.36
	0:30:00	0.00	0.00	0.26	0.33	0.37	0.43	0.49	0.54	0.68
	0:35:00	0.00	0.00	0.23	0.29	0.33	0.44	0.50	0.58	0.73
	0:40:00	0.00	0.00	0.20	0.25	0.28	0.41	0.46	0.53	0.67
	0:45:00	0.00	0.00	0.17	0.21	0.24	0.35	0.40	0.47	0.60
	0:50:00	0.00	0.00	0.14	0.18	0.20	0.31	0.35	0.41	0.52
	0:55:00	0.00	0.00	0.12	0.16	0.18	0.26	0.29	0.35	0.44
	1:00:00	0.00	0.00	0.11	0.14	0.16	0.22	0.25	0.31	0.39
	1:05:00	0.00	0.00	0.09	0.12	0.14	0.19	0.22	0.28	0.35
	1:10:00	0.00	0.00	0.07	0.10	0.12	0.16	0.18	0.22	0.28
	1:15:00	0.00	0.00	0.06	0.09	0.11	0.13	0.15	0.18	0.22
	1:20:00	0.00	0.00	0.05	0.08	0.10	0.11	0.12	0.13	0.17
	1:25:00	0.00	0.00	0.05	0.07	0.09	0.09	0.10	0.10	0.13
	1:30:00	0.00	0.00	0.05	0.07	0.08	0.08	0.09	0.09	0.11
	1:35:00	0.00	0.00	0.05	0.07	0.07	0.07	0.08	0.08	0.09
	1:40:00	0.00	0.00	0.04	0.06	0.07	0.06	0.07	0.07	0.08
	1:45:00	0.00	0.00	0.04	0.05	0.07	0.06	0.07	0.06	0.08
	1:50:00	0.00	0.00	0.04	0.05	0.06	0.06	0.06	0.06	0.07
	1:55:00	0.00	0.00	0.04	0.05	0.06	0.05	0.06	0.06	0.07
	2:00:00	0.00	0.00	0.03	0.04	0.06	0.05	0.06	0.06	0.07
	2:05:00	0.00	0.00	0.02	0.03	0.04	0.04	0.04	0.04	0.05
	2:10:00	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.03	0.04
	2:15:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	2:20:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	2:25:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	2:30:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Willowind Commercial**

Basin ID: **Pond 3**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**SF**	
Watershed Area =	1.03	acres
Watershed Length =	220	ft
Watershed Length to Centroid =	110	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	95.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	12.0	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) =	0.031	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.135	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.086	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.52 in.) =	0.112	acre-feet	1.52	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.130	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.151	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.171	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.194	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.244	acre-feet		inches
Approximate 2-yr Detention Volume =	0.089	acre-feet		
Approximate 5-yr Detention Volume =	0.117	acre-feet		
Approximate 10-yr Detention Volume =	0.137	acre-feet		
Approximate 25-yr Detention Volume =	0.161	acre-feet		
Approximate 50-yr Detention Volume =	0.175	acre-feet		
Approximate 100-yr Detention Volume =	0.186	acre-feet		

Define Zones and Basin Geometry

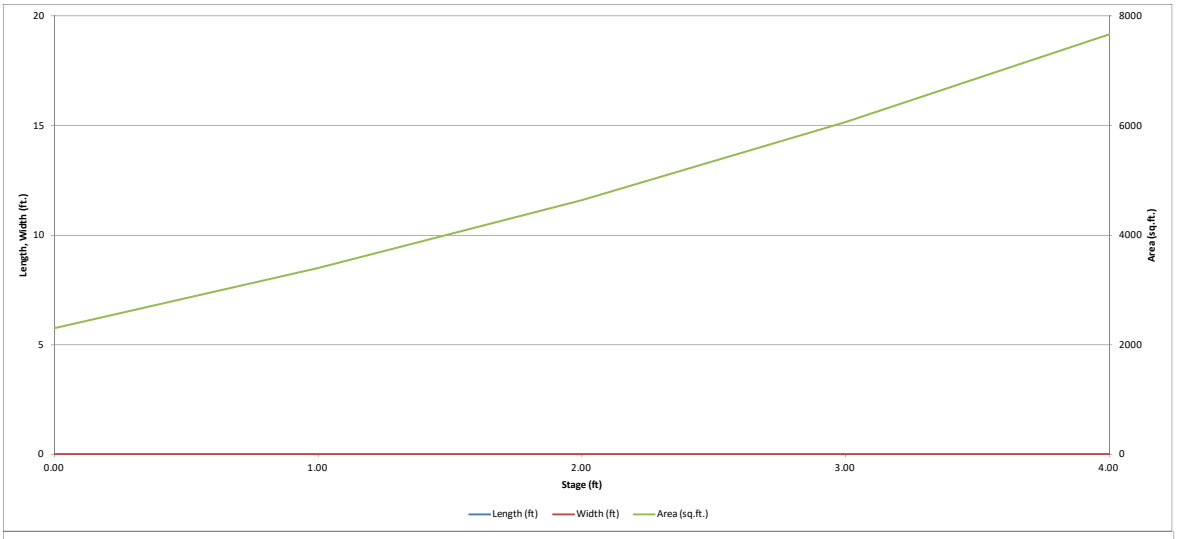
Zone 1 Volume (WQCV) =	0.031	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.104	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.051	acre-feet
Total Detention Basin Volume =	0.186	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	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

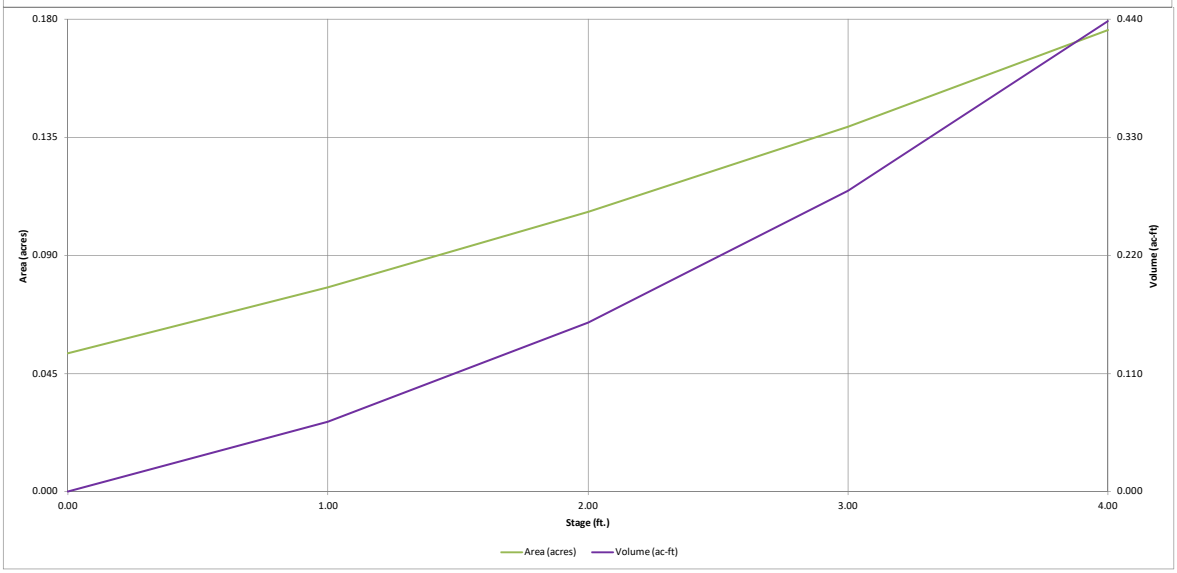
Depth Increment = ft

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)
Media Surface	--	0.00	--	--	--	2,300	0.053		
	--	1.00	--	--	--	3,396	0.078	2,848	0.065
	--	2.00	--	--	--	4,641	0.107	6,866	0.158
	--	3.00	--	--	--	6,063	0.139	12,218	0.280
	--	4.00	--	--	--	7,667	0.176	19,083	0.438

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



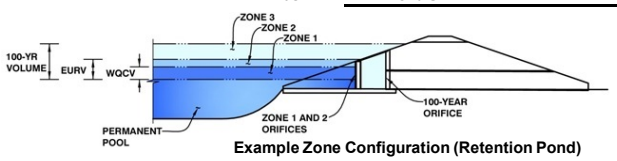


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Willowind Commercial**

Basin ID: **Pond 3**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.52	0.031	Filtration Media
Zone 2 (EURV)	1.79	0.104	Filtration Media
Zone 3 (100-year)	2.26	0.051	Weir&Pipe (Restrict)
Total (all zones)		0.186	

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

Underdrain Orifice Invert Depth =	2.50	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.84	inches	Underdrain Orifice Centroid =	0.04	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	N/A	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 =	N/A	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

Calculated Parameters for Plate

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

	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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)	Vertical Orifice Area =	N/A	N/A
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
Vertical Orifice Diameter =	N/A	N/A	inches			

Calculated Parameters for Vertical Orif

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			Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	1.79	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	1.79	N/A
Overflow Weir Front Edge Length =	2.91	N/A	feet	Overflow Weir Slope Length =	2.91	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	72.82	N/A
Horiz. Length of Weir Sides =	2.91	N/A	feet	Overflow Grate Open Area w/o Debris =	5.89	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	2.95	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow W

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected
Depth to Invert of Outlet Pipe =	2.75	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.08	N/A
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.08	N/A
Restrictor Plate Height Above Pipe Invert =	1.65		inches	Half-Central Angle of Restrictor Plate on Pipe =	0.62	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.20	feet
Spillway Crest Length =	15.00	feet	Stage at Top of Freeboard =	3.20	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.15	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.31	acre-ft

Calculated Parameters for Spillway

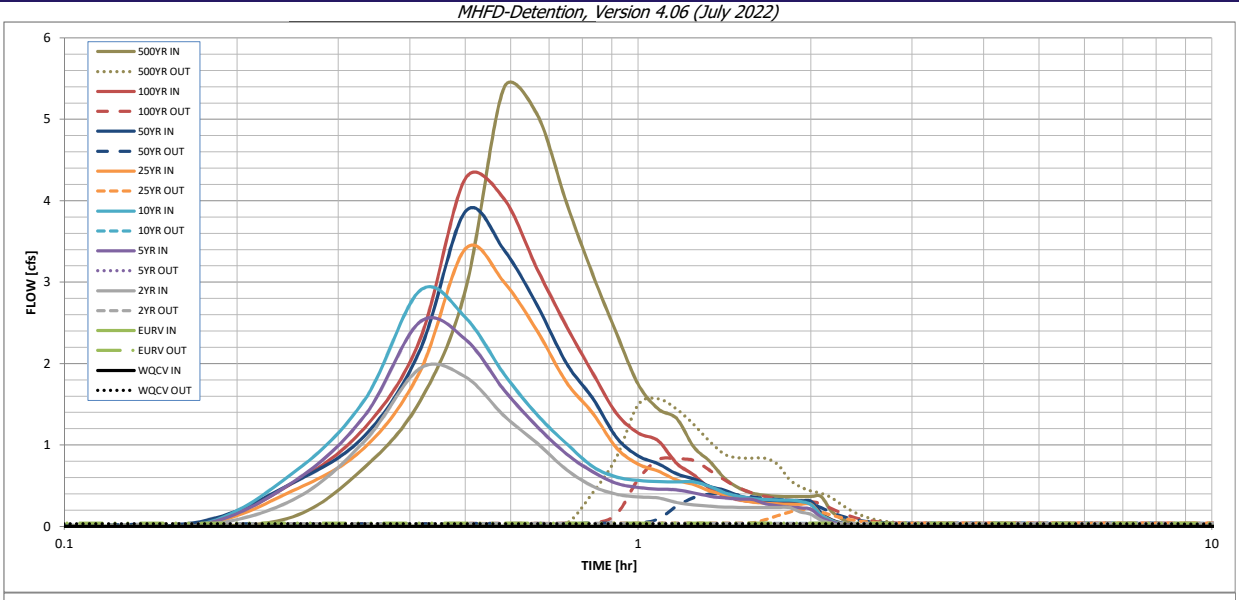
Routed Hydrograph Results

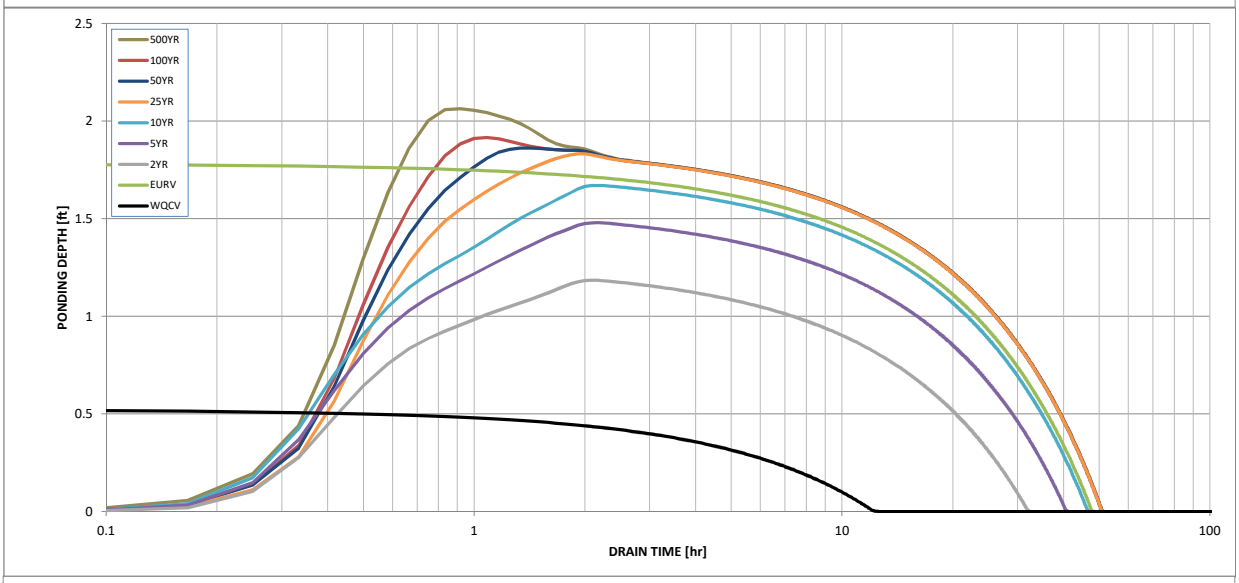
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AI

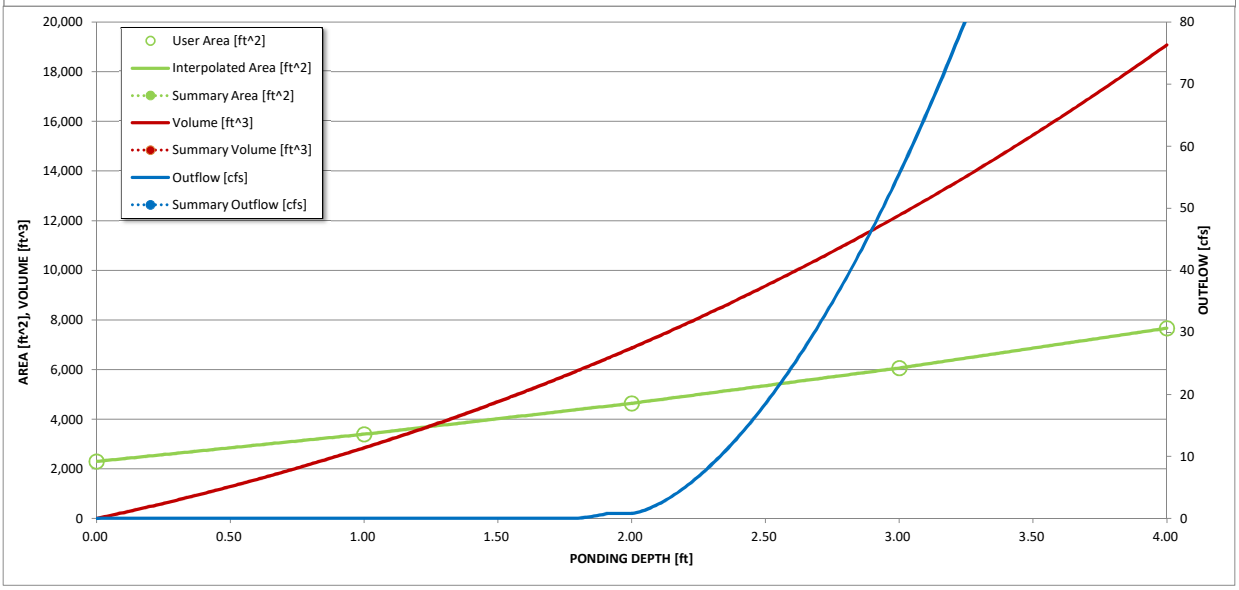
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.52	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.031	0.135	0.086	0.112	0.130	0.151	0.171	0.194
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.086	0.112	0.130	0.151	0.171	0.194
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.3	0.5	0.8
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	0.03	0.25	0.48	0.78
Peak Inflow Q (cfs) =	N/A	N/A	1.9	2.5	2.9	3.4	3.9	4.3
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.7	1.3	0.8	0.8	1.0
Structure Controlling Flow =	Filtration Media	Overflow Weir 1	Filtration Media	Filtration Media	Filtration Media	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.1	0.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	12	46	31	39	45	49	49	49
Time to Drain 99% of Inflow Volume (hours) =	**12**	47	32	40	46	50	50	50
Maximum Ponding Depth (ft) =	0.53	1.79	1.18	1.48	1.67	1.83	1.86	1.92
Area at Maximum Ponding Depth (acres) =	0.07	0.10	0.08	0.09	0.10	0.10	0.10	0.10
Maximum Volume Stored (acre-ft) =	0.032	0.136	0.080	0.105	0.124	0.140	0.143	0.148

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.

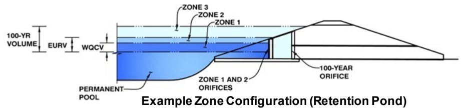
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.12
	0:15:00	0.00	0.00	0.33	0.54	0.65	0.44	0.53	0.53	0.72
	0:20:00	0.00	0.00	1.05	1.35	1.55	0.97	1.11	1.21	1.54
	0:25:00	0.00	0.00	1.94	2.51	2.90	1.91	2.17	2.30	2.90
	0:30:00	0.00	0.00	1.84	2.30	2.57	3.41	3.87	4.27	5.38
	0:35:00	0.00	0.00	1.36	1.68	1.88	3.00	3.40	4.03	5.06
	0:40:00	0.00	0.00	1.02	1.23	1.37	2.40	2.72	3.17	3.97
	0:45:00	0.00	0.00	0.70	0.89	1.02	1.77	2.00	2.46	3.09
	0:50:00	0.00	0.00	0.49	0.67	0.73	1.39	1.57	1.89	2.37
	0:55:00	0.00	0.00	0.40	0.53	0.61	0.97	1.09	1.39	1.75
	1:00:00	0.00	0.00	0.36	0.48	0.57	0.77	0.86	1.15	1.44
	1:05:00	0.00	0.00	0.35	0.46	0.55	0.68	0.77	1.05	1.33
	1:10:00	0.00	0.00	0.29	0.45	0.55	0.57	0.64	0.78	0.98
	1:15:00	0.00	0.00	0.26	0.41	0.55	0.51	0.58	0.63	0.80
	1:20:00	0.00	0.00	0.25	0.37	0.49	0.43	0.49	0.47	0.59
	1:25:00	0.00	0.00	0.24	0.35	0.41	0.39	0.44	0.38	0.47
	1:30:00	0.00	0.00	0.23	0.34	0.37	0.33	0.37	0.33	0.41
	1:35:00	0.00	0.00	0.23	0.33	0.34	0.30	0.34	0.31	0.38
	1:40:00	0.00	0.00	0.23	0.28	0.33	0.28	0.32	0.30	0.37
	1:45:00	0.00	0.00	0.23	0.25	0.32	0.28	0.31	0.29	0.37
	1:50:00	0.00	0.00	0.23	0.24	0.32	0.27	0.31	0.29	0.37
	1:55:00	0.00	0.00	0.18	0.23	0.31	0.27	0.31	0.29	0.37
	2:00:00	0.00	0.00	0.15	0.21	0.27	0.27	0.31	0.29	0.37
	2:05:00	0.00	0.00	0.08	0.11	0.14	0.14	0.16	0.16	0.19
	2:10:00	0.00	0.00	0.04	0.06	0.07	0.08	0.09	0.08	0.10
	2:15:00	0.00	0.00	0.02	0.03	0.03	0.04	0.04	0.04	0.05
	2:20:00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02
	2:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Willowind Commercial**

Basin ID: **Pond 4**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**SF**	
Watershed Area =	1.11	acres
Watershed Length =	250	ft
Watershed Length to Centroid =	125	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	95.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	12.0	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) =	0.033	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.146	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.094	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.52 in.) =	0.123	acre-feet	1.52	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.142	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.165	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.187	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.212	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.267	acre-feet		inches
Approximate 2-yr Detention Volume =	0.096	acre-feet		
Approximate 5-yr Detention Volume =	0.126	acre-feet		
Approximate 10-yr Detention Volume =	0.148	acre-feet		
Approximate 25-yr Detention Volume =	0.173	acre-feet		
Approximate 50-yr Detention Volume =	0.188	acre-feet		
Approximate 100-yr Detention Volume =	0.201	acre-feet		

Define Zones and Basin Geometry

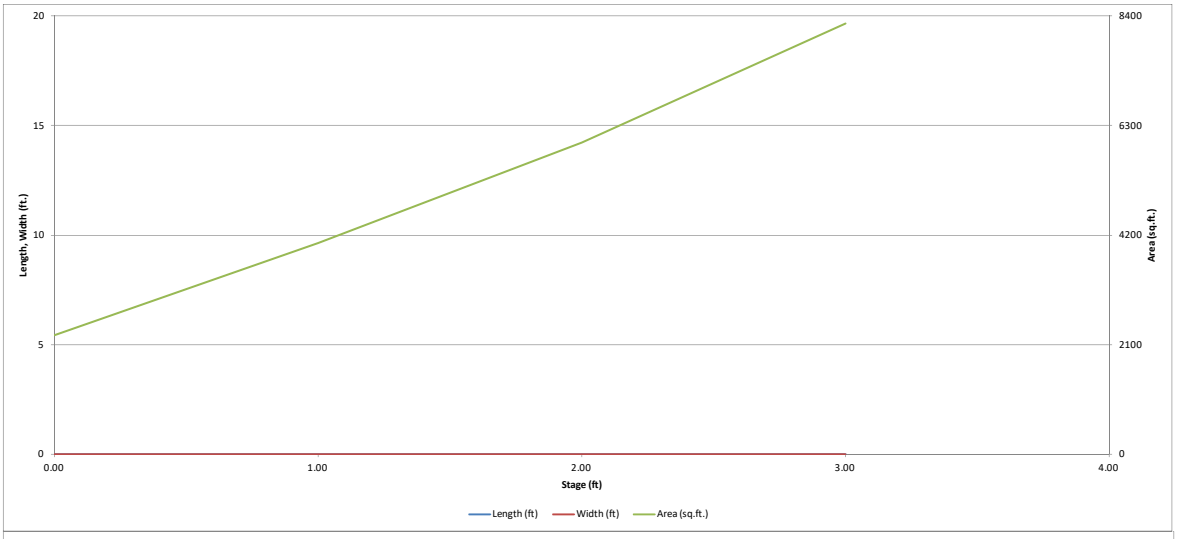
Zone 1 Volume (WQCV) =	0.033	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.112	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.055	acre-feet
Total Detention Basin Volume =	0.201	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	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

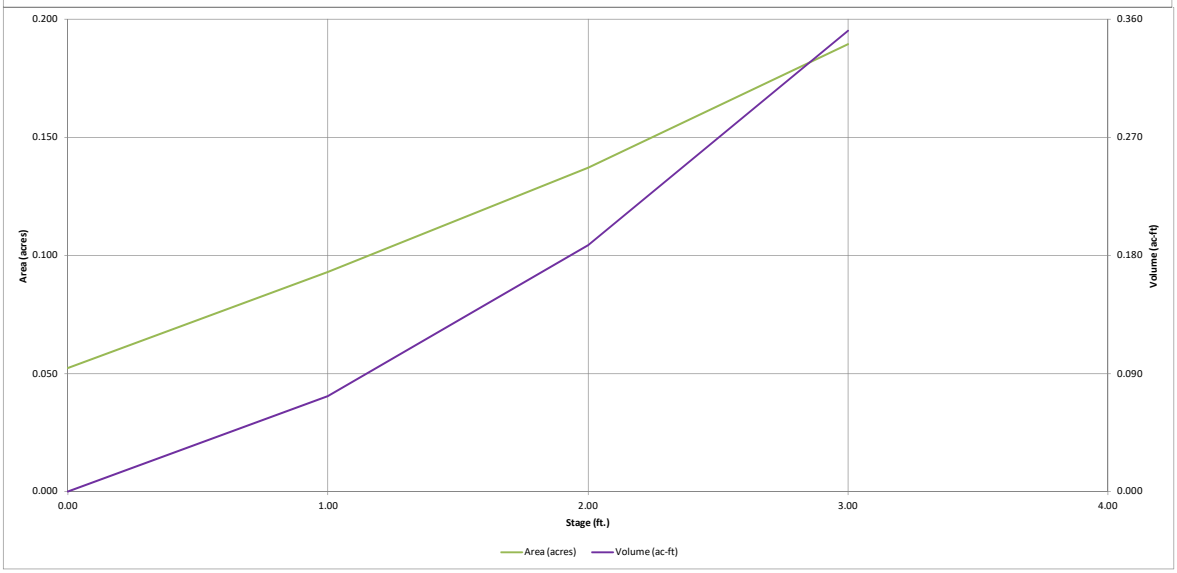
Depth Increment = ft

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)
Media Surface	--	0.00	--	--	--	2,281	0.052		
	--	1.00	--	--	--	4,053	0.093	3,167	0.073
	--	2.00	--	--	--	5,975	0.137	8,181	0.188
	--	3.00	--	--	--	8,256	0.190	15,296	0.351
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DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



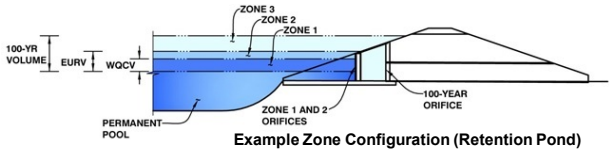


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Willowind Commercial**

Basin ID: **Pond 4**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.53	0.033	Filtration Media
Zone 2 (EURV)	1.68	0.112	Filtration Media
Zone 3 (100-year)	2.10	0.055	Weir&Pipe (Restrict)
Total (all zones)		0.201	

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

Underdrain Orifice Invert Depth =	2.50	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.87	inches	Underdrain Orifice Centroid =	0.04	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	N/A	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 =	N/A	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

Calculated Parameters for Plate

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

	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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)	Vertical Orifice Area =	N/A	N/A
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
Vertical Orifice Diameter =	N/A	N/A	inches			

Calculated Parameters for Vertical Orif

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			Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	1.68	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	1.68	N/A
Overflow Weir Front Edge Length =	2.91	N/A	feet	Overflow Weir Slope Length =	2.91	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	83.79	N/A
Horiz. Length of Weir Sides =	2.91	N/A	feet	Overflow Grate Open Area w/o Debris =	5.89	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	2.95	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow W

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected
Depth to Invert of Outlet Pipe =	2.75	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.07	N/A
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.07	N/A
Restrictor Plate Height Above Pipe Invert =	1.50		inches	Half-Central Angle of Restrictor Plate on Pipe =	0.59	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	1.95	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.20	feet
Spillway Crest Length =	15.00	feet	Stage at Top of Freeboard =	3.15	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.19	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.35	acre-ft

Calculated Parameters for Spillway

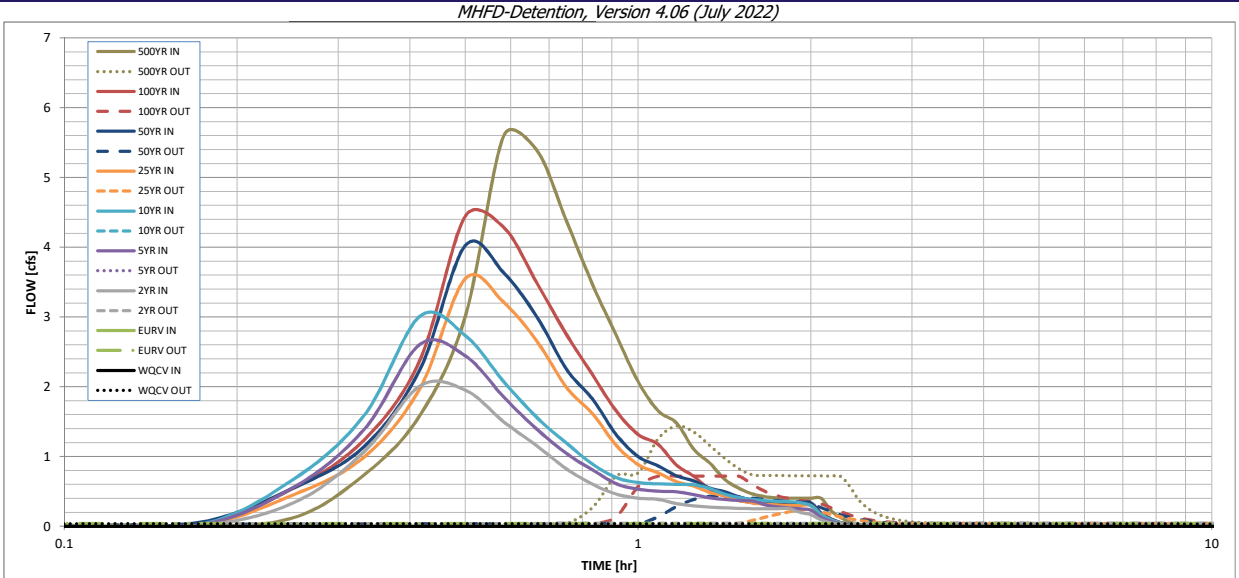
Routed Hydrograph Results

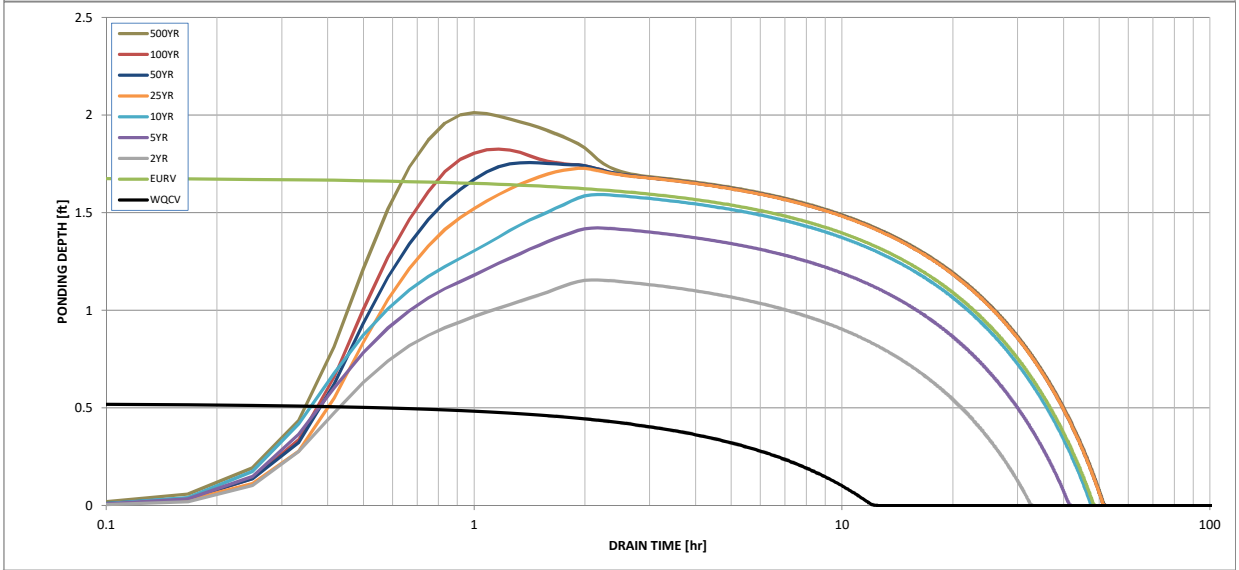
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AI

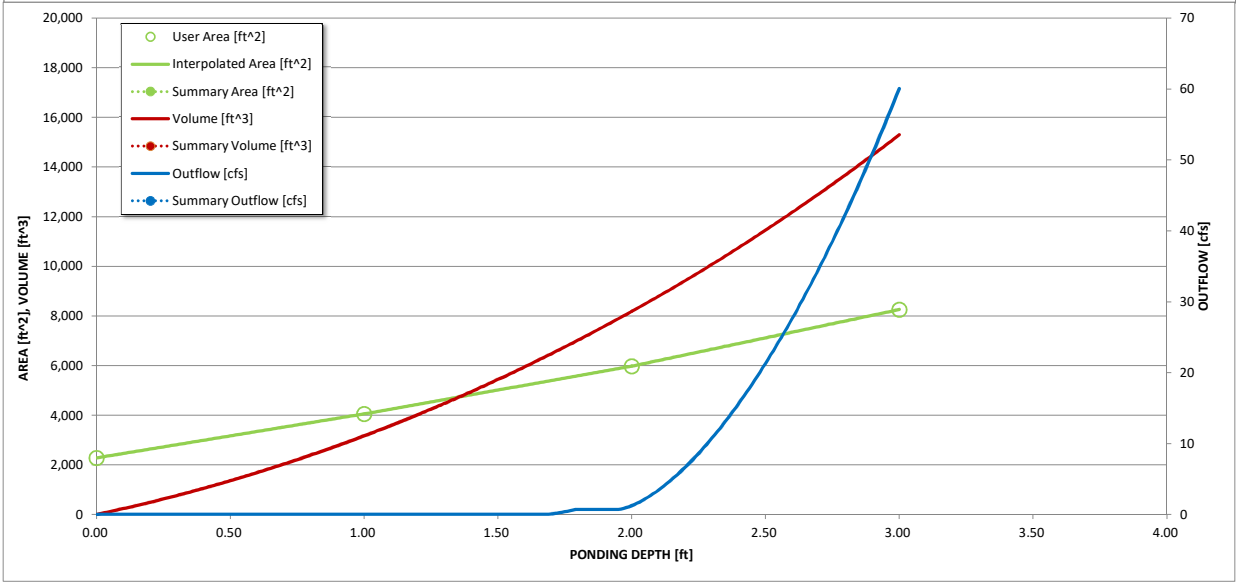
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.52	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.033	0.146	0.094	0.123	0.142	0.165	0.187	0.212
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.094	0.123	0.142	0.165	0.187	0.212
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.3	0.5	0.8
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	0.03	0.23	0.45	0.73
Peak Inflow Q (cfs) =	N/A	N/A	2.0	2.6	3.0	3.6	4.0	4.4
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.8	1.4	0.9	0.9	0.9
Structure Controlling Flow =	Filtration Media	Overflow Weir 1	Filtration Media	Filtration Media	Filtration Media	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.1	0.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	12	47	32	40	46	50	49	49
Time to Drain 99% of Inflow Volume (hours) =	**12**	48	32	41	47	51	51	51
Maximum Ponding Depth (ft) =	0.53	1.68	1.16	1.42	1.59	1.73	1.76	1.83
Area at Maximum Ponding Depth (acres) =	0.07	0.12	0.10	0.11	0.12	0.12	0.13	0.13
Maximum Volume Stored (acre-ft) =	0.033	0.146	0.087	0.116	0.135	0.151	0.155	0.164

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.

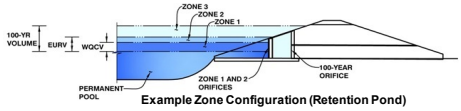
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.12
	0:15:00	0.00	0.00	0.33	0.55	0.67	0.45	0.54	0.54	0.74
	0:20:00	0.00	0.00	1.07	1.39	1.60	1.00	1.15	1.24	1.59
	0:25:00	0.00	0.00	2.01	2.61	3.01	1.98	2.25	2.39	3.02
	0:30:00	0.00	0.00	1.95	2.44	2.73	3.55	4.03	4.45	5.60
	0:35:00	0.00	0.00	1.49	1.85	2.07	3.21	3.63	4.28	5.38
	0:40:00	0.00	0.00	1.15	1.39	1.55	2.65	3.00	3.49	4.37
	0:45:00	0.00	0.00	0.82	1.04	1.19	1.99	2.25	2.75	3.46
	0:50:00	0.00	0.00	0.60	0.81	0.89	1.61	1.82	2.17	2.73
	0:55:00	0.00	0.00	0.46	0.61	0.70	1.16	1.31	1.65	2.07
	1:00:00	0.00	0.00	0.40	0.53	0.63	0.88	1.00	1.32	1.65
	1:05:00	0.00	0.00	0.39	0.50	0.61	0.77	0.86	1.18	1.48
	1:10:00	0.00	0.00	0.32	0.49	0.60	0.64	0.72	0.88	1.10
	1:15:00	0.00	0.00	0.29	0.45	0.60	0.58	0.65	0.72	0.90
	1:20:00	0.00	0.00	0.27	0.41	0.54	0.48	0.54	0.53	0.67
	1:25:00	0.00	0.00	0.26	0.38	0.46	0.44	0.49	0.43	0.54
	1:30:00	0.00	0.00	0.26	0.37	0.41	0.37	0.42	0.37	0.46
	1:35:00	0.00	0.00	0.25	0.36	0.38	0.34	0.38	0.34	0.42
	1:40:00	0.00	0.00	0.25	0.31	0.37	0.32	0.35	0.33	0.41
	1:45:00	0.00	0.00	0.25	0.28	0.36	0.30	0.34	0.32	0.40
	1:50:00	0.00	0.00	0.25	0.26	0.35	0.30	0.34	0.32	0.40
	1:55:00	0.00	0.00	0.20	0.25	0.34	0.30	0.34	0.32	0.40
	2:00:00	0.00	0.00	0.17	0.23	0.30	0.30	0.34	0.32	0.40
	2:05:00	0.00	0.00	0.09	0.13	0.17	0.17	0.19	0.18	0.23
	2:10:00	0.00	0.00	0.05	0.07	0.09	0.09	0.11	0.10	0.13
	2:15:00	0.00	0.00	0.02	0.04	0.05	0.05	0.06	0.05	0.07
	2:20:00	0.00	0.00	0.01	0.02	0.02	0.02	0.03	0.03	0.03
	2:25:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Willowind Commercial

Basin ID: Lot 5 Pond 4A



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	SF	
Watershed Area =	0.83	acres
Watershed Length =	215	ft
Watershed Length to Centroid =	110	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	95.90%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	12.0	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) =	0.025	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.110	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.071	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.52 in.) =	0.092	acre-feet	1.52	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.107	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.124	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.141	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.159	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.200	acre-feet		inches
Approximate 2-yr Detention Volume =	0.073	acre-feet		
Approximate 5-yr Detention Volume =	0.096	acre-feet		
Approximate 10-yr Detention Volume =	0.112	acre-feet		
Approximate 25-yr Detention Volume =	0.131	acre-feet		
Approximate 50-yr Detention Volume =	0.142	acre-feet		
Approximate 100-yr Detention Volume =	0.152	acre-feet		

Define Zones and Basin Geometry

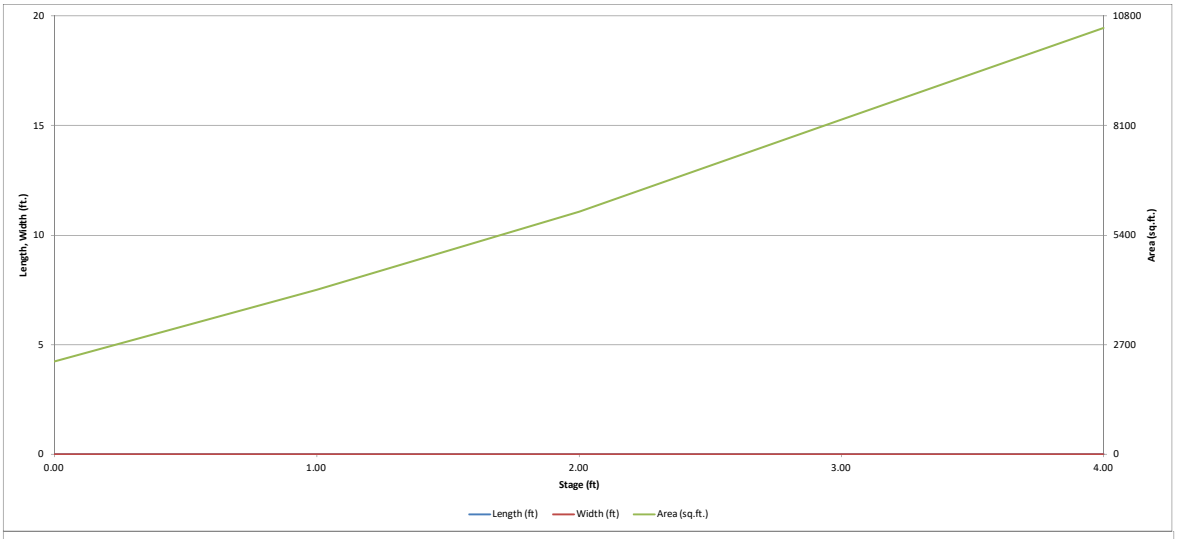
Zone 1 Volume (WQCV) =	0.025	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.085	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.042	acre-feet
Total Detention Basin Volume =	0.152	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	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

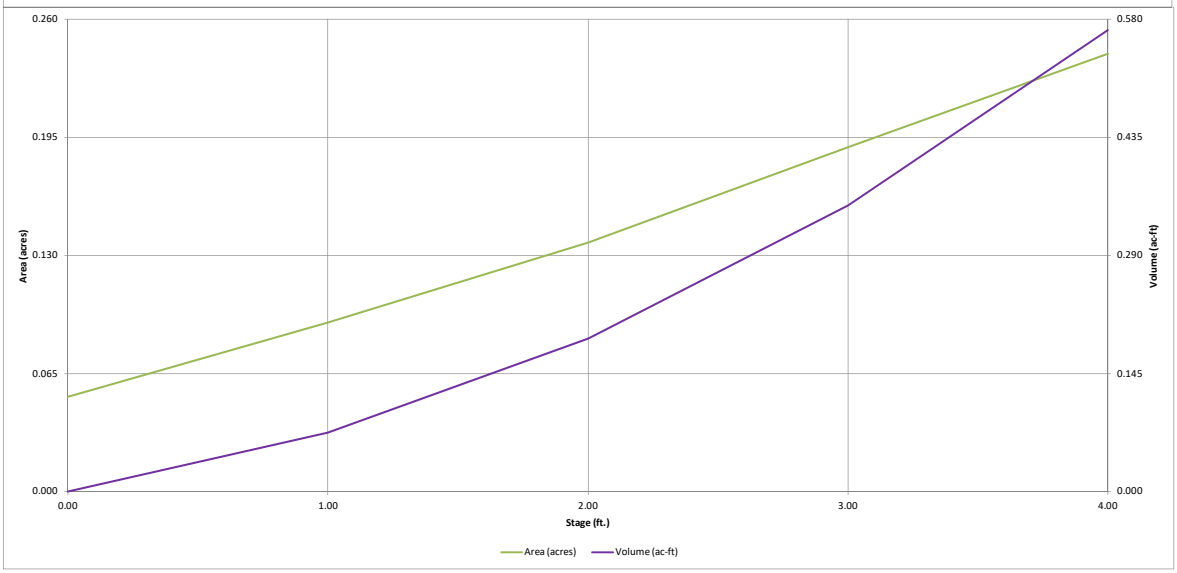
Depth Increment = ft

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)
Media Surface	--	0.00	--	--	--	2,281	0.052		
	--	1.00	--	--	--	4,053	0.093	3,167	0.073
	--	2.00	--	--	--	5,975	0.137	8,181	0.188
	--	3.00	--	--	--	8,256	0.190	15,296	0.351
	--	4.00	--	--	--	10,500	0.241	24,674	0.566

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



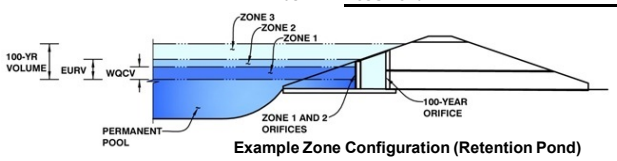


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Willowind Commercial

Basin ID: Lot 5 Pond 4A



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.42	0.025	Filtration Media
Zone 2 (EURV)	1.37	0.085	Filtration Media
Zone 3 (100-year)	1.73	0.042	Weir&Pipe (Restrict)
Total (all zones)		0.152	

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

Underdrain Orifice Invert Depth =	2.30	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.78	inches	Underdrain Orifice Centroid =	0.03	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	N/A	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 =	N/A	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

Calculated Parameters for Plate

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

	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			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
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
Vertical Orifice Diameter =	N/A	N/A	inches			

Calculated Parameters for Vertical Orif

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			Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	1.37	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	1.37	N/A
Overflow Weir Front Edge Length =	2.91	N/A	feet	Overflow Weir Slope Length =	2.91	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	212.53	N/A
Horiz. Length of Weir Sides =	2.91	N/A	feet	Overflow Grate Open Area w/o Debris =	5.89	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	2.95	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow W

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected
Depth to Invert of Outlet Pipe =	2.75	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.03	N/A
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.04	N/A
Restrictor Plate Height Above Pipe Invert =	0.80		inches	Half-Central Angle of Restrictor Plate on Pipe =	0.42	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	1.60	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.36	feet
Spillway Crest Length =	4.00	feet	Stage at Top of Freeboard =	2.96	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.19	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.34	acre-ft

Calculated Parameters for Spillway

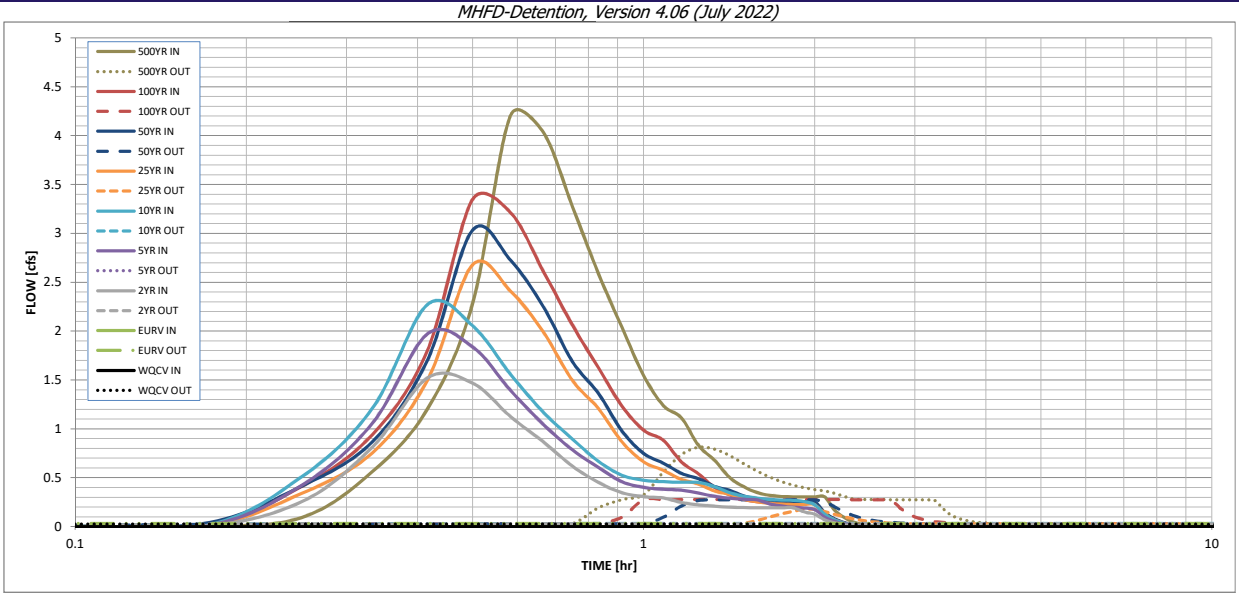
Routed Hydrograph Results

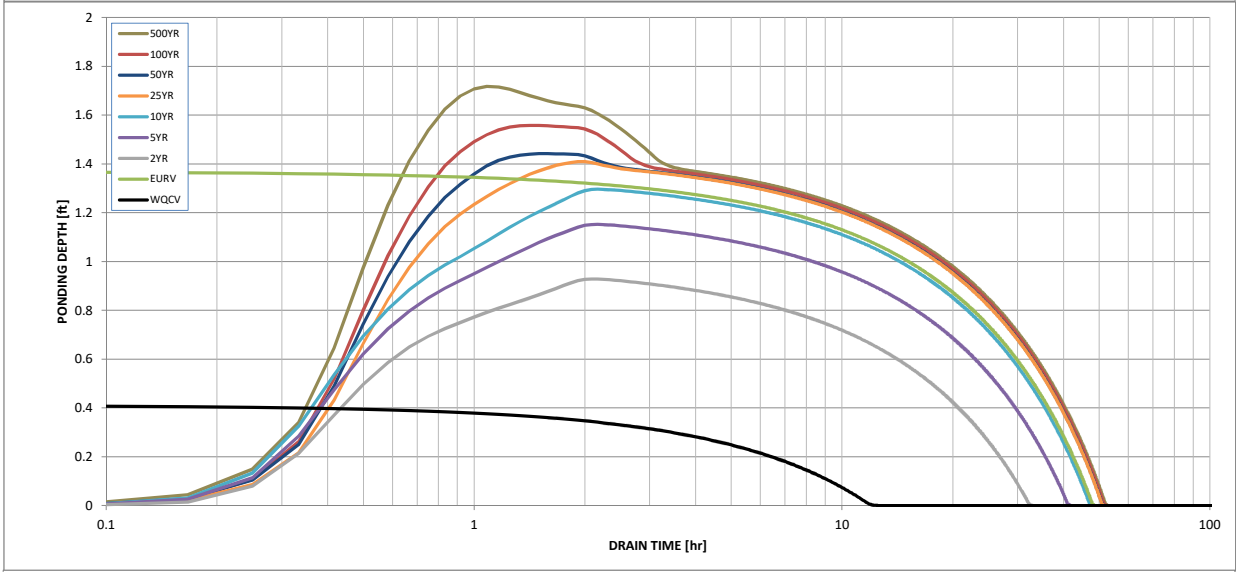
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AI

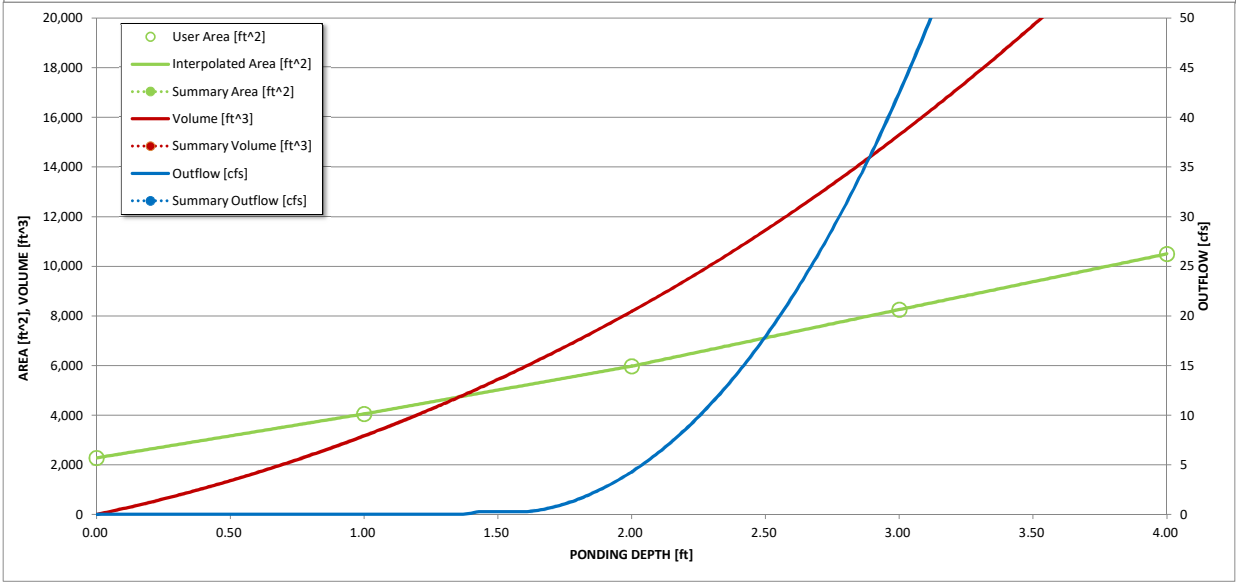
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.52	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.025	0.110	0.071	0.092	0.107	0.124	0.141	0.159
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.071	0.092	0.107	0.124	0.141	0.159
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.2	0.4	0.6
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	0.03	0.23	0.45	0.73
Peak Inflow Q (cfs) =	N/A	N/A	1.5	2.0	2.3	2.7	3.0	3.3
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.8	1.4	0.9	0.7	0.5
Structure Controlling Flow =	Filtration Media	Overflow Weir 1	Filtration Media	Filtration Media	Filtration Media	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.0	0.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	12	47	31	40	46	49	49	49
Time to Drain 99% of Inflow Volume (hours) =	**12**	48	32	41	47	51	51	51
Maximum Ponding Depth (ft) =	0.42	1.37	0.93	1.15	1.30	1.41	1.44	1.56
Area at Maximum Ponding Depth (acres) =	0.07	0.11	0.09	0.10	0.11	0.11	0.11	0.12
Maximum Volume Stored (acre-ft) =	0.026	0.110	0.065	0.087	0.102	0.113	0.118	0.131

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.

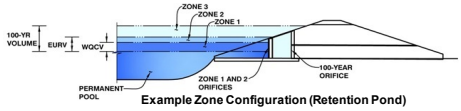
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.09
	0:15:00	0.00	0.00	0.25	0.42	0.51	0.34	0.41	0.41	0.56
	0:20:00	0.00	0.00	0.81	1.05	1.21	0.75	0.87	0.94	1.20
	0:25:00	0.00	0.00	1.52	1.97	2.27	1.50	1.70	1.80	2.28
	0:30:00	0.00	0.00	1.47	1.84	2.06	2.67	3.03	3.34	4.21
	0:35:00	0.00	0.00	1.13	1.39	1.56	2.41	2.73	3.21	4.03
	0:40:00	0.00	0.00	0.87	1.04	1.17	1.99	2.25	2.61	3.27
	0:45:00	0.00	0.00	0.62	0.78	0.89	1.49	1.69	2.06	2.59
	0:50:00	0.00	0.00	0.45	0.60	0.67	1.21	1.36	1.62	2.04
	0:55:00	0.00	0.00	0.35	0.46	0.52	0.87	0.98	1.23	1.55
	1:00:00	0.00	0.00	0.30	0.40	0.47	0.66	0.75	0.99	1.24
	1:05:00	0.00	0.00	0.29	0.38	0.46	0.58	0.65	0.88	1.11
	1:10:00	0.00	0.00	0.24	0.37	0.45	0.48	0.54	0.66	0.83
	1:15:00	0.00	0.00	0.22	0.34	0.45	0.43	0.49	0.54	0.68
	1:20:00	0.00	0.00	0.21	0.31	0.41	0.36	0.41	0.40	0.50
	1:25:00	0.00	0.00	0.20	0.29	0.35	0.33	0.37	0.33	0.41
	1:30:00	0.00	0.00	0.19	0.28	0.31	0.28	0.31	0.28	0.35
	1:35:00	0.00	0.00	0.19	0.27	0.29	0.25	0.28	0.26	0.32
	1:40:00	0.00	0.00	0.19	0.23	0.28	0.24	0.27	0.25	0.31
	1:45:00	0.00	0.00	0.19	0.21	0.27	0.23	0.26	0.24	0.30
	1:50:00	0.00	0.00	0.19	0.20	0.27	0.23	0.25	0.24	0.30
	1:55:00	0.00	0.00	0.15	0.19	0.25	0.22	0.25	0.24	0.30
	2:00:00	0.00	0.00	0.13	0.17	0.22	0.22	0.25	0.24	0.30
	2:05:00	0.00	0.00	0.07	0.10	0.12	0.13	0.14	0.14	0.17
	2:10:00	0.00	0.00	0.04	0.05	0.07	0.07	0.08	0.08	0.10
	2:15:00	0.00	0.00	0.02	0.03	0.03	0.04	0.04	0.04	0.05
	2:20:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.02
	2:25:00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Willowind Commercial

Basin ID: Lot 3 Pond 5



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	SF	
Watershed Area =	0.87	acres
Watershed Length =	225	ft
Watershed Length to Centroid =	112	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	95.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	12.0	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) =	0.026	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.114	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.074	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.52 in.) =	0.096	acre-feet	1.52	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.111	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.129	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.146	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.166	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.209	acre-feet		inches
Approximate 2-yr Detention Volume =	0.075	acre-feet		
Approximate 5-yr Detention Volume =	0.099	acre-feet		
Approximate 10-yr Detention Volume =	0.116	acre-feet		
Approximate 25-yr Detention Volume =	0.136	acre-feet		
Approximate 50-yr Detention Volume =	0.148	acre-feet		
Approximate 100-yr Detention Volume =	0.157	acre-feet		

Define Zones and Basin Geometry

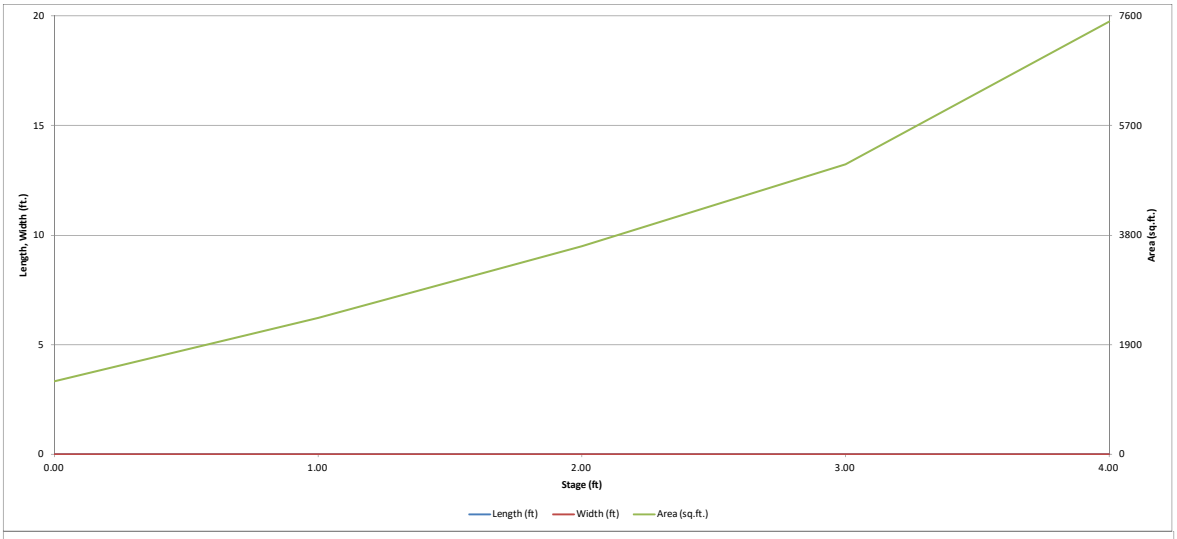
Zone 1 Volume (WQCV) =	0.026	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.088	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.043	acre-feet
Total Detention Basin Volume =	0.157	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	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

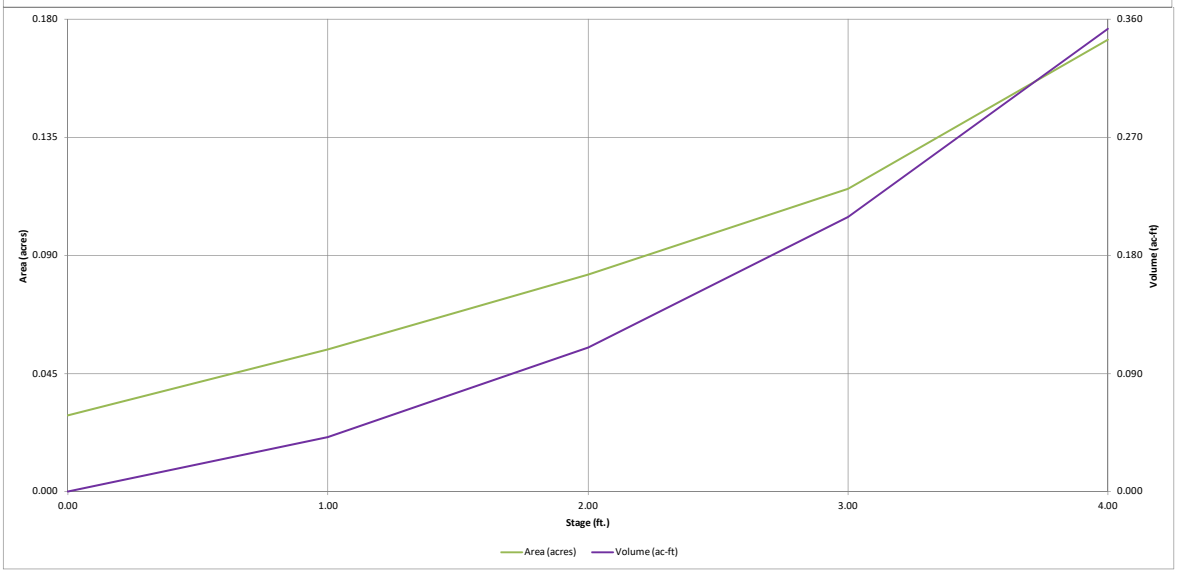
Depth Increment = ft

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)
Media Surface	--	0.00	--	--	--	1,266	0.029		
	--	1.00	--	--	--	2,361	0.054	1,813	0.042
	--	2.00	--	--	--	3,606	0.083	4,797	0.110
	--	3.00	--	--	--	5,028	0.115	9,114	0.209
	--	4.00	--	--	--	7,500	0.172	15,378	0.353

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



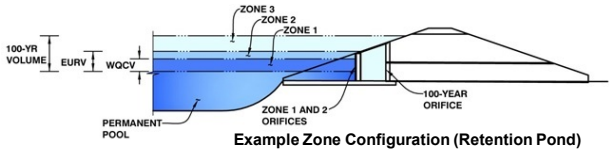


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Willowind Commercial

Basin ID: Lot 3 Pond 5



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.69	0.026	Filtration Media
Zone 2 (EURV)	2.05	0.088	Filtration Media
Zone 3 (100-year)	2.52	0.043	Weir&Pipe (Restrict)
Total (all zones)		0.157	

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

Underdrain Orifice Invert Depth =	2.50	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.77	inches	Underdrain Orifice Centroid =	0.03	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	N/A	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 =	N/A	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

Calculated Parameters for Plate

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

	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			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
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
Vertical Orifice Diameter =	N/A	N/A	inches			

Calculated Parameters for Vertical Orif

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			Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	2.05	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	2.05	N/A
Overflow Weir Front Edge Length =	2.91	N/A	feet	Overflow Weir Slope Length =	2.91	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	96.99	N/A
Horiz. Length of Weir Sides =	2.91	N/A	feet	Overflow Grate Open Area w/o Debris =	5.89	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	2.95	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow W

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected
Depth to Invert of Outlet Pipe =	2.75	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.06	N/A
Outlet Pipe Diameter =	15.00	N/A	inches	Outlet Orifice Centroid =	0.07	N/A
Restrictor Plate Height Above Pipe Invert =	1.45		inches	Half-Central Angle of Restrictor Plate on Pipe =	0.63	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.35	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.19	feet
Spillway Crest Length =	11.50	feet	Stage at Top of Freeboard =	3.54	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.15	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.28	acre-ft

Calculated Parameters for Spillway

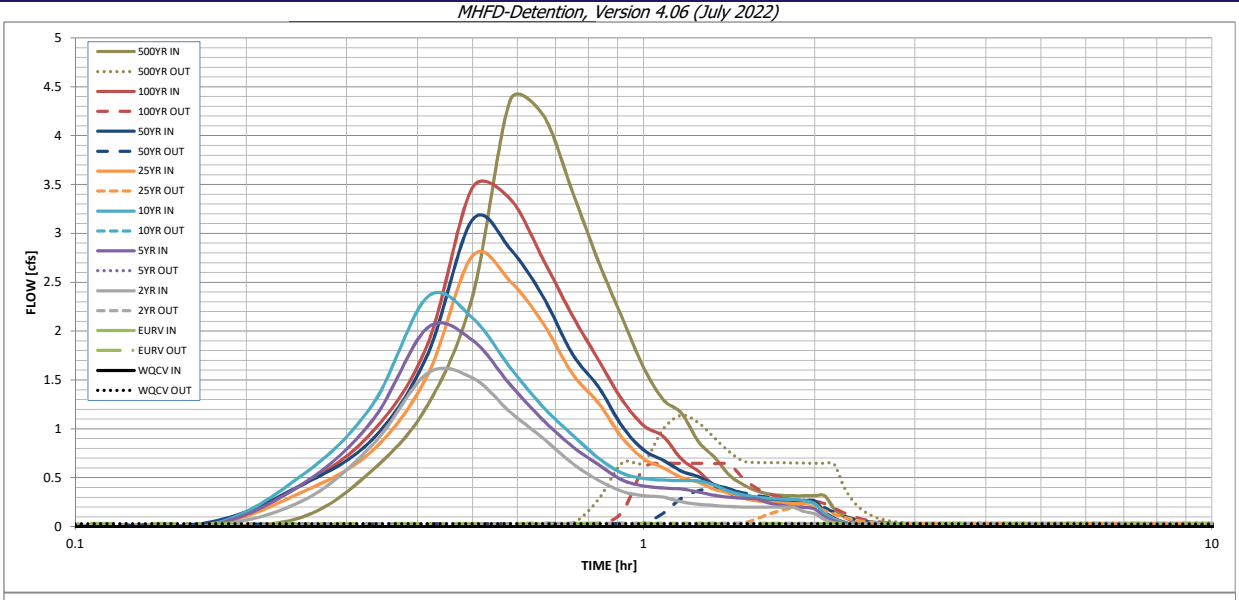
Routed Hydrograph Results

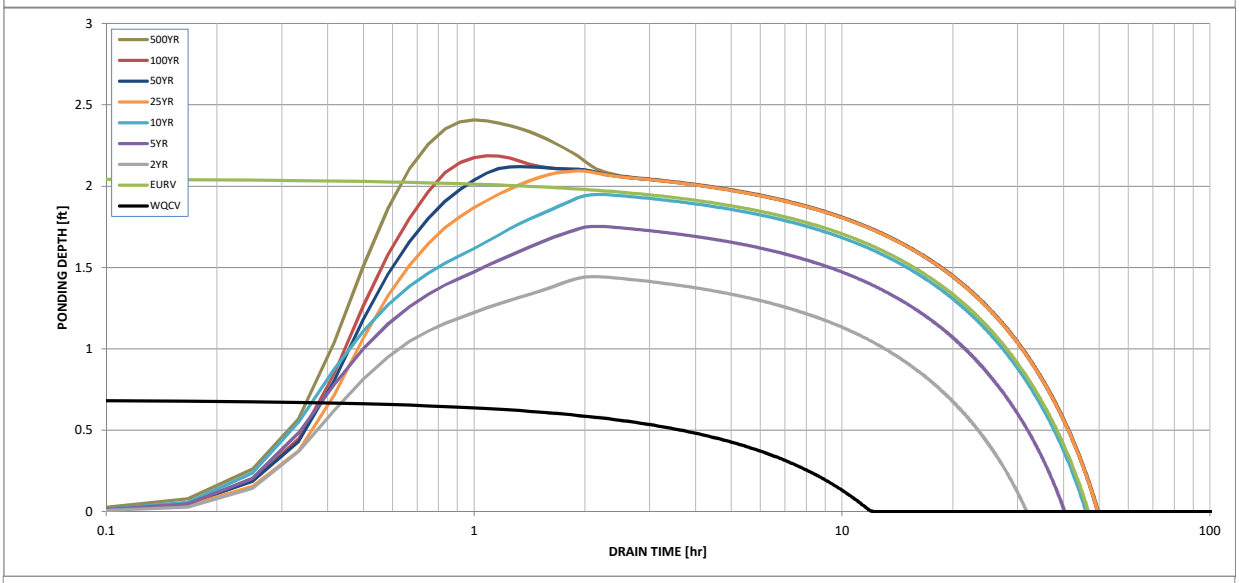
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AI

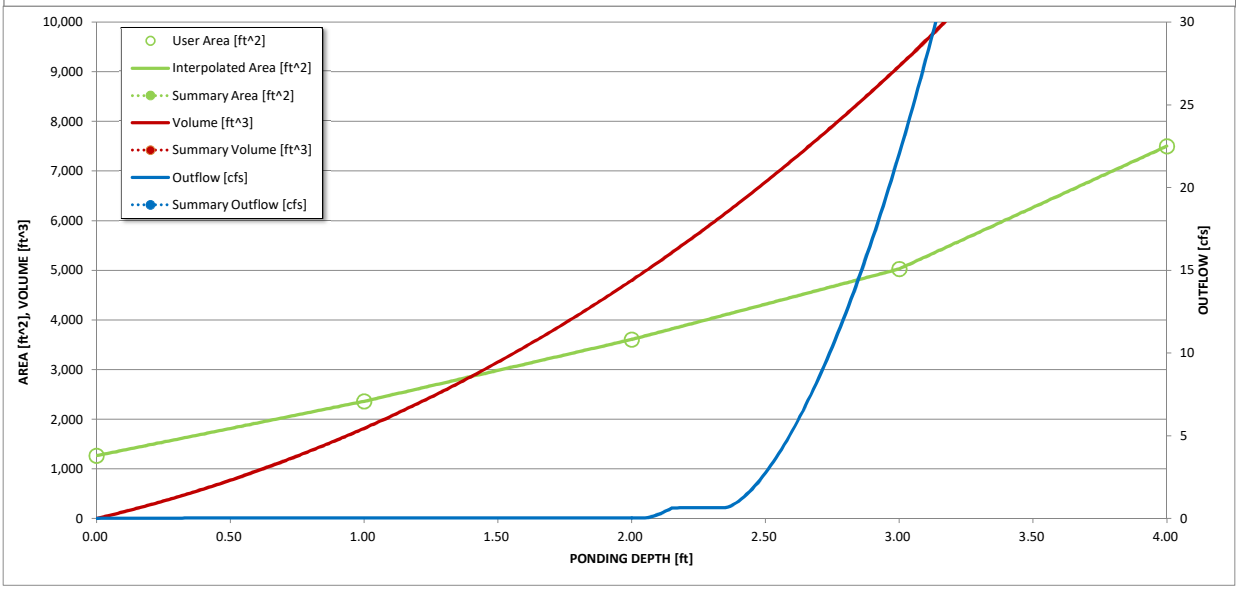
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.52	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.026	0.114	0.074	0.096	0.111	0.129	0.146	0.166
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.074	0.096	0.111	0.129	0.146	0.166
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.2	0.4	0.6
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	0.03	0.23	0.44	0.73
Peak Inflow Q (cfs) =	N/A	N/A	1.6	2.0	2.3	2.8	3.1	3.5
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.9	1.5	1.0	1.0	1.0
Structure Controlling Flow =	Filtration Media	Overflow Weir 1	Filtration Media	Filtration Media	Filtration Media	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.1	0.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	12	45	31	39	45	48	48	47
Time to Drain 99% of Inflow Volume (hours) =	**12**	46	31	40	46	49	49	49
Maximum Ponding Depth (ft) =	0.69	2.05	1.44	1.75	1.95	2.09	2.12	2.19
Area at Maximum Ponding Depth (acres) =	0.05	0.08	0.07	0.08	0.08	0.09	0.09	0.09
Maximum Volume Stored (acre-ft) =	0.026	0.114	0.068	0.090	0.105	0.118	0.120	0.126

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.

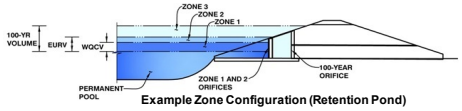
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.09
	0:15:00	0.00	0.00	0.26	0.43	0.52	0.35	0.42	0.42	0.58
	0:20:00	0.00	0.00	0.84	1.08	1.24	0.78	0.89	0.97	1.24
	0:25:00	0.00	0.00	1.57	2.03	2.35	1.54	1.76	1.86	2.35
	0:30:00	0.00	0.00	1.52	1.91	2.13	2.77	3.14	3.47	4.37
	0:35:00	0.00	0.00	1.17	1.45	1.62	2.51	2.84	3.35	4.21
	0:40:00	0.00	0.00	0.90	1.09	1.22	2.07	2.35	2.73	3.43
	0:45:00	0.00	0.00	0.65	0.82	0.94	1.56	1.76	2.16	2.71
	0:50:00	0.00	0.00	0.47	0.63	0.70	1.26	1.43	1.70	2.14
	0:55:00	0.00	0.00	0.36	0.48	0.55	0.91	1.03	1.30	1.63
	1:00:00	0.00	0.00	0.32	0.42	0.49	0.69	0.78	1.03	1.30
	1:05:00	0.00	0.00	0.30	0.40	0.48	0.60	0.68	0.92	1.16
	1:10:00	0.00	0.00	0.25	0.39	0.47	0.50	0.57	0.69	0.87
	1:15:00	0.00	0.00	0.23	0.35	0.47	0.45	0.51	0.56	0.71
	1:20:00	0.00	0.00	0.21	0.32	0.42	0.38	0.43	0.42	0.52
	1:25:00	0.00	0.00	0.21	0.30	0.36	0.34	0.39	0.34	0.43
	1:30:00	0.00	0.00	0.20	0.29	0.32	0.29	0.33	0.29	0.36
	1:35:00	0.00	0.00	0.20	0.28	0.30	0.26	0.30	0.27	0.33
	1:40:00	0.00	0.00	0.20	0.24	0.29	0.25	0.28	0.26	0.32
	1:45:00	0.00	0.00	0.20	0.22	0.28	0.24	0.27	0.25	0.31
	1:50:00	0.00	0.00	0.20	0.20	0.28	0.23	0.26	0.25	0.31
	1:55:00	0.00	0.00	0.16	0.20	0.26	0.23	0.26	0.25	0.31
	2:00:00	0.00	0.00	0.13	0.18	0.23	0.23	0.26	0.25	0.31
	2:05:00	0.00	0.00	0.07	0.10	0.13	0.13	0.15	0.14	0.18
	2:10:00	0.00	0.00	0.04	0.06	0.07	0.07	0.08	0.08	0.10
	2:15:00	0.00	0.00	0.02	0.03	0.04	0.04	0.04	0.04	0.05
	2:20:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.03
	2:25:00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Willowind Commercial

Basin ID: Lot 4 Pond 6



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	SF	
Watershed Area =	0.82	acres
Watershed Length =	245	ft
Watershed Length to Centroid =	155	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	95.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	12.0	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) =	0.024	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.108	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.072	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.52 in.) =	0.093	acre-feet	1.52	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.108	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.125	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.142	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.161	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.203	acre-feet		inches
Approximate 2-yr Detention Volume =	0.071	acre-feet		
Approximate 5-yr Detention Volume =	0.093	acre-feet		
Approximate 10-yr Detention Volume =	0.109	acre-feet		
Approximate 25-yr Detention Volume =	0.128	acre-feet		
Approximate 50-yr Detention Volume =	0.139	acre-feet		
Approximate 100-yr Detention Volume =	0.148	acre-feet		

Define Zones and Basin Geometry

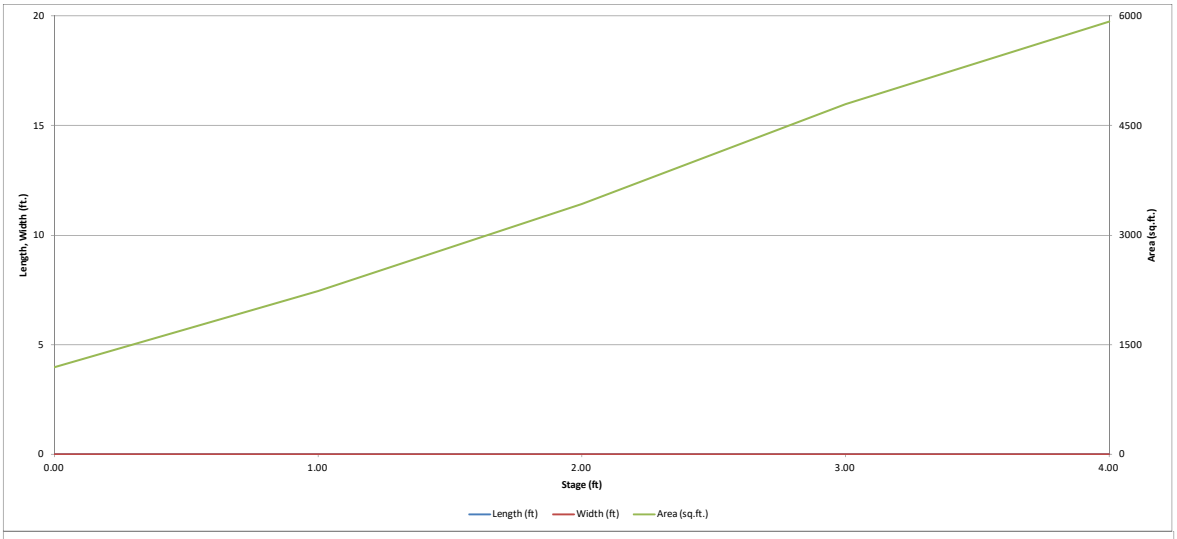
Zone 1 Volume (WQCV) =	0.024	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.083	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.041	acre-feet
Total Detention Basin Volume =	0.148	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	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

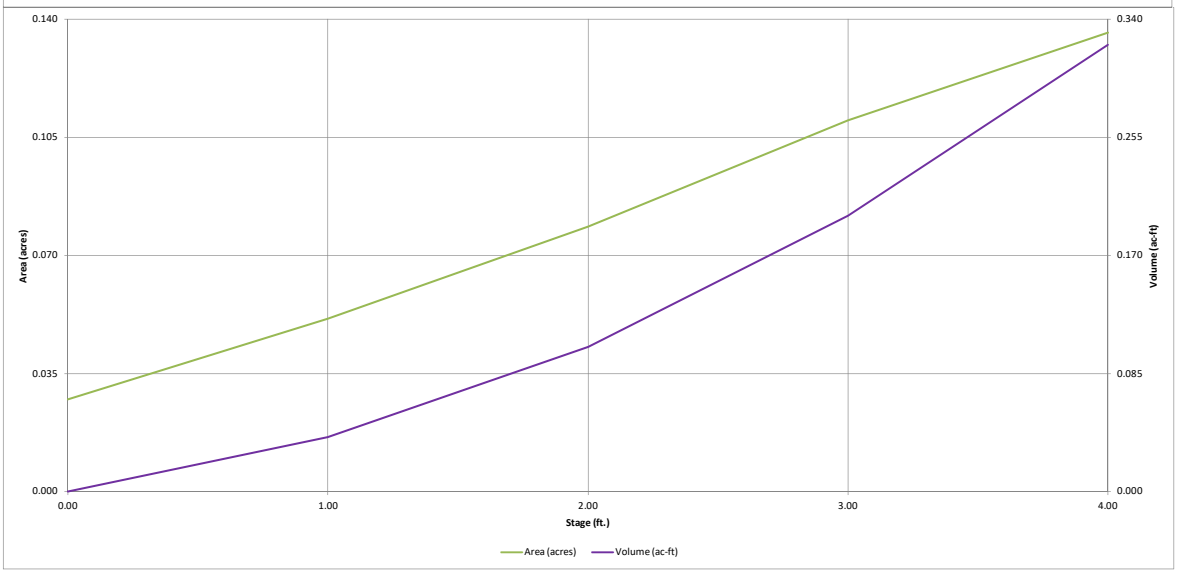
Depth Increment = ft

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)
Media Surface	--	0.00	--	--	--	1,190	0.027		
	--	1.00	--	--	--	2,234	0.051	1,712	0.039
	--	2.00	--	--	--	3,427	0.079	4,542	0.104
	--	3.00	--	--	--	4,795	0.110	8,653	0.199
	--	4.00	--	--	--	5,925	0.136	14,013	0.322

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



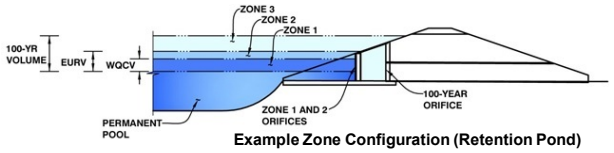


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Willowind Commercial

Basin ID: Lot 4 Pond 6



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.69	0.024	Filtration Media
Zone 2 (EURV)	2.05	0.083	Filtration Media
Zone 3 (100-year)	2.51	0.041	Weir&Pipe (Restrict)
Total (all zones)		0.148	

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

Underdrain Orifice Invert Depth =	2.50	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.73	inches	Underdrain Orifice Centroid =	0.03	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	N/A	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 =	N/A	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

Calculated Parameters for Plate

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

	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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)	Vertical Orifice Area =	N/A	N/A
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
Vertical Orifice Diameter =	N/A	N/A	inches			

Calculated Parameters for Vertical Orif

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 =	2.25	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	2.25	N/A
Overflow Weir Front Edge Length =	2.91	N/A	feet	Overflow Weir Slope Length =	2.91	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	83.79	N/A
Horiz. Length of Weir Sides =	2.91	N/A	feet	Overflow Grate Open Area w/o Debris =	5.89	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	2.95	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow W

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 =	2.75	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.07	N/A
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.07	N/A
Restrictor Plate Height Above Pipe Invert =	1.50		inches	Half-Central Angle of Restrictor Plate on Pipe =	0.59	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.45	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.30	feet
Spillway Crest Length =	5.00	feet	Stage at Top of Freeboard =	3.75	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.13	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.29	acre-ft

Calculated Parameters for Spillway

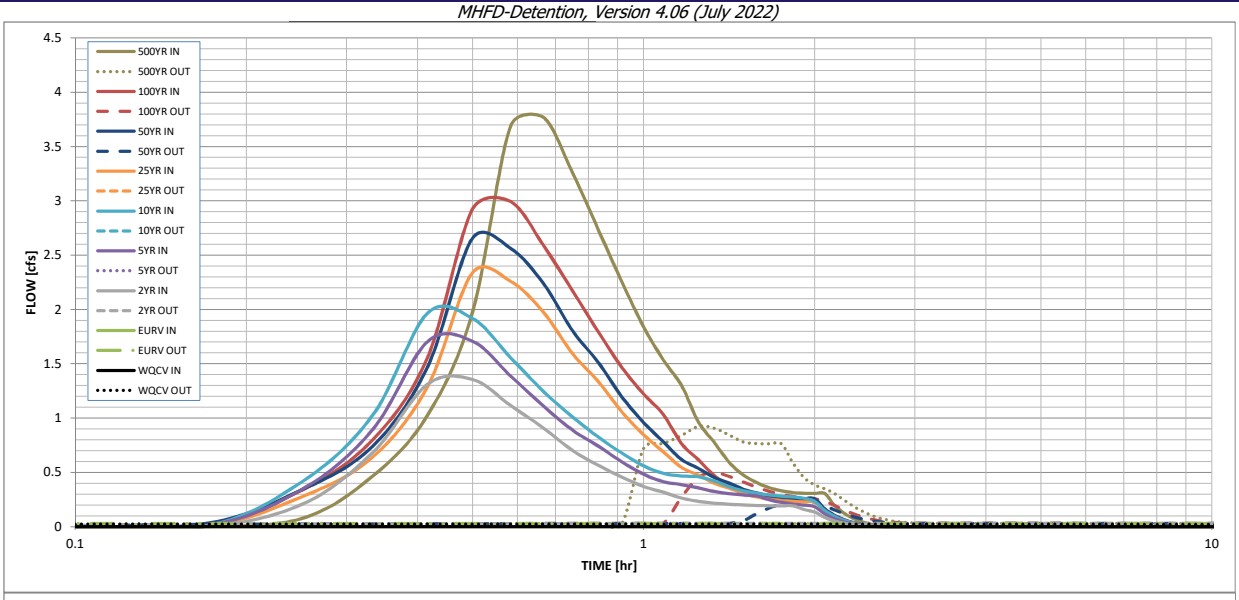
Routed Hydrograph Results

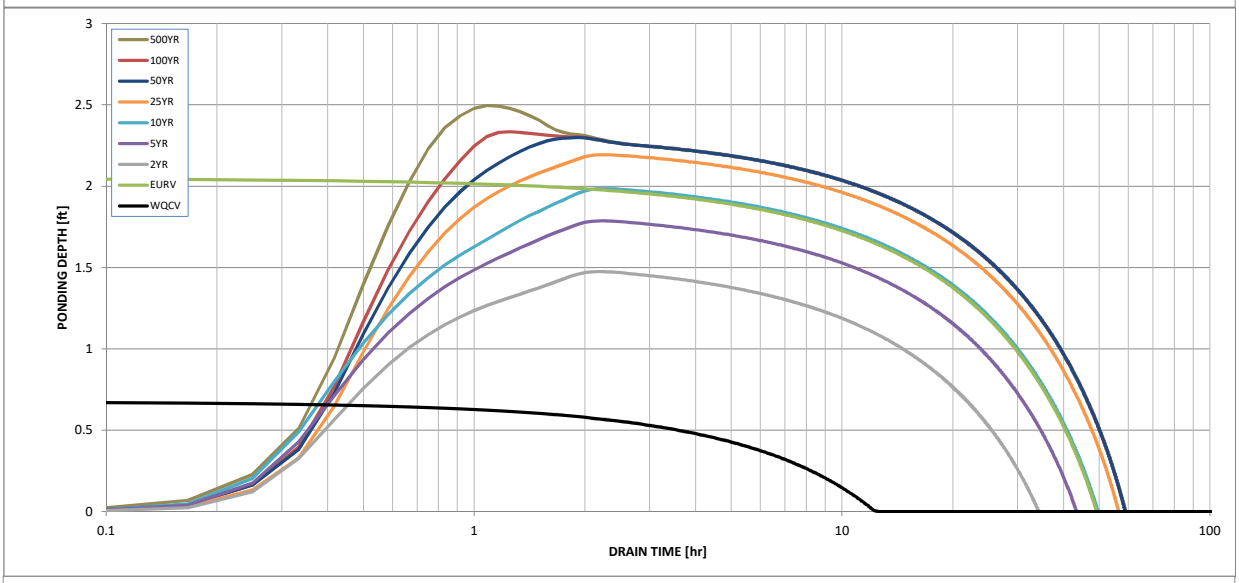
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AI

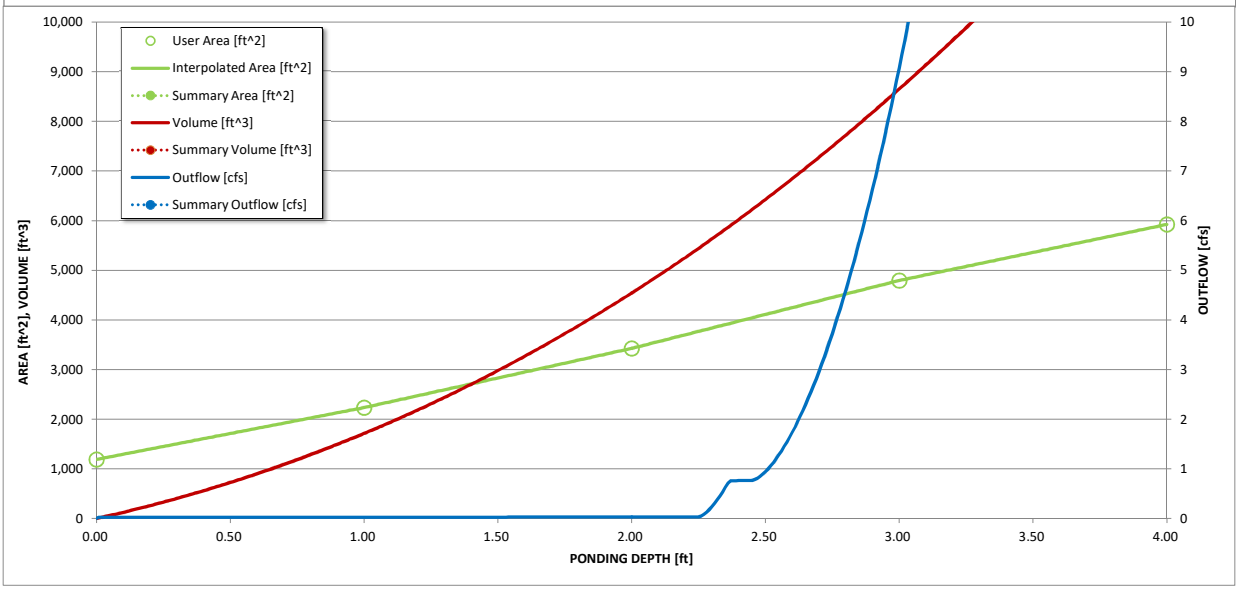
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.52	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.024	0.108	0.072	0.093	0.108	0.125	0.142	0.161
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.072	0.093	0.108	0.125	0.142	0.161
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.2	0.3	0.5
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	0.02	0.19	0.38	0.62
Peak Inflow Q (cfs) =	N/A	N/A	1.4	1.7	2.0	2.3	2.7	3.0
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.2	1.7	0.2	0.8	1.0
Structure Controlling Flow =	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Overflow Weir 1	Overflow Weir 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	0.0	0.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	12	48	33	42	48	55	57	56
Time to Drain 99% of Inflow Volume (hours) =	**12**	49	34	43	49	56	58	58
Maximum Ponding Depth (ft) =	0.68	2.05	1.47	1.79	1.99	2.19	2.30	2.34
Area at Maximum Ponding Depth (acres) =	0.04	0.08	0.06	0.07	0.08	0.08	0.09	0.09
Maximum Volume Stored (acre-ft) =	0.024	0.108	0.066	0.088	0.103	0.120	0.128	0.132

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	0.02	0.00	0.07
	0:15:00	0.00	0.00	0.20	0.34	0.41	0.27	0.34	0.33	0.46
	0:20:00	0.00	0.00	0.68	0.89	1.02	0.64	0.74	0.80	1.02
	0:25:00	0.00	0.00	1.31	1.70	1.96	1.29	1.47	1.56	1.97
	0:30:00	0.00	0.00	1.35	1.71	1.92	2.34	2.65	2.92	3.68
	0:35:00	0.00	0.00	1.12	1.39	1.56	2.26	2.56	3.00	3.77
	0:40:00	0.00	0.00	0.91	1.11	1.25	1.98	2.24	2.59	3.26
	0:45:00	0.00	0.00	0.70	0.89	1.01	1.59	1.80	2.17	2.73
	0:50:00	0.00	0.00	0.56	0.74	0.82	1.34	1.51	1.79	2.25
	0:55:00	0.00	0.00	0.46	0.60	0.68	1.06	1.19	1.47	1.84
	1:00:00	0.00	0.00	0.37	0.48	0.56	0.85	0.96	1.22	1.54
	1:05:00	0.00	0.00	0.32	0.41	0.49	0.69	0.78	1.03	1.30
	1:10:00	0.00	0.00	0.26	0.39	0.47	0.55	0.62	0.77	0.96
	1:15:00	0.00	0.00	0.23	0.35	0.46	0.47	0.54	0.62	0.77
	1:20:00	0.00	0.00	0.22	0.32	0.42	0.40	0.45	0.47	0.59
	1:25:00	0.00	0.00	0.21	0.30	0.37	0.35	0.40	0.38	0.47
	1:30:00	0.00	0.00	0.20	0.29	0.33	0.30	0.34	0.32	0.40
	1:35:00	0.00	0.00	0.20	0.28	0.31	0.27	0.31	0.29	0.36
	1:40:00	0.00	0.00	0.19	0.25	0.29	0.25	0.28	0.26	0.33
	1:45:00	0.00	0.00	0.19	0.22	0.28	0.24	0.27	0.25	0.31
	1:50:00	0.00	0.00	0.19	0.21	0.27	0.23	0.26	0.25	0.31
	1:55:00	0.00	0.00	0.16	0.20	0.26	0.23	0.26	0.24	0.31
	2:00:00	0.00	0.00	0.14	0.18	0.23	0.23	0.26	0.24	0.31
	2:05:00	0.00	0.00	0.09	0.12	0.15	0.15	0.16	0.16	0.20
	2:10:00	0.00	0.00	0.05	0.07	0.10	0.09	0.11	0.10	0.13
	2:15:00	0.00	0.00	0.03	0.04	0.06	0.06	0.07	0.06	0.08
	2:20:00	0.00	0.00	0.02	0.03	0.03	0.03	0.04	0.04	0.05
	2:25:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.03
	2:30:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

RATIONAL METHOD ANALYSIS
EXISTING CONDITIONS INLET
CALCULATIONS

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	DP5	DP6	DP8	DP14
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	In Sump	In Sump
Inlet Type	Colorado Springs D-10-R	Colorado Springs D-10-R	CDOT Type R Curb Opening	Colorado Springs D-10-R

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	7.3	14.2	2.5	11.8
Major Q_{Known} (cfs)	15.0	31.0	6.1	30.7

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

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)	**7.3**	**14.2**	**2.5**	**11.8**
Major Total Design Peak Flow, Q (cfs)	**15.0**	**31.0**	**6.1**	**30.7**
Minor Flow Bypassed Downstream, Q_b (cfs)	1.1	2.2	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	6.0	12.9	N/A	N/A

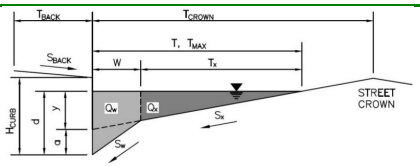
MHFD-Inlet, Version 5.02 (August 2022)

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

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

Project: **WILLOWIND COMMERCIAL SITE**

Inlet ID: **DP5**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	12.0	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} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	35.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.011	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} =	23.0	23.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

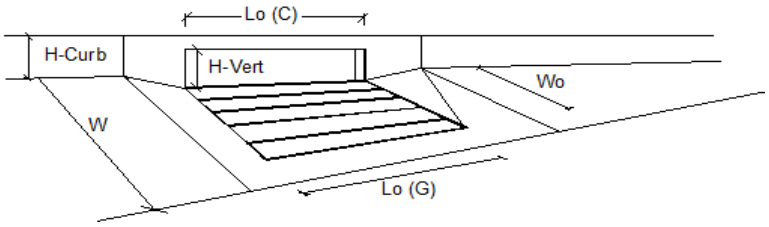
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**14.4**	**24.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 7.30 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 15.00 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**6.2**	**9.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.1**	**6.0**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**84**	**60**	**%**

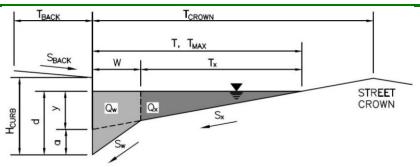
MHFD-Inlet, Version 5.02 (August 2022)

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

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

Project: **WILLOWIND COMMERCIAL SITE**

Inlet ID: **DP6**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	12.0	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} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	44.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	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} =	23.0	23.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

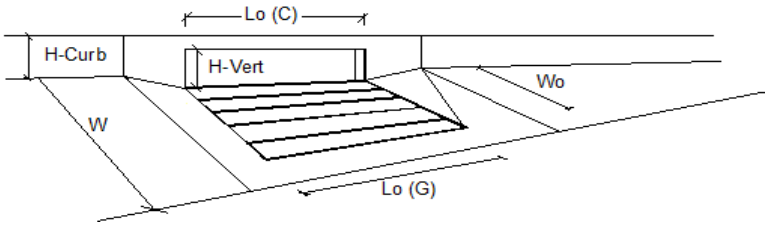
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**19.5**	**33.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 14.20 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 31.00 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	

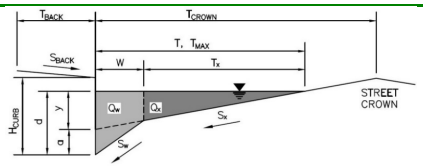
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**12.0**	**18.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**2.2**	**12.9**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**84**	**58**	**%**

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

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

Project: **WILLOWIND COMMERCIAL SITE**

Inlet ID: **DP8**



Gutter Geometry:

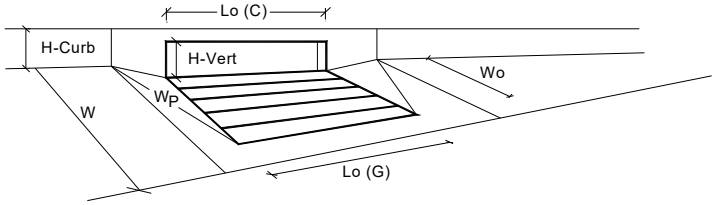
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	40.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.330	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	25.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	25.0	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)



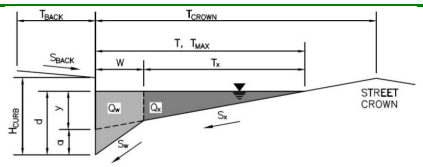
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.1	6.8	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) =	5.00	5.00	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 =	1.00	1.00	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} =	0.34	0.48	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} =	1.00	1.00	
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 =**	**4.4**	**7.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	2.5	6.1	cfs

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

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

Project: **WILLOWIND COMMERCIAL SITE**

Inlet ID: **DP14**



Gutter Geometry:

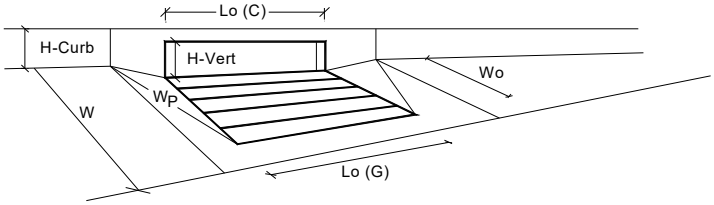
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	48.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	23.0	39.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	8.0	11.4	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)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	4.00	4.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	7.0	10.9	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) =	20.00	20.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	8.00	8.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	8.00	8.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	81.00	81.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	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} =	0.42	0.74	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} =	0.85	1.00	
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 =**	**16.0**	**44.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	11.8	30.7	cfs

RATIONAL METHOD ANALYSIS
PROPOSED CONDITIONS INLET
CALCULATIONS

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	I1	I2	EX IN	Z
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	In Sump	In Sump
Inlet Type	Colorado Springs D-10-R	Colorado Springs D-10-R	CDOT Type R Curb Opening	Colorado Springs D-10-R

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	7.3	14.2	1.8	12.1
Major Q_{Known} (cfs)	15.0	31.0	3.8	32.1

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

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)	**7.3**	**14.2**	**1.8**	**12.1**
Major Total Design Peak Flow, Q (cfs)	**15.0**	**31.0**	**3.8**	**32.1**
Minor Flow Bypassed Downstream, Q_b (cfs)	1.1	2.2	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	6.0	12.9	N/A	N/A

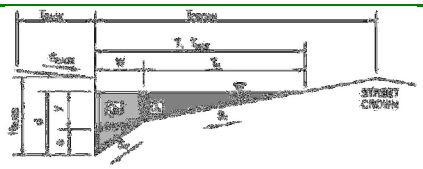
MHFD-Inlet, Version 5.02 (August 2022)

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

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

Project: **WILLOWIND COMMERCIAL SITE**

Inlet ID: **I1**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	12.0	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} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	35.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.011	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} =	23.0	23.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

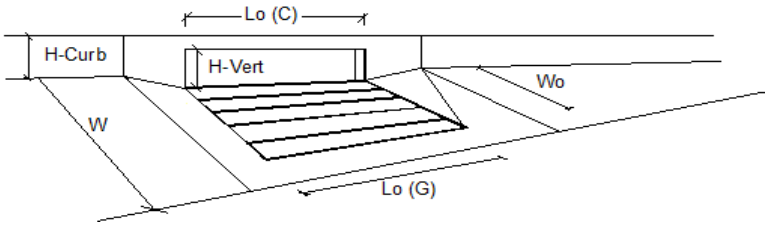
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**14.4**	**24.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 7.30 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 15.00 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**6.2**	**9.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.1**	**6.0**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**84**	**60**	**%**

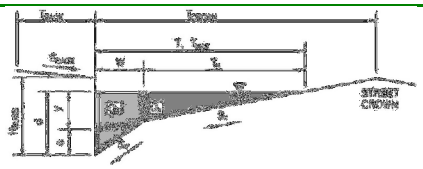
MHFD-Inlet, Version 5.02 (August 2022)

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

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

Project: **WILLOWIND COMMERCIAL SITE**

Inlet ID: **I2**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	12.0	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} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	44.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	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} =	23.0	23.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

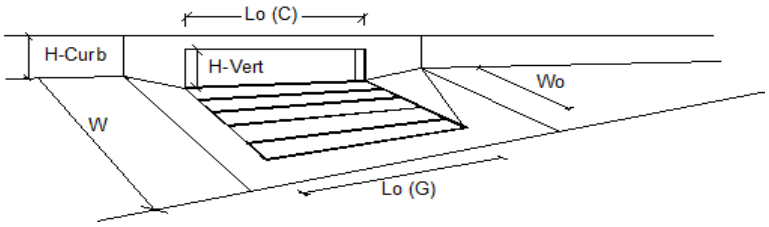
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**19.5**	**33.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 14.20 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 31.00 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Colorado Springs D-10-R)	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**12.0**	**18.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**2.2**	**12.9**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**84**	**58**	**%**

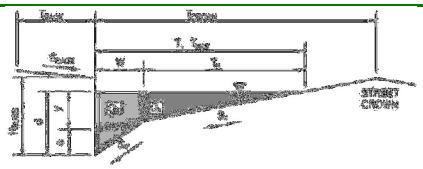
MHFD-Inlet, Version 5.02 (August 2022)

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

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

Project: **WILLOWIND COMMERCIAL SITE**

Inlet ID: **EX IN**



Gutter Geometry:

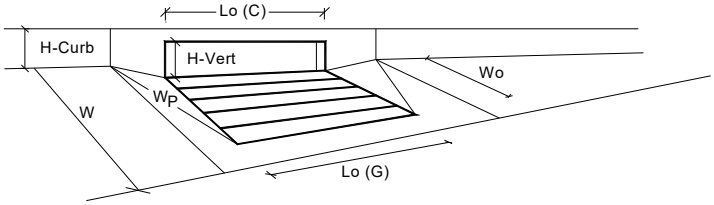
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	40.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.330	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	25.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	25.0	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)		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 =	5.1	6.8	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) =	5.00	5.00	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 =	1.00	1.00	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} =	0.34	0.48	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} =	1.00	1.00	
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 =**	**4.4**	**7.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	1.8	3.8	cfs

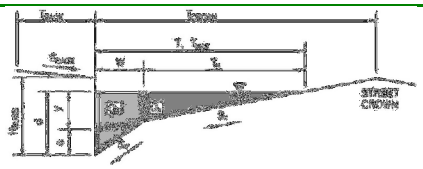
MHFD-Inlet, Version 5.02 (August 2022)

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

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

Project: **WILLOWIND COMMERCIAL SITE**

Inlet ID: **Z**



Gutter Geometry:

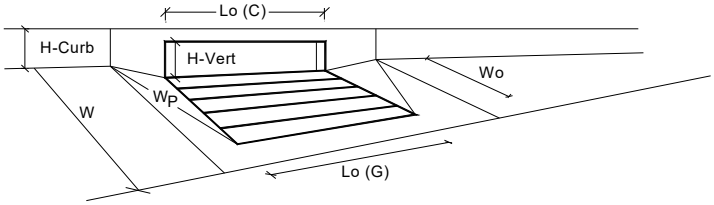
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	48.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	23.0	39.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	8.0	11.4	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)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	4.00	4.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	7.0	10.9	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) =	20.00	20.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	8.00	8.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	8.00	8.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	81.00	81.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	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} =	0.42	0.74	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} =	0.85	1.00	
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 =**	**16.0**	**44.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	12.1	32.1	cfs

HEC-HMS ANALYSIS
PROPOSED CONDITIONS INLET CALCULATIONS

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	INLET 1 (D1)	INLET 2 (D2)	INLET BASIN L	INLET J16
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	In Sump	In Sump
Inlet Type	Colorado Springs D-10-R	Colorado Springs D-10-R	CDOT Type R Curb Opening	Colorado Springs D-10-R

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	8.1	16.1	1.6	12.7
Major Q_{Known} (cfs)	15.3	30.7	3.2	41.0

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

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)	**8.1**	**16.1**	**1.6**	**12.7**
Major Total Design Peak Flow, Q (cfs)	**15.3**	**30.7**	**3.2**	**41.0**
Minor Flow Bypassed Downstream, Q_b (cfs)	1.5	3.2	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	6.2	12.7	N/A	N/A

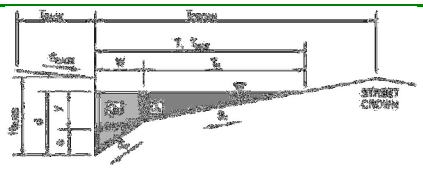
MHFD-Inlet, Version 5.02 (August 2022)

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

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

Project: **WILLOWIND COMMERCIAL SITE**

Inlet ID: **INLET 1 (D1)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	12.0	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} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	35.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.011	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} =	23.0	23.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

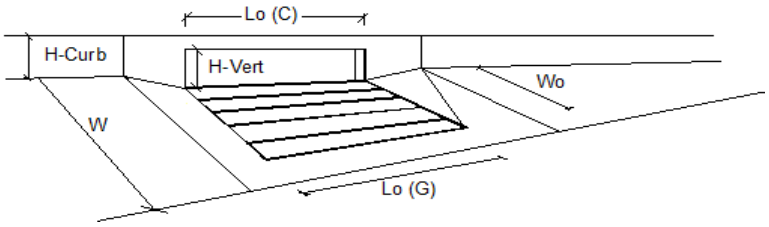
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**14.4**	**24.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 8.10 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 15.30 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**6.6**	**9.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.5**	**6.2**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**81**	**60**	**%**

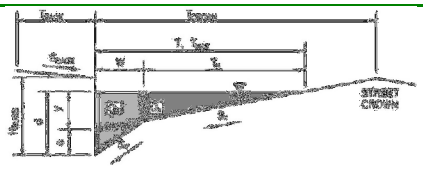
MHFD-Inlet, Version 5.02 (August 2022)

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

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

Project: **WILLOWIND COMMERCIAL SITE**

Inlet ID: **INLET 2 (D2)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	12.0	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} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	44.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	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} =	23.0	23.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

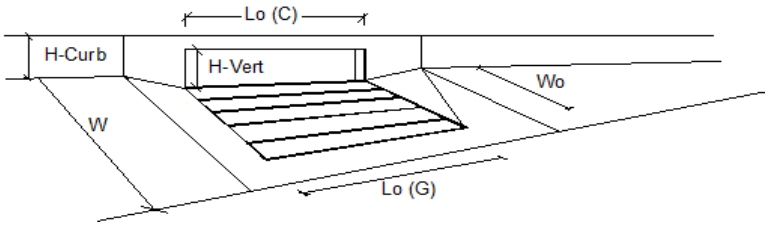
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**19.5**	**33.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 16.10 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 30.70 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**12.9**	**18.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**3.2**	**12.7**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**80**	**59**	**%**

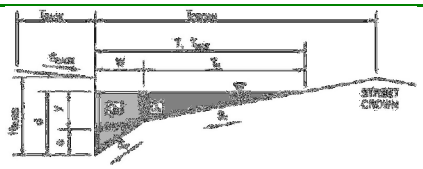
MHFD-Inlet, Version 5.02 (August 2022)

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

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

Project: **WILLOWIND COMMERCIAL SITE**

Inlet ID: **INLET BASIN L**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	40.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.330	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} =	25.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	25.0	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		☐	☐	

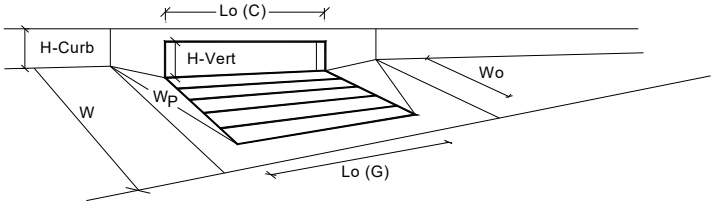
MINOR STORM Allowable Capacity is not applicable to Sump Condition

MAJOR STORM Allowable Capacity is not applicable to Sump Condition

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		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 =	5.1	6.8	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) =	5.00	5.00	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 =	1.00	1.00	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} =	0.34	0.48	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} =	1.00	1.00	
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 =**	**4.4**	**7.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	1.6	3.2	cfs

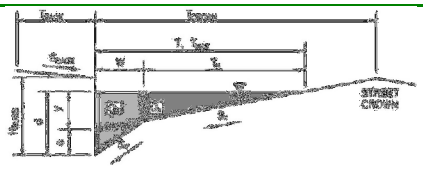
MHFD-Inlet, Version 5.02 (August 2022)

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

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

Project: **WILLOWIND COMMERCIAL SITE**

Inlet ID: **INLET J16**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	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} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	48.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	23.0	39.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	8.0	11.4	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

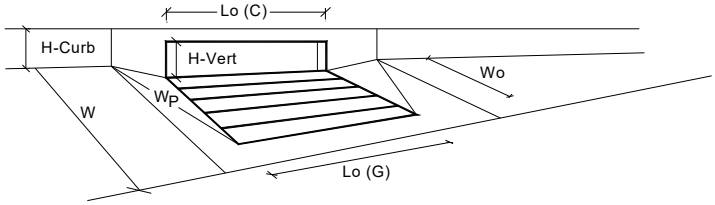
MINOR STORM Allowable Capacity is not applicable to Sump Condition

MAJOR STORM Allowable Capacity is not applicable to Sump Condition

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	4.00	4.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	7.0	10.9	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) =	20.00	20.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	8.00	8.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	8.00	8.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	81.00	81.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	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} =	0.42	0.74	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} =	0.85	1.00	
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 =**	**16.0**	**44.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	12.7	41.0	cfs

PROP. TYPE D INLET CALC (DP8)

table incr. 0.125 ft

width	2.667	ft	open area	15.114	sq ft	grate blockage	
length	5.667	ft	Perimeter			open area x 70%	10.580 sq ft
perimeter	16.668	sq ft	blockage	4	ft	avail perm	12.668 ft
			(1' at corners)			**Orifice**	**Weir**
58	0					0	0
58.125	0.125					18.0104	1.735541
58.25	0.25					25.47056	4.90885
58.375	0.375					31.19494	9.018133
58.5	0.5					36.02081	13.88432
58.625	0.625					40.27249	19.40393
58.75	0.75					44.1163	25.50713
58.875	0.875					47.65105	32.14266
59	1					50.94112	39.2708
59.125	1.125					54.03121	46.8596
59.25	1.25					56.9539	54.88261 ponding depth @ 51.3cfs
59.375	1.375					59.73375	63.31751
59.5	1.5					62.38987	72.14507
59.625	1.625					64.93744	81.34855
59.75	1.75					67.38876	90.91317
59.875	1.875					69.754	100.8258
60	2					72.04162	111.0746
60.125	2.125					74.2588	121.6489
60.25	2.25					76.41167	132.539
60.375	2.375					78.50553	143.7359
60.5	2.5					80.54498	155.2315
60.625	2.625					82.53404	167.0182
60.75	2.75					84.47628	179.0889
60.875	2.875					86.37486	191.4373
61	3					88.2326	204.0571
61.125	3.125					90.05202	216.9426
61.25	3.25					91.8354	230.0884

PROP. TYPE D IN									table incr.
width	2.667	ft	open area	=B2*B3	sq ft	grate blockage			
length	5.667	ft	Perimeter			open area x 70%		=E2*0.7	sq ft
perimeter	=B2+B3+B2+B3	sq ft	blockage	4	ft	avail perm		=(B4-E4)	ft
			(1' at corners)			**Orifice**	**Weir**		
58	=A6-$A$6					=0.6*$I$3*(64.4*B6)^(0.5)	=3.1*$I$4*(B6)^(3/2)		
=A6+$K$1	=B6+$K$1					=0.6*$I$3*(64.4*B7)^(0.5)	=3.1*$I$4*(B7)^(3/2)		
=A7+$K$1	=B7+$K$1					=0.6*$I$3*(64.4*B8)^(0.5)	=3.1*$I$4*(B8)^(3/2)		
=A8+$K$1	=B8+$K$1					=0.6*$I$3*(64.4*B9)^(0.5)	=3.1*$I$4*(B9)^(3/2)		
=A9+$K$1	=B9+$K$1					=0.6*$I$3*(64.4*B10)^(0.5)	=3.1*$I$4*(B10)^(3/2)		
=A10+$K$1	=B10+$K$1					=0.6*$I$3*(64.4*B11)^(0.5)	=3.1*$I$4*(B11)^(3/2)		
=A11+$K$1	=B11+$K$1					=0.6*$I$3*(64.4*B12)^(0.5)	=3.1*$I$4*(B12)^(3/2)		
=A12+$K$1	=B12+$K$1					=0.6*$I$3*(64.4*B13)^(0.5)	=3.1*$I$4*(B13)^(3/2)		
=A13+$K$1	=B13+$K$1					=0.6*$I$3*(64.4*B14)^(0.5)	=3.1*$I$4*(B14)^(3/2)		
=A14+$K$1	=B14+$K$1					=0.6*$I$3*(64.4*B15)^(0.5)	=3.1*$I$4*(B15)^(3/2)		
=A15+$K$1	=B15+$K$1					=0.6*$I$3*(64.4*B16)^(0.5)	=3.1*$I$4*(B16)^(3/2)	ponding depth @ 51.3cfs	
=A16+$K$1	=B16+$K$1					=0.6*$I$3*(64.4*B17)^(0.5)	=3.1*$I$4*(B17)^(3/2)		
=A17+$K$1	=B17+$K$1					=0.6*$I$3*(64.4*B18)^(0.5)	=3.1*$I$4*(B18)^(3/2)		
=A18+$K$1	=B18+$K$1					=0.6*$I$3*(64.4*B19)^(0.5)	=3.1*$I$4*(B19)^(3/2)		
=A19+$K$1	=B19+$K$1					=0.6*$I$3*(64.4*B20)^(0.5)	=3.1*$I$4*(B20)^(3/2)		
=A20+$K$1	=B20+$K$1					=0.6*$I$3*(64.4*B21)^(0.5)	=3.1*$I$4*(B21)^(3/2)		
=A21+$K$1	=B21+$K$1					=0.6*$I$3*(64.4*B22)^(0.5)	=3.1*$I$4*(B22)^(3/2)		
=A22+$K$1	=B22+$K$1					=0.6*$I$3*(64.4*B23)^(0.5)	=3.1*$I$4*(B23)^(3/2)		
=A23+$K$1	=B23+$K$1					=0.6*$I$3*(64.4*B24)^(0.5)	=3.1*$I$4*(B24)^(3/2)		
=A24+$K$1	=B24+$K$1					=0.6*$I$3*(64.4*B25)^(0.5)	=3.1*$I$4*(B25)^(3/2)		
=A25+$K$1	=B25+$K$1					=0.6*$I$3*(64.4*B26)^(0.5)	=3.1*$I$4*(B26)^(3/2)		
=A26+$K$1	=B26+$K$1					=0.6*$I$3*(64.4*B27)^(0.5)	=3.1*$I$4*(B27)^(3/2)		
=A27+$K$1	=B27+$K$1					=0.6*$I$3*(64.4*B28)^(0.5)	=3.1*$I$4*(B28)^(3/2)		
=A28+$K$1	=B28+$K$1					=0.6*$I$3*(64.4*B29)^(0.5)	=3.1*$I$4*(B29)^(3/2)		
=A29+$K$1	=B29+$K$1					=0.6*$I$3*(64.4*B30)^(0.5)	=3.1*$I$4*(B30)^(3/2)		
=A30+$K$1	=B30+$K$1					=0.6*$I$3*(64.4*B31)^(0.5)	=3.1*$I$4*(B31)^(3/2)		
=A31+$K$1	=B31+$K$1					=0.6*$I$3*(64.4*B32)^(0.5)	=3.1*$I$4*(B32)^(3/2)		
=A32+$K$1	=B32+$K$1					=0.6*$I$3*(64.4*B33)^(0.5)	=3.1*$I$4*(B33)^(3/2)		
=A33+$K$1	=B33+$K$1					=0.6*$I$3*(64.4*B34)^(0.5)	=3.1*$I$4*(B34)^(3/2)		
=A34+$K$1	=B34+$K$1					=0.6*$I$3*(64.4*B35)^(0.5)	=3.1*$I$4*(B35)^(3/2)		
=A35+$K$1	=B35+$K$1					=0.6*$I$3*(64.4*B36)^(0.5)	=3.1*$I$4*(B36)^(3/2)		
=A36+$K$1	=B36+$K$1					=0.6*$I$3*(64.4*B37)^(0.5)	=3.1*$I$4*(B37)^(3/2)		
=A37+$K$1	=B37+$K$1					=0.6*$I$3*(64.4*B38)^(0.5)	=3.1*$I$4*(B38)^(3/2)		
=A38+$K$1	=B38+$K$1					=0.6*$I$3*(64.4*B39)^(0.5)	=3.1*$I$4*(B39)^(3/2)		
=A39+$K$1	=B39+$K$1					=0.6*$I$3*(64.4*B40)^(0.5)	=3.1*$I$4*(B40)^(3/2)		

Worksheet for Reach 11 - 7.5 cfs Swale A-A

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.030
Channel Slope	0.010 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	4.000 H:V
Bottom Width	7.50 ft
Discharge	7.50 cfs

Results	
Normal Depth	4.4 in
Flow Area	3.2 ft²
Wetted Perimeter	10.2 ft
Hydraulic Radius	3.8 in
Top Width	10.08 ft
Critical Depth	3.6 in
Critical Slope	0.021 ft/ft
Velocity	2.31 ft/s
Velocity Head	0.08 ft
Specific Energy	0.45 ft
Froude Number	0.718
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	4.4 in
Critical Depth	3.6 in
Channel Slope	0.010 ft/ft
Critical Slope	0.021 ft/ft

Worksheet for Reach above Junction 8 - 51.2 cfs Swale B-B

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.030
Channel Slope	0.005 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	4.000 H:V
Bottom Width	7.50 ft
Discharge	51.20 cfs

Results	
Normal Depth	15.5 in
Flow Area	15.5 ft²
Wetted Perimeter	16.9 ft
Hydraulic Radius	11.0 in
Top Width	16.53 ft
Critical Depth	11.6 in
Critical Slope	0.015 ft/ft
Velocity	3.31 ft/s
Velocity Head	0.17 ft
Specific Energy	1.46 ft
Froude Number	0.602
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	15.5 in
Critical Depth	11.6 in
Channel Slope	0.005 ft/ft
Critical Slope	0.015 ft/ft

Worksheet for Culvert 24" - 6.9 cfs

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.042 ft/ft
Diameter	24.0 in
Discharge	6.90 cfs

Results	
Normal Depth	6.3 in
Flow Area	0.7 ft²
Wetted Perimeter	2.1 ft
Hydraulic Radius	3.7 in
Top Width	1.76 ft
Critical Depth	11.2 in
Percent Full	26.1 %
Critical Slope	0.005 ft/ft
Velocity	10.56 ft/s
Velocity Head	1.73 ft
Specific Energy	2.26 ft
Froude Number	3.055
Maximum Discharge	49.69 cfs
Discharge Full	46.19 cfs
Slope Full	0.001 ft/ft
Flow Type	Supercritical

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
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	26.1 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	6.3 in
Critical Depth	11.2 in
Channel Slope	0.042 ft/ft
Critical Slope	0.005 ft/ft

CIVIL CONSULTANTS, INC.

20 BOULDER CRESCENT, STE 110
COLORADO SPRINGS, CO 80903
(719) 955-5485

PROJECT: Willrwind Comm. Fil 4

DATE: MDDP - Concept Riprap Sizing

Proposed (Future) 24" Culvert - Riprap Apron Calc.

$n = 0.013$ $D = 2.0$ $Inv = 64.00$ $Inv = 61.68$ $L = 70' \pm$

$Q = 6.9$ cfs $S = \frac{2.92}{70.0} = 0.0417 = 4.2\%$

$TW = 0.4 \times 2.0 = 0.5$

Flow is supercritical $y_n = 6.3/12' = 0.825$

$y_n = y_o$ (Per flowmaster)

$D' = \frac{D + y_n}{2}$

$D' = \frac{2.0 + 0.825}{2} = \frac{2.825}{2} = 1.41$

$D_{50} = 0.2(1.41)\left(\frac{6.9}{\sqrt{32.2}(1.41)^{2.5}}\right)^{4/3}\left(\frac{1.41}{0.8}\right) = 0.21' = 2.5"$

Upsize to $D_{50} = 12"$

Depth $= 2.0 \times D_{50} = 24"$

Length $L = 4.0 \times D$

$L = 4.0 \times 2.0 = 8.0'$ Lengthen to 9'

End Width $= 3.0(2.0) + 3/4(9.0) = 10.5'$

6.0 Outlet Protection

Scour at culvert outlets is typical and mitigation must be included in the design. This section provides background information and speaks to the complexity of this transitional area. See the *Hydraulic Structures* chapter for detailed discussion and details of outlet protection practices.



Photograph 11-4. Energy dissipation and outlet protection are essential to promote channel stability.

Compared to the stream, flow in a culvert barrel is usually confined to a lesser width and greater depth. This results in increased velocity and potentially erosive capabilities as flow exits the barrel. Turbulence and erosive eddies form as the flow expands to conform to the natural channel. However, the velocity and depth of flow at the culvert outlet and the velocity distribution upon reentering the stream are not the only factors that need consideration.

The characteristics of the stream bed and bank material, velocity, and depth of flow in the stream at the culvert outlet, and the amount of sediment and other debris in the flow are all contributing factors to scour potential. Due to the variation in expected flows and the difficulty in evaluating some of these factors, scour prediction is not a exact science.

As discussed in the *Hydraulic Structures* chapter, riprap channel expansions and concrete aprons stabilize the transition and redistribute or spread the flow. Barrel outlet expansions operate in a similar manner. Headwalls and cutoff walls protect the integrity of the fill. At some locations, use of a rougher culvert material may alleviate the need for a special outlet protection device. When outlet velocities are high enough to create excessive downstream problems, consideration should be given to more complex energy dissipation devices. These include hydraulic jump basins, impact basins, drop structures, and stilling wells. Design information for the general types of energy dissipators is provided in the *Hydraulic Structures* chapter of the USDCM and in *Hydraulic Design of Energy Dissipators for Culverts and Channels* (FHWA 1983 and 2000).

Publication No. FHWA-NHI-06-086
July 2006

U.S. Department of Transportation

Federal Highway Administration

Hydraulic Engineering Circular No. 14, Third Edition

Hydraulic Design of Energy Dissipators for Culverts and Channels

National Highway Institute

L_B min = $4W_o$ = 4(6) = 24 ft, use L_B = 24 ft

$W_B = W_o + 2(L_B/3) = 6 + 2(24/3) = 22$ ft

However, since the trial D_{50} is not available, the next larger riprap size (D_{50} = 0.83 ft) would be used to line a basin with the given dimensions.

Step 4 (3rd iteration). Determine the basin exit depth, $y_B = y_c$ and exit velocity, $V_B = V_c$.

$Q^2/g = (A_c)^3/T_c = [y_c(W_B + zy_c)]^3/ (W_B + 2zy_c)$

$135^2/32.2 = 566 = [y_c(22 + 2y_c)]^3/ (22 + 4y_c)$

By trial and success, y_c = 1.02 ft, T_c =26.1 ft, A_c = 24.5 ft^2

$V_c = Q/A_c = 135/24.5 = 5.5$ ft/s (acceptable)

Two feasible options have been identified. First, a 2.3-ft-deep, 23-ft-long pool, with an 11.5-ft-apron using D_{50} = 0.5 ft. Second, a 1.4-ft-deep, 18-ft-long pool, with a 6-ft-apron using D_{50} = 0.83 ft. The choice between these two options will likely depend on the available space and the cost of riprap.

Step 5. For the design discharge, determine if $TW/y_o \leq 0.75$

$TW/y_o = 2.0/2.7 = 0.74$, which satisfies $TW/y_o \leq 0.75$. No additional riprap needed.

10.2 RIPRAP APRON

The most commonly used device for outlet protection, primarily for culverts 1500 mm (60 in) or smaller, is a riprap apron. An example schematic of an apron taken from the Federal Lands Division of the Federal Highway Administration is shown in Figure 10.4.

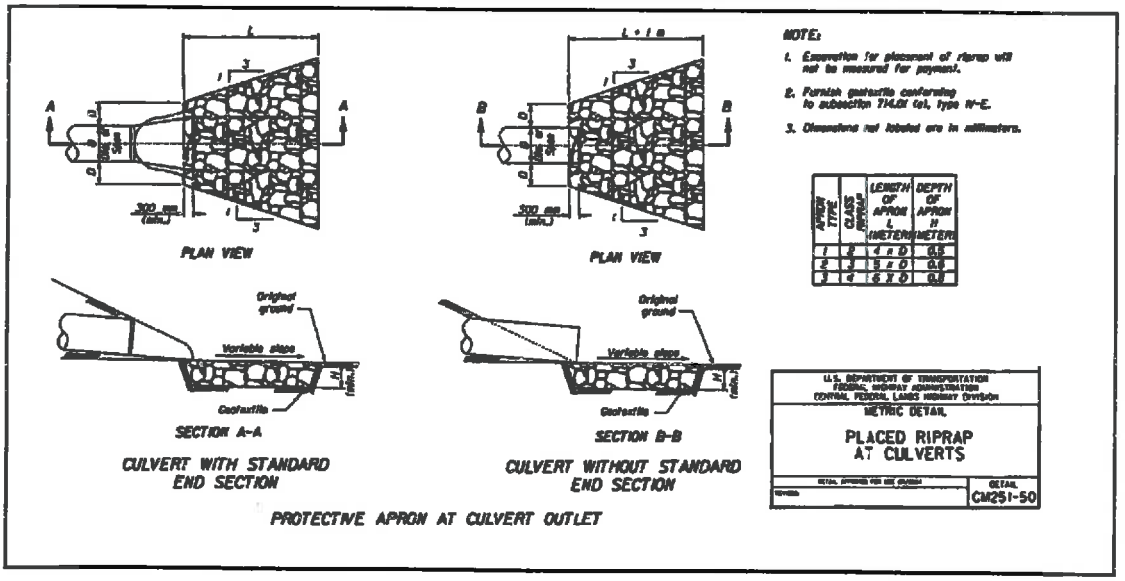


Figure 10.4. Placed Riprap at Culverts (Central Federal Lands Highway Division)

They are constructed of riprap or grouted riprap at a zero grade for a distance that is often related to the outlet pipe diameter. These aprons do not dissipate significant energy except

through increased roughness for a short distance. However, they do serve to spread the flow helping to transition to the natural drainage way or to sheet flow where no natural drainage way exists. However, if they are too short, or otherwise ineffective, they simply move the location of potential erosion downstream. The key design elements of the riprap apron are the riprap size as well as the length, width, and depth of the apron.

Several relationships have been proposed for riprap sizing for culvert aprons and several of these are discussed in greater detail in Appendix D. The independent variables in these relationships include one or more of the following variables: outlet velocity, rock specific gravity, pipe dimension (e.g. diameter), outlet Froude number, and tailwater. The following equation (Fletcher and Grace, 1972) is recommended for circular culverts:

$$D_{50} = 0.2\,D\left(\frac{Q}{\sqrt{g}D^{2.5}}\right)^{4/3}\left(\frac{D}{TW}\right) \qquad (10.4)$$

where,

D_{50} = riprap size, m (ft)
Q = design discharge, m^3/s (ft^3/s)
D = culvert diameter (circular), m (ft)
TW = tailwater depth, m (ft)
g = acceleration due to gravity, 9.81 m/s^2 (32.2 ft/s^2)

Tailwater depth for Equation 10.4 should be limited to between 0.4D and 1.0D. If tailwater is unknown, use 0.4D.

Whenever the flow is supercritical in the culvert, the culvert diameter is adjusted as follows:

$$D' = \frac{D + y_n}{2} \qquad (10.5)$$

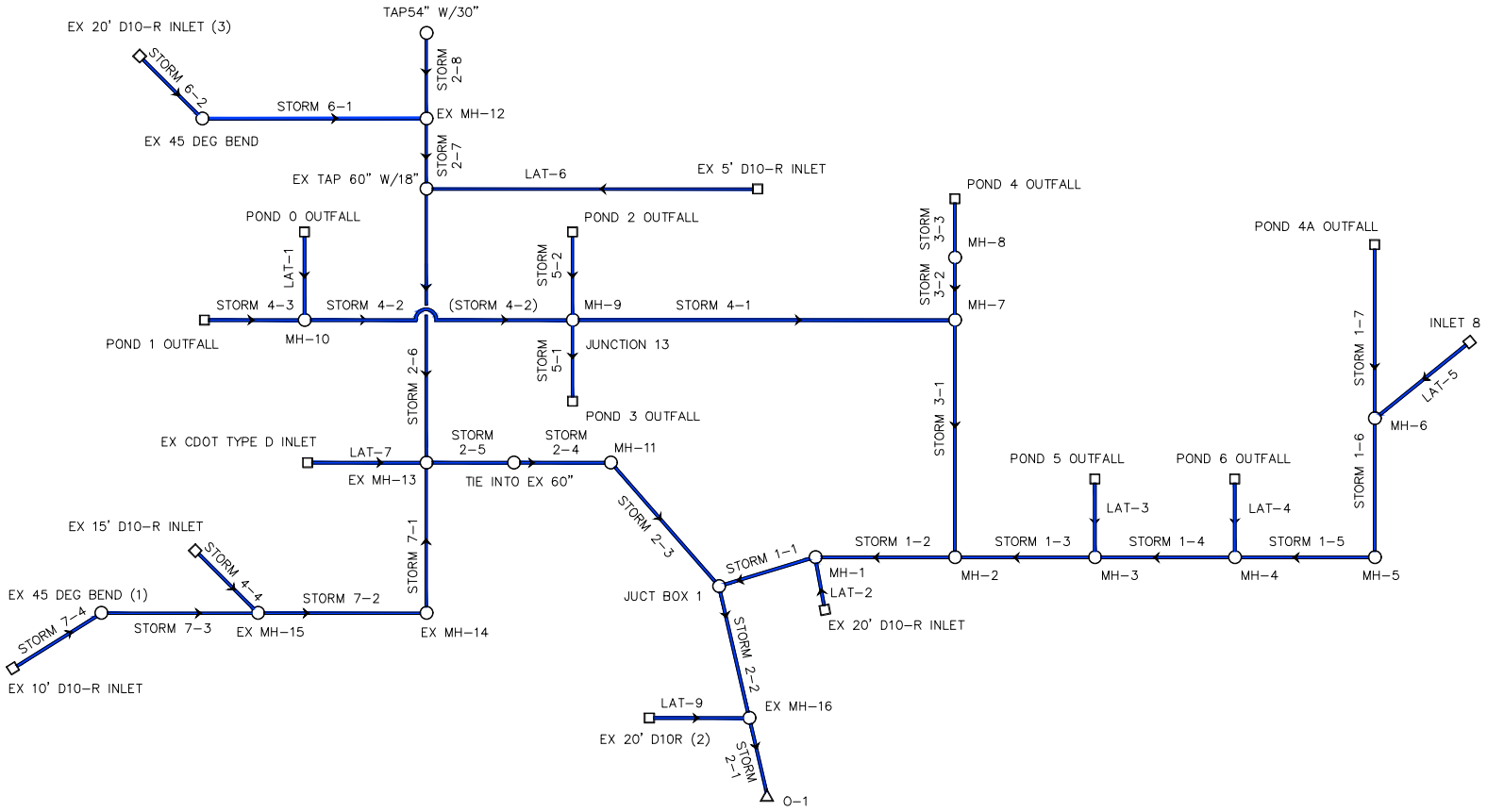
where,

D' = adjusted culvert rise, m (ft)
y_n = normal (supercritical) depth in the culvert, m (ft)

Equation 10.4 assumes that the rock specific gravity is 2.65. If the actual specific gravity differs significantly from this value, the D_{50} should be adjusted inversely to specific gravity.

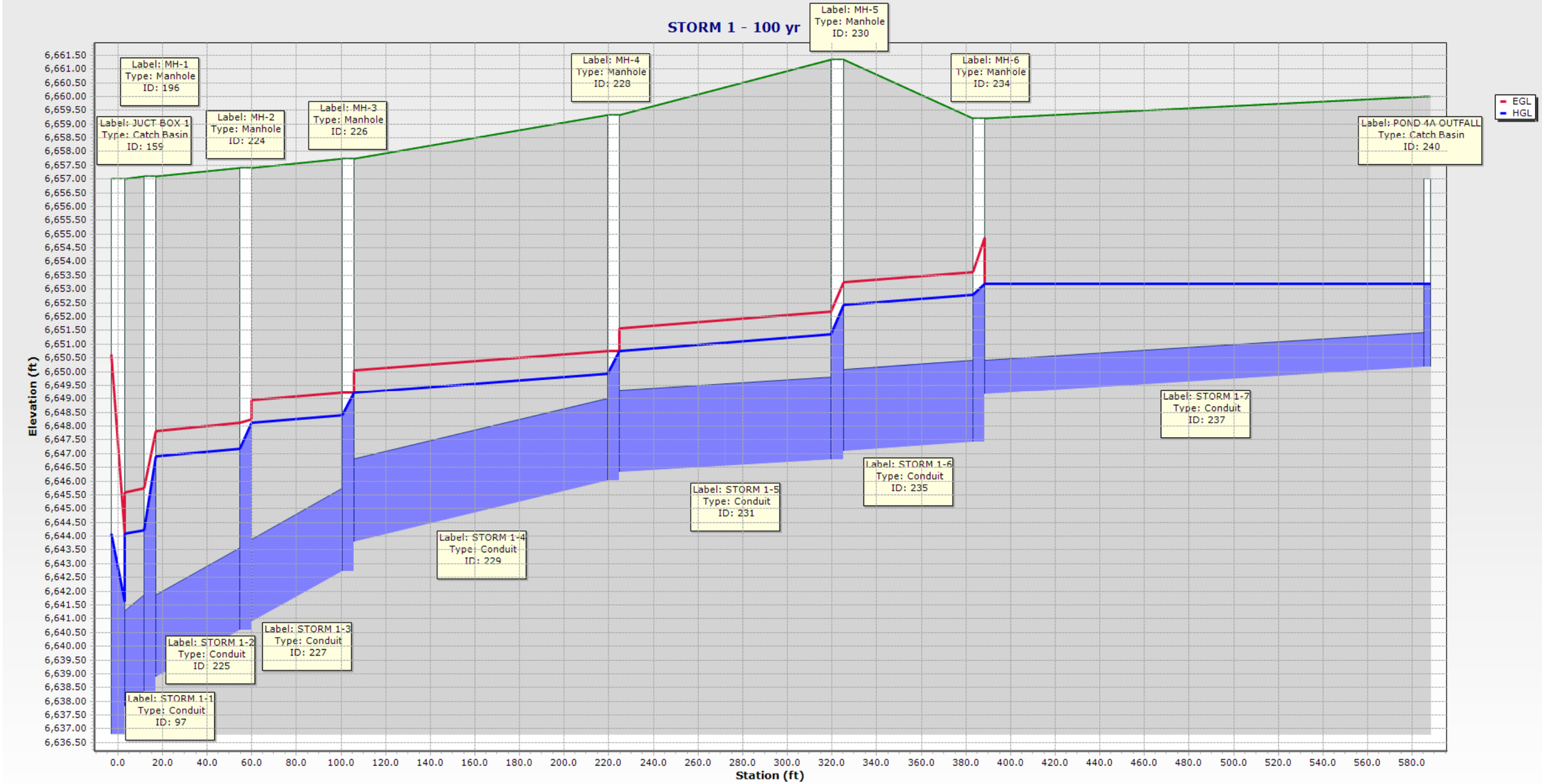
The designer should calculate D_{50} using Equation 10.4 and compare with available riprap classes. A project or design standard can be developed such as the example from the Federal Highway Administration Federal Lands Highway Division (FHWA, 2003) shown in Table 10.1 (first two columns). The class of riprap to be specified is that which has a D_{50} greater than or equal to the required size. For projects with several riprap aprons, it is often cost effective to use fewer riprap classes to simplify acquiring and installing the riprap at multiple locations. In such a case, the designer must evaluate the tradeoffs between over sizing riprap at some locations in order to reduce the number of classes required on a project.

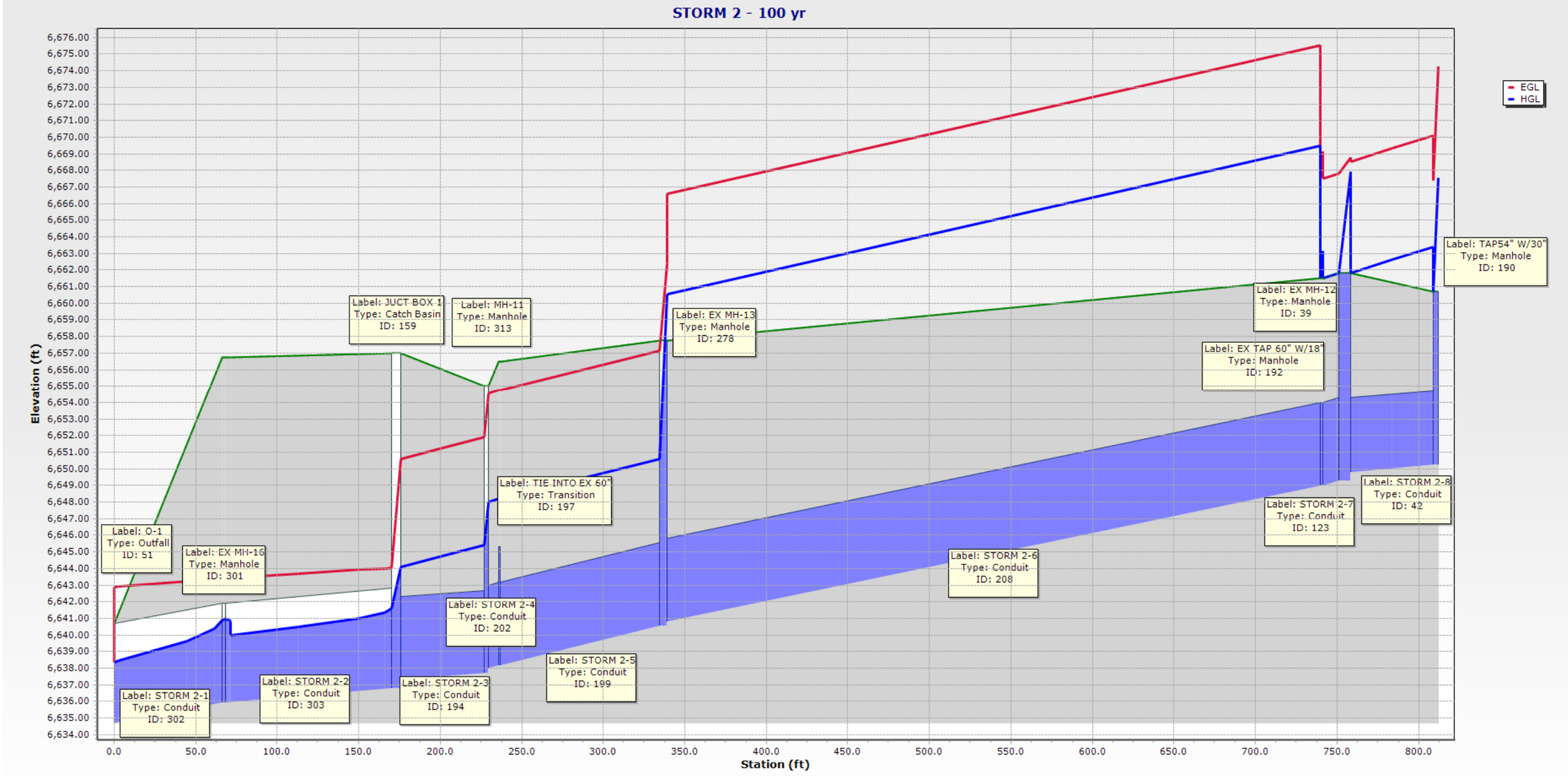
STORMCAD SCHEMATIC

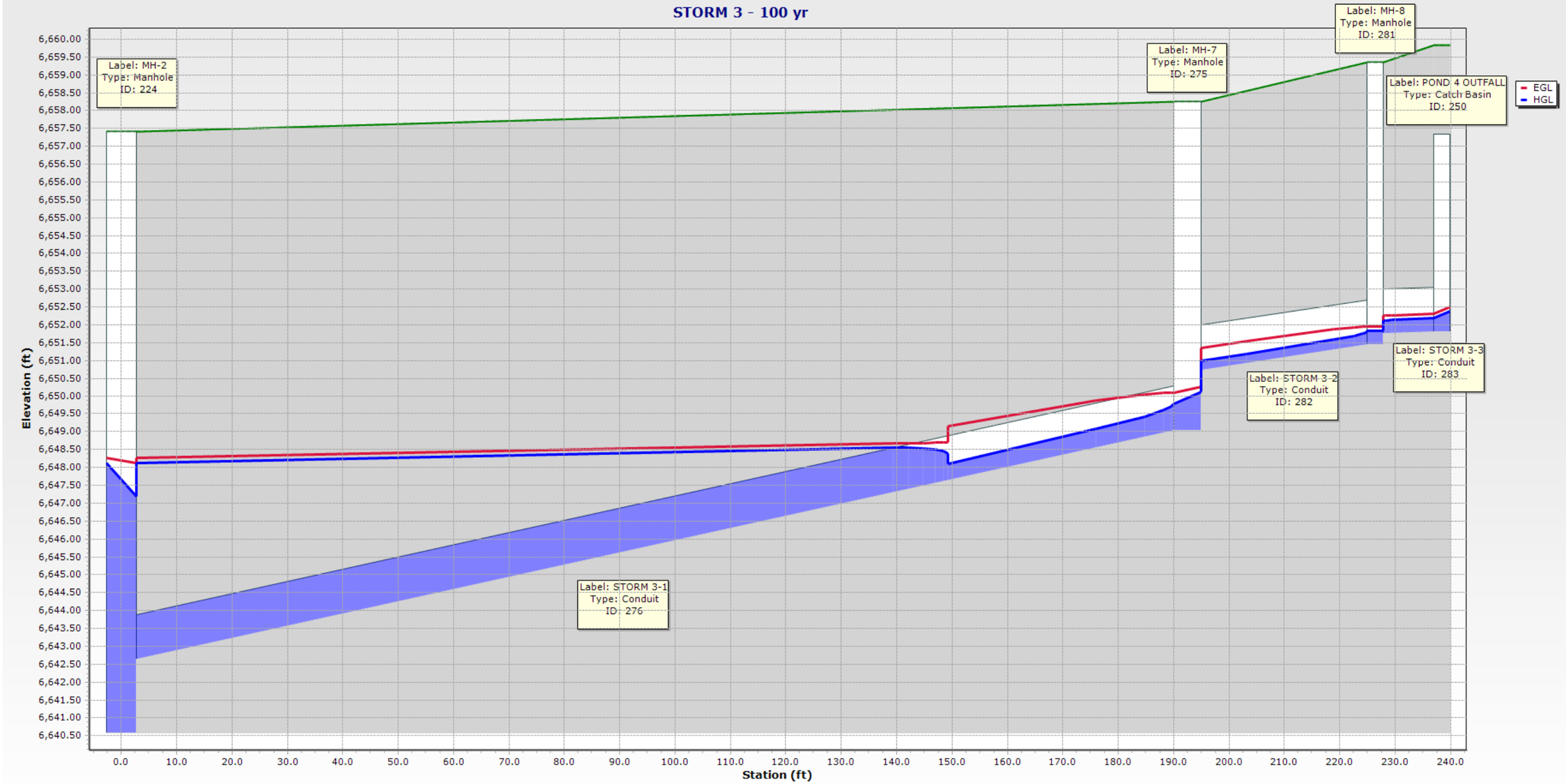


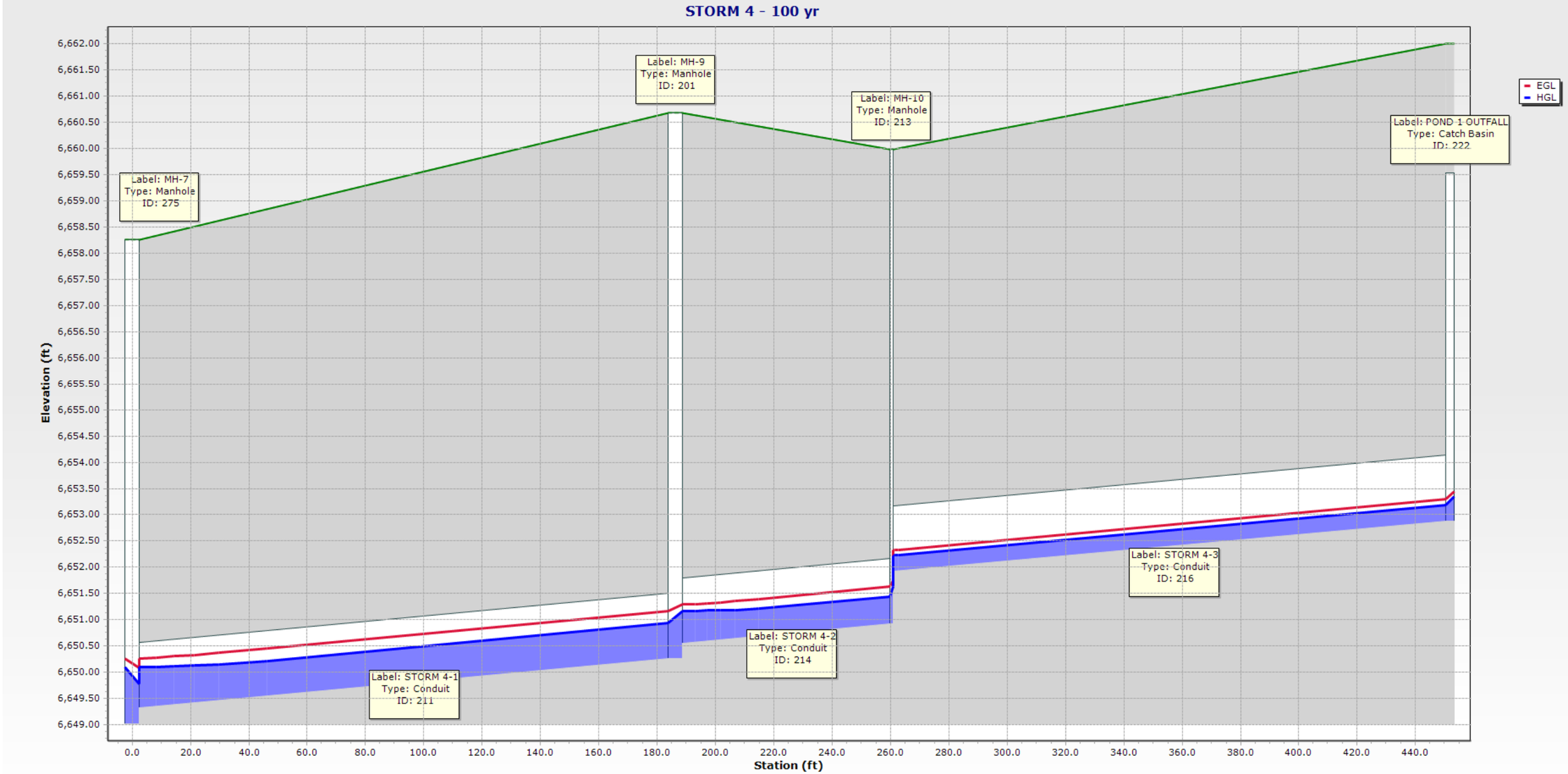
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212 N. WAHSATCH AVE., STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

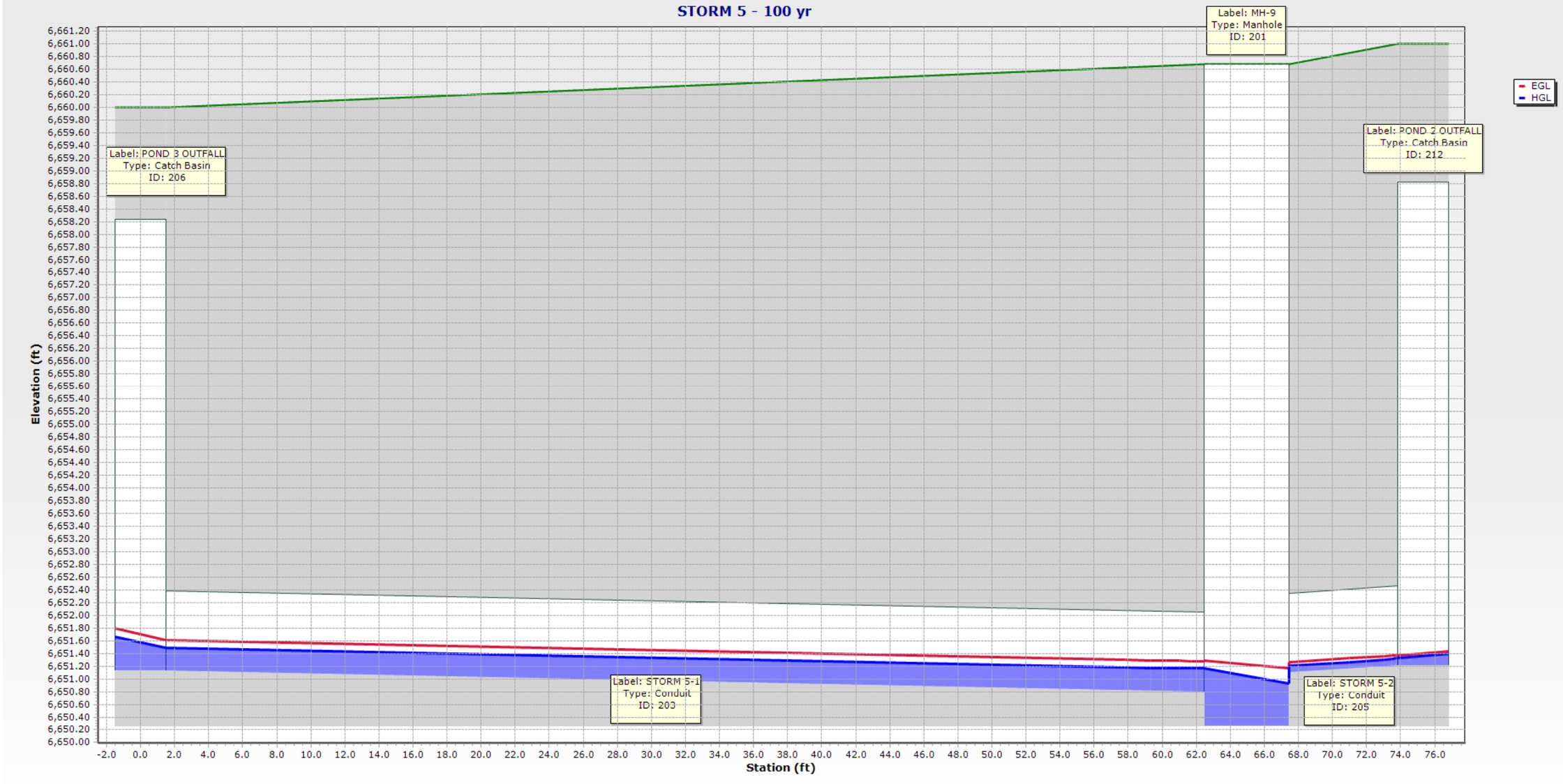
File: O:\10021A-Willowwind-Dunkin Donuts\Dunkin Donuts\Dwg\Eng Exhibits\StormCAD Schematic.dwg Plotstamp: 9/15/2023 12:12 PM

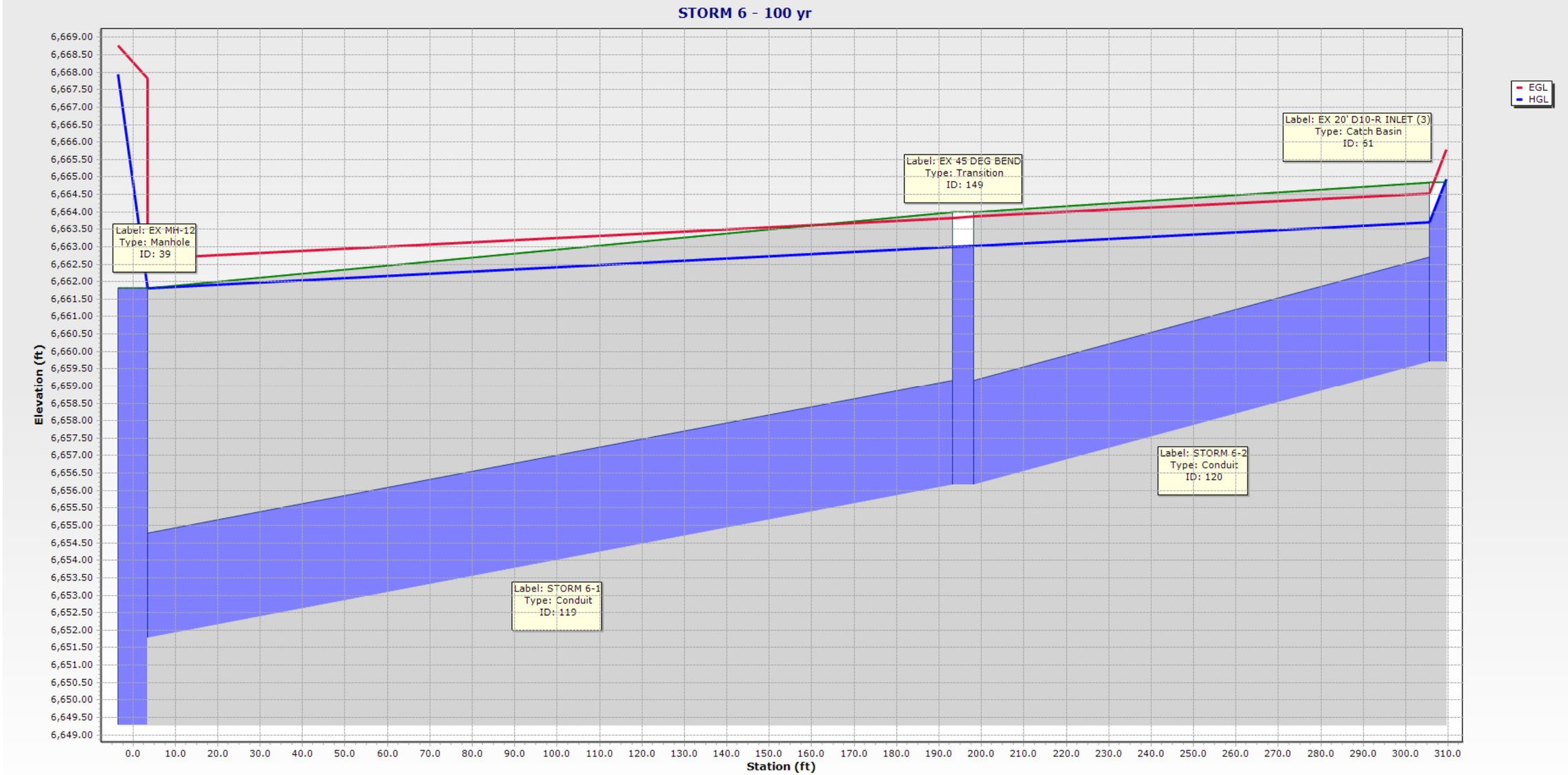

STORM 1 - 100 yr
Label: MH-1
Type: Manhole
ID: 196
Label: JUCT BOX 1
Type: Catch Basin
ID: 159
Label: MH-2
Type: Manhole
ID: 224
Label: MH-3
Type: Manhole
ID: 226
Label: MH-4
Type: Manhole
ID: 228
Label: MH-5
Type: Manhole
ID: 230
Label: MH-6
Type: Manhole
ID: 234
Label: POND 4A OUTFALL
Type: Catch Basin
ID: 240
EGL
HGL
Label: STORM 1-7
Type: Conduit
ID: 237
Label: STORM 1-6
Type: Conduit
ID: 235
Label: STORM 1-5
Type: Conduit
ID: 231
Label: STORM 1-4
Type: Conduit
ID: 229
Label: STORM 1-3
Type: Conduit
ID: 227
Label: STORM 1-2
Type: Conduit
ID: 225
Label: STORM 1-1
Type: Conduit
ID: 97
Elevation (ft)
6,661.50
6,661.00
6,660.50
6,660.00
6,659.50
6,659.00
6,658.50
6,658.00
6,657.50
6,657.00
6,656.50
6,656.00
6,655.50
6,655.00
6,654.50
6,654.00
6,653.50
6,653.00
6,652.50
6,652.00
6,651.50
6,651.00
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6,642.00
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6,641.00
6,640.50
6,640.00
6,639.50
6,639.00
6,638.50
6,638.00
6,637.50
6,637.00
6,636.50
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
220.0
240.0
260.0
280.0
300.0
320.0
340.0
360.0
380.0
400.0
420.0
440.0
460.0
480.0
500.0
520.0
540.0
560.0
580.0
Station (ft)

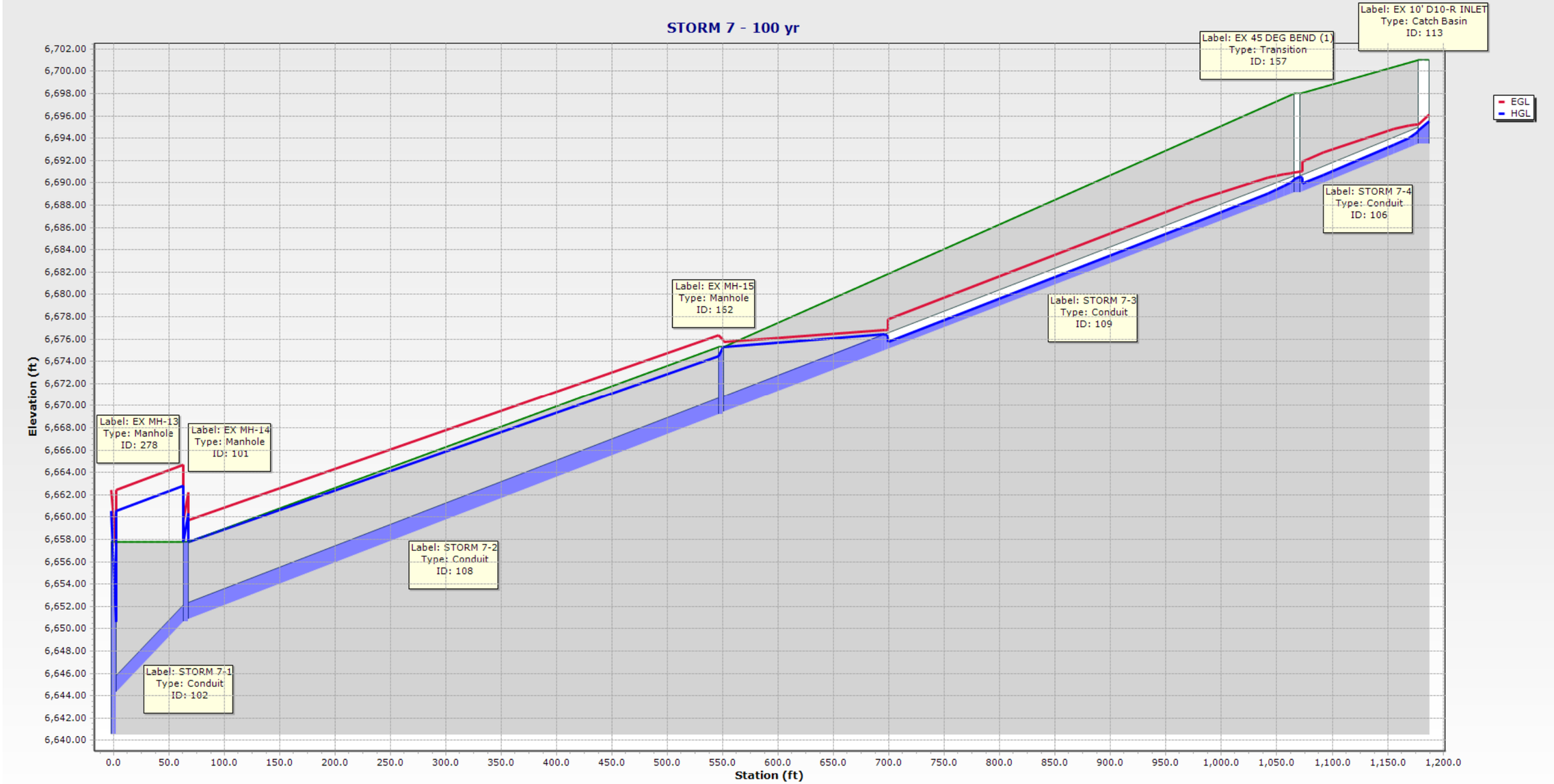

STORM 2 - 100 yr
Elevation (ft)
Station (ft)
EGL
HGL
Label: JUCT BOX 1
Type: Catch Basin
ID: 159
Label: MH-11
Type: Manhole
ID: 313
Label: EX MH-13
Type: Manhole
ID: 278
Label: EX MH-12
Type: Manhole
ID: 39
Label: TAP54" W/30"
Type: Manhole
ID: 190
Label: EX TAP 60" W/18"
Type: Manhole
ID: 192
Label: TIE INTO EX 60"
Type: Transition
ID: 197
Label: STORM 2-8
Type: Conduit
ID: 42
Label: STORM 2-7
Type: Conduit
ID: 123
Label: O-1
Type: Outfall
ID: 51
Label: EX MH-16
Type: Manhole
ID: 301
Label: STORM 2-6
Type: Conduit
ID: 208
Label: STORM 2-4
Type: Conduit
ID: 202
Label: STORM 2-5
Type: Conduit
ID: 199
Label: STORM 2-1
Type: Conduit
ID: 302
Label: STORM 2-2
Type: Conduit
ID: 303
Label: STORM 2-3
Type: Conduit
ID: 194

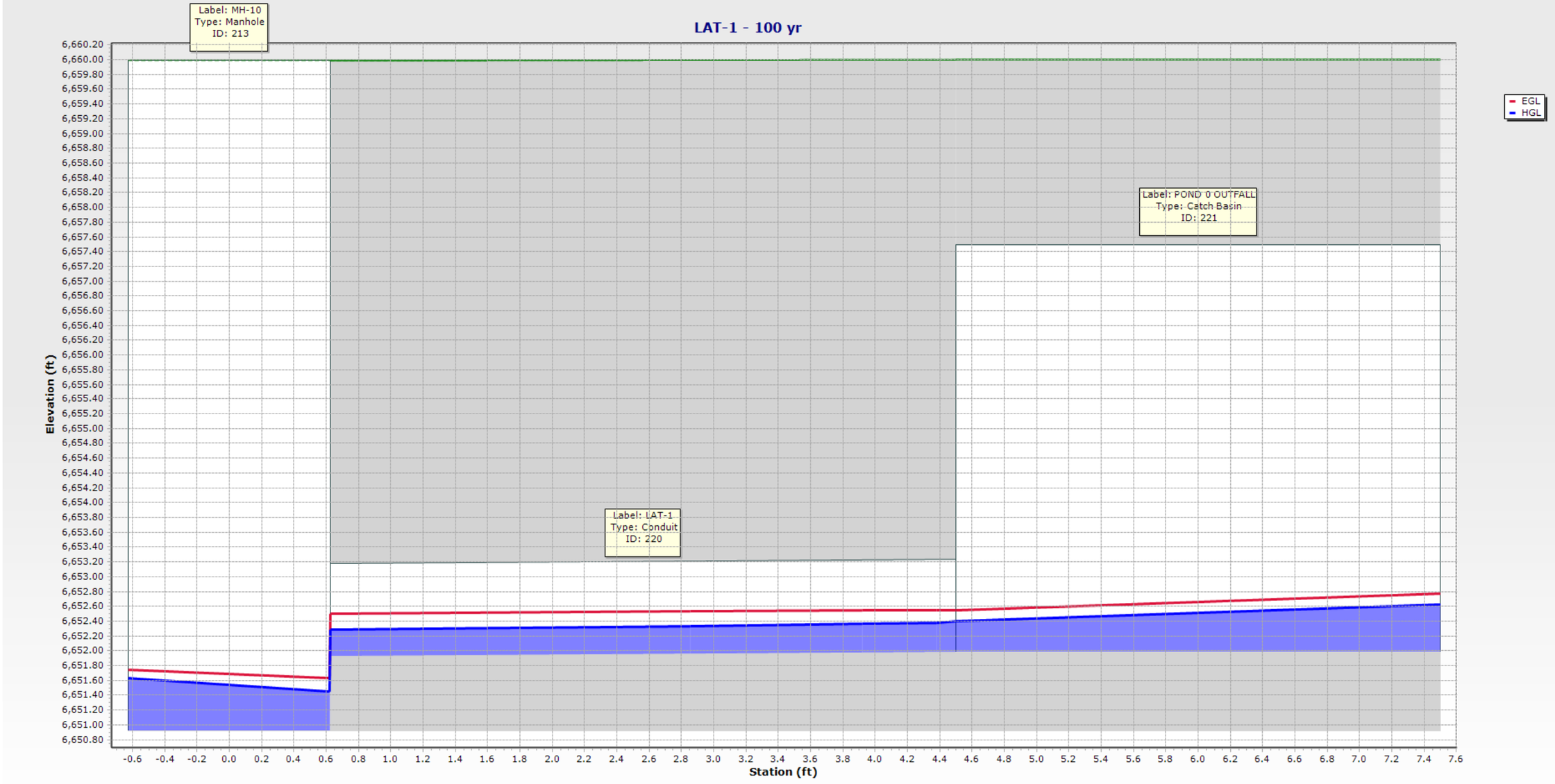

STORM 3 - 100 yr
Label: MH-2
Type: Manhole
ID: 224
Label: MH-7
Type: Manhole
ID: 275
Label: MH-8
Type: Manhole
ID: 281
Label: POND 4 OUTFALL
Type: Catch Basin
ID: 250
EGL
HGL
Label: STORM 3-3
Type: Conduit
ID: 283
Label: STORM 3-2
Type: Conduit
ID: 282
Label: STORM 3-1
Type: Conduit
ID: 276
Elevation (ft)
6,660.00
6,659.50
6,659.00
6,658.50
6,658.00
6,657.50
6,657.00
6,656.50
6,656.00
6,655.50
6,655.00
6,654.50
6,654.00
6,653.50
6,653.00
6,652.50
6,652.00
6,651.50
6,651.00
6,650.50
6,650.00
6,649.50
6,649.00
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6,648.00
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6,645.50
6,645.00
6,644.50
6,644.00
6,643.50
6,643.00
6,642.50
6,642.00
6,641.50
6,641.00
6,640.50
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0
210.0
220.0
230.0
240.0
Station (ft)


STORM 4 - 100 yr
Elevation (ft)
Station (ft)
6,662.00
6,661.50
6,661.00
6,660.50
6,660.00
6,659.50
6,659.00
6,658.50
6,658.00
6,657.50
6,657.00
6,656.50
6,656.00
6,655.50
6,655.00
6,654.50
6,654.00
6,653.50
6,653.00
6,652.50
6,652.00
6,651.50
6,651.00
6,650.50
6,650.00
6,649.50
6,649.00
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
220.0
240.0
260.0
280.0
300.0
320.0
340.0
360.0
380.0
400.0
420.0
440.0
Label: MH-7
Type: Manhole
ID: 275
Label: MH-9
Type: Manhole
ID: 201
Label: MH-10
Type: Manhole
ID: 213
Label: POND 1 OUTFALL
Type: Catch Basin
ID: 222
EGL
HGL
Label: STORM 4-1
Type: Conduit
ID: 211
Label: STORM 4-2
Type: Conduit
ID: 214
Label: STORM 4-3
Type: Conduit
ID: 216

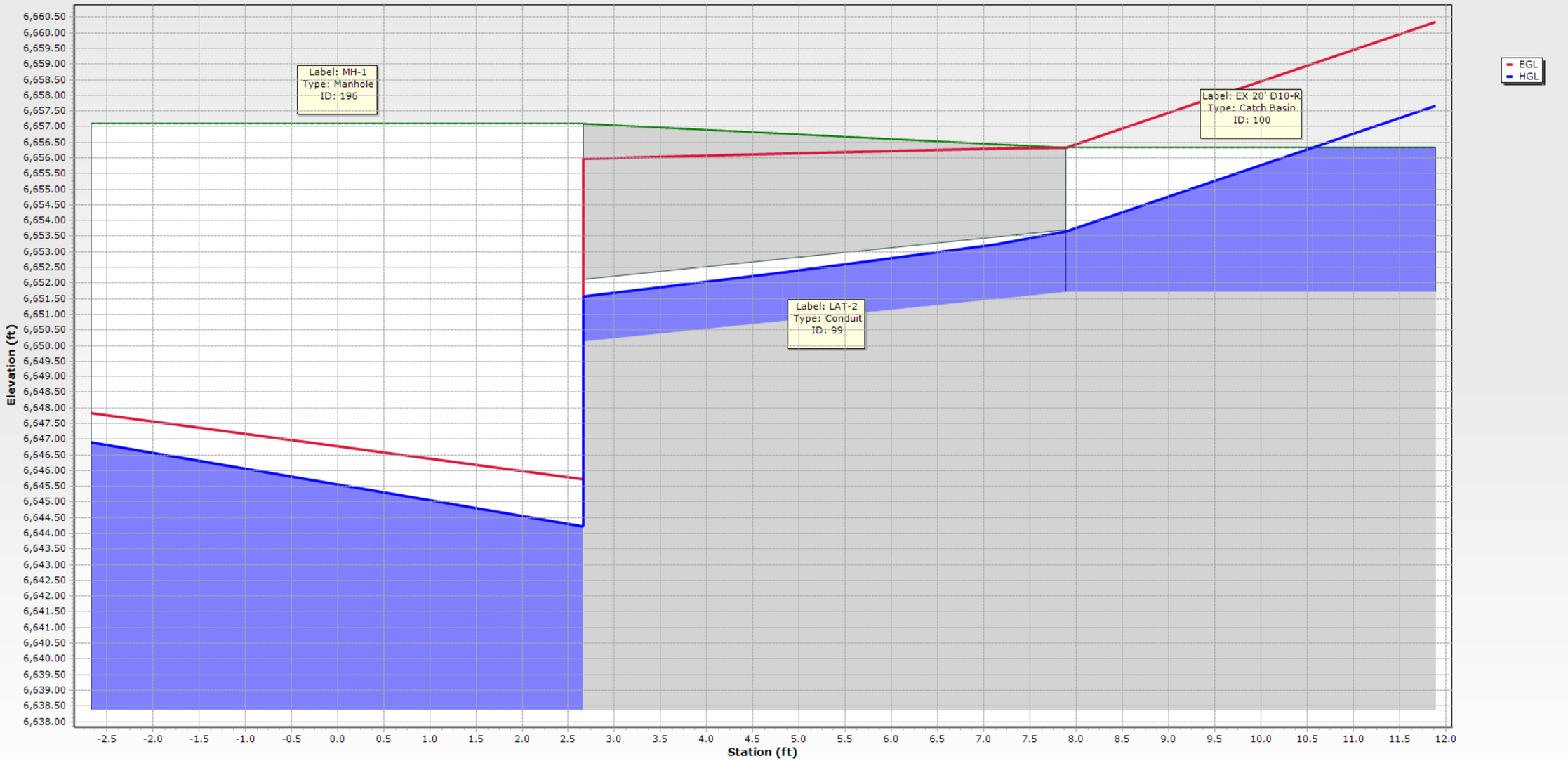

STORM 5 - 100 yr
Label: MH-9
Type: Manhole
ID: 201
Label: POND 3 OUTFALL
Type: Catch Basin
ID: 206
Label: POND 2 OUTFALL
Type: Catch Basin
ID: 212
EGL
HGL
Label: STORM 5-1
Type: Conduit
ID: 203
Label: STORM 5-2
Type: Conduit
ID: 205
Elevation (ft)
Station (ft)

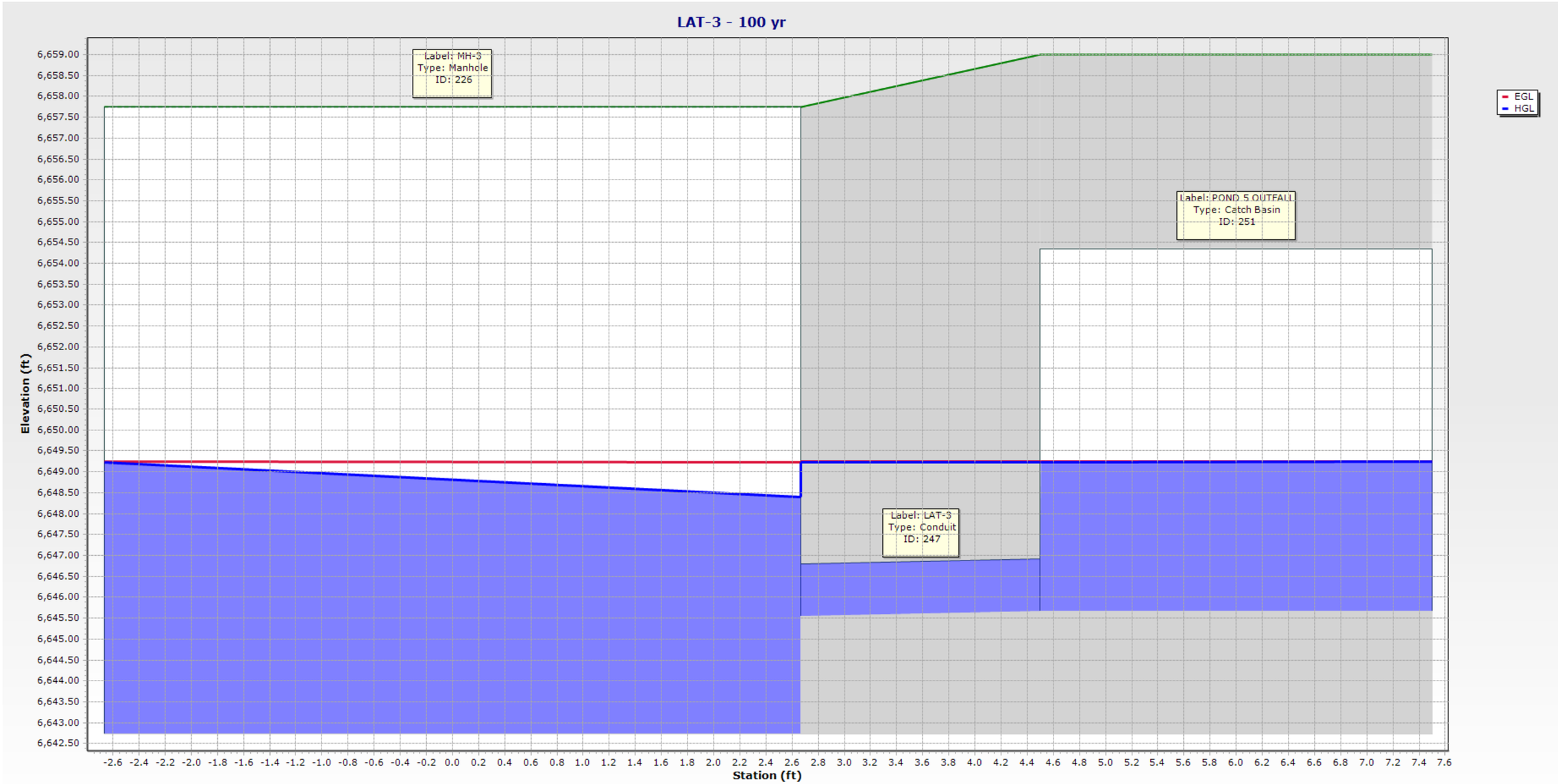

STORM 6 - 100 yr
EGL
HGL
Label: EX MH-12
Type: Manhole
ID: 39
Label: EX 45 DEG BEND
Type: Transition
ID: 149
Label: EX 20' D10-R INLET (3)
Type: Catch Basin
ID: 51
Label: STORM 6-2
Type: Conduit
ID: 120
Label: STORM 6-1
Type: Conduit
ID: 119
Elevation (ft)
Station (ft)
6,669.00
6,668.50
6,668.00
6,667.50
6,667.00
6,666.50
6,666.00
6,665.50
6,665.00
6,664.50
6,664.00
6,663.50
6,663.00
6,662.50
6,662.00
6,661.50
6,661.00
6,660.50
6,660.00
6,659.50
6,659.00
6,658.50
6,658.00
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6,657.00
6,656.50
6,656.00
6,655.50
6,655.00
6,654.50
6,654.00
6,653.50
6,653.00
6,652.50
6,652.00
6,651.50
6,651.00
6,650.50
6,650.00
6,649.50
6,649.00
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0
210.0
220.0
230.0
240.0
250.0
260.0
270.0
280.0
290.0
300.0
310.0

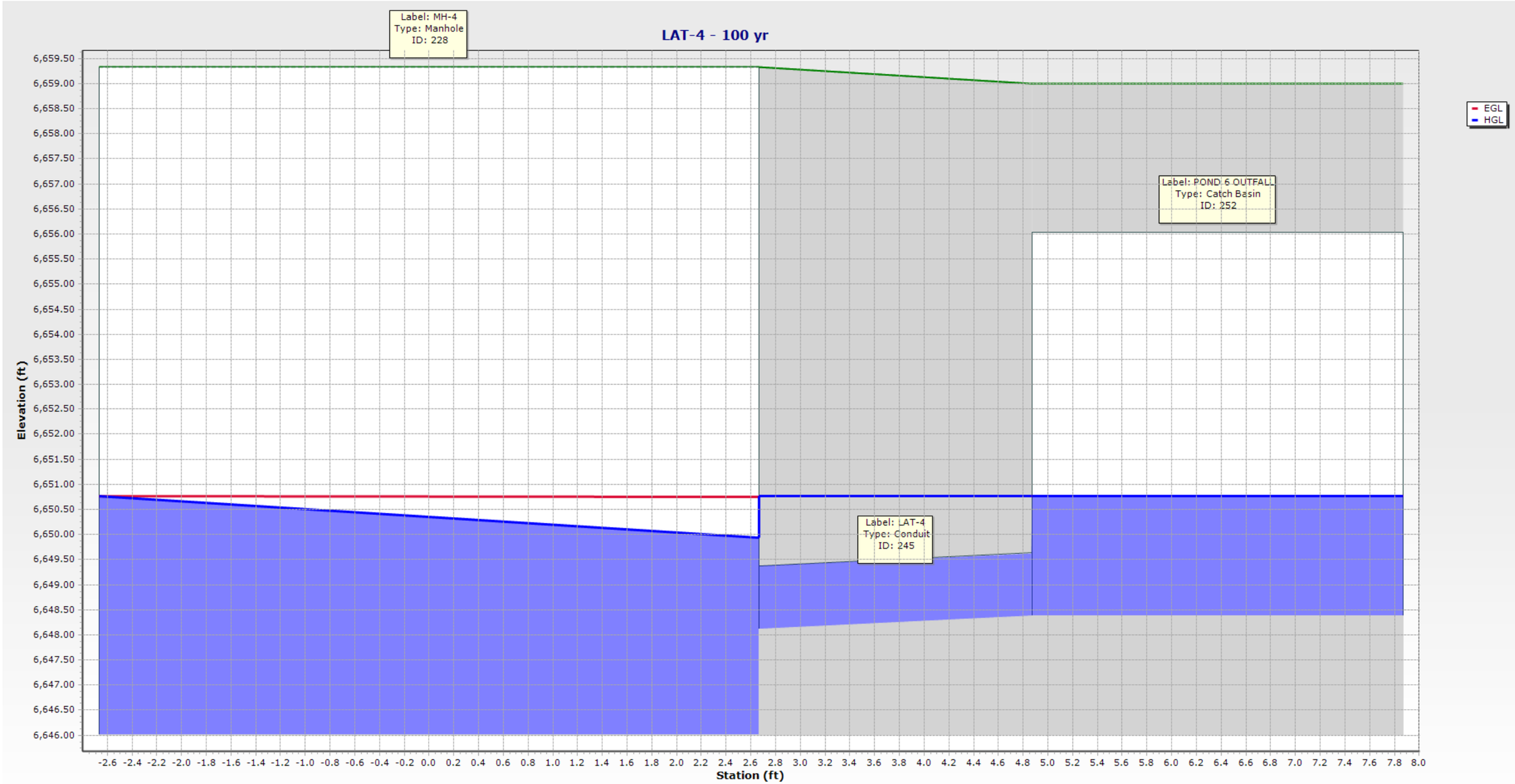

STORM 7 - 100 yr
Label: EX 10' D10-R INLET
Type: Catch Basin
ID: 113
Label: EX 45 DEG BEND (1)
Type: Transition
ID: 157
EGL
HGL
Label: STORM 7-4
Type: Conduit
ID: 106
Label: EX MH-15
Type: Manhole
ID: 152
Label: STORM 7-3
Type: Conduit
ID: 109
Label: EX MH-13
Type: Manhole
ID: 278
Label: EX MH-14
Type: Manhole
ID: 101
Label: STORM 7-2
Type: Conduit
ID: 108
Label: STORM 7-1
Type: Conduit
ID: 102
Elevation (ft)
6,702.00
6,700.00
6,698.00
6,696.00
6,694.00
6,692.00
6,690.00
6,688.00
6,686.00
6,684.00
6,682.00
6,680.00
6,678.00
6,676.00
6,674.00
6,672.00
6,670.00
6,668.00
6,666.00
6,664.00
6,662.00
6,660.00
6,658.00
6,656.00
6,654.00
6,652.00
6,650.00
6,648.00
6,646.00
6,644.00
6,642.00
6,640.00
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
500.0
550.0
600.0
650.0
700.0
750.0
800.0
850.0
900.0
950.0
1,000.0
1,050.0
1,100.0
1,150.0
1,200.0
Station (ft)

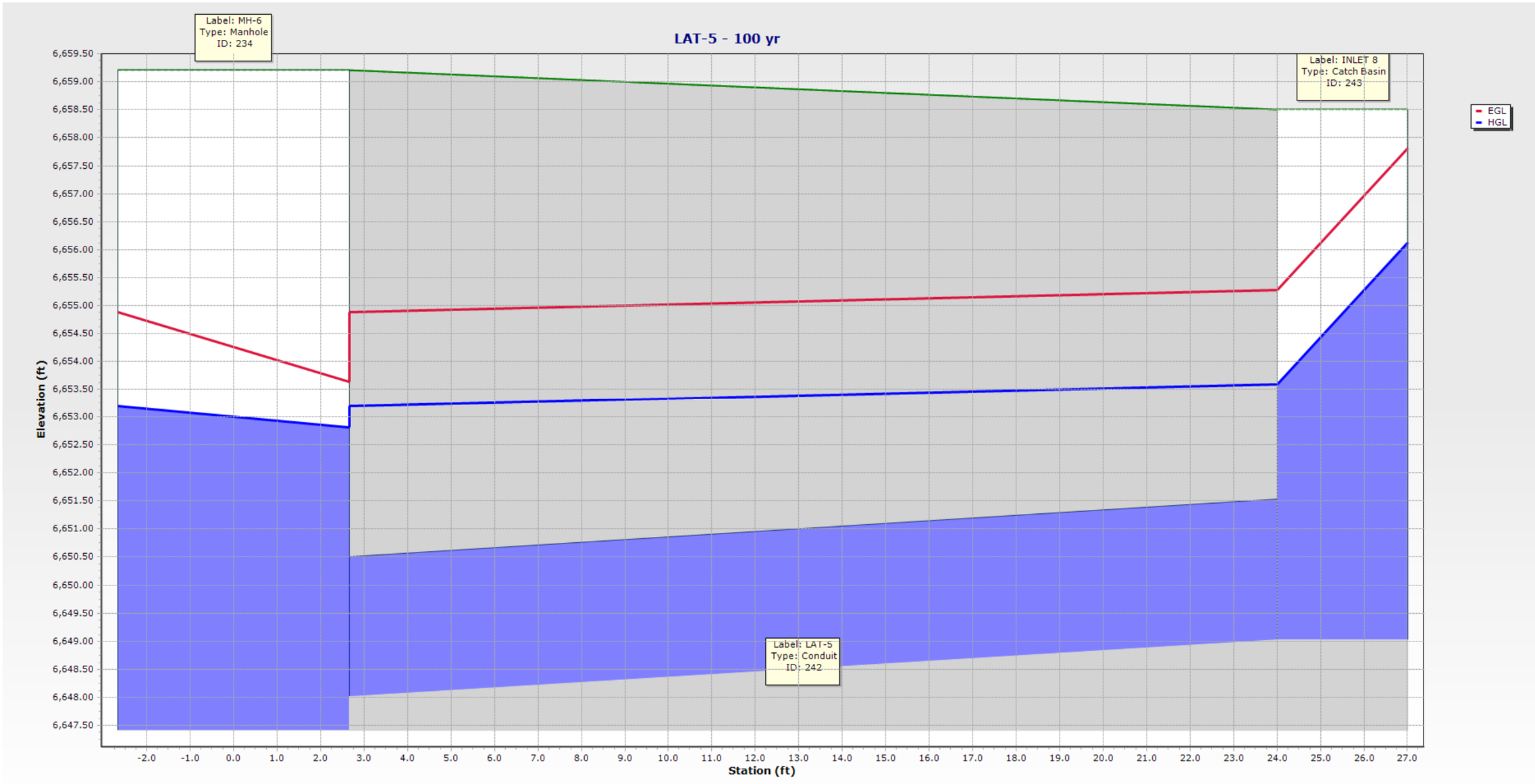

LAT-1 - 100 yr
Label: MH-10
Type: Manhole
ID: 213
Label: POND 0 OUTFALL
Type: Catch Basin
ID: 221
Label: LAT-1
Type: Conduit
ID: 220
EGL
HGL
Elevation (ft)
Station (ft)
6,660.20
6,660.00
6,659.80
6,659.60
6,659.40
6,659.20
6,659.00
6,658.80
6,658.60
6,658.40
6,658.20
6,658.00
6,657.80
6,657.60
6,657.40
6,657.20
6,657.00
6,656.80
6,656.60
6,656.40
6,656.20
6,656.00
6,655.80
6,655.60
6,655.40
6,655.20
6,655.00
6,654.80
6,654.60
6,654.40
6,654.20
6,654.00
6,653.80
6,653.60
6,653.40
6,653.20
6,653.00
6,652.80
6,652.60
6,652.40
6,652.20
6,652.00
6,651.80
6,651.60
6,651.40
6,651.20
6,651.00
6,650.80
-0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0 4.2 4.4 4.6 4.8 5.0 5.2 5.4 5.6 5.8 6.0 6.2 6.4 6.6 6.8 7.0 7.2 7.4 7.6

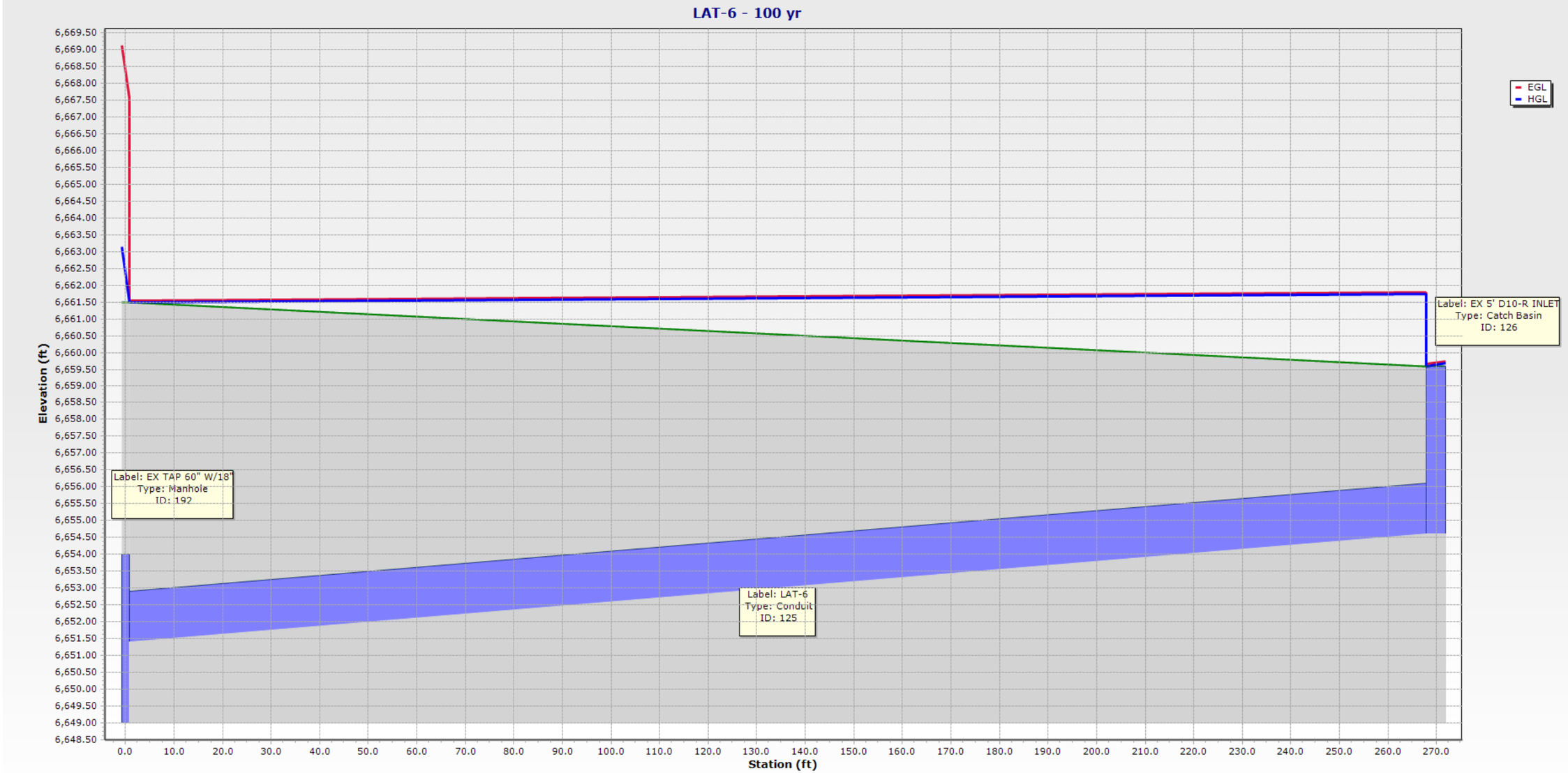
LAT-2 - 100 yr

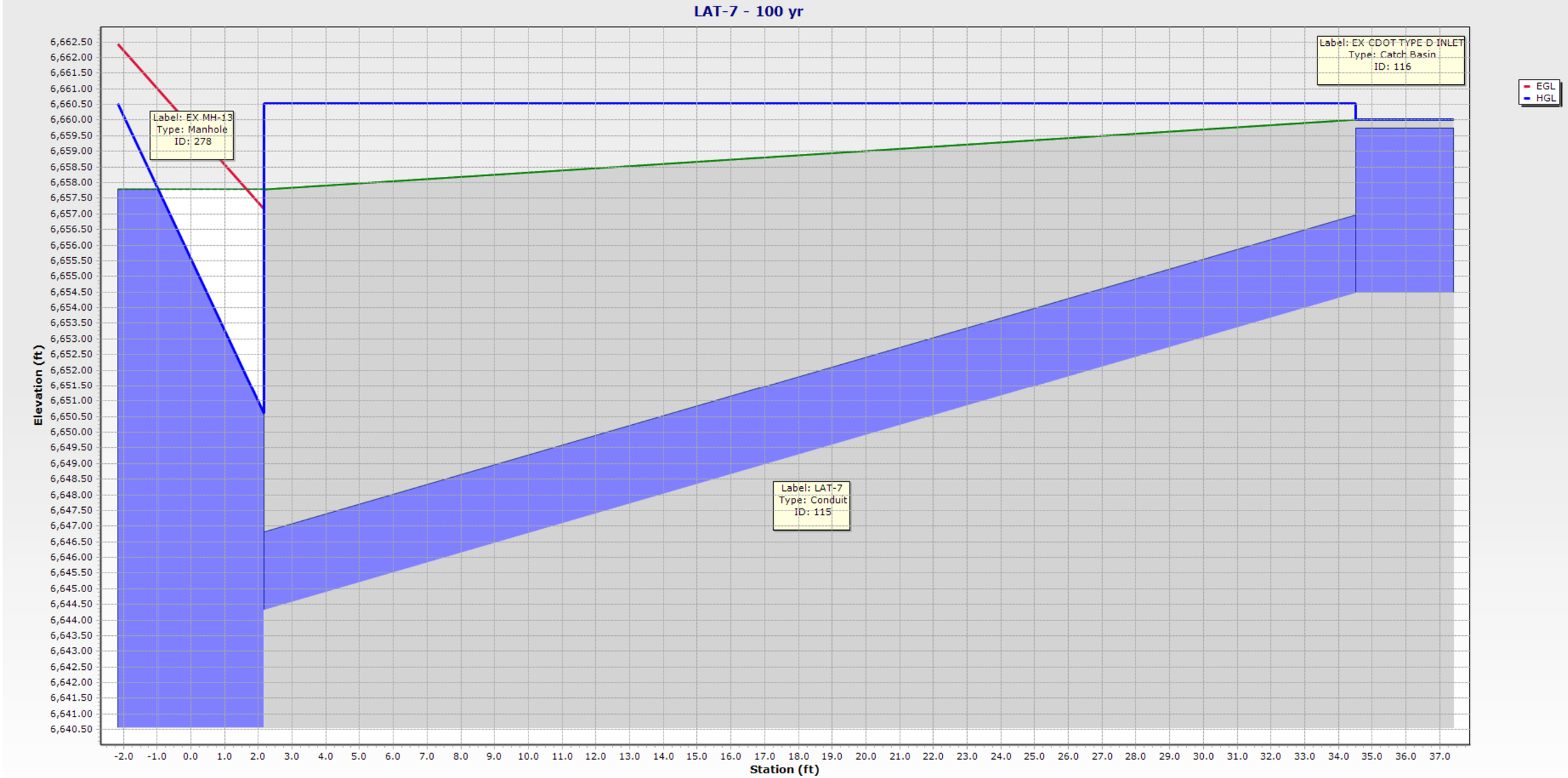

Label: MH-1
Type: Manhole
ID: 196
Label: EX 20' D10-R
Type: Catch Basin
ID: 100
Label: LAT-2
Type: Conduit
ID: 99
EGL
HGL
Elevation (ft)
Station (ft)
6,660.50
6,660.00
6,659.50
6,659.00
6,658.50
6,658.00
6,657.50
6,657.00
6,656.50
6,656.00
6,655.50
6,655.00
6,654.50
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6,652.50
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6,650.50
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6,649.50
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6,648.50
6,648.00
6,647.50
6,647.00
6,646.50
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6,644.50
6,644.00
6,643.50
6,643.00
6,642.50
6,642.00
6,641.50
6,641.00
6,640.50
6,640.00
6,639.50
6,639.00
6,638.50
6,638.00
-2.5
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
10.5
11.0
11.5
12.0

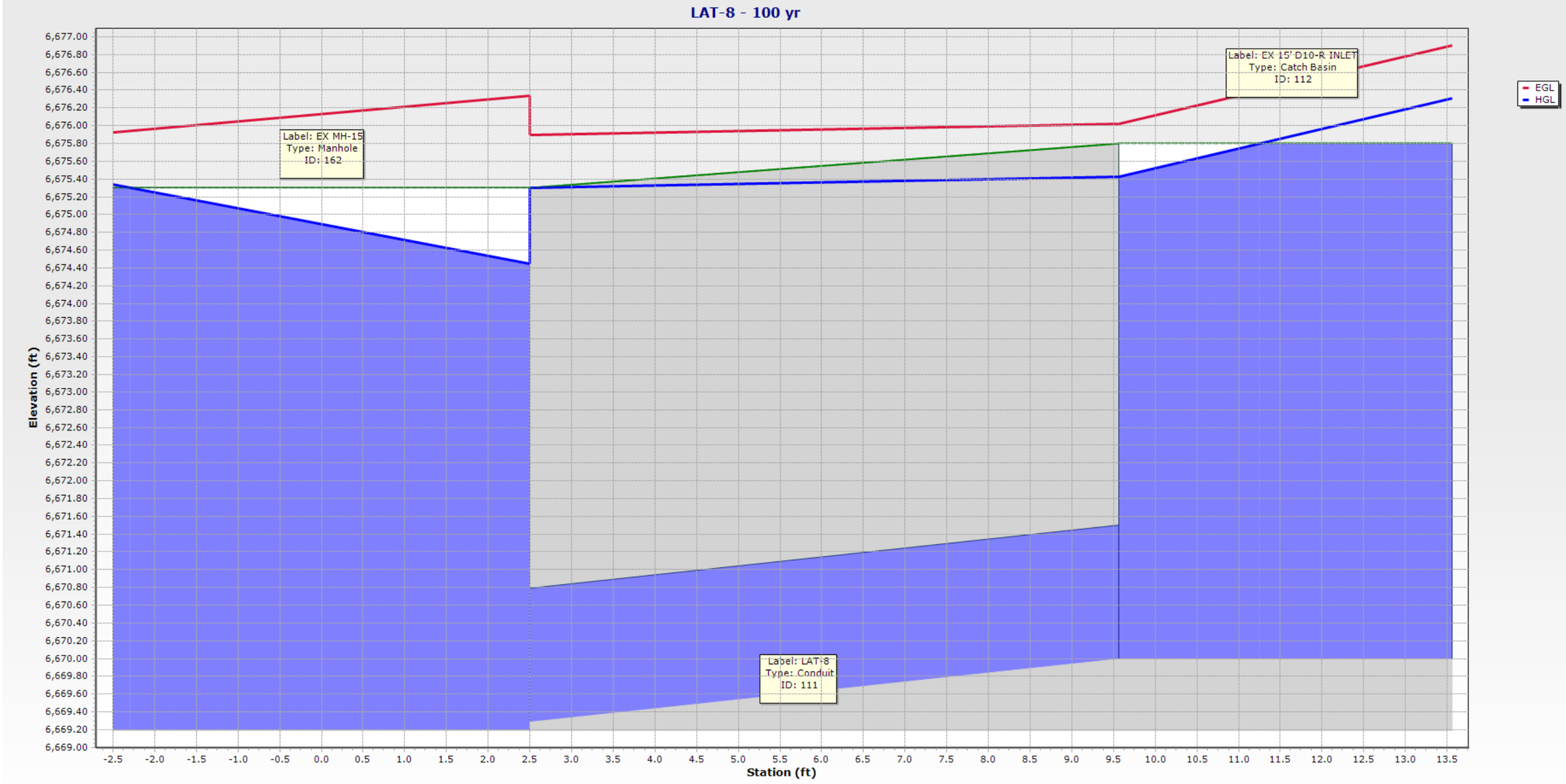

LAT-3 - 100 yr
Label: MH-3
Type: Manhole
ID: 226
Label: POND 5 OUTFALL
Type: Catch Basin
ID: 251
Label: LAT-3
Type: Conduit
ID: 247
EGL
HGL
Elevation (ft)
6,659.00
6,658.50
6,658.00
6,657.50
6,657.00
6,656.50
6,656.00
6,655.50
6,655.00
6,654.50
6,654.00
6,653.50
6,653.00
6,652.50
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6,648.50
6,648.00
6,647.50
6,647.00
6,646.50
6,646.00
6,645.50
6,645.00
6,644.50
6,644.00
6,643.50
6,643.00
6,642.50
-2.6 -2.4 -2.2 -2.0 -1.8 -1.6 -1.4 -1.2 -1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0 4.2 4.4 4.6 4.8 5.0 5.2 5.4 5.6 5.8 6.0 6.2 6.4 6.6 6.8 7.0 7.2 7.4 7.6
Station (ft)

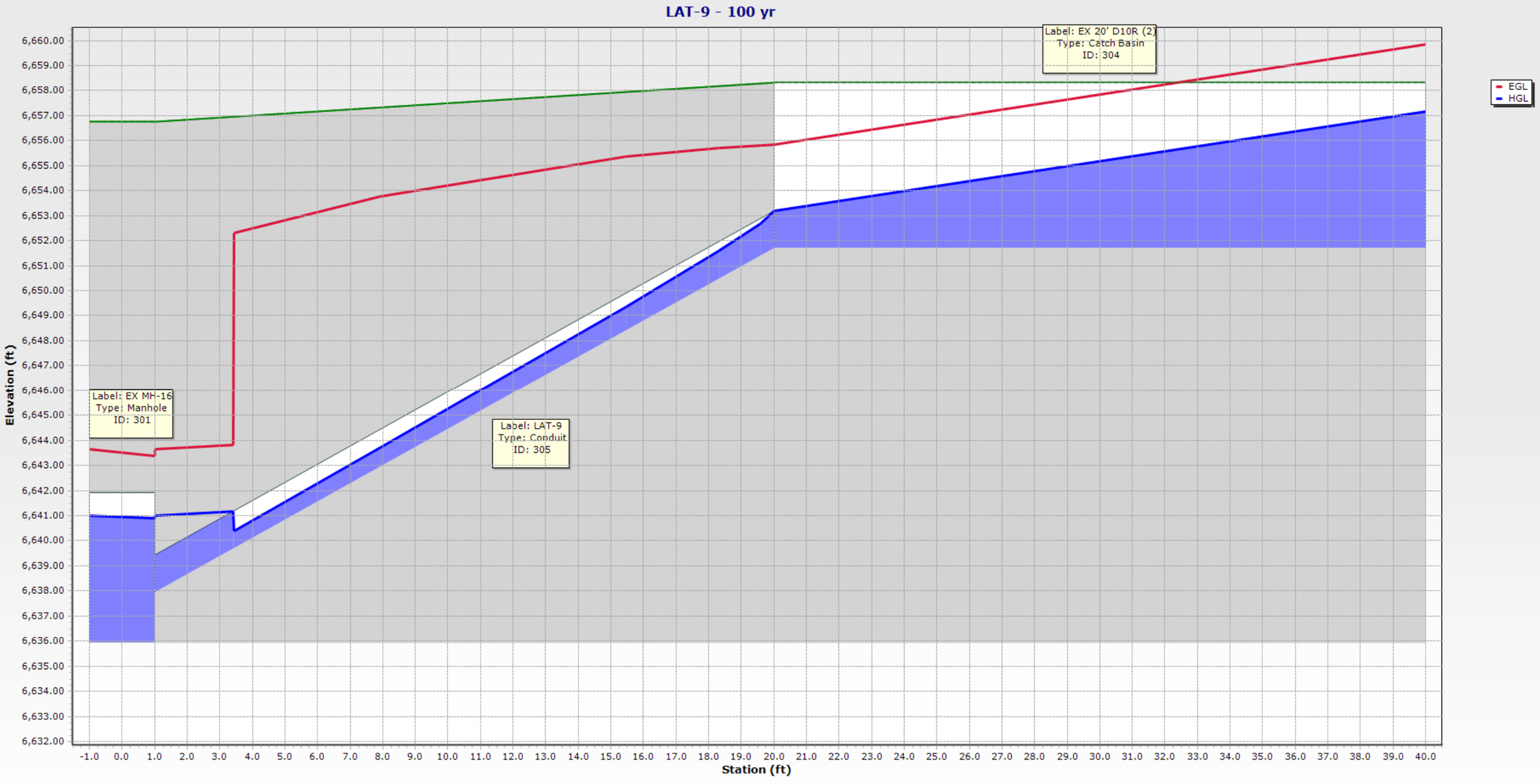

LAT-4 - 100 yr
Label: MH-4
Type: Manhole
ID: 228
Label: POND 6 OUTFALL
Type: Catch Basin
ID: 252
Label: LAT-4
Type: Conduit
ID: 245
EGL
HGL
Elevation (ft)
6,659.50
6,659.00
6,658.50
6,658.00
6,657.50
6,657.00
6,656.50
6,656.00
6,655.50
6,655.00
6,654.50
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6,650.50
6,650.00
6,649.50
6,649.00
6,648.50
6,648.00
6,647.50
6,647.00
6,646.50
6,646.00
-2.6 -2.4 -2.2 -2.0 -1.8 -1.6 -1.4 -1.2 -1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0 4.2 4.4 4.6 4.8 5.0 5.2 5.4 5.6 5.8 6.0 6.2 6.4 6.6 6.8 7.0 7.2 7.4 7.6 7.8 8.0
Station (ft)


LAT-5 - 100 yr
Label: MH-6
Type: Manhole
ID: 234
Label: INLET 8
Type: Catch Basin
ID: 243
Label: LAT-5
Type: Conduit
ID: 242
EGL
HGL
Elevation (ft)
Station (ft)
6,659.50
6,659.00
6,658.50
6,658.00
6,657.50
6,657.00
6,656.50
6,656.00
6,655.50
6,655.00
6,654.50
6,654.00
6,653.50
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6,652.50
6,652.00
6,651.50
6,651.00
6,650.50
6,650.00
6,649.50
6,649.00
6,648.50
6,648.00
6,647.50
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0


LAT-6 - 100 yr
EGL
HGL
Elevation (ft)
6,669.50
6,669.00
6,668.50
6,668.00
6,667.50
6,667.00
6,666.50
6,666.00
6,665.50
6,665.00
6,664.50
6,664.00
6,663.50
6,663.00
6,662.50
6,662.00
6,661.50
6,661.00
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6,653.50
6,653.00
6,652.50
6,652.00
6,651.50
6,651.00
6,650.50
6,650.00
6,649.50
6,649.00
6,648.50
Label: EX 5' D10-R INLET
Type: Catch Basin
ID: 126
Label: EX TAP 60" W/18"
Type: Manhole
ID: 192
Label: LAT-6
Type: Conduit
ID: 125
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0
210.0
220.0
230.0
240.0
250.0
260.0
270.0
Station (ft)


LAT-7 - 100 yr
Label: EX MH-13
Type: Manhole
ID: 278
Label: EX CDOT TYPE D INLET
Type: Catch Basin
ID: 116
Label: LAT-7
Type: Conduit
ID: 115
EGL
HGL
Elevation (ft)
6,662.50
6,662.00
6,661.50
6,661.00
6,660.50
6,660.00
6,659.50
6,659.00
6,658.50
6,658.00
6,657.50
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6,644.50
6,644.00
6,643.50
6,643.00
6,642.50
6,642.00
6,641.50
6,641.00
6,640.50
-2.0 -1.0 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0 25.0 26.0 27.0 28.0 29.0 30.0 31.0 32.0 33.0 34.0 35.0 36.0 37.0
Station (ft)


LAT-8 - 100 yr
Label: EX MH-15
Type: Manhole
ID: 162
Label: EX 15' D10-R INLET
Type: Catch Basin
ID: 112
Label: LAT-8
Type: Conduit
ID: 111
EGL
HGL
Elevation (ft)
Station (ft)
6,677.00
6,676.80
6,676.60
6,676.40
6,676.20
6,676.00
6,675.80
6,675.60
6,675.40
6,675.20
6,675.00
6,674.80
6,674.60
6,674.40
6,674.20
6,674.00
6,673.80
6,673.60
6,673.40
6,673.20
6,673.00
6,672.80
6,672.60
6,672.40
6,672.20
6,672.00
6,671.80
6,671.60
6,671.40
6,671.20
6,671.00
6,670.80
6,670.60
6,670.40
6,670.20
6,670.00
6,669.80
6,669.60
6,669.40
6,669.20
6,669.00
-2.5 -2.0 -1.5 -1.0 -0.5 0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5


LAT-9 - 100 yr
Label: EX 20' D10R (2)
Type: Catch Basin
ID: 304
Label: EX MH-16
Type: Manhole
ID: 301
Label: LAT-9
Type: Conduit
ID: 305
EGL
HGL
Elevation (ft)
Station (ft)
6,660.00
6,659.00
6,658.00
6,657.00
6,656.00
6,655.00
6,654.00
6,653.00
6,652.00
6,651.00
6,650.00
6,649.00
6,648.00
6,647.00
6,646.00
6,645.00
6,644.00
6,643.00
6,642.00
6,641.00
6,640.00
6,639.00
6,638.00
6,637.00
6,636.00
6,635.00
6,634.00
6,633.00
6,632.00
-1.0 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0 25.0 26.0 27.0 28.0 29.0 30.0 31.0 32.0 33.0 34.0 35.0 36.0 37.0 38.0 39.0 40.0

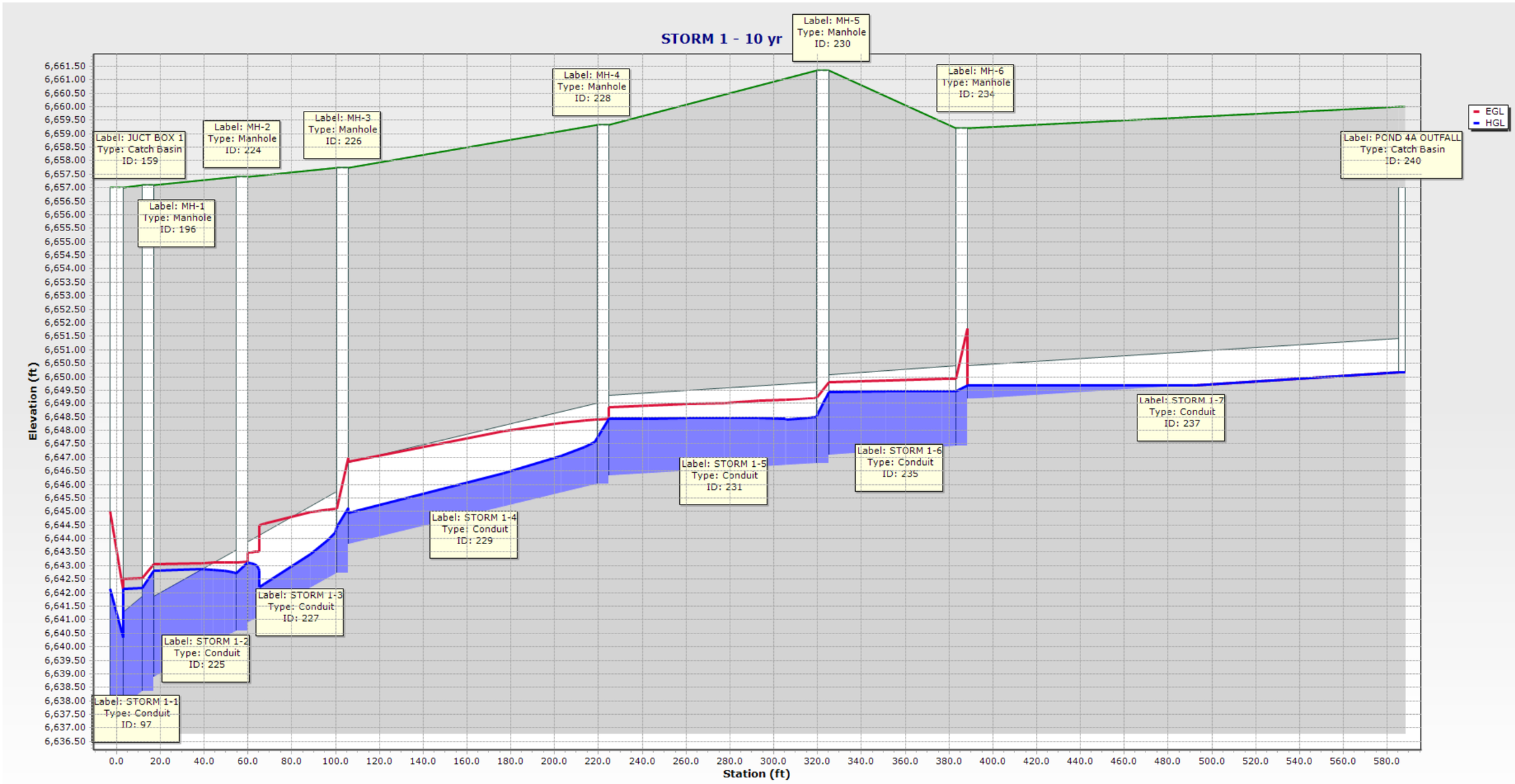
Conduit FlexTable: STRM - 100YR

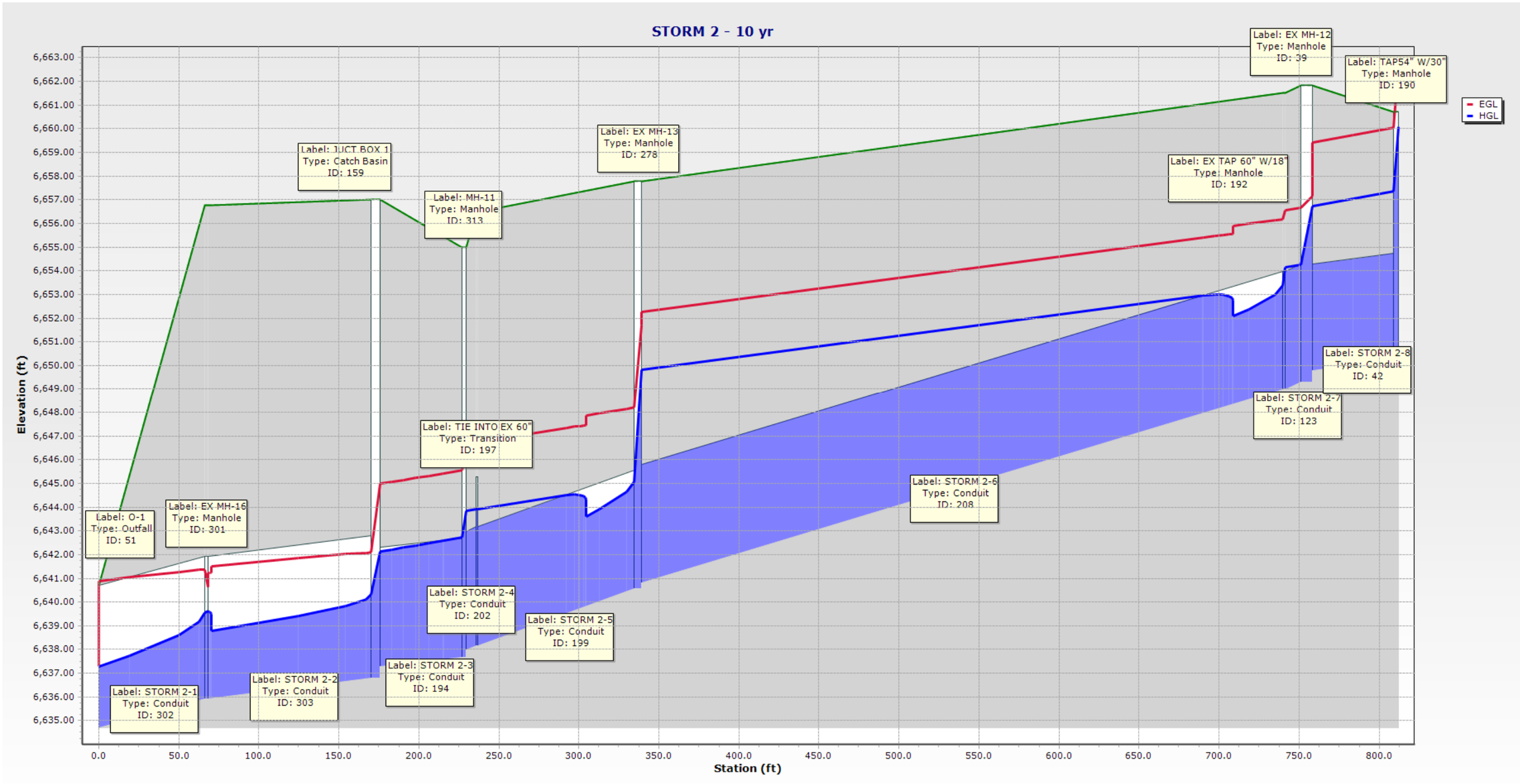
Label	ID	Upstream Structure	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number	Depth (Normal) (ft)	Depth (Critical) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
LAT-1	220	POND 0 OUTFALL	1.10	17.0	6.0	3.93	(N/A)	0.35	0.41	6,652.55	6,652.50	6,652.40	6,652.29
LAT-2	99	EX 20' D10-R	41.00	45.5	9.9	28.02	(N/A)	0.95	1.96	6,656.33	6,655.98	6,653.66	6,651.58
LAT-3	247	POND 5 OUTFALL	0.60	6.6	6.0	0.49	(N/A)	0.22	0.30	6,649.24	6,649.24	6,649.23	6,649.23
LAT-4	245	POND 6 OUTFALL	0.50	3.9	6.4	0.41	(N/A)	0.17	0.28	6,650.76	6,650.76	6,650.76	6,650.76
LAT-5	242	INLET 8	51.20	62.4	25.5	10.43	(N/A)	1.43	2.31	6,655.28	6,654.88	6,653.59	6,653.19
LAT-6	125	EX 5' D10-R INLET	3.20	27.9	269.9	1.81	(N/A)	0.54	0.68	6,661.80	6,661.55	6,661.75	6,661.50
LAT-7	115	EX CDOT TYPE D INLET	0.00	0.0	36.0	0.00	(N/A)	(N/A)	0.00	6,660.54	6,660.54	6,660.54	6,660.54
LAT-8	111	EX 15' D10-R INLET	10.90	41.9	11.6	6.17	(N/A)	0.68	1.27	6,676.02	6,675.89	6,675.42	6,675.30
LAT-9	305	EX 20' D10R (2)	23.10	32.5	30.0	35.96	(N/A)	0.59	1.48	6,655.85	6,643.64	6,653.18	6,640.99
STORM 1-1	97	MH-1	95.20	47.3	14.3	9.89	(N/A)	1.69	3.01	6,645.73	6,645.60	6,644.21	6,644.08
STORM 1-2	225	MH-2	54.50	40.9	42.8	7.71	(N/A)	1.34	2.40	6,648.11	6,647.83	6,647.19	6,646.90
STORM 1-3	227	MH-3	51.20	38.4	46.1	7.24	(N/A)	1.29	2.33	6,649.22	6,648.95	6,648.40	6,648.13
STORM 1-4	229	MH-4	51.10	56.2	118.9	7.23	(N/A)	1.61	2.33	6,650.74	6,650.05	6,649.93	6,649.23
STORM 1-5	231	MH-5	51.30	111.2	100.3	7.26	(N/A)	(N/A)	2.33	6,652.17	6,651.58	6,651.35	6,650.76
STORM 1-6	235	MH-6	51.30	108.2	63.3	7.26	(N/A)	(N/A)	2.33	6,653.63	6,653.25	6,652.81	6,652.43
STORM 1-7	237	POND 4A OUTFALL	0.30	6.6	201.1	0.24	(N/A)	0.22	0.21	6,653.20	6,653.19	6,653.20	6,653.19
STORM 2-1	302	EX MH-16	516.70	46.6	67.0	21.95	(N/A)	2.85	4.96	6,643.37	6,642.88	6,640.89	6,638.38
STORM 2-2	303	JUCT BOX 1	495.50	66.9	106.0	16.18	(N/A)	3.71	4.82	6,644.03	6,643.18	6,641.62	6,640.99
STORM 2-3	194	MH-11	402.60	187.0	55.2	20.50	(N/A)	(N/A)	4.89	6,651.93	6,650.61	6,645.40	6,644.08
STORM 2-4	202	TIE INTO EX 60"	402.60	100.3	8.0	20.50	(N/A)	4.11	4.89	6,654.74	6,654.55	6,648.21	6,648.01
STORM 2-5	199	EX MH-13	402.60	100.3	100.7	20.50	(N/A)	4.11	4.89	6,657.15	6,654.74	6,650.61	6,648.21
STORM 2-6	208	EX TAP 60" W/18"	387.50	104.5	403.6	19.74	(N/A)	4.34	4.87	6,675.53	6,666.59	6,669.48	6,660.54
STORM 2-7	123	EX MH-12	385.80	104.0	14.4	19.65	(N/A)	4.31	4.87	6,667.82	6,667.50	6,661.82	6,661.50
STORM 2-8	42	TAP54" W/30"	330.70	187.3	55.8	20.79	(N/A)	(N/A)	4.42	6,670.12	6,668.54	6,663.40	6,661.82
STORM 3-1	276	MH-7	3.50	29.7	192.5	8.36	(N/A)	0.47	0.76	6,650.09	6,648.26	6,649.77	6,648.13
STORM 3-2	282	MH-8	0.90	9.6	33.9	4.82	(N/A)	0.26	0.37	6,651.96	6,651.36	6,651.82	6,651.00
STORM 3-3	283	POND 4 OUTFALL	0.90	19.7	12.0	2.89	(N/A)	0.38	0.37	6,652.32	6,652.26	6,652.19	6,652.12
STORM 4-1	211	MH-9	2.60	56.7	186.3	3.86	(N/A)	0.67	0.65	6,651.16	6,650.26	6,650.93	6,650.10
STORM 4-2	214	MH-10	1.70	37.2	74.1	3.45	(N/A)	0.53	0.52	6,651.63	6,651.29	6,651.45	6,651.17
STORM 4-3	216	POND 1 OUTFALL	0.60	13.1	191.4	2.58	(N/A)	0.31	0.30	6,653.29	6,652.33	6,653.19	6,652.22
STORM 5-1	203	POND 3 OUTFALL	0.80	17.4	64.9	2.82	(N/A)	0.35	0.35	6,651.61	6,651.28	6,651.48	6,651.17
STORM 5-2	205	POND 2 OUTFALL	0.10	1.5	10.4	1.97	(N/A)	0.11	0.12	6,651.37	6,651.27	6,651.33	6,651.21
STORM 6-1	119	EX 45 DEG BEND	51.70	51.8	195.8	7.31	(N/A)	1.53	2.34	6,663.83	6,662.65	6,663.00	6,661.82
STORM 6-2	120	EX 20' D10-R INLET (3)	51.70	43.6	111.8	7.31	(N/A)	1.38	2.34	6,664.53	6,663.86	6,663.70	6,663.03
STORM 7-1	102	EX MH-14	19.50	59.6	65.3	11.03	(N/A)	0.83	1.46	6,664.68	6,662.43	6,662.79	6,660.54
STORM 7-2	108	EX MH-15	19.50	95.2	483.0	11.03	(N/A)	1.17	1.46	6,676.34	6,659.69	6,674.45	6,657.80

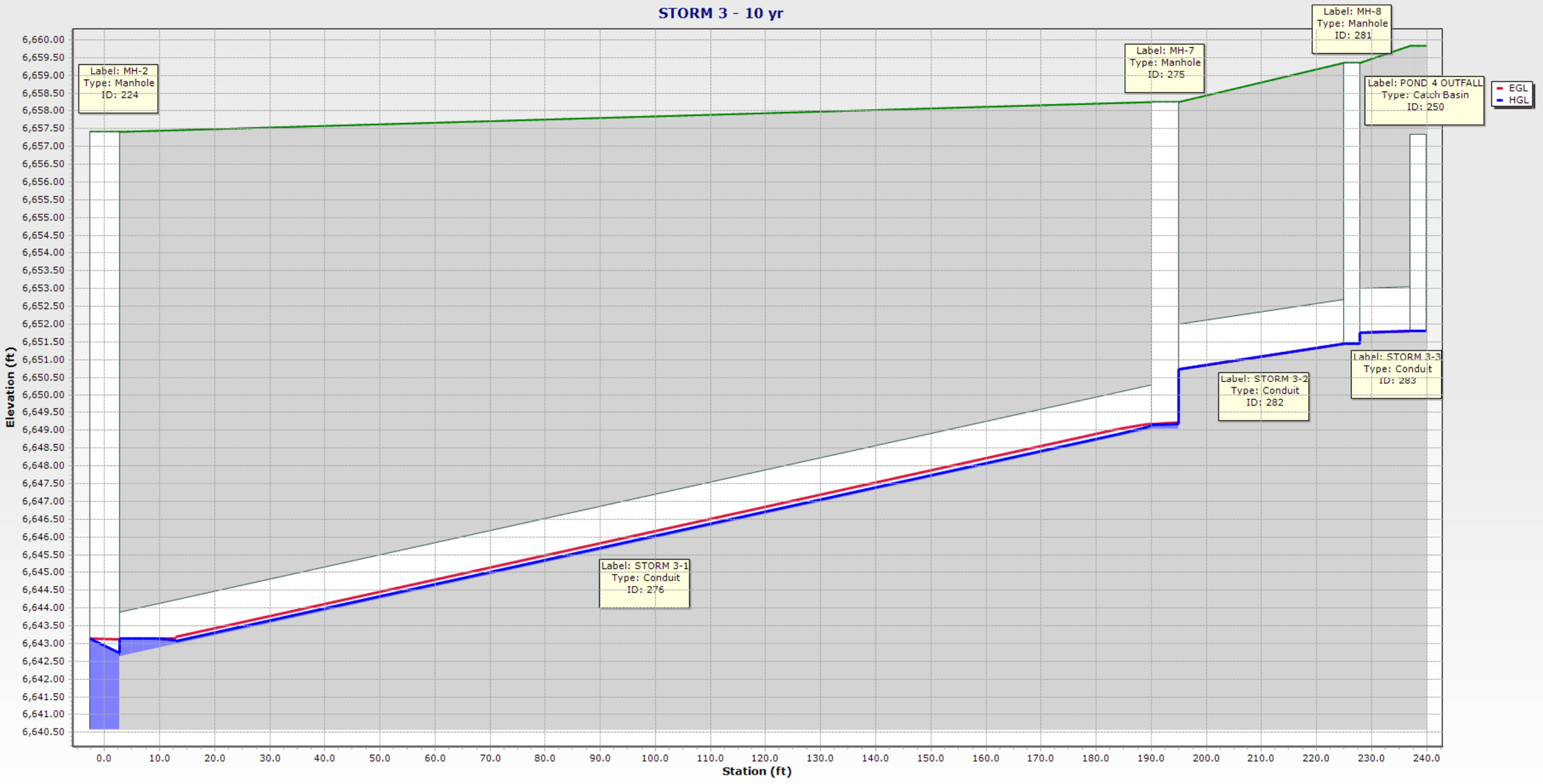
Conduit FlexTable: STRM - 100YR

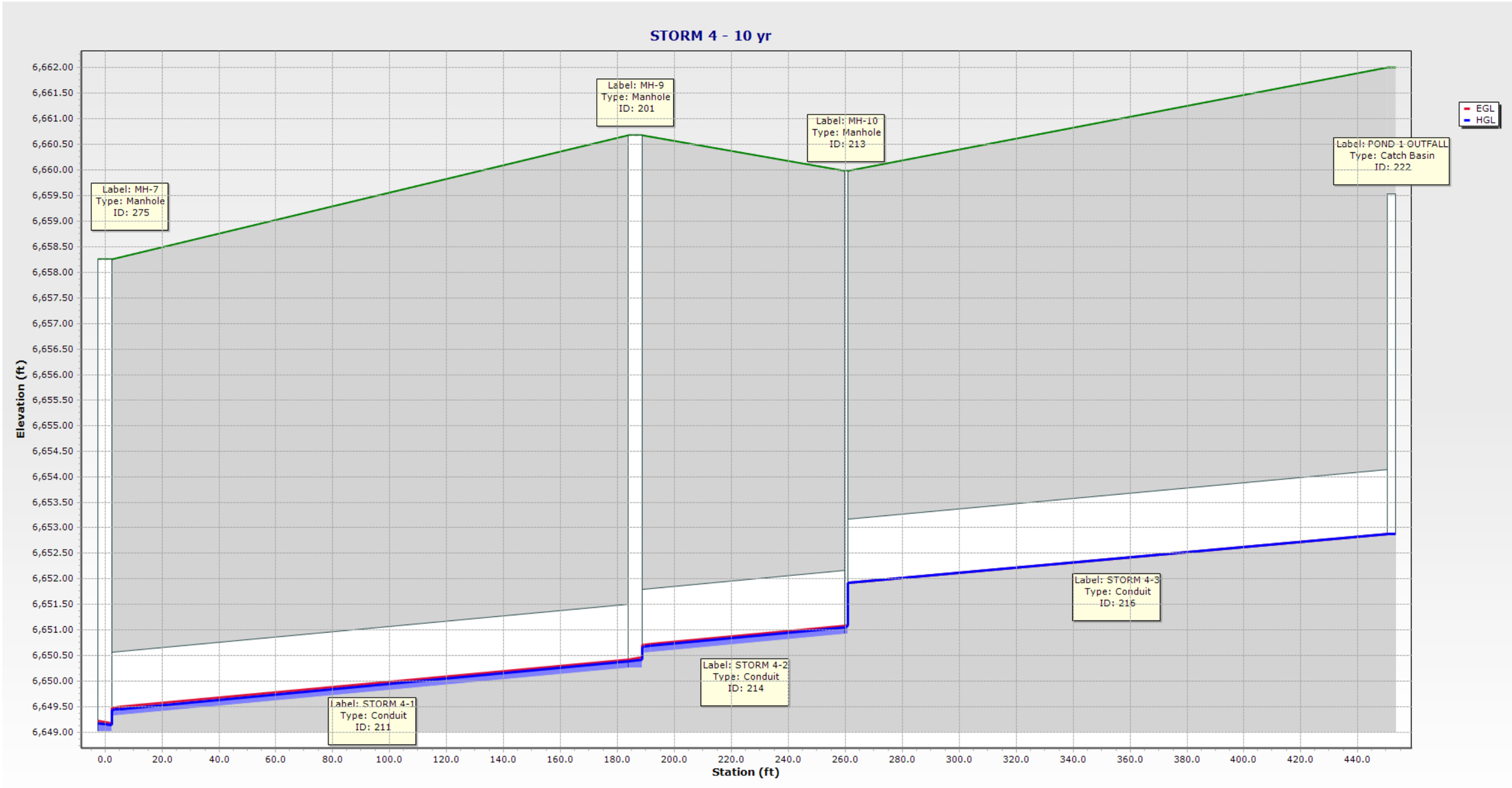
Label	ID	Upstream Structure	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number	Depth (Normal) (ft)	Depth (Critical) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
STORM 7-2	108	EX MH-15	19.50	95.2	483.0	11.03	(N/A)	1.17	1.46	6,676.34	6,659.69	6,674.45	6,657.80
STORM 7-3	109	EX 45 DEG BEND (1)	9.10	44.4	519.8	11.25	(N/A)	0.70	1.17	6,690.90	6,675.71	6,690.31	6,675.30
STORM 7-4	106	EX 10' D10-R INLET	9.10	44.4	114.4	11.25	(N/A)	0.70	1.17	6,695.25	6,690.98	6,694.66	6,690.54

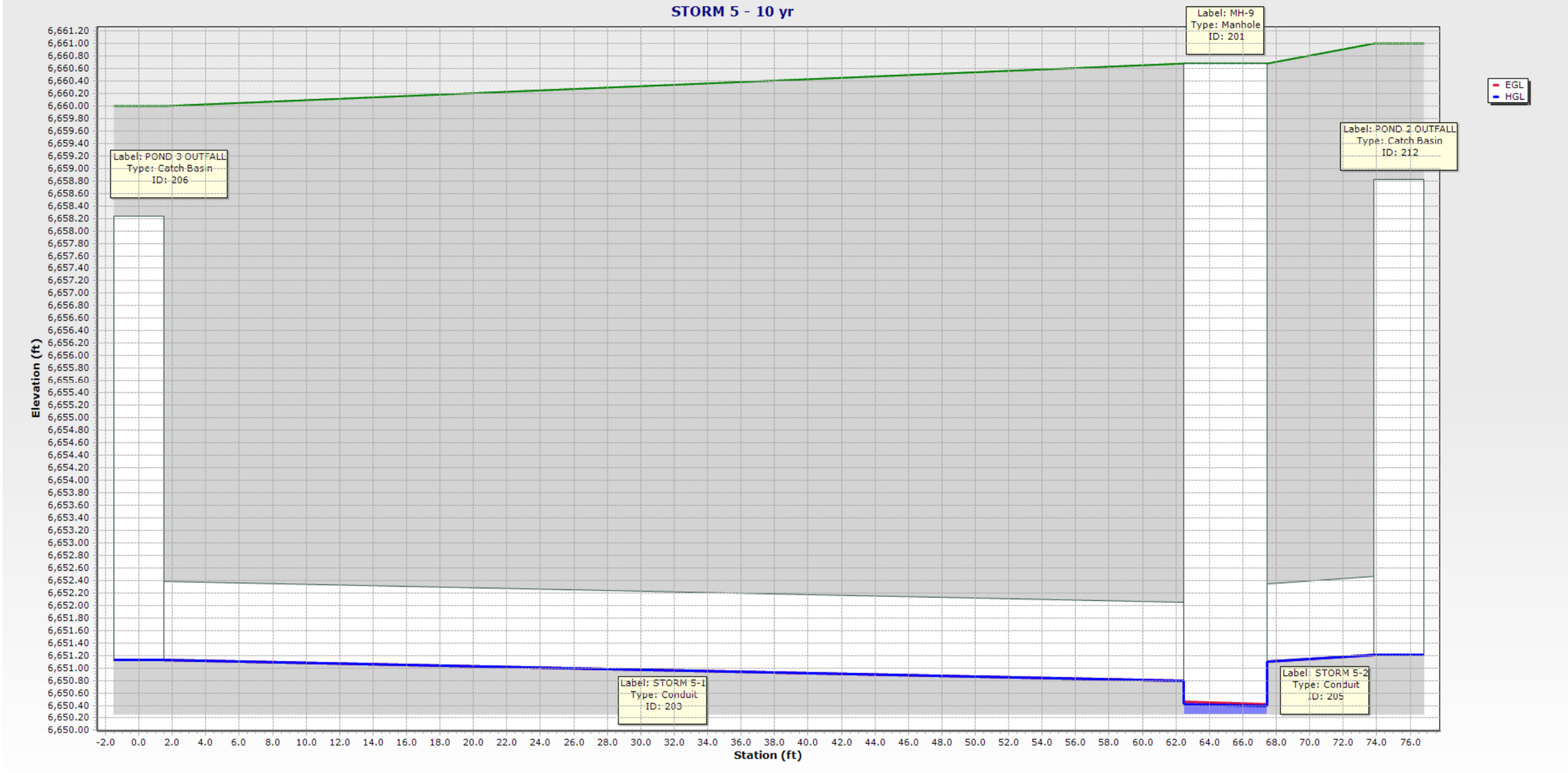
Headloss (ft)	Upstream Structure Hydraulic Grade Line (In) (ft)	Upstream Structure Velocity (In-Governing) (ft/s)	Upstream Structure Headloss Coefficient	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Conduit Description
0.09	6,652.69	3.09	1.500	0.22	6,659.99	6,657.49	6,651.96	6,652.05	Circle - 15.0 in
2.08	6,657.67	13.12	1.500	4.01	6,657.14	6,656.33	6,650.13	6,651.70	Circle - 24.0 in
0.00	6,650.23	0.49	1.500	0.01	6,657.07	6,654.45	6,648.46	6,648.61	Circle - 15.0 in
0.00	6,651.76	0.41	1.500	0.00	6,659.00	6,659.00	6,648.12	6,648.38	Circle - 15.0 in
0.40	6,657.14	10.43	1.500	2.54	6,659.25	6,658.50	6,648.01	6,649.03	Circle - 30.0 in
0.25	6,659.68	1.81	1.500	0.08	6,661.50	6,659.60	6,651.40	6,654.61	Circle - 18.0 in
0.00	6,660.00	0.00	1.500	0.00	6,657.78	6,660.00	6,644.31	6,654.46	Circle - 30.0 in
0.12	6,676.31	6.17	1.500	0.89	6,675.30	6,675.80	6,669.29	6,670.00	Circle - 18.0 in
12.19	6,657.18	13.10	1.500	4.00	6,656.75	6,658.33	6,637.93	6,651.70	Circle - 18.0 in
0.12	6,647.89	7.71	1.770	2.69	6,657.01	6,657.14	6,639.79	6,640.32	Circle - 42.0 in
0.28	6,649.12	2.85	1.020	0.94	6,657.14	6,658.86	6,640.82	6,642.52	Circle - 36.0 in
0.27	6,650.22	0.49	1.020	0.83	6,658.86	6,657.07	6,642.82	6,644.67	Circle - 36.0 in
0.70	6,651.75	0.41	1.020	0.83	6,657.07	6,659.00	6,645.48	6,646.07	Circle - 36.0 in
0.59	6,653.43	7.26	1.320	1.08	6,659.00	6,659.00	6,646.37	6,646.87	Circle - 36.0 in
0.39	6,654.21	10.43	0.470	0.38	6,659.00	6,659.25	6,647.17	6,647.51	Circle - 36.0 in
0.00	6,654.21	0.24	1.500	0.00	6,659.25	6,659.96	6,649.26	6,650.26	Circle - 15.0 in
2.51	6,640.99	13.07	0.040	0.10	6,640.70	6,656.75	6,634.70	6,635.93	Box - 8.3 x 6.0 ft
1.63	6,645.08	20.50	1.020	2.46	6,656.75	6,657.01	6,635.93	6,637.80	Box - 8.3 x 6.0 ft
1.40	6,649.09	20.50	0.400	2.61	6,657.01	6,655.00	6,637.80	6,638.88	Circle - 60.0 in
1.72	6,650.82	20.50	0.000	0.00	6,655.00	6,656.50	6,638.88	6,640.29	Circle - 60.0 in
0.78	6,661.53	19.74	1.520	9.93	6,656.50	6,657.78	6,640.29	6,640.56	Circle - 60.0 in
8.93	6,663.13	19.65	0.270	1.63	6,657.78	6,661.50	6,640.81	6,648.99	Circle - 60.0 in
0.32	6,667.94	7.31	1.020	6.12	6,661.50	6,661.82	6,648.99	6,649.28	Circle - 60.0 in
1.58	6,667.55	20.79	1.020	6.85	6,661.82	6,660.70	6,649.78	6,650.23	Circle - 54.0 in
0.48	6,649.83	4.06	1.020	0.23	6,658.86	6,658.85	6,645.07	6,648.72	Circle - 15.0 in
0.82	6,651.83	2.94	0.050	0.01	6,658.85	6,659.56	6,650.74	6,651.45	Circle - 15.0 in
0.06	6,652.37	2.84	1.500	0.19	6,659.56	6,659.83	6,651.75	6,651.80	Circle - 15.0 in
0.96	6,651.16	2.86	1.020	0.23	6,658.85	6,660.68	6,649.32	6,650.25	Circle - 15.0 in
0.29	6,651.64	2.62	1.020	0.19	6,660.68	6,659.99	6,650.55	6,650.92	Circle - 15.0 in
0.91	6,653.22	2.16	0.400	0.04	6,659.99	6,661.98	6,651.96	6,652.87	Circle - 15.0 in
0.35	6,653.72	2.62	1.500	0.16	6,661.98	6,659.53	6,652.87	6,653.26	Circle - 15.0 in
0.32	6,651.67	2.82	1.500	0.18	6,660.00	6,660.68	6,651.13	6,650.80	Circle - 15.0 in
0.12	6,651.39	1.64	1.500	0.06	6,661.00	6,660.68	6,651.21	6,651.10	Circle - 15.0 in
1.18	6,663.03	7.31	0.040	0.03	6,661.82	6,664.00	6,651.78	6,656.17	Circle - 36.0 in
0.67	6,664.95	7.31	1.500	1.25	6,664.00	6,664.83	6,656.17	6,659.71	Circle - 36.0 in
2.25	6,660.30	11.03	1.320	2.50	6,657.78	6,657.80	6,644.31	6,650.64	Circle - 18.0 in
16.65	6,675.34	6.17	0.470	0.89	6,657.80	6,675.30	6,650.84	6,669.19	Circle - 18.0 in
15.01	6,690.54	5.29	0.400	0.24	6,675.30	6,698.00	6,669.39	6,689.14	Circle - 18.0 in
4.11	6,695.54	6.17	1.500	0.89	6,698.00	6,701.00	6,689.14	6,693.49	Circle - 18.0 in

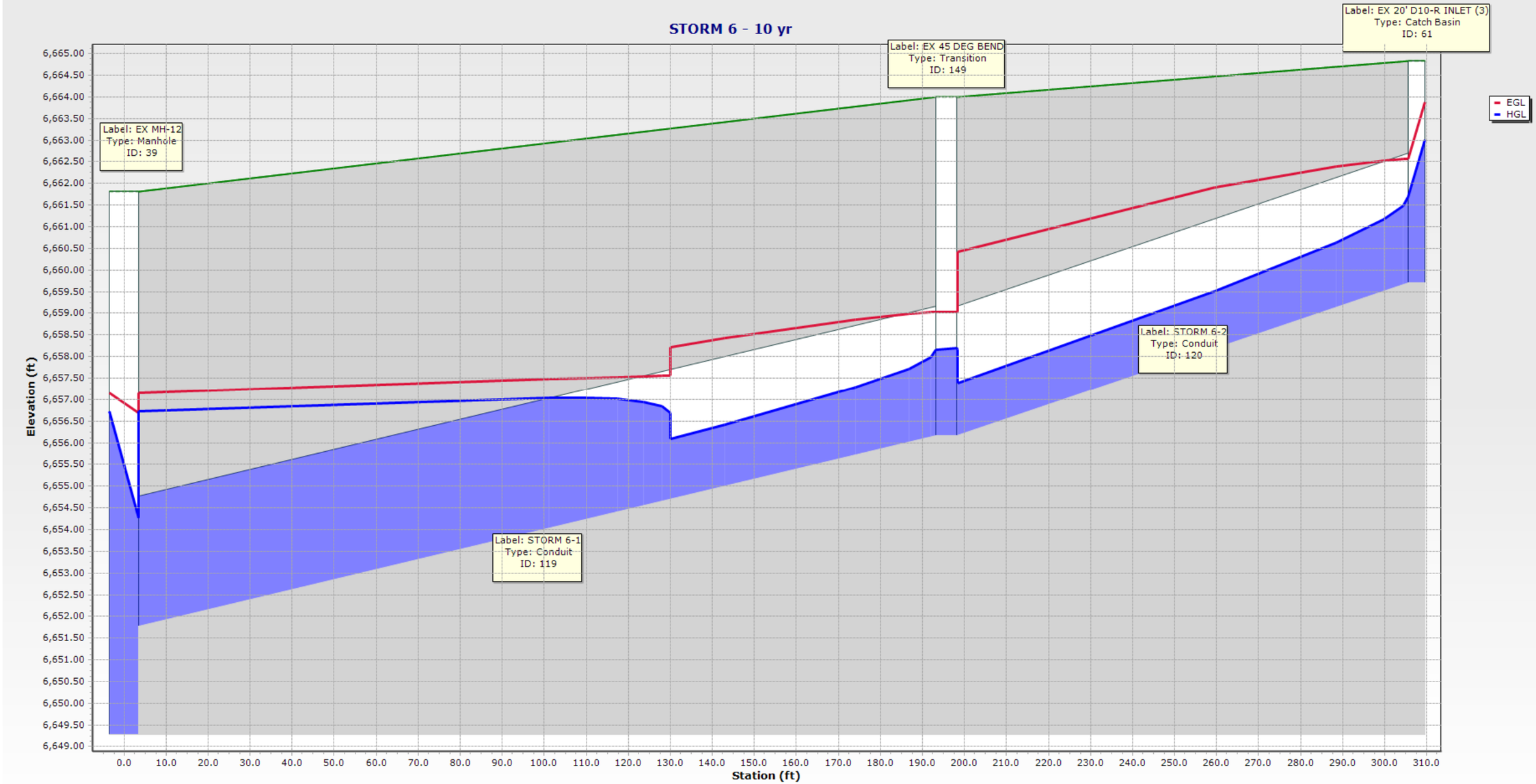

STORM 1 - 10 yr
Label: MH-5
Type: Manhole
ID: 230
Label: MH-4
Type: Manhole
ID: 228
Label: MH-6
Type: Manhole
ID: 234
Label: JUCT BOX 1
Type: Catch Basin
ID: 159
Label: MH-2
Type: Manhole
ID: 224
Label: MH-3
Type: Manhole
ID: 226
Label: POND 4A OUTFALL
Type: Catch Basin
ID: 240
EGL
HGL
Label: MH-1
Type: Manhole
ID: 196
Label: STORM 1-7
Type: Conduit
ID: 237
Label: STORM 1-5
Type: Conduit
ID: 231
Label: STORM 1-6
Type: Conduit
ID: 235
Label: STORM 1-4
Type: Conduit
ID: 229
Label: STORM 1-3
Type: Conduit
ID: 227
Label: STORM 1-2
Type: Conduit
ID: 225
Label: STORM 1-1
Type: Conduit
ID: 97
Elevation (ft)
6,661.50
6,661.00
6,660.50
6,660.00
6,659.50
6,659.00
6,658.50
6,658.00
6,657.50
6,657.00
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6,637.50
6,637.00
6,636.50
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
220.0
240.0
260.0
280.0
300.0
320.0
340.0
360.0
380.0
400.0
420.0
440.0
460.0
480.0
500.0
520.0
540.0
560.0
580.0
Station (ft)

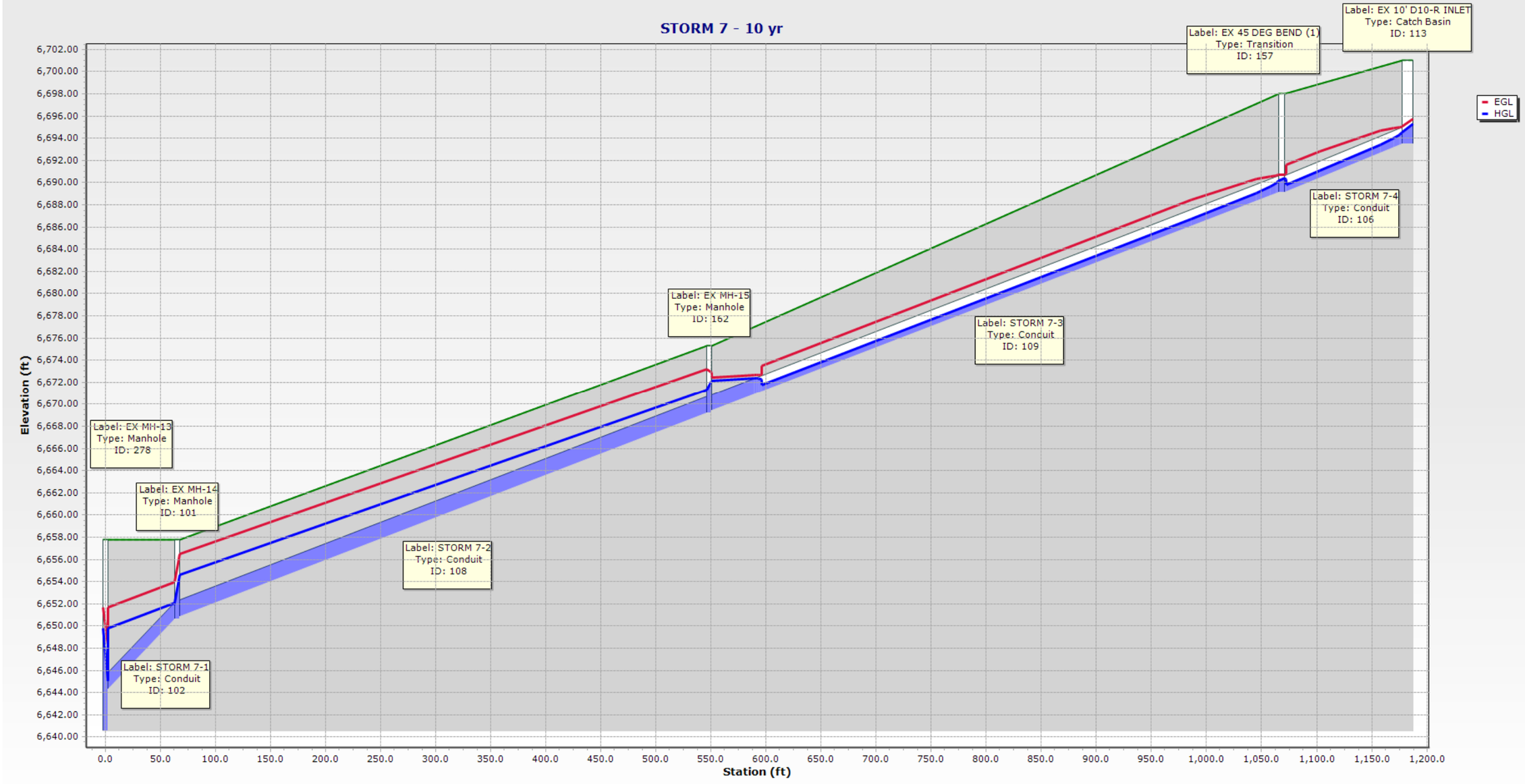

STORM 2 - 10 yr
Elevation (ft)
Station (ft)
6,663.00
6,662.00
6,661.00
6,660.00
6,659.00
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6,657.00
6,656.00
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6,641.00
6,640.00
6,639.00
6,638.00
6,637.00
6,636.00
6,635.00
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
500.0
550.0
600.0
650.0
700.0
750.0
800.0
EGL
HGL
Label: EX MH-12
Type: Manhole
ID: 39
Label: TAP54" W/30"
Type: Manhole
ID: 190
Label: JUCT BOX 1
Type: Catch Basin
ID: 159
Label: EX MH-13
Type: Manhole
ID: 278
Label: MH-11
Type: Manhole
ID: 313
Label: EX TAP 60" W/18"
Type: Manhole
ID: 192
Label: STORM 2-8
Type: Conduit
ID: 42
Label: STORM 2-7
Type: Conduit
ID: 123
Label: TIE INTO EX 60"
Type: Transition
ID: 197
Label: O-1
Type: Outfall
ID: 51
Label: EX MH-16
Type: Manhole
ID: 301
Label: STORM 2-6
Type: Conduit
ID: 208
Label: STORM 2-4
Type: Conduit
ID: 202
Label: STORM 2-5
Type: Conduit
ID: 199
Label: STORM 2-3
Type: Conduit
ID: 194
Label: STORM 2-2
Type: Conduit
ID: 303
Label: STORM 2-1
Type: Conduit
ID: 302

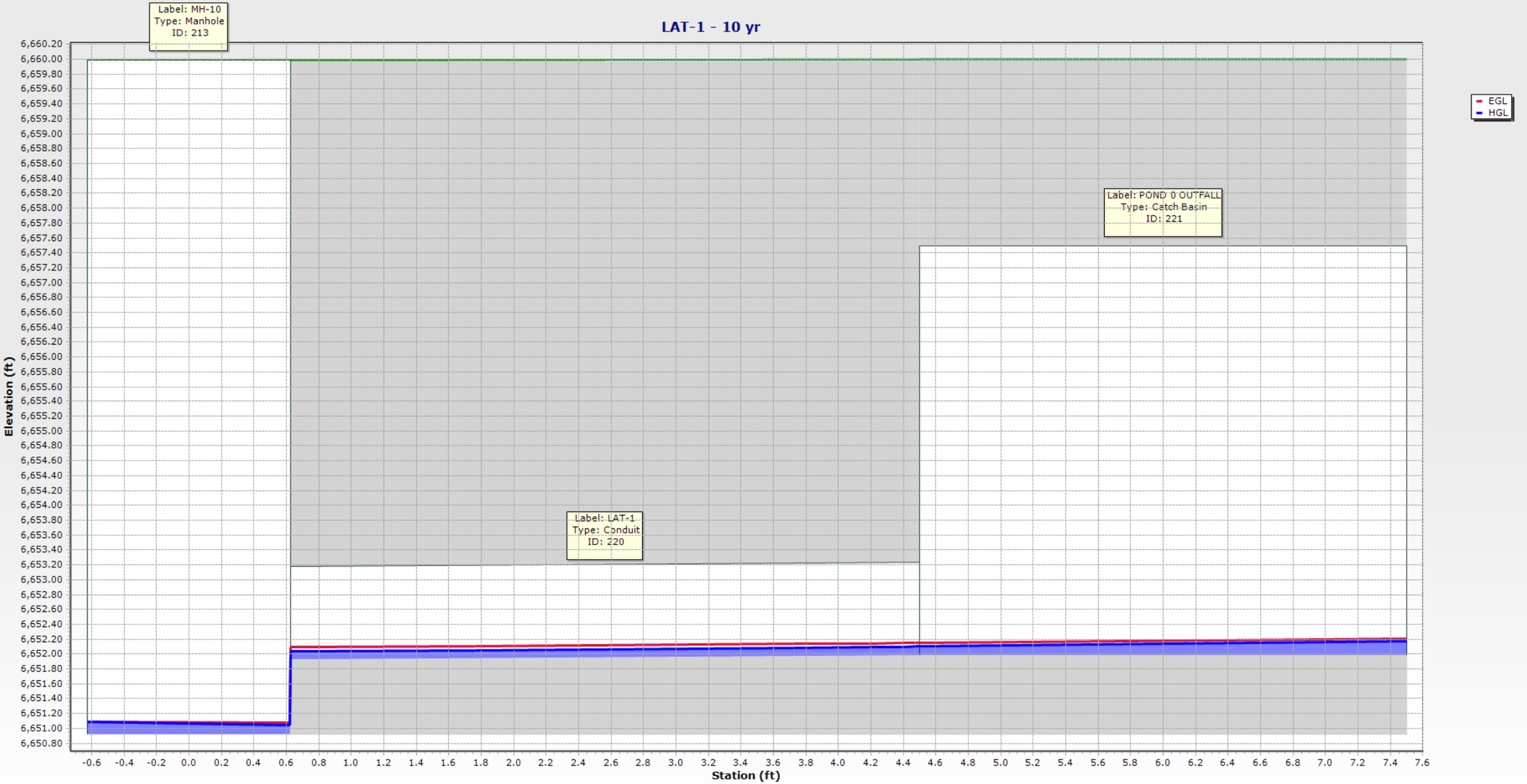

STORM 3 - 10 yr
Label: MH-2
Type: Manhole
ID: 224
Label: MH-7
Type: Manhole
ID: 275
Label: MH-8
Type: Manhole
ID: 281
Label: POND 4 OUTFALL
Type: Catch Basin
ID: 250
EGL
HGL
Label: STORM 3-3
Type: Conduit
ID: 283
Label: STORM 3-2
Type: Conduit
ID: 282
Label: STORM 3-1
Type: Conduit
ID: 276
Elevation (ft)
Station (ft)

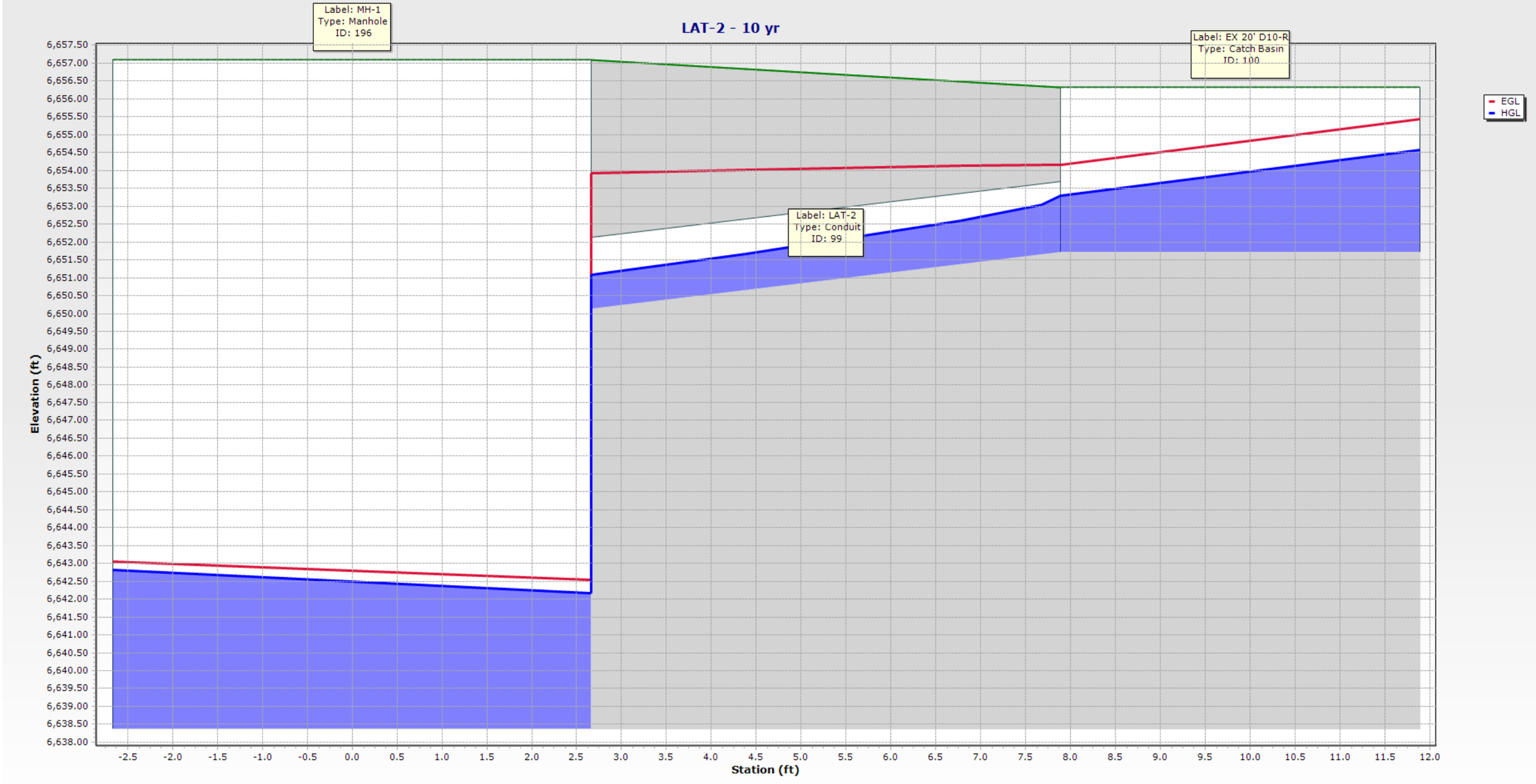

STORM 4 - 10 yr
Elevation (ft)
6,662.00
6,661.50
6,661.00
6,660.50
6,660.00
6,659.50
6,659.00
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6,652.50
6,652.00
6,651.50
6,651.00
6,650.50
6,650.00
6,649.50
6,649.00
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
220.0
240.0
260.0
280.0
300.0
320.0
340.0
360.0
380.0
400.0
420.0
440.0
Station (ft)
EGL
HGL
Label: MH-7
Type: Manhole
ID: 275
Label: MH-9
Type: Manhole
ID: 201
Label: MH-10
Type: Manhole
ID: 213
Label: POND 1 OUTFALL
Type: Catch Basin
ID: 222
Label: STORM 4-1
Type: Conduit
ID: 211
Label: STORM 4-2
Type: Conduit
ID: 214
Label: STORM 4-3
Type: Conduit
ID: 216

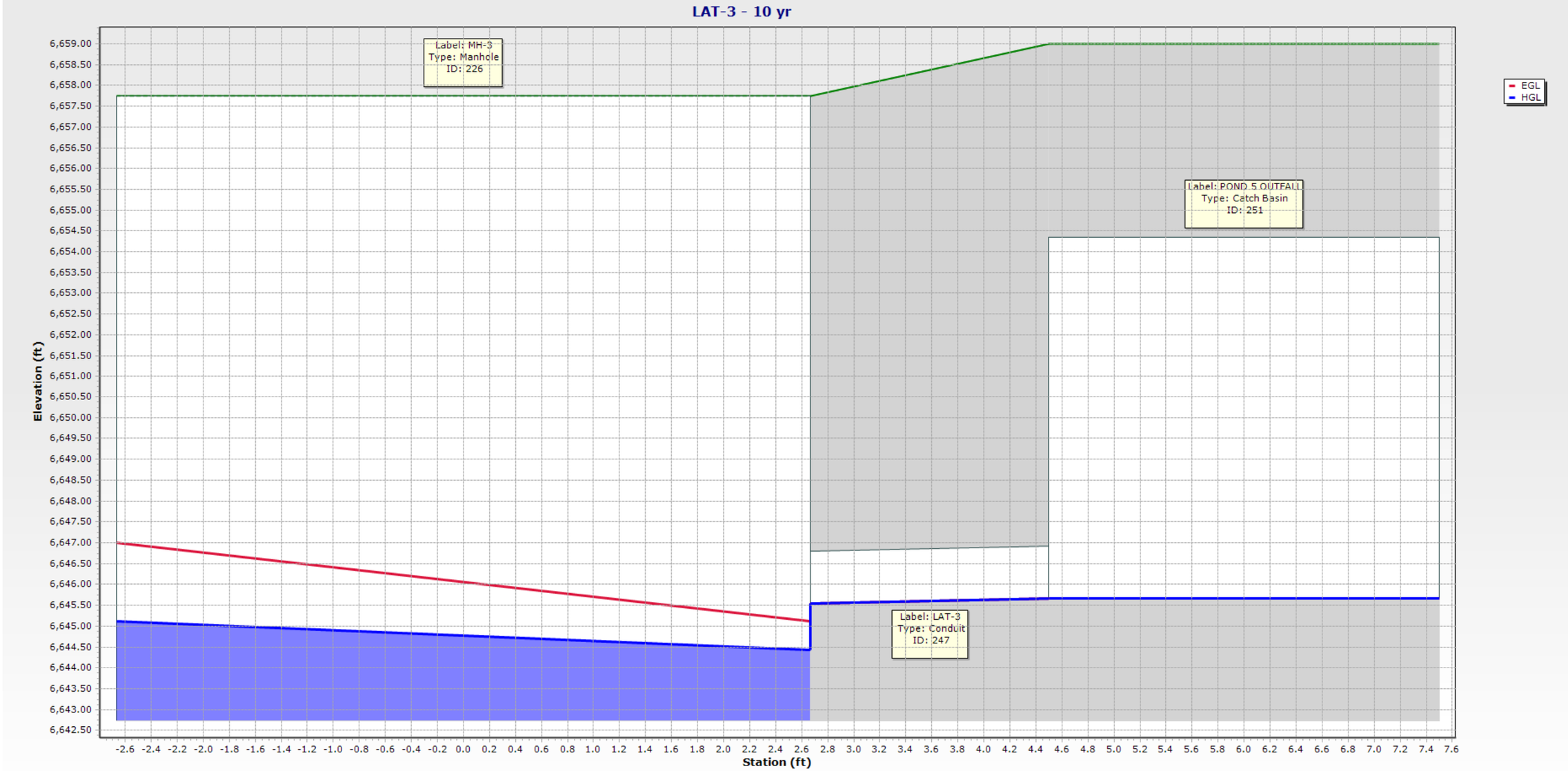

STORM 5 - 10 yr
Label: MH-9
Type: Manhole
ID: 201
Label: POND 2 OUTFALL
Type: Catch Basin
ID: 212
Label: POND 3 OUTFALL
Type: Catch Basin
ID: 206
EGL
HGL
Label: STORM 5-1
Type: Conduit
ID: 203
Label: STORM 5-2
Type: Conduit
ID: 205
Elevation (ft)
Station (ft)
6,661.20
6,661.00
6,660.80
6,660.60
6,660.40
6,660.20
6,660.00
6,659.80
6,659.60
6,659.40
6,659.20
6,659.00
6,658.80
6,658.60
6,658.40
6,658.20
6,658.00
6,657.80
6,657.60
6,657.40
6,657.20
6,657.00
6,656.80
6,656.60
6,656.40
6,656.20
6,656.00
6,655.80
6,655.60
6,655.40
6,655.20
6,655.00
6,654.80
6,654.60
6,654.40
6,654.20
6,654.00
6,653.80
6,653.60
6,653.40
6,653.20
6,653.00
6,652.80
6,652.60
6,652.40
6,652.20
6,652.00
6,651.80
6,651.60
6,651.40
6,651.20
6,651.00
6,650.80
6,650.60
6,650.40
6,650.20
6,650.00
-2.0 0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0 34.0 36.0 38.0 40.0 42.0 44.0 46.0 48.0 50.0 52.0 54.0 56.0 58.0 60.0 62.0 64.0 66.0 68.0 70.0 72.0 74.0 76.0

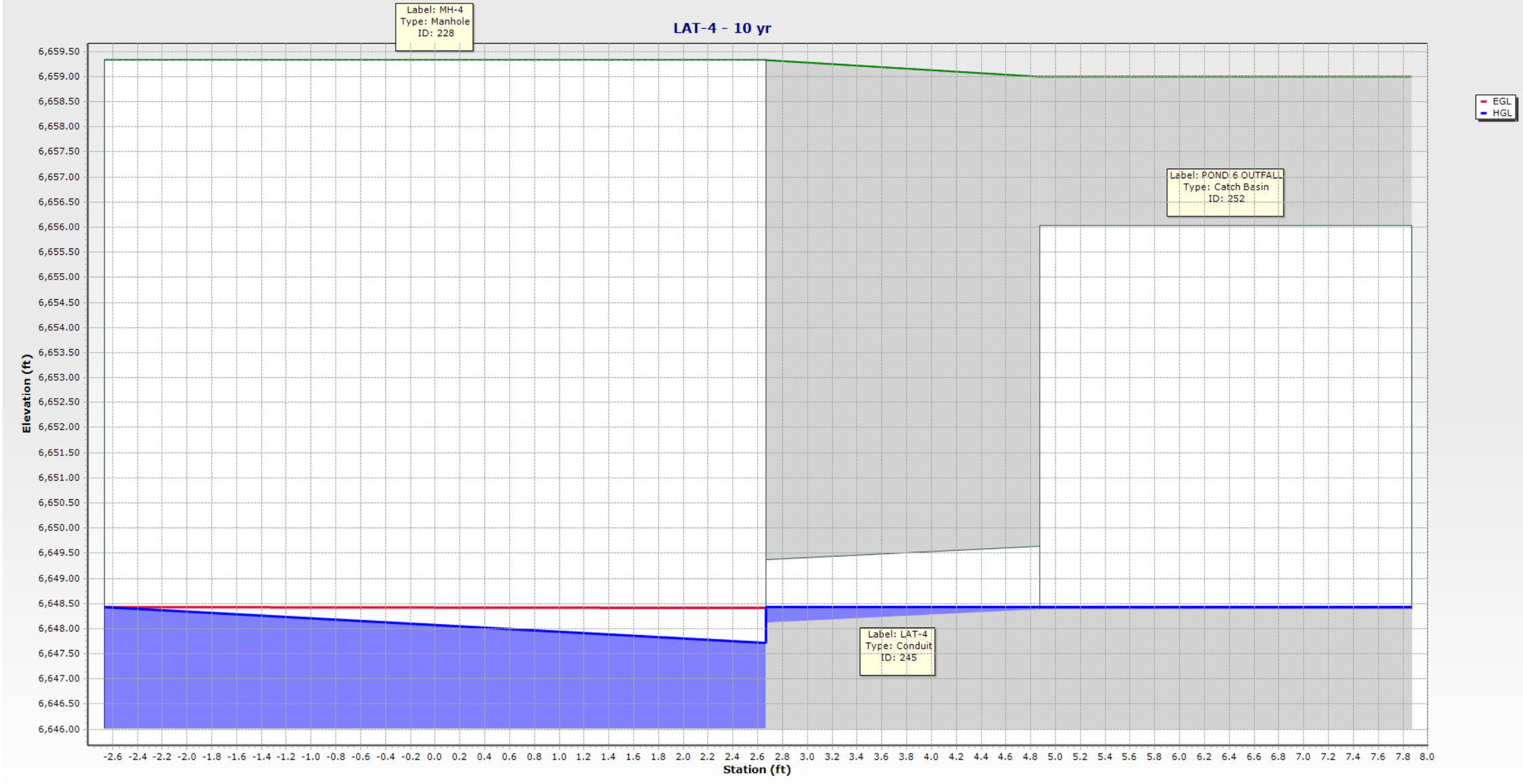

STORM 6 - 10 yr
Label: EX 20' D10-R INLET (3)
Type: Catch Basin
ID: 61
Label: EX 45 DEG BEND
Type: Transition
ID: 149
Label: EX MH-12
Type: Manhole
ID: 39
Label: STORM 6-2
Type: Conduit
ID: 120
Label: STORM 6-1
Type: Conduit
ID: 119
EGL
HGL
Elevation (ft)
6,665.00
6,664.50
6,664.00
6,663.50
6,663.00
6,662.50
6,662.00
6,661.50
6,661.00
6,660.50
6,660.00
6,659.50
6,659.00
6,658.50
6,658.00
6,657.50
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6,656.50
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6,652.50
6,652.00
6,651.50
6,651.00
6,650.50
6,650.00
6,649.50
6,649.00
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0
210.0
220.0
230.0
240.0
250.0
260.0
270.0
280.0
290.0
300.0
310.0
Station (ft)

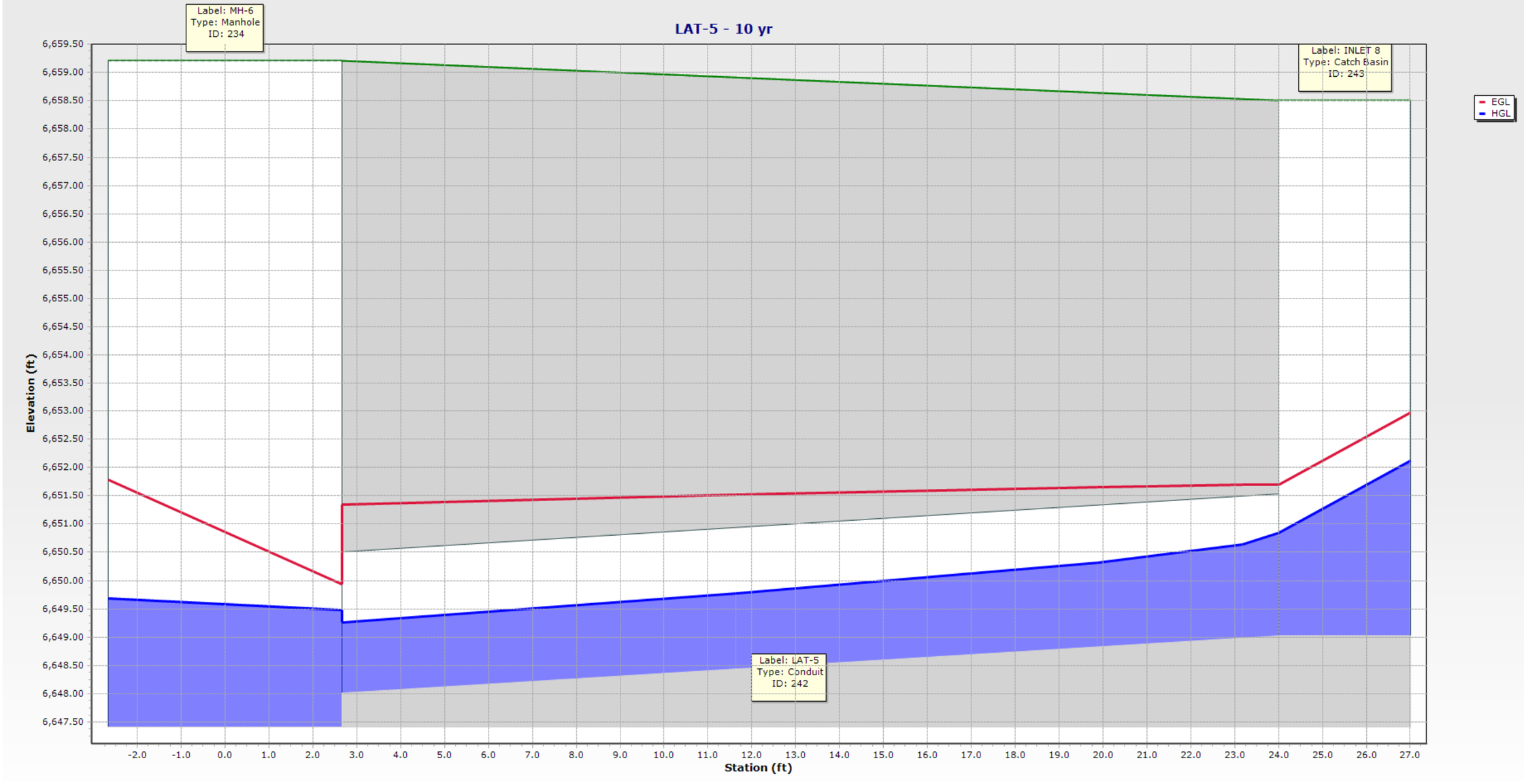

STORM 7 - 10 yr
Label: EX 10' D10-R INLET
Type: Catch Basin
ID: 113
Label: EX 45 DEG BEND (1)
Type: Transition
ID: 157
EGL
HGL
Label: STORM 7-4
Type: Conduit
ID: 106
Label: EX MH-15
Type: Manhole
ID: 162
Label: STORM 7-3
Type: Conduit
ID: 109
Label: EX MH-13
Type: Manhole
ID: 278
Label: EX MH-14
Type: Manhole
ID: 101
Label: STORM 7-2
Type: Conduit
ID: 108
Label: STORM 7-1
Type: Conduit
ID: 102
Elevation (ft)
6,702.00
6,700.00
6,698.00
6,696.00
6,694.00
6,692.00
6,690.00
6,688.00
6,686.00
6,684.00
6,682.00
6,680.00
6,678.00
6,676.00
6,674.00
6,672.00
6,670.00
6,668.00
6,666.00
6,664.00
6,662.00
6,660.00
6,658.00
6,656.00
6,654.00
6,652.00
6,650.00
6,648.00
6,646.00
6,644.00
6,642.00
6,640.00
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
500.0
550.0
600.0
650.0
700.0
750.0
800.0
850.0
900.0
950.0
1,000.0
1,050.0
1,100.0
1,150.0
1,200.0
Station (ft)

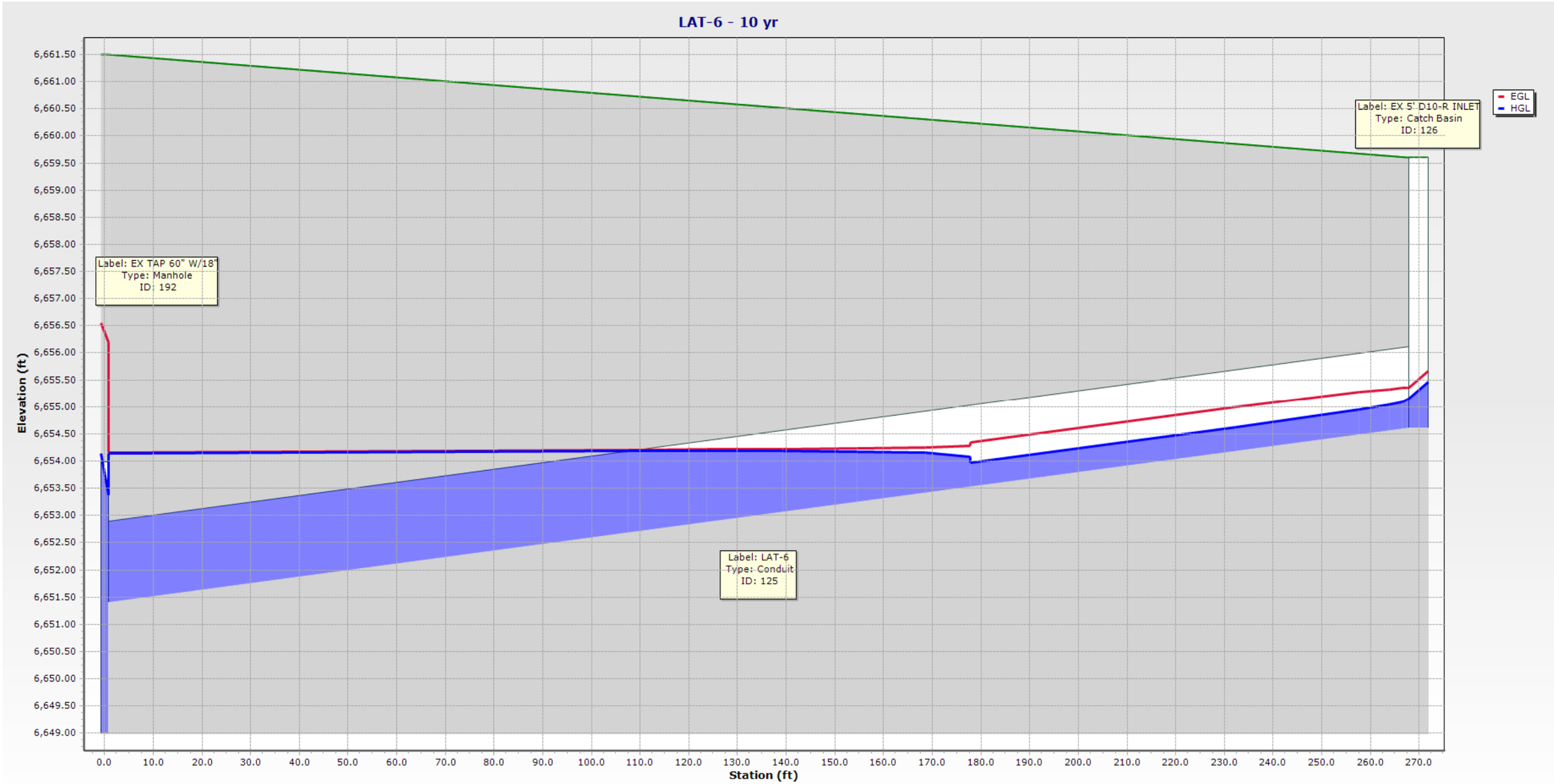

LAT-1 - 10 yr
Label: MH-10
Type: Manhole
ID: 213
Label: POND 0 OUTFALL
Type: Catch Basin
ID: 221
Label: LAT-1
Type: Conduit
ID: 220
EGL
HGL
Elevation (ft)
Station (ft)
6,660.20
6,660.00
6,659.80
6,659.60
6,659.40
6,659.20
6,659.00
6,658.80
6,658.60
6,658.40
6,658.20
6,658.00
6,657.80
6,657.60
6,657.40
6,657.20
6,657.00
6,656.80
6,656.60
6,656.40
6,656.20
6,656.00
6,655.80
6,655.60
6,655.40
6,655.20
6,655.00
6,654.80
6,654.60
6,654.40
6,654.20
6,654.00
6,653.80
6,653.60
6,653.40
6,653.20
6,653.00
6,652.80
6,652.60
6,652.40
6,652.20
6,652.00
6,651.80
6,651.60
6,651.40
6,651.20
6,651.00
6,650.80
-0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0 4.2 4.4 4.6 4.8 5.0 5.2 5.4 5.6 5.8 6.0 6.2 6.4 6.6 6.8 7.0 7.2 7.4 7.6

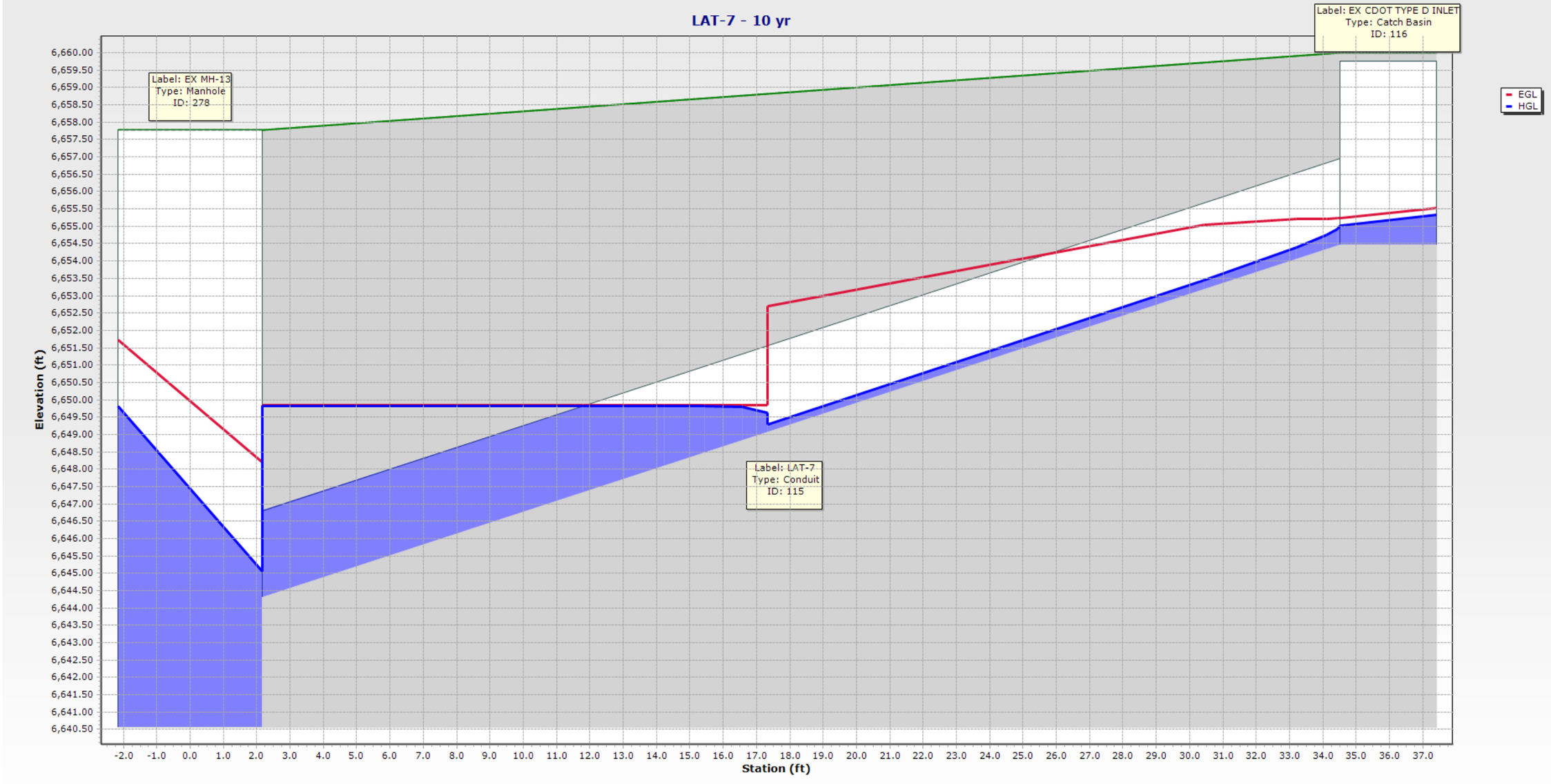

LAT-2 - 10 yr
Label: MH-1
Type: Manhole
ID: 196
Label: EX 20' D10-R
Type: Catch Basin
ID: 100
Label: LAT-2
Type: Conduit
ID: 99
EGL
HGL
Elevation (ft)
Station (ft)
6,657.50
6,657.00
6,656.50
6,656.00
6,655.50
6,655.00
6,654.50
6,654.00
6,653.50
6,653.00
6,652.50
6,652.00
6,651.50
6,651.00
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6,648.50
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6,647.50
6,647.00
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6,643.50
6,643.00
6,642.50
6,642.00
6,641.50
6,641.00
6,640.50
6,640.00
6,639.50
6,639.00
6,638.50
6,638.00
-2.5
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
10.5
11.0
11.5
12.0

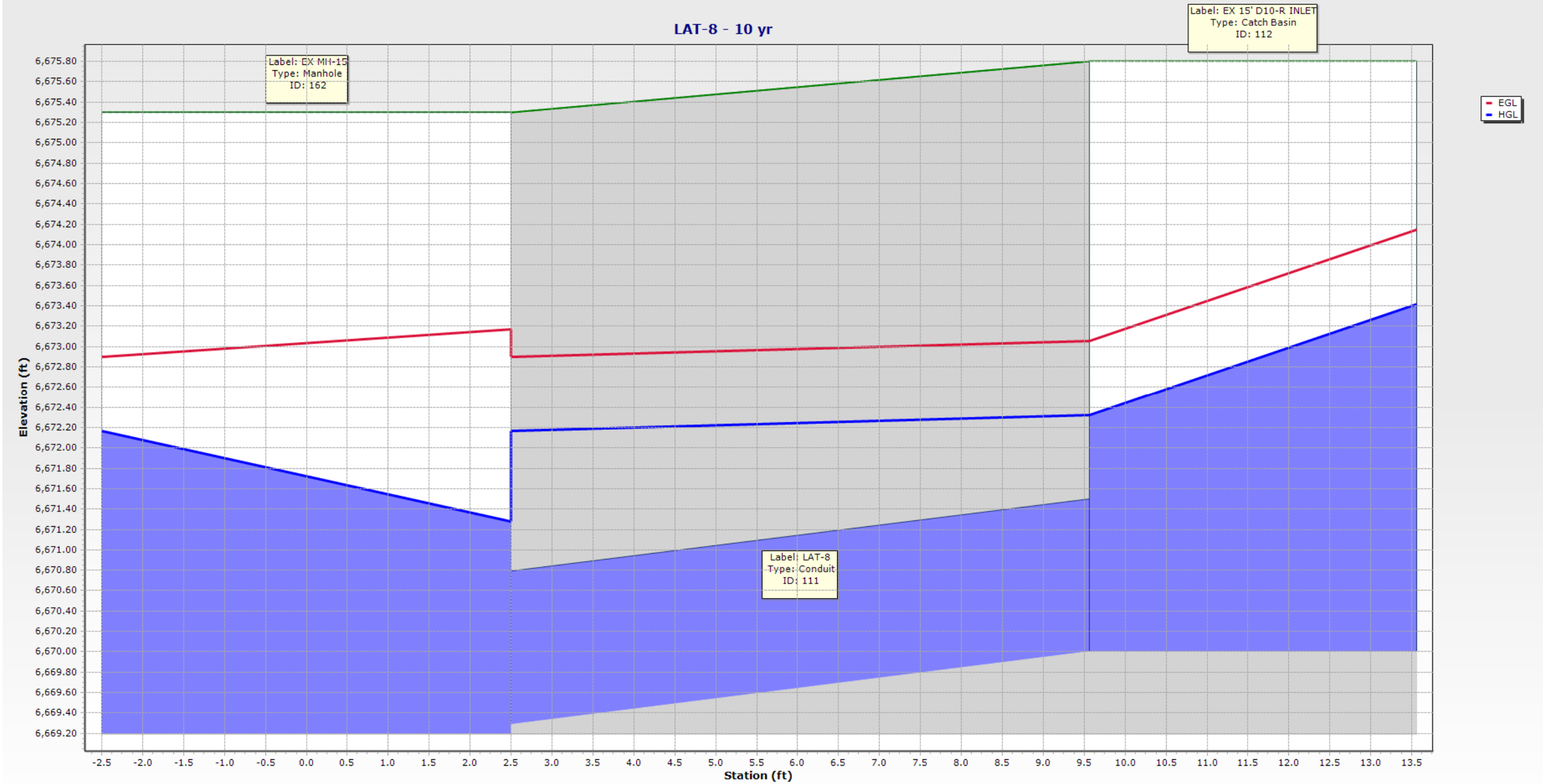

LAT-3 - 10 yr
Label: MH-3
Type: Manhole
ID: 226
Label: POND 5 OUTFALL
Type: Catch Basin
ID: 251
Label: LAT-3
Type: Conduit
ID: 247
EGL
HGL
Elevation (ft)
Station (ft)
6,659.00
6,658.50
6,658.00
6,657.50
6,657.00
6,656.50
6,656.00
6,655.50
6,655.00
6,654.50
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6,646.50
6,646.00
6,645.50
6,645.00
6,644.50
6,644.00
6,643.50
6,643.00
6,642.50
-2.6 -2.4 -2.2 -2.0 -1.8 -1.6 -1.4 -1.2 -1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0 4.2 4.4 4.6 4.8 5.0 5.2 5.4 5.6 5.8 6.0 6.2 6.4 6.6 6.8 7.0 7.2 7.4 7.6

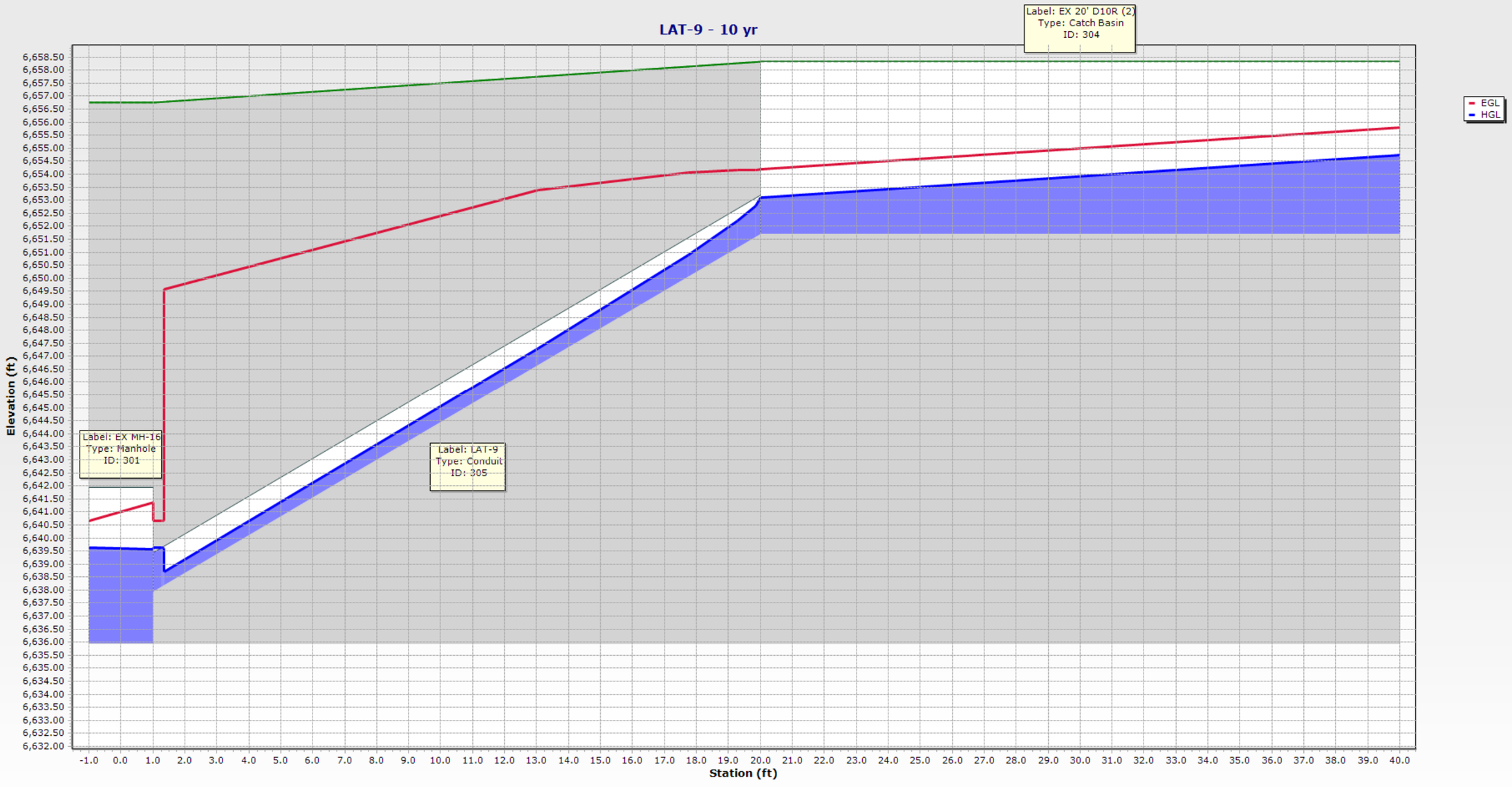

LAT-4 - 10 yr
Label: MH-4
Type: Manhole
ID: 228
Label: POND 6 OUTFALL
Type: Catch Basin
ID: 252
Label: LAT-4
Type: Conduit
ID: 245
EGL
HGL
Elevation (ft)
6,659.50
6,659.00
6,658.50
6,658.00
6,657.50
6,657.00
6,656.50
6,656.00
6,655.50
6,655.00
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6,649.50
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6,648.50
6,648.00
6,647.50
6,647.00
6,646.50
6,646.00
-2.6 -2.4 -2.2 -2.0 -1.8 -1.6 -1.4 -1.2 -1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0 4.2 4.4 4.6 4.8 5.0 5.2 5.4 5.6 5.8 6.0 6.2 6.4 6.6 6.8 7.0 7.2 7.4 7.6 7.8 8.0
Station (ft)


LAT-5 - 10 yr
Label: MH-6
Type: Manhole
ID: 234
Label: INLET 8
Type: Catch Basin
ID: 243
Label: LAT-5
Type: Conduit
ID: 242
EGL
HGL
Elevation (ft)
Station (ft)
6,659.50
6,659.00
6,658.50
6,658.00
6,657.50
6,657.00
6,656.50
6,656.00
6,655.50
6,655.00
6,654.50
6,654.00
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6,650.00
6,649.50
6,649.00
6,648.50
6,648.00
6,647.50
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0


LAT-6 - 10 yr
Elevation (ft)
6,661.50
6,661.00
6,660.50
6,660.00
6,659.50
6,659.00
6,658.50
6,658.00
6,657.50
6,657.00
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6,650.00
6,649.50
6,649.00
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0
210.0
220.0
230.0
240.0
250.0
260.0
270.0
Station (ft)
EGL
HGL
Label: EX TAP 60" W/18"
Type: Manhole
ID: 192
Label: EX 5' D10-R INLET
Type: Catch Basin
ID: 126
Label: LAT-6
Type: Conduit
ID: 125


LAT-7 - 10 yr
Label: EX MH-13
Type: Manhole
ID: 278
Label: EX CDOT TYPE D INLET
Type: Catch Basin
ID: 116
Label: LAT-7
Type: Conduit
ID: 115
EGL
HGL
Elevation (ft)
Station (ft)
6,660.00
6,659.50
6,659.00
6,658.50
6,658.00
6,657.50
6,657.00
6,656.50
6,656.00
6,655.50
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6,642.50
6,642.00
6,641.50
6,641.00
6,640.50
-2.0 -1.0 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0 25.0 26.0 27.0 28.0 29.0 30.0 31.0 32.0 33.0 34.0 35.0 36.0 37.0


LAT-8 - 10 yr
Label: EX MH-15
Type: Manhole
ID: 162
Label: EX 15' D10-R INLET
Type: Catch Basin
ID: 112
Label: LAT-8
Type: Conduit
ID: 111
EGL
HGL
Elevation (ft)
Station (ft)
6,675.80
6,675.60
6,675.40
6,675.20
6,675.00
6,674.80
6,674.60
6,674.40
6,674.20
6,674.00
6,673.80
6,673.60
6,673.40
6,673.20
6,673.00
6,672.80
6,672.60
6,672.40
6,672.20
6,672.00
6,671.80
6,671.60
6,671.40
6,671.20
6,671.00
6,670.80
6,670.60
6,670.40
6,670.20
6,670.00
6,669.80
6,669.60
6,669.40
6,669.20
-2.5 -2.0 -1.5 -1.0 -0.5 0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5


LAT-9 - 10 yr
Label: EX 20' D10R (2)
Type: Catch Basin
ID: 304
Label: EX MH-16
Type: Manhole
ID: 301
Label: LAT-9
Type: Conduit
ID: 305
EGL
HGL
Elevation (ft)
6,658.50
6,658.00
6,657.50
6,657.00
6,656.50
6,656.00
6,655.50
6,655.00
6,654.50
6,654.00
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6,635.50
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6,634.50
6,634.00
6,633.50
6,633.00
6,632.50
6,632.00
-1.0 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0 25.0 26.0 27.0 28.0 29.0 30.0 31.0 32.0 33.0 34.0 35.0 36.0 37.0 38.0 39.0 40.0
Station (ft)

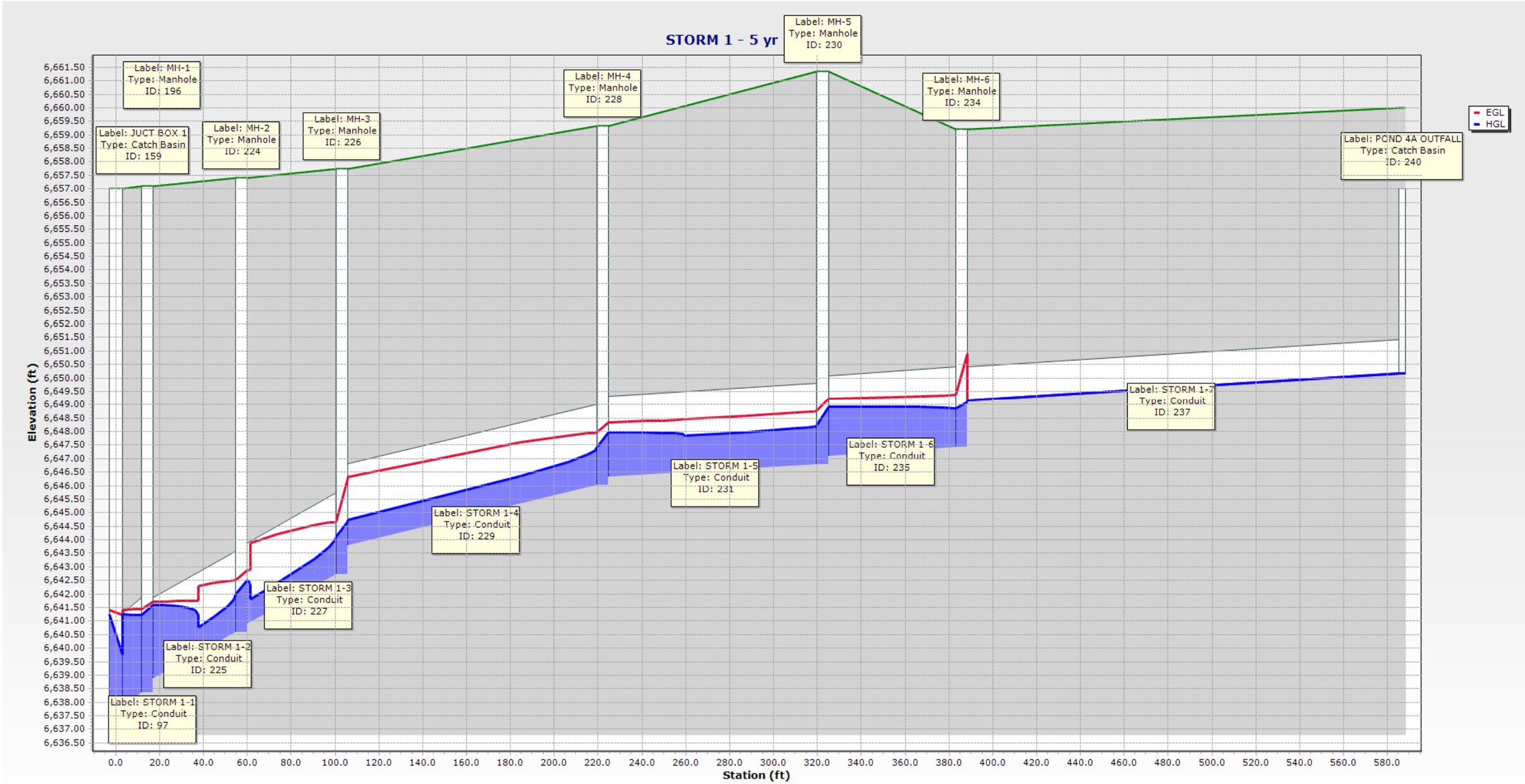
Conduit FlexTable: STRM - 10YR

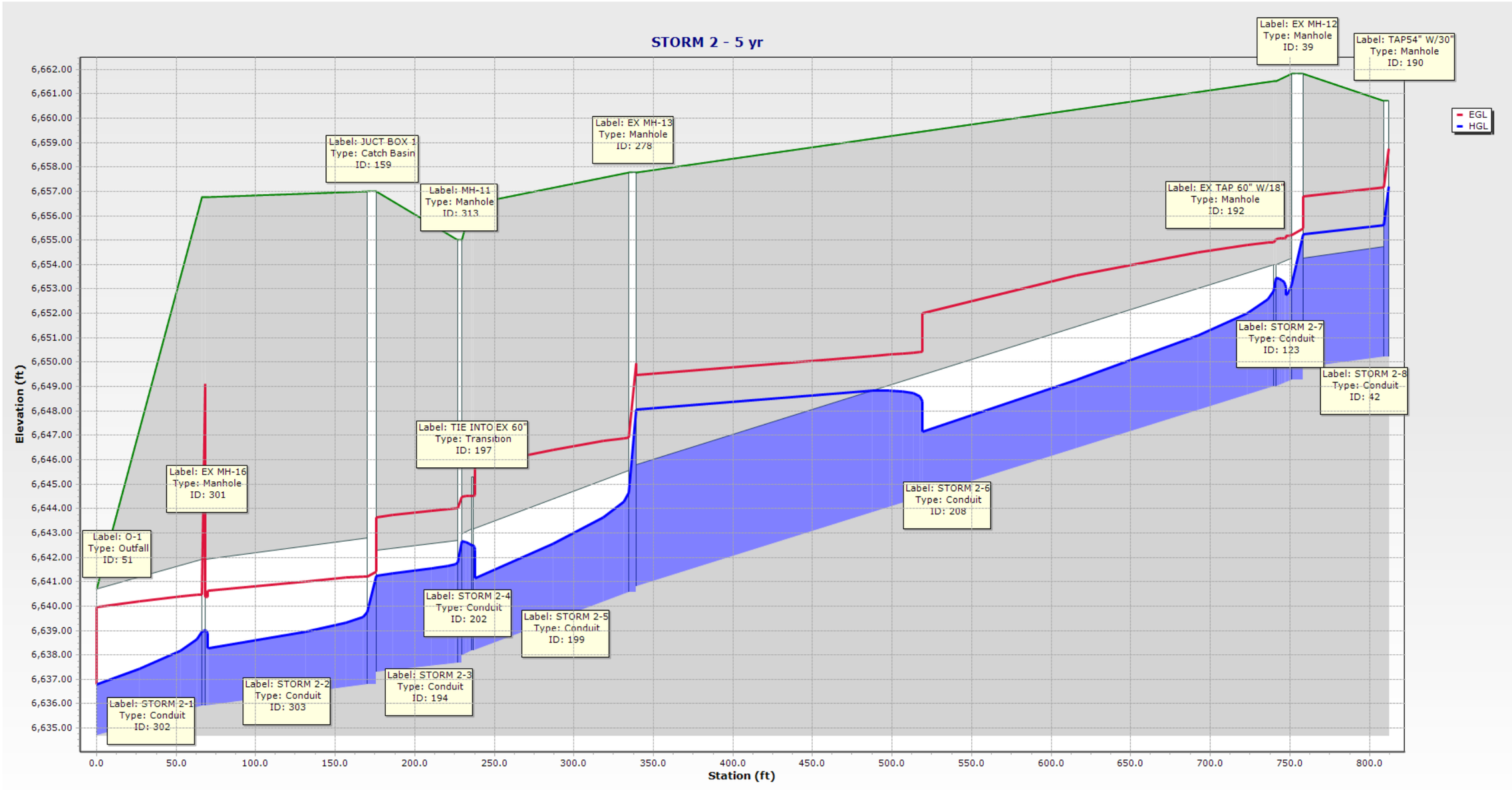
Label	ID	Upstream Structure	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number	Depth (Normal) (ft)	Depth (Critical) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
LAT-1	220	POND 0 OUTFALL	0.10	1.5	6.0	1.93	(N/A)	0.11	0.12	6,652.15	6,652.09	6,652.11	6,652.03
LAT-2	99	EX 20' D10-R	20.00	22.2	9.9	23.07	(N/A)	0.64	1.61	6,654.16	6,653.92	6,653.31	6,651.08
LAT-3	247	POND 5 OUTFALL	0.00	0.0	6.0	0.00	(N/A)	(N/A)	0.00	6,645.67	6,645.55	6,645.67	6,645.55
LAT-4	245	POND 6 OUTFALL	0.00	0.0	6.4	0.00	(N/A)	(N/A)	0.00	6,648.42	6,648.42	6,648.42	6,648.42
LAT-5	242	INLET 8	28.30	34.5	25.5	15.17	(N/A)	1.01	1.81	6,651.70	6,651.34	6,650.84	6,649.25
LAT-6	125	EX 5' D10-R INLET	2.10	18.3	269.9	4.94	(N/A)	0.43	0.55	6,655.36	6,654.16	6,655.16	6,654.14
LAT-7	115	EX CDOT TYPE D INLET	3.00	1.4	36.0	15.70	(N/A)	0.21	0.57	6,655.23	6,649.83	6,655.03	6,649.83
LAT-8	111	EX 15' D10-R INLET	12.10	46.5	11.6	6.85	(N/A)	0.72	1.32	6,673.05	6,672.90	6,672.32	6,672.17
LAT-9	305	EX 20' D10R (2)	14.30	20.1	30.0	31.48	(N/A)	0.46	1.39	6,654.18	6,640.64	6,653.09	6,639.63
STORM 1-1	97	MH-1	47.20	23.5	14.3	4.91	(N/A)	1.15	2.14	6,642.53	6,642.50	6,642.16	6,642.13
STORM 1-2	225	MH-2	27.30	20.5	42.8	14.82	(N/A)	0.92	1.69	6,643.13	6,643.05	6,642.73	6,642.82
STORM 1-3	227	MH-3	27.40	20.5	46.1	14.85	(N/A)	0.92	1.69	6,645.11	6,643.49	6,644.42	6,643.13
STORM 1-4	229	MH-4	27.70	30.5	118.9	11.29	(N/A)	1.14	1.70	6,648.41	6,646.84	6,647.71	6,644.96
STORM 1-5	231	MH-5	28.20	61.1	100.3	6.85	(N/A)	1.69	1.72	6,649.21	6,648.86	6,648.51	6,648.42
STORM 1-6	235	MH-6	28.20	59.5	63.3	7.00	(N/A)	1.67	1.72	6,649.93	6,649.79	6,649.47	6,649.44
STORM 1-7	237	POND 4A OUTFALL	0.00	0.0	201.1	0.00	(N/A)	(N/A)	0.00	6,650.17	6,649.69	6,650.17	6,649.69
STORM 2-1	302	EX MH-16	322.90	29.2	67.0	19.10	(N/A)	2.05	3.62	6,641.37	6,640.87	6,639.55	6,637.27
STORM 2-2	303	JUCT BOX 1	310.20	41.9	106.0	14.23	(N/A)	2.64	3.53	6,642.09	6,641.23	6,640.33	6,639.63
STORM 2-3	194	MH-11	264.60	122.9	55.2	13.48	(N/A)	(N/A)	4.51	6,645.54	6,645.01	6,642.72	6,642.13
STORM 2-4	202	TIE INTO EX 60"	264.60	65.9	8.0	13.48	(N/A)	2.96	4.51	6,646.76	6,646.67	6,643.93	6,643.85
STORM 2-5	199	EX MH-13	264.60	65.9	100.7	21.84	(N/A)	2.96	4.51	6,648.20	6,646.76	6,645.07	6,643.93
STORM 2-6	208	EX TAP 60" W/18"	245.60	66.2	403.6	20.19	(N/A)	2.97	4.40	6,656.19	6,652.26	6,653.38	6,649.83
STORM 2-7	123	EX MH-12	244.60	66.0	14.4	20.17	(N/A)	2.96	4.39	6,656.68	6,656.55	6,654.27	6,654.14
STORM 2-8	42	TAP54" W/30"	208.90	118.3	55.8	13.13	(N/A)	(N/A)	4.09	6,660.04	6,659.41	6,657.36	6,656.73
STORM 3-1	276	MH-7	0.10	0.8	192.5	2.94	(N/A)	0.08	0.12	6,649.18	6,643.13	6,649.14	6,643.13
STORM 3-2	282	MH-8	0.00	0.0	33.9	0.00	(N/A)	(N/A)	0.00	6,651.45	6,650.74	6,651.45	6,650.74
STORM 3-3	283	POND 4 OUTFALL	0.00	0.0	12.0	0.00	(N/A)	(N/A)	0.00	6,651.81	6,651.75	6,651.81	6,651.75
STORM 4-1	211	MH-9	0.10	2.2	186.3	1.52	(N/A)	0.13	0.12	6,650.42	6,649.48	6,650.39	6,649.44
STORM 4-2	214	MH-10	0.10	2.2	74.1	1.51	(N/A)	0.13	0.12	6,651.08	6,650.71	6,651.05	6,650.67
STORM 4-3	216	POND 1 OUTFALL	0.00	0.0	191.4	0.00	(N/A)	(N/A)	0.00	6,652.88	6,651.92	6,652.88	6,651.92
STORM 5-1	203	POND 3 OUTFALL	0.00	0.0	64.9	0.00	(N/A)	(N/A)	0.00	6,651.13	6,650.80	6,651.13	6,650.80
STORM 5-2	205	POND 2 OUTFALL	0.00	0.0	10.4	0.00	(N/A)	(N/A)	0.00	6,651.21	6,651.10	6,651.21	6,651.10
STORM 6-1	119	EX 45 DEG BEND	37.20	37.2	195.8	13.09	(N/A)	1.27	1.98	6,659.03	6,657.16	6,658.15	6,656.73
STORM 6-2	120	EX 20' D10-R INLET (3)	37.20	31.3	111.8	14.85	(N/A)	1.15	1.98	6,662.57	6,659.03	6,661.69	6,658.19
STORM 7-1	102	EX MH-14	19.50	59.6	65.3	19.32	(N/A)	0.83	1.46	6,654.02	6,651.72	6,652.10	6,649.83
STORM 7-2	108	EX MH-15	19.50	95.2	483.0	11.03	(N/A)	1.17	1.46	6,673.17	6,656.53	6,671.28	6,654.63

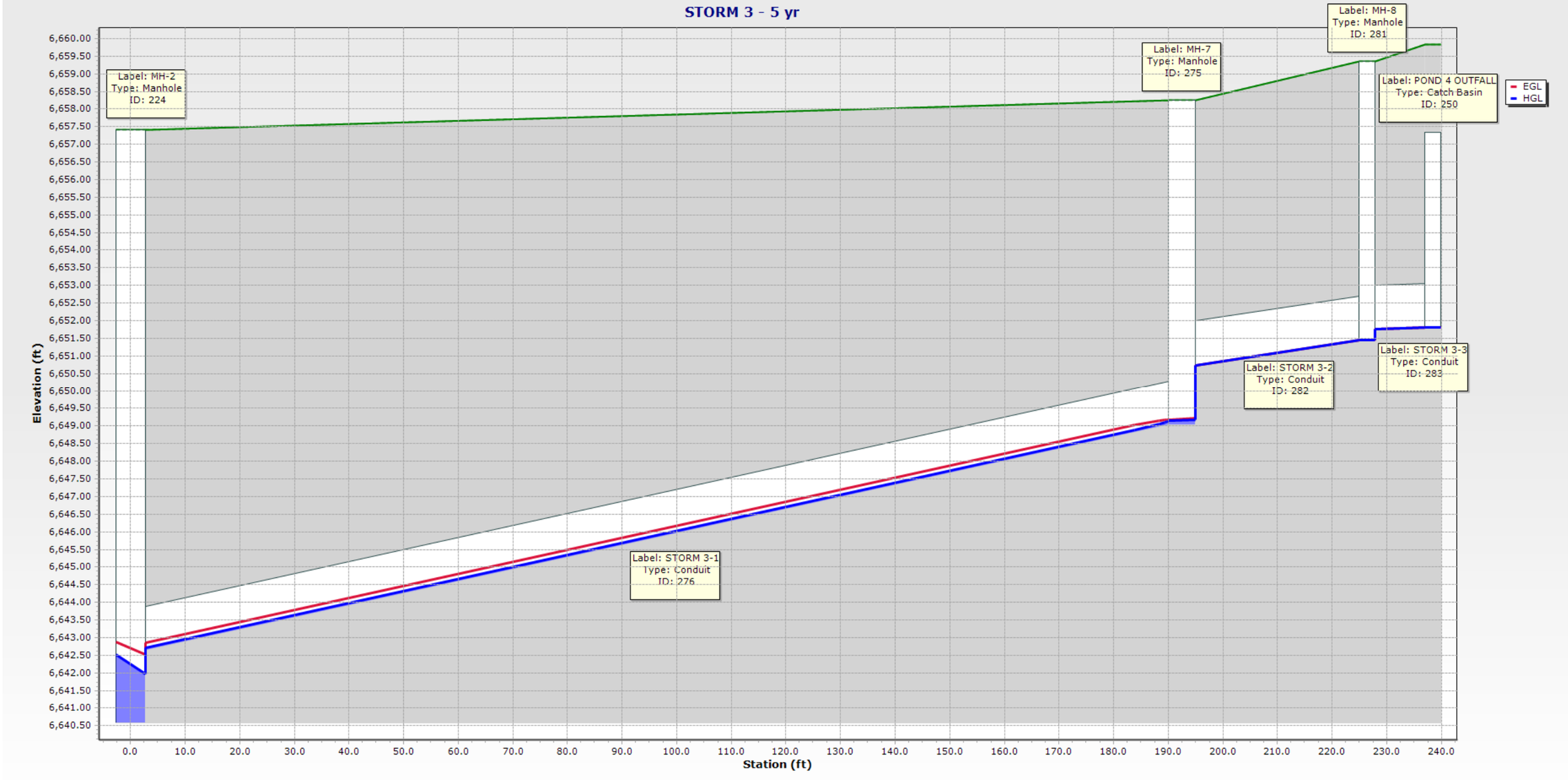
Conduit FlexTable: STRM - 10YR

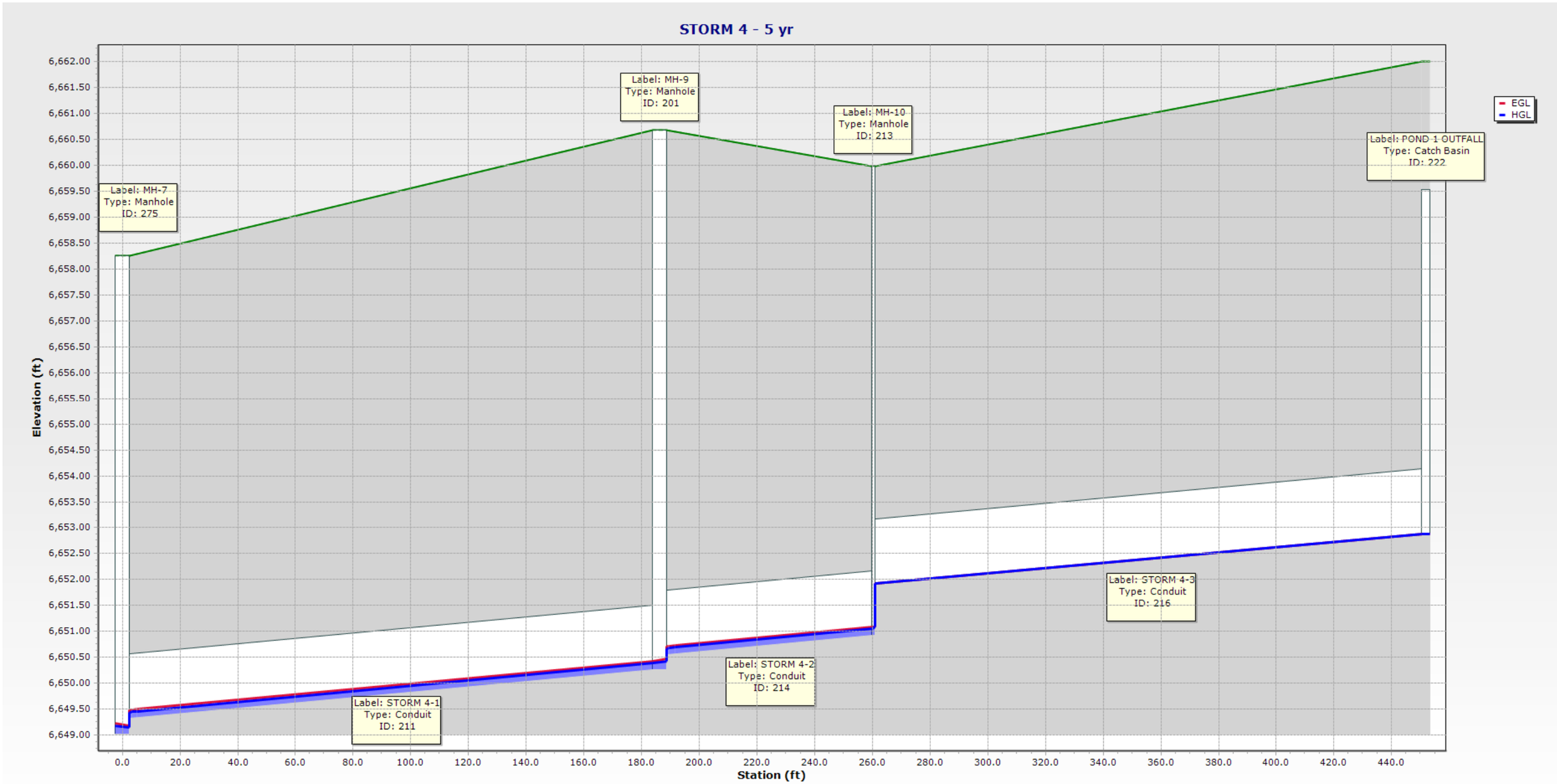
Label	ID	Upstream Structure	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number	Depth (Normal) (ft)	Depth (Critical) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
STORM 7-3	109	EX 45 DEG BEND (1)	7.40	36.1	519.8	10.65	(N/A)	0.62	1.05	6,690.68	6,672.44	6,690.19	6,672.17
STORM 7-4	106	EX 10' D10-R INLET	7.40	36.1	114.4	10.65	(N/A)	0.62	1.05	6,695.03	6,690.73	6,694.54	6,690.39

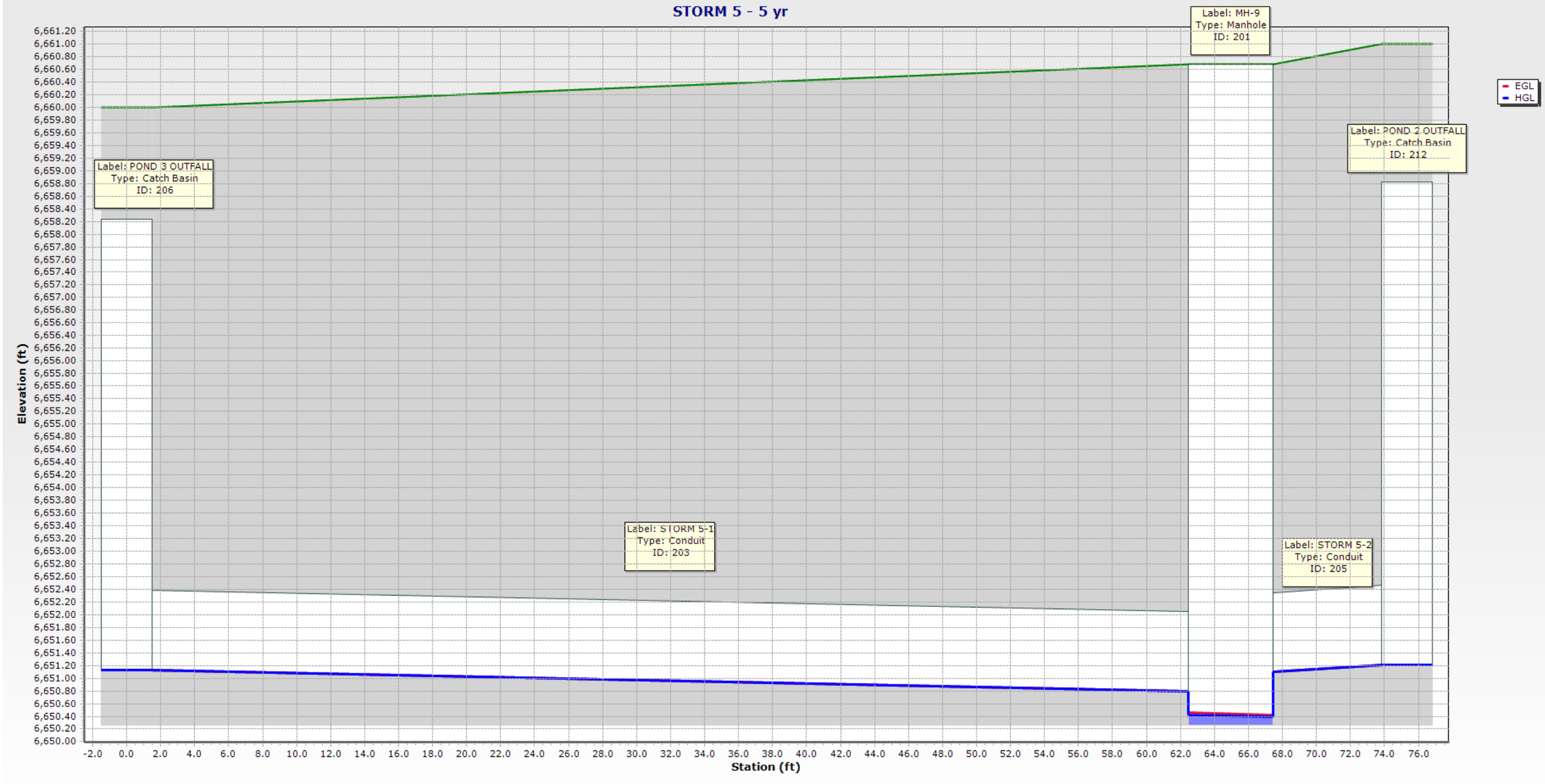
Headloss (ft)	Upstream Structure Hydraulic Grade Line (In) (ft)	Upstream Structure Velocity (In-Governing) (ft/s)	Upstream Structure Headloss Coefficient	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Conduit Description
0.07	6,652.17	1.64	1.500	0.06	6,659.99	6,660.00	6,651.92	6,651.98	Circle - 15.0 in
2.22	6,654.58	7.40	1.500	1.28	6,657.09	6,656.33	6,650.13	6,651.70	Circle - 24.0 in
0.12	6,645.67	0.00	1.500	0.00	6,657.75	6,659.00	6,645.55	6,645.67	Circle - 15.0 in
0.00	6,648.42	0.00	1.500	0.00	6,659.33	6,659.00	6,648.12	6,648.38	Circle - 15.0 in
1.59	6,652.12	7.42	1.500	1.28	6,659.21	6,658.50	6,648.01	6,649.03	Circle - 30.0 in
1.02	6,655.46	3.60	1.500	0.30	6,661.50	6,659.60	6,651.40	6,654.61	Circle - 18.0 in
5.20	6,655.33	3.58	1.500	0.30	6,657.78	6,660.00	6,644.31	6,654.46	Circle - 30.0 in
0.15	6,673.42	6.85	1.500	1.09	6,675.30	6,675.80	6,669.29	6,670.00	Circle - 18.0 in
13.46	6,654.72	8.37	1.500	1.63	6,656.75	6,658.33	6,637.93	6,651.70	Circle - 18.0 in
0.03	6,642.82	3.86	1.770	0.66	6,657.01	6,657.09	6,637.80	6,638.37	Circle - 42.0 in
-0.09	6,643.13	0.22	1.020	0.40	6,657.09	6,657.41	6,638.87	6,640.58	Circle - 36.0 in
1.29	6,645.13	10.99	1.020	0.70	6,657.41	6,657.75	6,640.88	6,642.73	Circle - 36.0 in
2.75	6,648.42	0.00	1.020	0.71	6,657.75	6,659.33	6,643.80	6,646.01	Circle - 36.0 in
0.09	6,649.44	4.75	1.320	0.93	6,659.33	6,661.34	6,646.31	6,646.79	Circle - 36.0 in
0.03	6,649.69	11.59	0.470	0.22	6,661.34	6,659.21	6,647.09	6,647.41	Circle - 36.0 in
0.48	6,650.17	0.00	1.500	0.00	6,659.21	6,660.00	6,649.16	6,650.17	Circle - 15.0 in
2.28	6,639.63	8.09	0.040	0.07	6,640.70	6,656.75	6,634.70	6,635.93	Box - 8.3 x 6.0 ft
0.70	6,642.13	13.62	1.020	1.80	6,656.75	6,657.01	6,635.93	6,636.80	Box - 8.3 x 6.0 ft
0.59	6,643.85	13.48	0.400	1.13	6,657.01	6,655.00	6,637.30	6,637.68	Circle - 60.0 in
0.08	6,643.93	13.48	0.000	0.00	6,655.00	6,656.50	6,637.98	6,638.17	Circle - 60.0 in
1.14	6,649.83	11.03	1.520	4.76	6,656.50	6,657.78	6,638.17	6,640.56	Circle - 60.0 in
3.55	6,654.14	12.46	0.270	0.76	6,657.78	6,661.50	6,640.81	6,648.99	Circle - 60.0 in
0.13	6,656.73	5.26	1.020	2.46	6,661.50	6,661.82	6,648.99	6,649.28	Circle - 60.0 in
0.63	6,660.09	13.13	1.020	2.73	6,661.82	6,660.70	6,649.78	6,650.23	Circle - 54.0 in
6.01	6,649.18	1.64	1.020	0.04	6,657.41	6,658.26	6,642.63	6,649.02	Circle - 15.0 in
0.71	6,651.45	0.00	0.050	0.00	6,658.26	6,659.34	6,650.74	6,651.45	Circle - 15.0 in
0.06	6,651.81	0.00	1.500	0.00	6,659.34	6,659.83	6,651.75	6,651.81	Circle - 15.0 in
0.95	6,650.42	1.64	1.020	0.04	6,658.26	6,660.68	6,649.32	6,650.26	Circle - 15.0 in
0.38	6,651.08	0.00	1.020	0.04	6,660.68	6,659.99	6,650.55	6,650.92	Circle - 15.0 in
0.96	6,652.88	0.00	1.500	0.00	6,659.99	6,662.00	6,651.92	6,652.88	Circle - 15.0 in
0.33	6,651.13	0.00	1.500	0.00	6,660.00	6,660.68	6,651.13	6,650.80	Circle - 15.0 in
0.11	6,651.21	0.00	1.500	0.00	6,661.00	6,660.68	6,651.21	6,651.10	Circle - 15.0 in
1.43	6,658.19	7.35	0.040	0.03	6,661.82	6,664.00	6,651.78	6,656.17	Circle - 36.0 in
3.50	6,663.00	7.50	1.500	1.31	6,664.00	6,664.83	6,656.17	6,659.71	Circle - 36.0 in
2.27	6,654.63	11.03	1.320	2.53	6,657.78	6,657.80	6,644.31	6,650.64	Circle - 18.0 in
16.65	6,672.17	6.85	0.470	0.89	6,657.80	6,675.30	6,650.84	6,669.19	Circle - 18.0 in
18.02	6,690.39	4.71	0.400	0.19	6,675.30	6,698.00	6,669.39	6,689.14	Circle - 18.0 in
4.16	6,695.27	5.58	1.500	0.73	6,698.00	6,701.00	6,689.14	6,693.49	Circle - 18.0 in

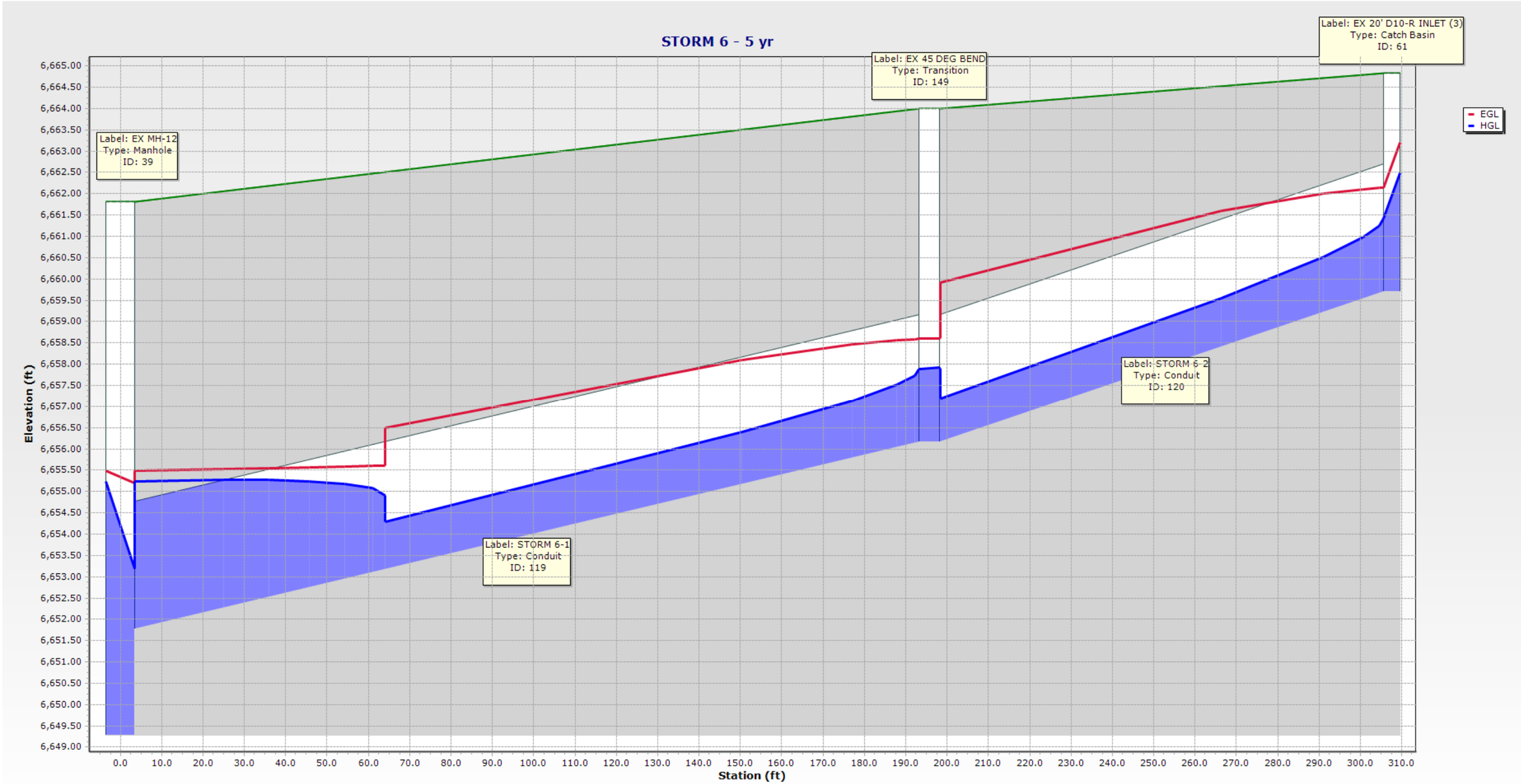

STORM 1 - 5 yr
Label: MH-5
Type: Manhole
ID: 230
Label: MH-1
Type: Manhole
ID: 196
Label: MH-4
Type: Manhole
ID: 228
Label: MH-6
Type: Manhole
ID: 234
Label: JUCT BOX 1
Type: Catch Basin
ID: 159
Label: MH-2
Type: Manhole
ID: 224
Label: MH-3
Type: Manhole
ID: 226
Label: POND 4A OUTFALL
Type: Catch Basin
ID: 240
EGL
HGL
Label: STORM 1-7
Type: Conduit
ID: 237
Label: STORM 1-6
Type: Conduit
ID: 235
Label: STORM 1-5
Type: Conduit
ID: 231
Label: STORM 1-4
Type: Conduit
ID: 229
Label: STORM 1-3
Type: Conduit
ID: 227
Label: STORM 1-2
Type: Conduit
ID: 225
Label: STORM 1-1
Type: Conduit
ID: 97
Elevation (ft)
6,661.50
6,661.00
6,660.50
6,660.00
6,659.50
6,659.00
6,658.50
6,658.00
6,657.50
6,657.00
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6,640.00
6,639.50
6,639.00
6,638.50
6,638.00
6,637.50
6,637.00
6,636.50
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
220.0
240.0
260.0
280.0
300.0
320.0
340.0
360.0
380.0
400.0
420.0
440.0
460.0
480.0
500.0
520.0
540.0
560.0
580.0
Station (ft)

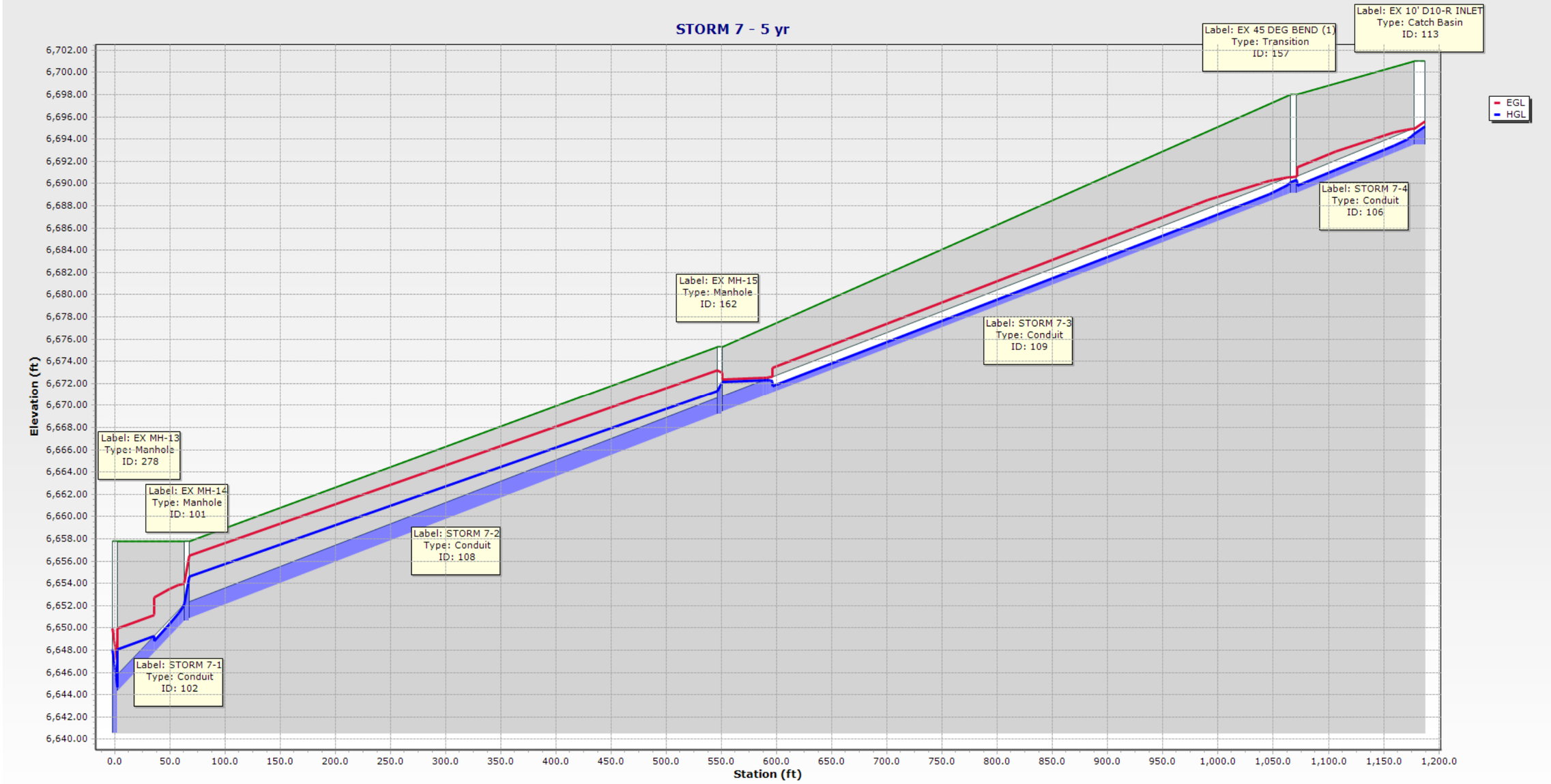

STORM 2 - 5 yr
Elevation (ft)
Station (ft)
6,662.00
6,661.00
6,660.00
6,659.00
6,658.00
6,657.00
6,656.00
6,655.00
6,654.00
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6,642.00
6,641.00
6,640.00
6,639.00
6,638.00
6,637.00
6,636.00
6,635.00
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
500.0
550.0
600.0
650.0
700.0
750.0
800.0
EGL
HGL
Label: EX MH-12
Type: Manhole
ID: 39
Label: TAP54" W/30"
Type: Manhole
ID: 190
Label: EX MH-13
Type: Manhole
ID: 278
Label: JUCT BOX 1
Type: Catch Basin
ID: 159
Label: MH-11
Type: Manhole
ID: 313
Label: EX TAP 60" W/18"
Type: Manhole
ID: 192
Label: STORM 2-7
Type: Conduit
ID: 123
Label: STORM 2-8
Type: Conduit
ID: 42
Label: TIE INTO EX 60"
Type: Transition
ID: 197
Label: EX MH-16
Type: Manhole
ID: 301
Label: STORM 2-6
Type: Conduit
ID: 208
Label: O-1
Type: Outfall
ID: 51
Label: STORM 2-4
Type: Conduit
ID: 202
Label: STORM 2-5
Type: Conduit
ID: 199
Label: STORM 2-2
Type: Conduit
ID: 303
Label: STORM 2-3
Type: Conduit
ID: 194
Label: STORM 2-1
Type: Conduit
ID: 302

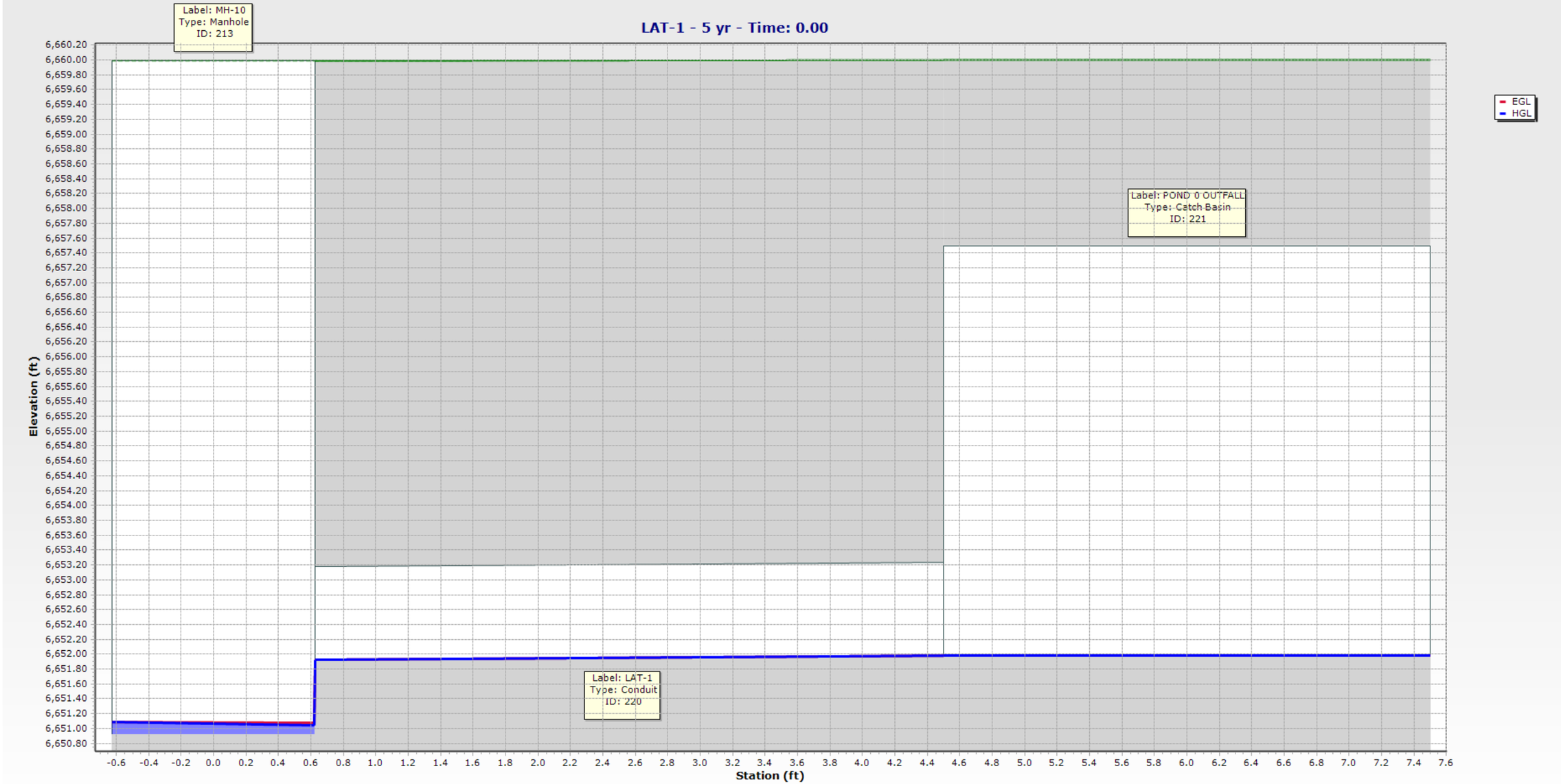

STORM 3 - 5 yr
Label: MH-2
Type: Manhole
ID: 224
Label: MH-7
Type: Manhole
ID: 275
Label: MH-8
Type: Manhole
ID: 281
Label: POND 4 OUTFALL
Type: Catch Basin
ID: 250
EGL
HGL
Label: STORM 3-2
Type: Conduit
ID: 282
Label: STORM 3-3
Type: Conduit
ID: 283
Label: STORM 3-1
Type: Conduit
ID: 276
Elevation (ft)
6,660.00
6,659.50
6,659.00
6,658.50
6,658.00
6,657.50
6,657.00
6,656.50
6,656.00
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6,643.00
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6,642.00
6,641.50
6,641.00
6,640.50
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0
210.0
220.0
230.0
240.0
Station (ft)

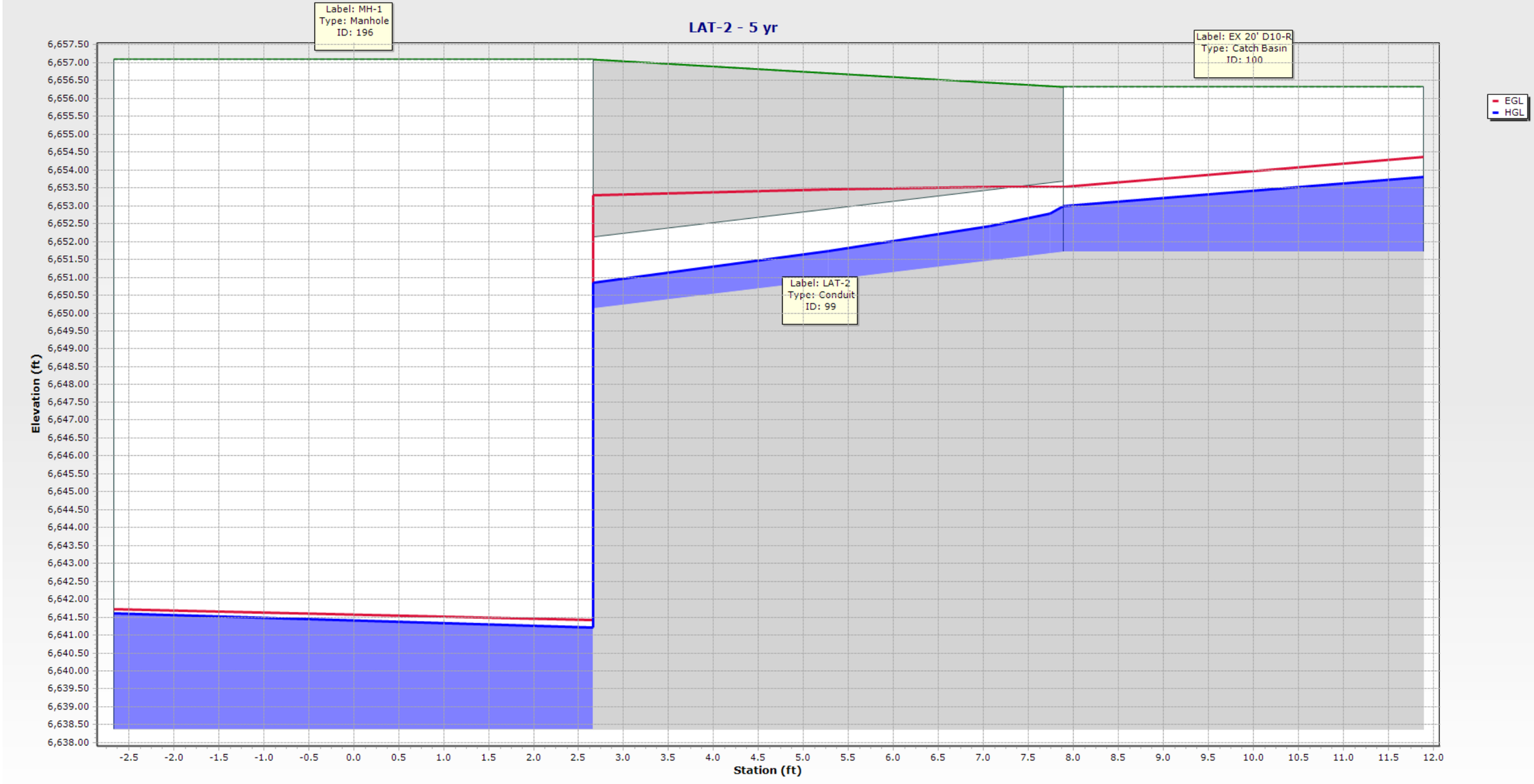

STORM 4 - 5 yr
Elevation (ft)
Station (ft)
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6,661.50
6,661.00
6,660.50
6,660.00
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6,652.50
6,652.00
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6,650.00
6,649.50
6,649.00
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
220.0
240.0
260.0
280.0
300.0
320.0
340.0
360.0
380.0
400.0
420.0
440.0
Label: MH-7
Type: Manhole
ID: 275
Label: MH-9
Type: Manhole
ID: 201
Label: MH-10
Type: Manhole
ID: 213
Label: POND 1 OUTFALL
Type: Catch Basin
ID: 222
Label: STORM 4-1
Type: Conduit
ID: 211
Label: STORM 4-2
Type: Conduit
ID: 214
Label: STORM 4-3
Type: Conduit
ID: 216
EGL
HGL

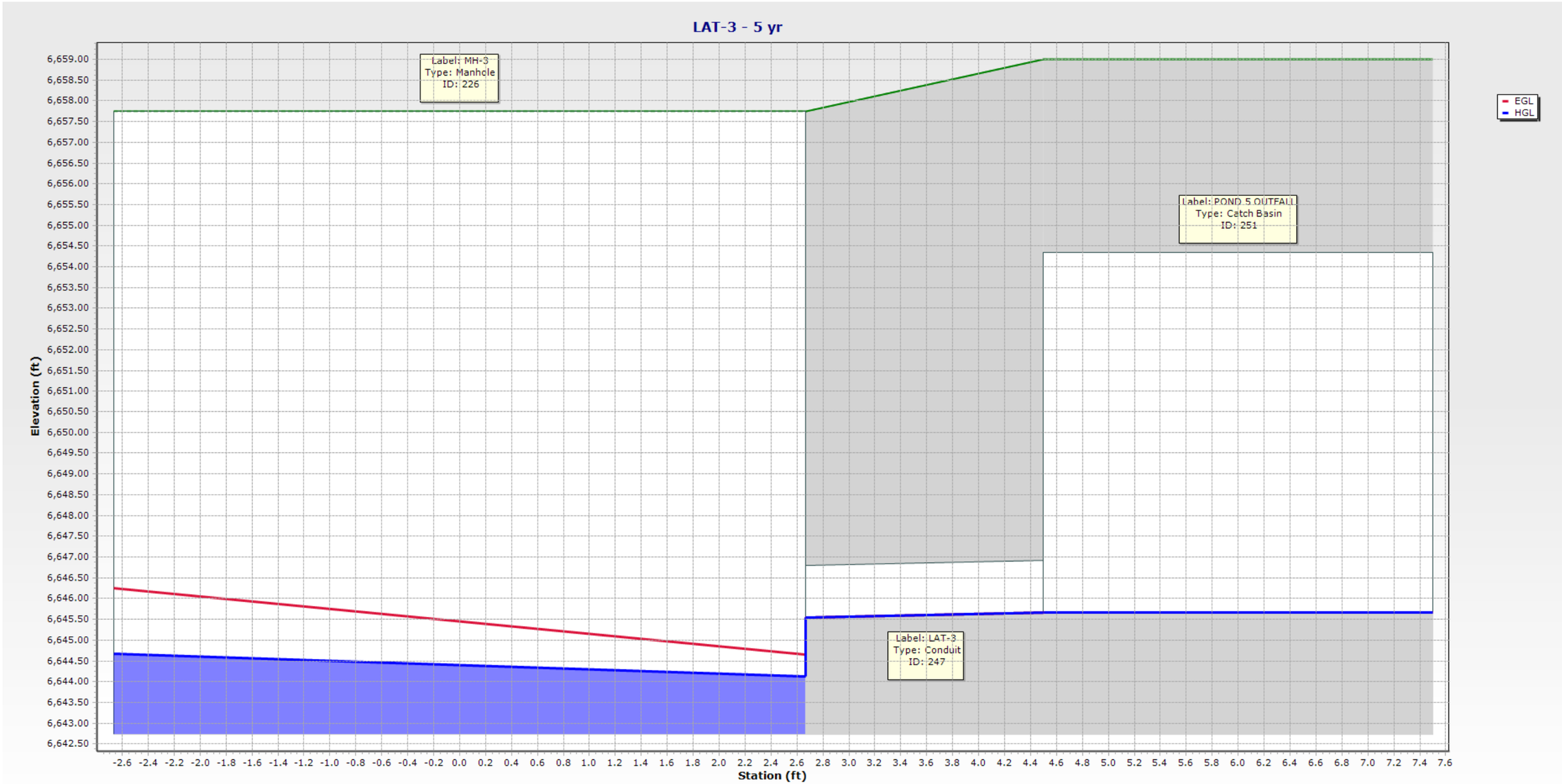

STORM 5 - 5 yr
Label: MH-9
Type: Manhole
ID: 201
Label: POND 2 OUTFALL
Type: Catch Basin
ID: 212
Label: POND 3 OUTFALL
Type: Catch Basin
ID: 206
Label: STORM 5-1
Type: Conduit
ID: 203
Label: STORM 5-2
Type: Conduit
ID: 205
EGL
HGL
Elevation (ft)
Station (ft)

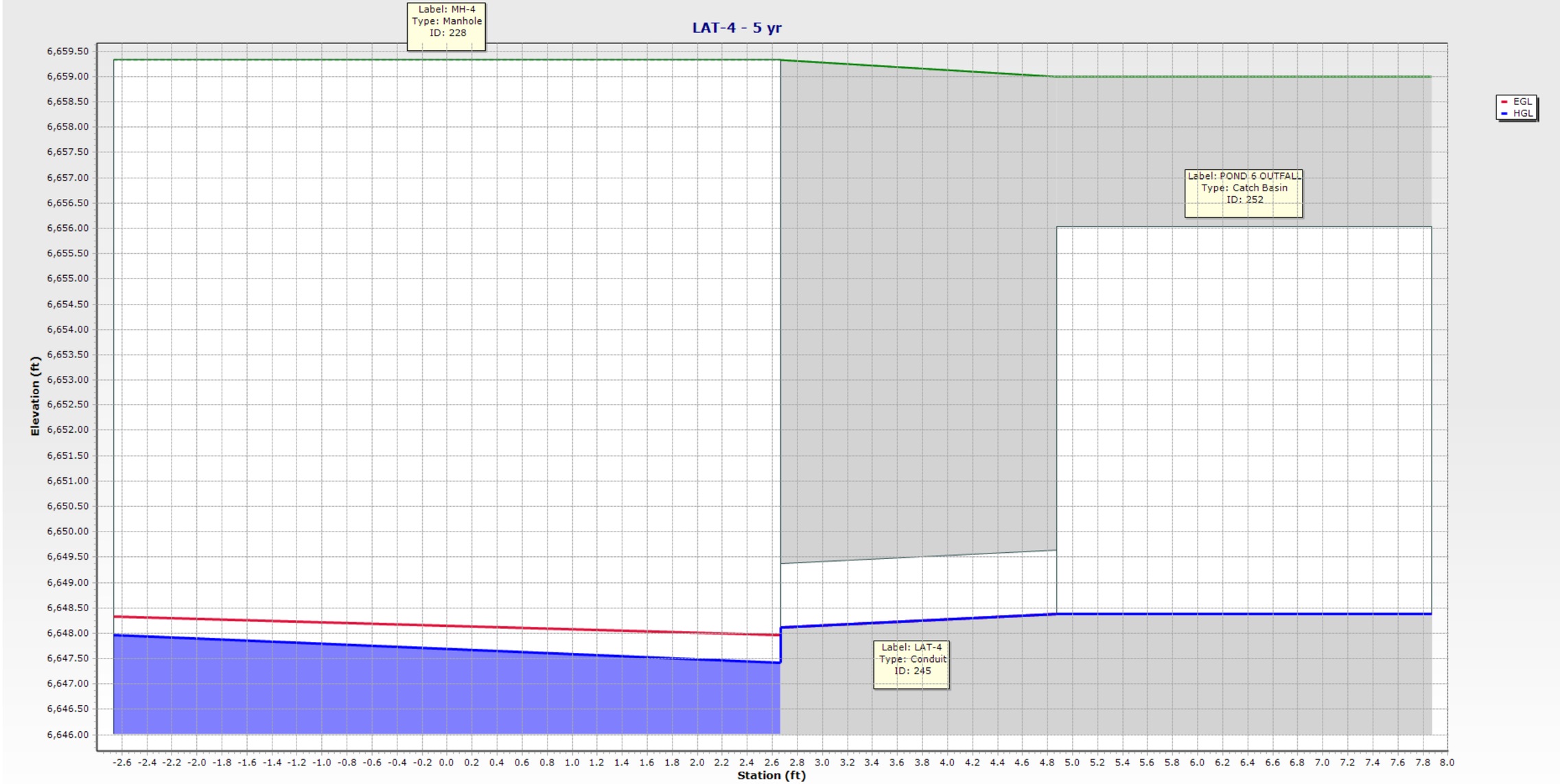

STORM 6 - 5 yr
Label: EX 20' D10-R INLET (3)
Type: Catch Basin
ID: 61
Label: EX 45 DEG BEND
Type: Transition
ID: 149
Label: EX MH-12
Type: Manhole
ID: 39
Label: STORM 6-2
Type: Conduit
ID: 120
Label: STORM 6-1
Type: Conduit
ID: 119
EGL
HGL
Elevation (ft)
6,665.00
6,664.50
6,664.00
6,663.50
6,663.00
6,662.50
6,662.00
6,661.50
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0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0
210.0
220.0
230.0
240.0
250.0
260.0
270.0
280.0
290.0
300.0
310.0
Station (ft)

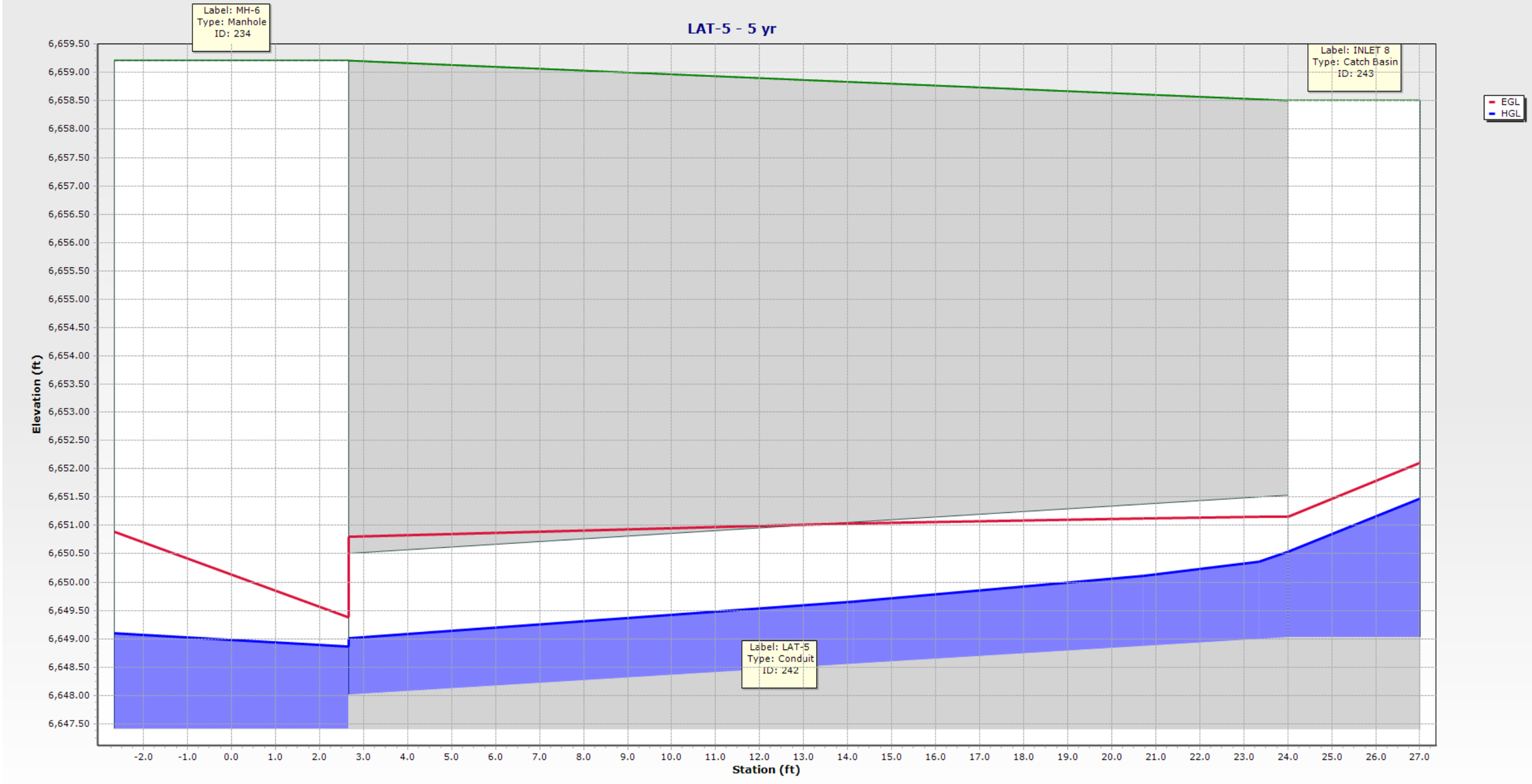

STORM 7 - 5 yr
Label: EX 10' D10-R INLET
Type: Catch Basin
ID: 113
Label: EX 45 DEG BEND (1)
Type: Transition
ID: 157
EGL
HGL
Label: STORM 7-4
Type: Conduit
ID: 106
Label: EX MH-15
Type: Manhole
ID: 162
Label: STORM 7-3
Type: Conduit
ID: 109
Label: EX MH-13
Type: Manhole
ID: 278
Label: EX MH-14
Type: Manhole
ID: 101
Label: STORM 7-2
Type: Conduit
ID: 108
Label: STORM 7-1
Type: Conduit
ID: 102
Elevation (ft)
6,702.00
6,700.00
6,698.00
6,696.00
6,694.00
6,692.00
6,690.00
6,688.00
6,686.00
6,684.00
6,682.00
6,680.00
6,678.00
6,676.00
6,674.00
6,672.00
6,670.00
6,668.00
6,666.00
6,664.00
6,662.00
6,660.00
6,658.00
6,656.00
6,654.00
6,652.00
6,650.00
6,648.00
6,646.00
6,644.00
6,642.00
6,640.00
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
500.0
550.0
600.0
650.0
700.0
750.0
800.0
850.0
900.0
950.0
1,000.0
1,050.0
1,100.0
1,150.0
1,200.0
Station (ft)

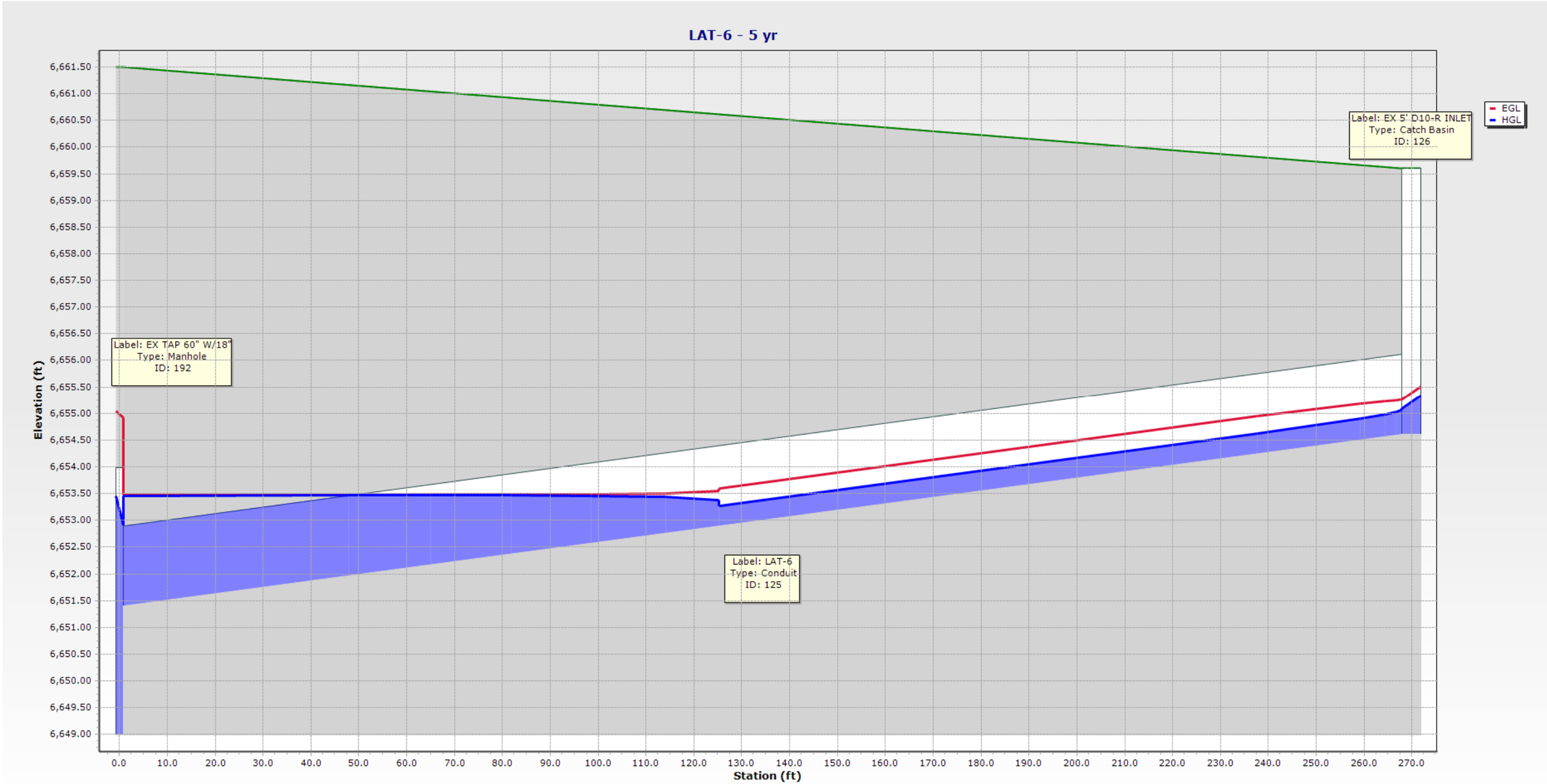

LAT-1 - 5 yr - Time: 0.00
Label: MH-10
Type: Manhole
ID: 213
Label: POND 0 OUTFALL
Type: Catch Basin
ID: 221
Label: LAT-1
Type: Conduit
ID: 220
EGL
HGL
Elevation (ft)
Station (ft)
6,660.20
6,660.00
6,659.80
6,659.60
6,659.40
6,659.20
6,659.00
6,658.80
6,658.60
6,658.40
6,658.20
6,658.00
6,657.80
6,657.60
6,657.40
6,657.20
6,657.00
6,656.80
6,656.60
6,656.40
6,656.20
6,656.00
6,655.80
6,655.60
6,655.40
6,655.20
6,655.00
6,654.80
6,654.60
6,654.40
6,654.20
6,654.00
6,653.80
6,653.60
6,653.40
6,653.20
6,653.00
6,652.80
6,652.60
6,652.40
6,652.20
6,652.00
6,651.80
6,651.60
6,651.40
6,651.20
6,651.00
6,650.80
-0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0 4.2 4.4 4.6 4.8 5.0 5.2 5.4 5.6 5.8 6.0 6.2 6.4 6.6 6.8 7.0 7.2 7.4 7.6

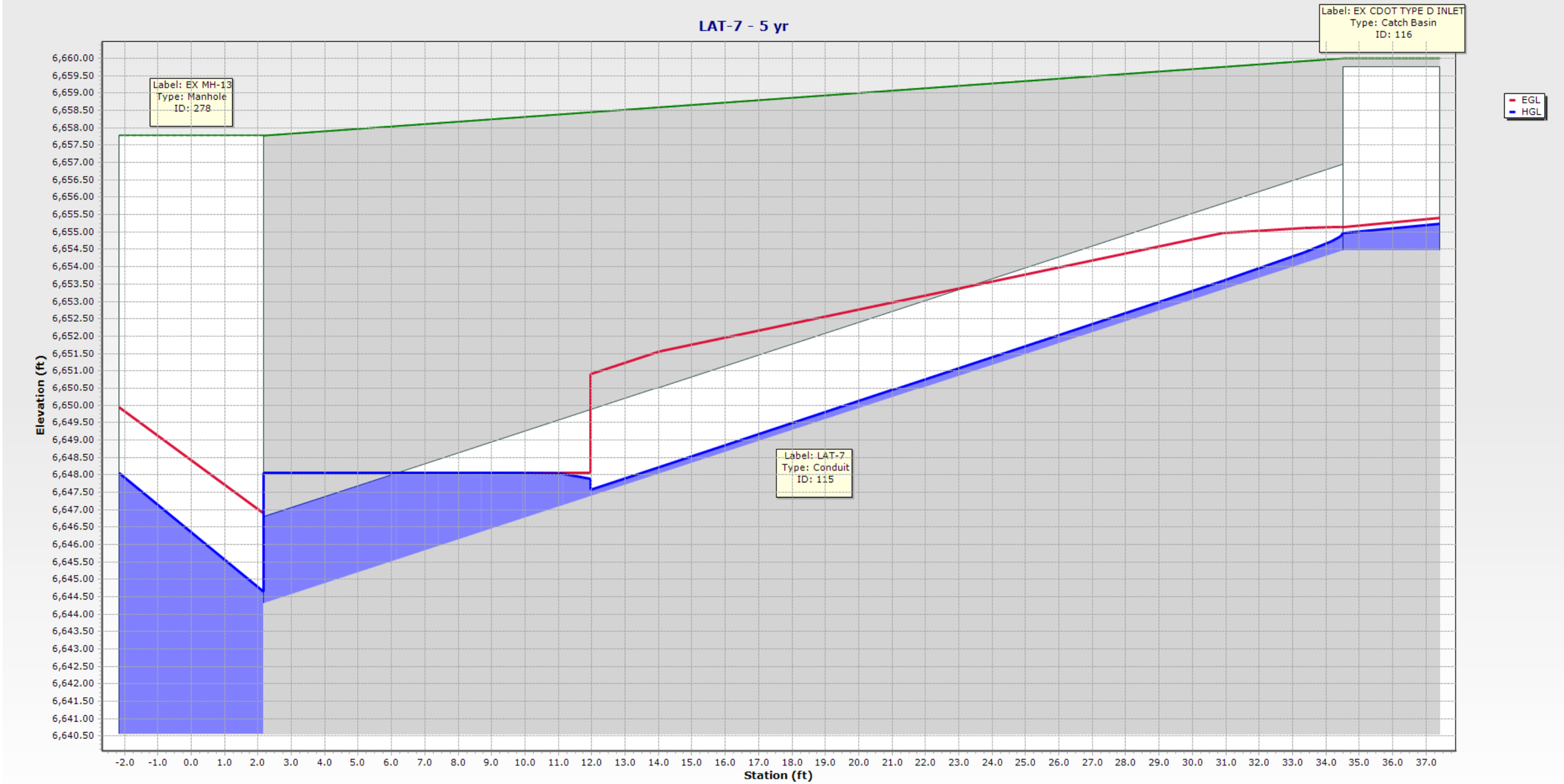

LAT-2 - 5 yr
Label: MH-1
Type: Manhole
ID: 196
Label: EX 20' D10-R
Type: Catch Basin
ID: 100
Label: LAT-2
Type: Conduit
ID: 99
EGL
HGL
Elevation (ft)
6,657.50
6,657.00
6,656.50
6,656.00
6,655.50
6,655.00
6,654.50
6,654.00
6,653.50
6,653.00
6,652.50
6,652.00
6,651.50
6,651.00
6,650.50
6,650.00
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6,649.00
6,648.50
6,648.00
6,647.50
6,647.00
6,646.50
6,646.00
6,645.50
6,645.00
6,644.50
6,644.00
6,643.50
6,643.00
6,642.50
6,642.00
6,641.50
6,641.00
6,640.50
6,640.00
6,639.50
6,639.00
6,638.50
6,638.00
-2.5
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
10.5
11.0
11.5
12.0
Station (ft)

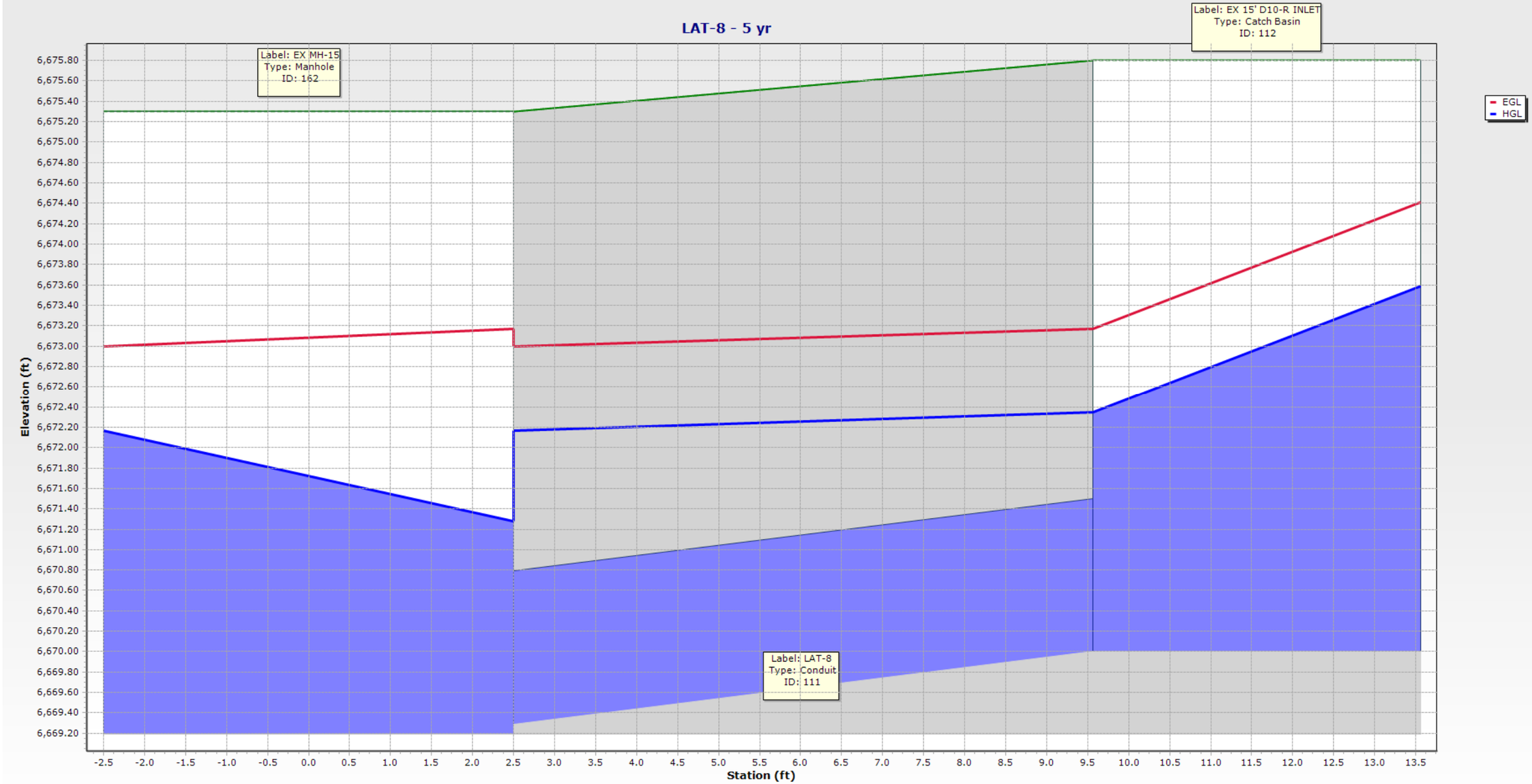

LAT-3 - 5 yr
Label: MH-3
Type: Manhole
ID: 226
Label: POND 5 OUTFALL
Type: Catch Basin
ID: 251
Label: LAT-3
Type: Conduit
ID: 247
EGL
HGL
Elevation (ft)
6,659.00
6,658.50
6,658.00
6,657.50
6,657.00
6,656.50
6,656.00
6,655.50
6,655.00
6,654.50
6,654.00
6,653.50
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6,647.50
6,647.00
6,646.50
6,646.00
6,645.50
6,645.00
6,644.50
6,644.00
6,643.50
6,643.00
6,642.50
-2.6 -2.4 -2.2 -2.0 -1.8 -1.6 -1.4 -1.2 -1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0 4.2 4.4 4.6 4.8 5.0 5.2 5.4 5.6 5.8 6.0 6.2 6.4 6.6 6.8 7.0 7.2 7.4 7.6
Station (ft)

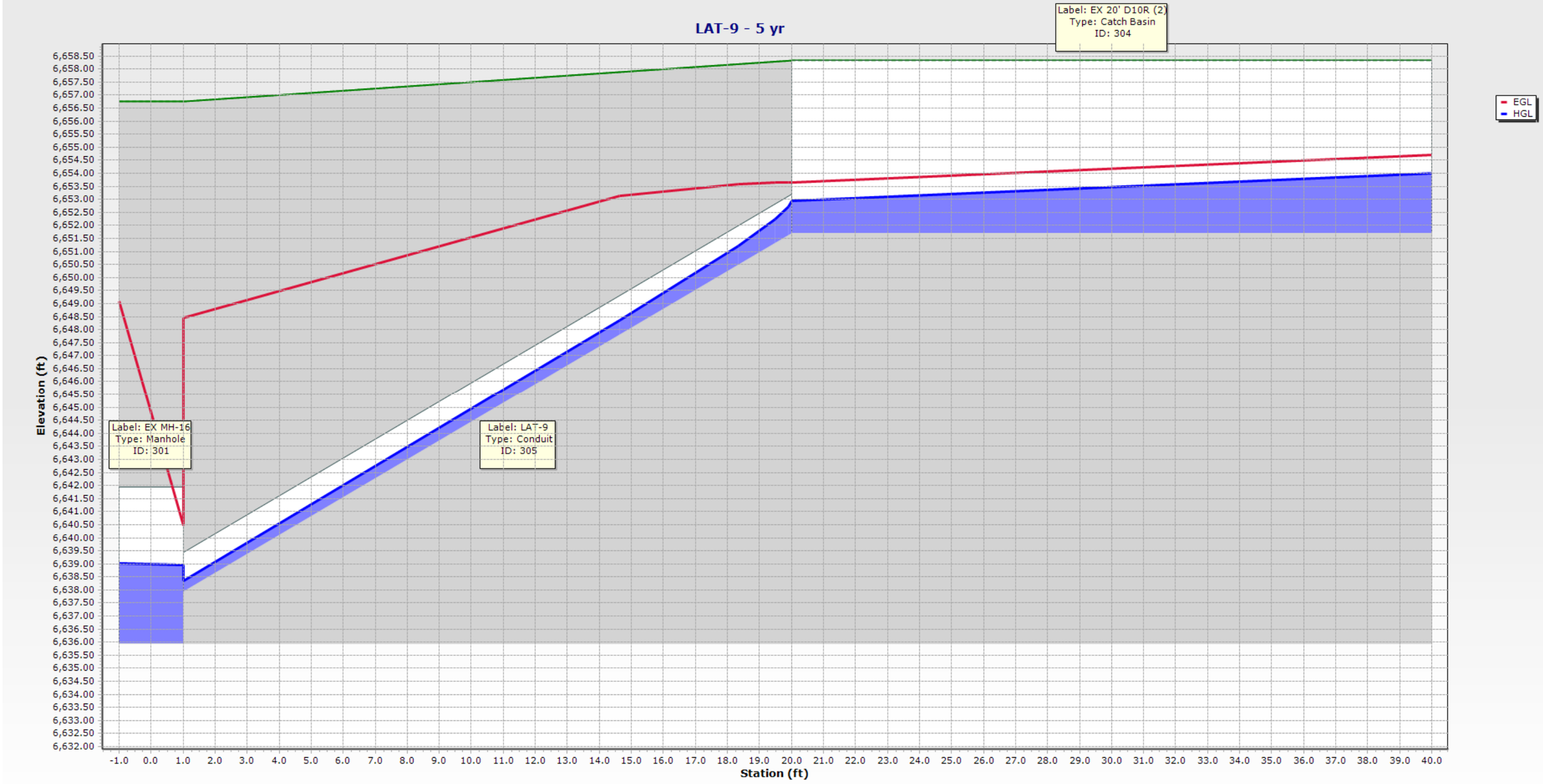

LAT-4 - 5 yr
Label: MH-4
Type: Manhole
ID: 228
Label: POND 6 OUTFALL
Type: Catch Basin
ID: 252
Label: LAT-4
Type: Conduit
ID: 245
EGL
HGL
Elevation (ft)
6,659.50
6,659.00
6,658.50
6,658.00
6,657.50
6,657.00
6,656.50
6,656.00
6,655.50
6,655.00
6,654.50
6,654.00
6,653.50
6,653.00
6,652.50
6,652.00
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6,651.00
6,650.50
6,650.00
6,649.50
6,649.00
6,648.50
6,648.00
6,647.50
6,647.00
6,646.50
6,646.00
-2.6 -2.4 -2.2 -2.0 -1.8 -1.6 -1.4 -1.2 -1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0 4.2 4.4 4.6 4.8 5.0 5.2 5.4 5.6 5.8 6.0 6.2 6.4 6.6 6.8 7.0 7.2 7.4 7.6 7.8 8.0
Station (ft)


LAT-5 - 5 yr
Label: MH-6
Type: Manhole
ID: 234
Label: INLET 8
Type: Catch Basin
ID: 243
Label: LAT-5
Type: Conduit
ID: 242
EGL
HGL
Elevation (ft)
6,659.50
6,659.00
6,658.50
6,658.00
6,657.50
6,657.00
6,656.50
6,656.00
6,655.50
6,655.00
6,654.50
6,654.00
6,653.50
6,653.00
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6,652.00
6,651.50
6,651.00
6,650.50
6,650.00
6,649.50
6,649.00
6,648.50
6,648.00
6,647.50
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
Station (ft)


LAT-6 - 5 yr
Elevation (ft)
6,661.50
6,661.00
6,660.50
6,660.00
6,659.50
6,659.00
6,658.50
6,658.00
6,657.50
6,657.00
6,656.50
6,656.00
6,655.50
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6,652.50
6,652.00
6,651.50
6,651.00
6,650.50
6,650.00
6,649.50
6,649.00
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0
210.0
220.0
230.0
240.0
250.0
260.0
270.0
Station (ft)
EGL
HGL
Label: EX 5' D10-R INLET
Type: Catch Basin
ID: 126
Label: EX TAP 60" W/18"
Type: Manhole
ID: 192
Label: LAT-6
Type: Conduit
ID: 125


LAT-7 - 5 yr
Label: EX CDOT TYPE D INLET
Type: Catch Basin
ID: 116
Label: EX MH-13
Type: Manhole
ID: 278
Label: LAT-7
Type: Conduit
ID: 115
EGL
HGL
Elevation (ft)
6,660.00
6,659.50
6,659.00
6,658.50
6,658.00
6,657.50
6,657.00
6,656.50
6,656.00
6,655.50
6,655.00
6,654.50
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6,647.50
6,647.00
6,646.50
6,646.00
6,645.50
6,645.00
6,644.50
6,644.00
6,643.50
6,643.00
6,642.50
6,642.00
6,641.50
6,641.00
6,640.50
-2.0 -1.0 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0 25.0 26.0 27.0 28.0 29.0 30.0 31.0 32.0 33.0 34.0 35.0 36.0 37.0
Station (ft)


LAT-8 - 5 yr
Label: EX MH-15
Type: Manhole
ID: 162
Label: EX 15' D10-R INLET
Type: Catch Basin
ID: 112
Label: LAT-8
Type: Conduit
ID: 111
EGL
HGL
Elevation (ft)
Station (ft)
6,675.80
6,675.60
6,675.40
6,675.20
6,675.00
6,674.80
6,674.60
6,674.40
6,674.20
6,674.00
6,673.80
6,673.60
6,673.40
6,673.20
6,673.00
6,672.80
6,672.60
6,672.40
6,672.20
6,672.00
6,671.80
6,671.60
6,671.40
6,671.20
6,671.00
6,670.80
6,670.60
6,670.40
6,670.20
6,670.00
6,669.80
6,669.60
6,669.40
6,669.20
-2.5 -2.0 -1.5 -1.0 -0.5 0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5


LAT-9 - 5 yr
Label: EX 20' D10R (2)
Type: Catch Basin
ID: 304
Label: EX MH-16
Type: Manhole
ID: 301
Label: LAT-9
Type: Conduit
ID: 305
EGL
HGL
Elevation (ft)
Station (ft)
6,658.50
6,658.00
6,657.50
6,657.00
6,656.50
6,656.00
6,655.50
6,655.00
6,654.50
6,654.00
6,653.50
6,653.00
6,652.50
6,652.00
6,651.50
6,651.00
6,650.50
6,650.00
6,649.50
6,649.00
6,648.50
6,648.00
6,647.50
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6,646.00
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6,645.00
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6,644.00
6,643.50
6,643.00
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6,640.00
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6,639.00
6,638.50
6,638.00
6,637.50
6,637.00
6,636.50
6,636.00
6,635.50
6,635.00
6,634.50
6,634.00
6,633.50
6,633.00
6,632.50
6,632.00
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0

Conduit FlexTable: STRM - 5YR

Label	ID	Upstream Structure	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number	Depth (Normal) (ft)	Depth (Critical) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
LAT-1	220	POND 0 OUTFALL	0.10	1.5	6.0	1.93	(N/A)	0.11	0.12	6,652.15	6,652.09	6,652.11	6,652.03
LAT-2	99	EX 20' D10-R	12.70	14.1	9.9	20.27	(N/A)	0.51	1.28	6,653.54	6,653.29	6,652.98	6,650.85
LAT-3	247	POND 5 OUTFALL	0.00	0.0	6.0	0.00	(N/A)	(N/A)	0.00	6,645.67	6,645.55	6,645.67	6,645.55
LAT-4	245	POND 6 OUTFALL	0.00	0.0	6.4	0.00	(N/A)	(N/A)	0.00	6,648.38	6,648.12	6,648.38	6,648.12
LAT-5	242	INLET 8	19.60	23.9	25.5	13.72	(N/A)	0.83	1.50	6,651.16	6,650.80	6,650.53	6,649.00
LAT-6	125	EX 5' D10-R INLET	1.60	14.0	269.9	4.57	(N/A)	0.38	0.48	6,655.26	6,653.47	6,655.08	6,653.45
LAT-7	115	EX CDOT TYPE D INLET	2.40	1.1	36.0	14.68	(N/A)	0.18	0.51	6,655.14	6,648.06	6,654.97	6,648.06
LAT-8	111	EX 15' D10-R INLET	12.90	49.6	11.6	7.30	(N/A)	0.75	1.35	6,673.17	6,673.00	6,672.34	6,672.17
LAT-9	305	EX 20' D10R (2)	10.60	14.9	30.0	28.91	(N/A)	0.39	1.25	6,653.66	6,648.44	6,652.95	6,638.36
STORM 1-1	97	MH-1	31.50	15.7	14.3	15.23	(N/A)	0.94	1.74	6,641.43	6,641.42	6,641.21	6,641.25
STORM 1-2	225	MH-2	18.90	14.2	42.8	13.34	(N/A)	0.76	1.39	6,642.51	6,641.72	6,641.97	6,641.60
STORM 1-3	227	MH-3	18.90	14.2	46.1	13.35	(N/A)	0.76	1.39	6,644.66	6,642.88	6,644.12	6,642.52
STORM 1-4	229	MH-4	19.20	21.1	118.9	10.20	(N/A)	0.94	1.40	6,647.96	6,646.33	6,647.42	6,644.74
STORM 1-5	231	MH-5	19.50	42.3	100.3	6.25	(N/A)	1.36	1.42	6,648.75	6,648.34	6,648.21	6,647.97
STORM 1-6	235	MH-6	19.50	41.1	63.3	6.38	(N/A)	1.34	1.42	6,649.38	6,649.22	6,648.86	6,648.93
STORM 1-7	237	POND 4A OUTFALL	0.00	0.0	201.1	0.00	(N/A)	(N/A)	0.00	6,650.17	6,649.16	6,650.17	6,649.16
STORM 2-1	302	EX MH-16	246.10	22.2	67.0	17.53	(N/A)	1.70	3.02	6,640.47	6,639.96	6,638.95	6,636.79
STORM 2-2	303	JUCT BOX 1	236.80	32.0	106.0	13.13	(N/A)	2.19	2.95	6,641.22	6,640.36	6,639.75	6,639.01
STORM 2-3	194	MH-11	206.70	96.0	55.2	12.48	(N/A)	3.93	4.10	6,644.01	6,643.65	6,641.77	6,641.26
STORM 2-4	202	TIE INTO EX 60"	206.70	51.5	8.0	20.59	(N/A)	2.54	4.10	6,644.53	6,644.48	6,642.48	6,642.67
STORM 2-5	199	EX MH-13	206.70	51.5	100.7	20.60	(N/A)	2.54	4.10	6,646.90	6,644.53	6,644.66	6,642.48
STORM 2-6	208	EX TAP 60" W/18"	188.00	50.7	403.6	18.95	(N/A)	2.52	3.92	6,654.92	6,649.48	6,652.91	6,648.06
STORM 2-7	123	EX MH-12	187.20	50.5	14.4	18.93	(N/A)	2.51	3.92	6,655.20	6,655.04	6,653.20	6,653.45
STORM 2-8	42	TAP54" W/30"	159.60	90.4	55.8	10.04	(N/A)	3.35	3.70	6,657.17	6,656.80	6,655.60	6,655.24
STORM 3-1	276	MH-7	0.10	0.8	192.5	2.94	(N/A)	0.08	0.12	6,649.18	6,642.85	6,649.14	6,642.71
STORM 3-2	282	MH-8	0.00	0.0	33.9	0.00	(N/A)	(N/A)	0.00	6,651.45	6,650.74	6,651.45	6,650.74
STORM 3-3	283	POND 4 OUTFALL	0.00	0.0	12.0	0.00	(N/A)	(N/A)	0.00	6,651.81	6,651.75	6,651.81	6,651.75
STORM 4-1	211	MH-9	0.10	2.2	186.3	1.52	(N/A)	0.13	0.12	6,650.42	6,649.48	6,650.39	6,649.44
STORM 4-2	214	MH-10	0.10	2.2	74.1	1.51	(N/A)	0.13	0.12	6,651.08	6,650.71	6,651.05	6,650.67
STORM 4-3	216	POND 1 OUTFALL	0.00	0.0	191.4	0.00	(N/A)	(N/A)	0.00	6,652.88	6,651.92	6,652.88	6,651.92
STORM 5-1	203	POND 3 OUTFALL	0.00	0.0	64.9	0.00	(N/A)	(N/A)	0.00	6,651.13	6,650.80	6,651.13	6,650.80
STORM 5-2	205	POND 2 OUTFALL	0.00	0.0	10.4	0.00	(N/A)	(N/A)	0.00	6,651.21	6,651.10	6,651.21	6,651.10
STORM 6-1	119	EX 45 DEG BEND	28.30	28.3	195.8	12.16	(N/A)	1.09	1.72	6,658.60	6,655.49	6,657.89	6,655.24
STORM 6-2	120	EX 20' D10-R INLET (3)	28.30	23.8	111.8	13.77	(N/A)	1.00	1.72	6,662.14	6,658.60	6,661.43	6,657.92
STORM 7-1	102	EX MH-14	19.50	59.6	65.3	19.32	(N/A)	0.83	1.46	6,654.02	6,649.95	6,652.10	6,648.06
STORM 7-2	108	EX MH-15	19.50	95.2	483.0	11.03	(N/A)	1.17	1.46	6,673.17	6,656.53	6,671.28	6,654.63

Conduit FlexTable: STRM - 5YR

Label	ID	Upstream Structure	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number	Depth (Normal) (ft)	Depth (Critical) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
STORM 7-3	109	EX 45 DEG BEND (1)	6.60	32.2	519.8	10.33	(N/A)	0.59	0.99	6,690.57	6,672.39	6,690.13	6,672.17
STORM 7-4	106	EX 10' D10-R INLET	6.60	32.2	114.4	10.33	(N/A)	0.59	0.99	6,694.92	6,690.62	6,694.48	6,690.31

Headloss (ft)	Upstream Structure Hydraulic Grade Line (In) (ft)	Upstream Structure Velocity (In-Governing) (ft/s)	Upstream Structure Headloss Coefficient	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Conduit Description
0.07	6,652.17	1.64	1.500	0.06	6,659.99	6,660.00	6,651.92	6,651.98	Circle - 15.0 in
2.13	6,653.81	5.97	1.500	0.83	6,657.09	6,656.33	6,650.13	6,651.70	Circle - 24.0 in
0.12	6,645.67	0.00	1.500	0.00	6,657.75	6,659.00	6,645.55	6,645.67	Circle - 15.0 in
0.25	6,648.38	0.00	1.500	0.00	6,659.33	6,659.00	6,648.12	6,648.38	Circle - 15.0 in
1.53	6,651.47	6.36	1.500	0.94	6,659.21	6,658.50	6,648.01	6,649.03	Circle - 30.0 in
1.63	6,655.34	3.33	1.500	0.26	6,661.50	6,659.60	6,651.40	6,654.61	Circle - 18.0 in
6.91	6,655.23	3.37	1.500	0.27	6,657.78	6,660.00	6,644.31	6,654.46	Circle - 30.0 in
0.17	6,673.59	7.30	1.500	1.24	6,675.30	6,675.80	6,669.29	6,670.00	Circle - 18.0 in
14.59	6,654.01	6.73	1.500	1.06	6,656.75	6,658.33	6,637.93	6,651.70	Circle - 18.0 in
-0.04	6,641.60	2.80	1.770	0.39	6,657.01	6,657.09	6,637.80	6,638.37	Circle - 42.0 in
0.37	6,642.52	4.79	1.020	0.55	6,657.09	6,657.41	6,638.87	6,640.58	Circle - 36.0 in
1.60	6,644.67	10.10	1.020	0.55	6,657.41	6,657.75	6,640.88	6,642.73	Circle - 36.0 in
2.67	6,647.97	4.86	1.020	0.55	6,657.75	6,659.33	6,643.80	6,646.01	Circle - 36.0 in
0.24	6,648.93	4.29	1.320	0.72	6,659.33	6,661.34	6,646.31	6,646.79	Circle - 36.0 in
-0.07	6,649.10	10.74	0.470	0.24	6,661.34	6,659.21	6,647.09	6,647.41	Circle - 36.0 in
1.01	6,650.17	0.00	1.500	0.00	6,659.21	6,660.00	6,649.16	6,650.17	Circle - 15.0 in
2.17	6,639.01	25.47	0.040	0.06	6,640.70	6,656.75	6,634.70	6,635.93	Box - 8.3 x 6.0 ft
0.73	6,641.25	3.28	1.020	1.50	6,656.75	6,657.01	6,635.93	6,636.80	Box - 8.3 x 6.0 ft
0.52	6,642.67	10.80	0.400	0.90	6,657.01	6,655.00	6,637.30	6,637.68	Circle - 60.0 in
-0.19	6,642.48	11.48	0.000	0.00	6,655.00	6,656.50	6,637.98	6,638.17	Circle - 60.0 in
2.18	6,648.06	11.03	1.520	3.40	6,656.50	6,657.78	6,638.17	6,640.56	Circle - 60.0 in
4.85	6,653.45	10.11	0.270	0.54	6,657.78	6,661.50	6,640.81	6,648.99	Circle - 60.0 in
-0.26	6,655.24	4.00	1.020	2.04	6,661.50	6,661.82	6,648.99	6,649.28	Circle - 60.0 in
0.37	6,657.20	10.04	1.020	1.60	6,661.82	6,660.70	6,649.78	6,650.23	Circle - 54.0 in
6.43	6,649.18	1.64	1.020	0.04	6,657.41	6,658.26	6,642.63	6,649.02	Circle - 15.0 in
0.71	6,651.45	0.00	0.050	0.00	6,658.26	6,659.34	6,650.74	6,651.45	Circle - 15.0 in
0.06	6,651.81	0.00	1.500	0.00	6,659.34	6,659.83	6,651.75	6,651.81	Circle - 15.0 in
0.95	6,650.42	1.64	1.020	0.04	6,658.26	6,660.68	6,649.32	6,650.26	Circle - 15.0 in
0.38	6,651.08	0.00	1.020	0.04	6,660.68	6,659.99	6,650.55	6,650.92	Circle - 15.0 in
0.96	6,652.88	0.00	1.500	0.00	6,659.99	6,662.00	6,651.92	6,652.88	Circle - 15.0 in
0.33	6,651.13	0.00	1.500	0.00	6,660.00	6,660.68	6,651.13	6,650.80	Circle - 15.0 in
0.11	6,651.21	0.00	1.500	0.00	6,661.00	6,660.68	6,651.21	6,651.10	Circle - 15.0 in
2.65	6,657.92	6.61	0.040	0.03	6,661.82	6,664.00	6,651.78	6,656.17	Circle - 36.0 in
3.51	6,662.49	6.74	1.500	1.06	6,664.00	6,664.83	6,656.17	6,659.71	Circle - 36.0 in
4.04	6,654.63	11.03	1.320	2.53	6,657.78	6,657.80	6,644.31	6,650.64	Circle - 18.0 in
16.65	6,672.17	7.30	0.470	0.89	6,657.80	6,675.30	6,650.84	6,669.19	Circle - 18.0 in
17.96	6,690.31	4.47	0.400	0.18	6,675.30	6,698.00	6,669.39	6,689.14	Circle - 18.0 in
4.17	6,695.14	5.31	1.500	0.66	6,698.00	6,701.00	6,689.14	6,693.49	Circle - 18.0 in

DRAINAGE MAPS



LEGEND

- BASIN DESIGNATION: G1 — 2.35 ACRES — .53 C5 — .66 C100
- 4 — PIPE RUN REFERENCE LABEL
- 6 — SURFACE DESIGN POINT
- BASIN BOUNDARY
- (6920) — EXISTING CONTOUR
- SUBDIVISION BOUNDARY
- EXISTING STORM SEWER PIPE
- EXISTING FLOW DIRECTION ARROW
- H.P. — HIGH POINT
- L.P. — LOW POINT

1" = 40'

0 20 40 80

Scale in Feet

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BASIN SUMMARY

BASIN	AREA (ACRES)	Q_5	Q_{100}
A	0.93	0.3	2.0
B	0.86	2.6	5.0
C	1.14	0.3	2.3
D	0.10	0.1	0.3
E	1.09	2.8	5.9
F	0.27	1.1	2.0
G	1.40	2.5	6.1
H	1.39	1.6	4.6
I	1.25	3.9	7.9
J	1.21	0.3	2.4
OS1	0.04	0.02	0.1
OS2	0.05	0.02	0.2
OS3	3.75	7.3	15.0

BASIN SUMMARY

BASIN	AREA (ACRES)	Q_5	Q_{100}
OS4	4.96	8.9	20.1
OS5	2.84	5.9	12.3
OS6	1.48	2.1	5.1
OS7	0.02	0.01	0.1
OS8	1.46	4.6	8.9
OS9	15.45	7.0	36.1
OS10	3.45	3.8	11.1
OS11	0.95	3.2	6.3

DESIGN POINT SUMMARY

DESIGN POINT	Q_5	Q_{100}	BASIN	STRUCTURE
1	0.3	2.02	OS1, A	EXISTING DESERT VARNISH DRIVE
2	0.3	.4	OS2, C	EXISTING DESERT VARNISH DRIVE
3	2.6	8.4	DP1, DP2, B	EXISTING DESERT VARNISH DRIVE
4	2.8	5.9	E	EX AREA DRAIN-WQ POND (PVT)
5	7.3	15.0	OS3	EX. 10' AT-GRADE INLET (PUB)
6	14.2	31.0	OS4, OS5	EX. 15' AT-GRADE INLET (PUB)
7	9.8	27.0	OS6, OS8, OS7, D, FBDP6, DP3, F	EXSITING BARNES ROAD
8	2.5	6.1	G	EX. 5' SUMP INLET (PVT)
9	7.0	36.1	OS9	EXISTING 24" CMP
10	10.6	46.4	DP9, OS10	SHEET FLOW TO OFFSITE AREA WEST OF MARKSHEFFEL RD
11	10.6	44.4	DP10, H	SHEET FLOW TO OFFSITE AREA WEST OF MARKSHEFFEL RD
12	3.9	7.9	I	SHEET FLOW TO OFFSITE LOW POINDT AREA WEST OF MARKSHEFFEL RD
13	12.5	48.4	DP11, DP12, J	EX GRATED INLET ATOP BOX CULVERT
14	11.8	30.7	DP7, OS11	EX. 20' SUMP INLET (PUB)

STORM SEWER SUMMARY

PIPE RUN	Q_5	Q_{100}	PIPE SIZE
#1	5.9	8.7	EX 18" RCP
#2	2.6	9.8	EX 18" RCP
#3	17.5	26.3	EX 18" RCP
#4	127.4	266.9	EX 54" RCP
#5	25.3	50.5	EX 36" RCP
#6	168.1	346.4	EX 60" RCP
7	1.9	3.9	EX 24" RCP
#8	168.0	346.4	EX 60" RCP
9	2.5	4.2	PROP 15" RCP
10	0.2	1.3	PROP 15" RCP
11	0.1	1.1	PROP 15" RCP
12	0.1	0.5	PROP 15" RCP
#13	166.9	346.7	EX 60" RCP
#14	1.9	3.3	EX 24" RCP

#~FROM HEC-HMS MODEL

STORM SEWER SUMMARY

PIPE RUN	Q_5	Q_{100}	PIPE SIZE
15	1.0	1.8	PROP 15" RCP
#16	185.2	374.3	EX 60" RCP
16.1	0.2	1.0	PROP 15" RCP
#17	185.4	375.3	EX 60" RCP
#18	17.4	45.5	PROP 36" RCP
19	0.1	0.5	PROP 15" RCP
#20	17.4	45.8	PROP 36" RCP
21	0.2	0.8	PROP 15" RCP
22	0.1	0.5	PROP 15" RCP
23	0.3	1.2	PROP 15" RCP
#24	17.5	46.5	PROP 36" RCP
#25	8.3	20.0	EX 24" RCP
#26	25.6	66.1	PROP 42" RCP
#27	209.9	439.8	EX 8.5'x6.0' CBC

#~FROM HEC-HMS MODEL

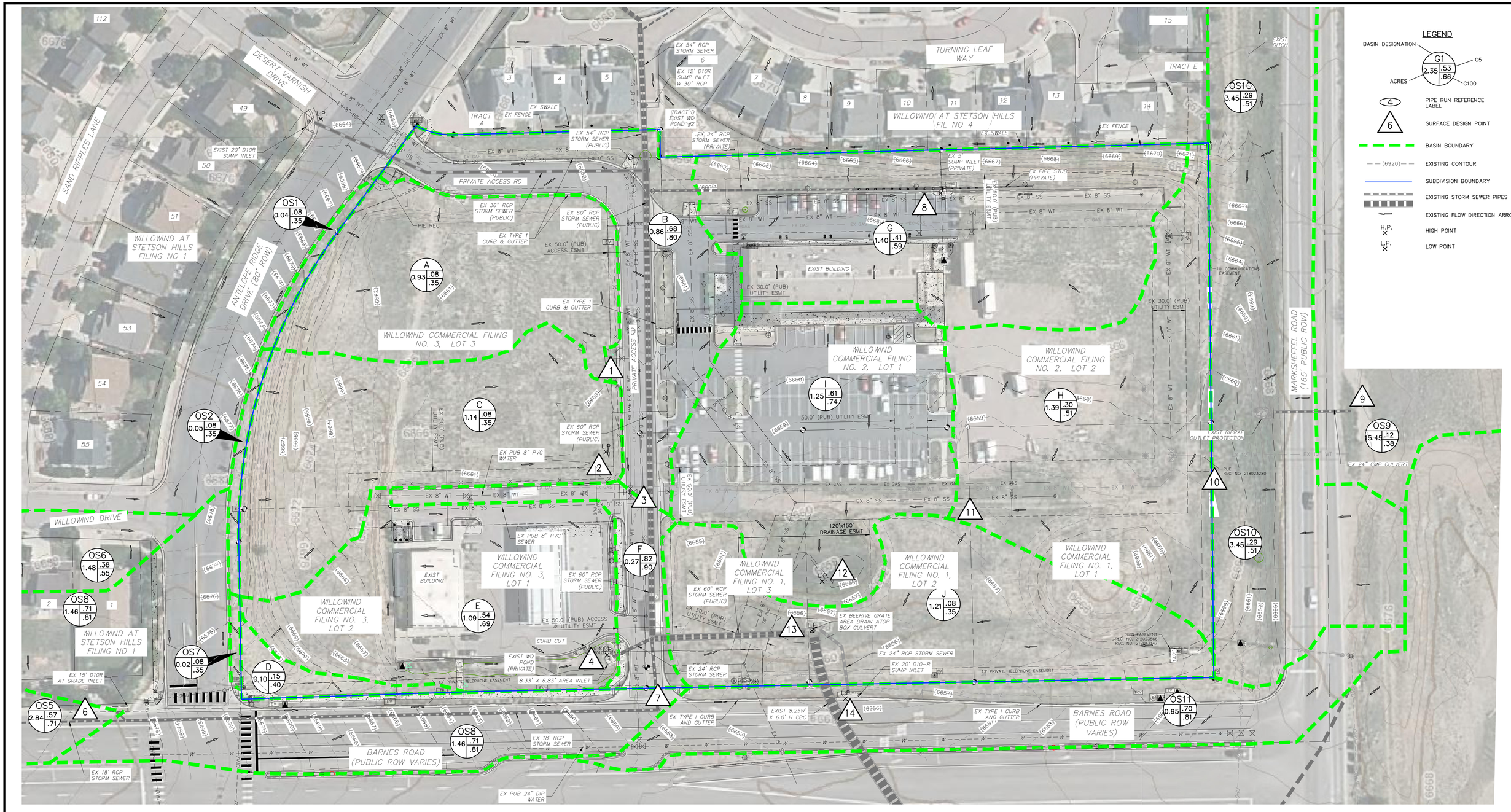
CIVIL CONSULTANTS, INC.
212 N. WAHSATCH AVE., STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

WILLOWIND COMMERICAL FILING NO.4

EXISTING CONDITIONS DRAINAGE MAP

PROJECT NO. 10-021
DESIGNED BY: DLM
DRAWN BY: DLM
CHECKED BY: VAS
SCALE: HORIZONTAL: 1"=80' VERTICAL: N/A
DATE: 08-04-2023
SHEET 1 OF 2
EDM1

File: O:\10021A- Willowwind-Durkin Donuts\Drainage\Drainage Map\10-021 Existing Condition Drainage Plan Map.dwg Plotstamp: 9/17/2023 4:08 PM



BASIN SUMMARY			
BASIN	AREA (ACRES)	Q_5	Q_{100}
A	0.93	0.3	2.0
B	0.86	2.6	5.0
C	1.14	0.3	2.3
D	0.10	0.1	0.3
E	1.09	2.8	5.9
F	0.27	1.1	2.0
G	1.40	2.5	6.1
H	1.39	1.6	4.6
I	1.25	3.9	7.9
J	1.21	0.3	2.4
OS1	0.04	0.02	0.1
OS2	0.05	0.02	0.2
OS3	3.75	7.3	15.0

BASIN SUMMARY			
BASIN	AREA (ACRES)	Q_5	Q_{100}
OS4	4.96	8.9	20.1
OS5	2.84	5.9	12.3
OS6	1.48	2.1	5.1
OS7	0.02	0.01	0.1
OS8	1.46	4.6	8.9
OS9	15.45	7.0	36.1
OS10	3.45	3.8	11.1
OS11	0.95	3.2	6.3

DESIGN POINT SUMMARY				
DESIGN POINT	Q_5	Q_{100}	BASIN	STRUCTURE
1	0.3	2.02	OS1, A	EXISTING DESERT VARNISH DRIVE
2	0.3	.4	OS2, C	EXISTING DESERT VARNISH DRIVE
3	2.6	8.4	DP1, DP2, B	EXISTING DESERT VARNISH DRIVE
4	2.8	5.9	E	EX AREA DRAIN-WQ POND (PVT)
5	7.3	15.0	OS3	EX. 10' AT-GRADE INLET (PUB)
6	14.2	31.0	OS4, OS5	EX. 15' AT-GRADE INLET (PUB)
7	9.8	27.0	OS6, OS8, OS7, D, FBDP6, DP3, F	EXSITING BARNES ROAD
8	2.5	6.1	G	EX. 5' SUMP INLET (PVT)
9	7.0	36.1	OS9	EXISTING 24" CMP
10	10.6	46.4	DP9, OS10	SHEET FLOW TO OFFSITE AREA WEST OF MARKSHEFFEL RD
11	10.6	44.4	DP10, H	SHEET FLOW TO OFFSITE AREA WEST OF MARKSHEFFEL RD
12	3.9	7.9	I	SHEET FLOW TO OFFSITE LOW POINDT AREA WEST OF MARKSHEFFEL RD
13	12.5	48.4	DP11, DP12, J	EX GRATED INLET ATOP BOX CULVERT
14	11.8	30.7	DP7, OS11	EX. 20' SUMP INLET (PUB)

1" = 40'

0 20 40 80

Scale in Feet

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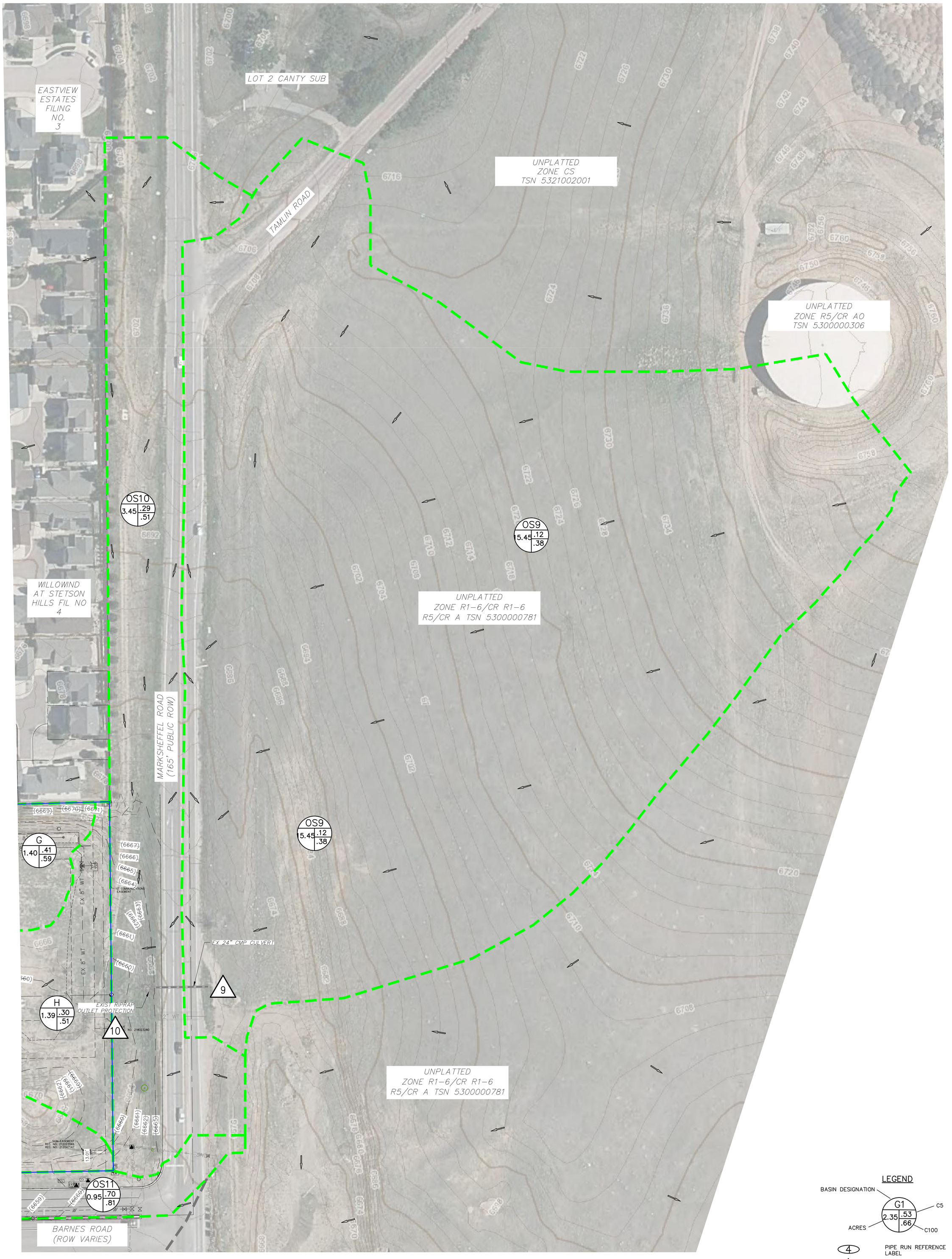
CIVIL CONSULTANTS, INC.
212 N. WAHSATCH AVE., STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

WILLOWIND COMMERICAL FILING NO.4

EXISTING CONDITIONS DRAINAGE MAP

PROJECT NO. 10-021	SCALE: HORIZONTAL: 1"=40' VERTICAL: N/A	DATE: 10-28-2023	
DESIGNED BY: DLM		SHEET 2 OF 3	EDM2
DRAWN BY: DLM			
CHECKED BY: VAS			

File: O:\10021A-Willowind-Dunkin Donuts\Dunkin Donuts\Drainage\Drainage Map\10-021 Existing Condition Drainage Plan Map.dwg Plotstamp: 10/28/2023 12:47 PM



BASIN SUMMARY			
BASIN	AREA (ACRES)	Q_5	Q_{100}
A	0.93	0.3	2.0
B	0.86	2.6	5.0
C	1.14	0.3	2.3
D	0.10	0.1	0.3
E	1.09	2.8	5.9
F	0.27	1.1	2.0
G	1.40	2.5	6.1
H	1.39	1.6	4.6
I	1.25	3.9	7.9
J	1.21	0.3	2.4
OS1	0.04	0.02	0.1
OS2	0.05	0.02	0.2
OS3	3.75	7.3	15.0

BASIN SUMMARY			
BASIN	AREA (ACRES)	Q_5	Q_{100}
OS4	4.96	8.9	20.1
OS5	2.84	5.9	12.3
OS6	1.48	2.1	5.1
OS7	0.02	0.01	0.1
OS8	1.46	4.6	8.9
OS9	15.45	7.0	36.1
OS10	3.45	3.8	11.1
OS11	0.95	3.2	6.3

DESIGN POINT SUMMARY				
DESIGN POINT	Q_5	Q_{100}	BASIN	STRUCTURE
1	0.3	2.02	OS1, A	EXISTING DESERT VARNISH DRIVE
2	0.3	.4	OS2, C	EXISTING DESERT VARNISH DRIVE
3	2.6	8.4	DP1, DP2, B	EXISTING DESERT VARNISH DRIVE
4	2.8	5.9	E	EX AREA DRAIN-WQ POND (PVT)
5	7.3	15.0	OS3	EX. 10' AT-GRADE INLET (PUB)
6	14.2	31.0	OS4, OS5	EX. 15' AT-GRADE INLET (PUB)
7	9.8	27.0	OS6, OS8, OS7, D, FBDP6, DP3, F	EXSITING BARNES ROAD
8	2.5	6.1	G	EX. 5' SUMP INLET (PVT)
9	7.0	36.1	OS9	EXISTING 24" CMP
10	10.6	46.4	DP9, OS10	SHEET FLOW TO OFFSITE AREA WEST OF MARKSHEFFEL RD
11	10.6	44.4	DP10, H	SHEET FLOW TO OFFSITE AREA WEST OF MARKSHEFFEL RD
12	3.9	7.9	I	SHEET FLOW TO OFFSITE LOW POINDT AREA WEST OF MARKSHEFFEL RD
13	12.5	48.4	DP11, DP12, J	EX GRATED INLET ATOP BOX CULVERT
14	11.8	30.7	DP7, OS11	EX. 20' SUMP INLET (PUB)

LEGEND

BASIN DESIGNATION — G1 — 2.35 ACRES — .53 C5 — .66 C100

4 — PIPE RUN REFERENCE LABEL

6 — SURFACE DESIGN POINT

BASIN BOUNDARY

(6920) EXISTING CONTOUR

SUBDIVISION BOUNDARY

EXISTING STORM SEWER PIPE

EXISTING FLOW DIRECTION ARROW

H.P. — HIGH POINT

L.P. — LOW POINT

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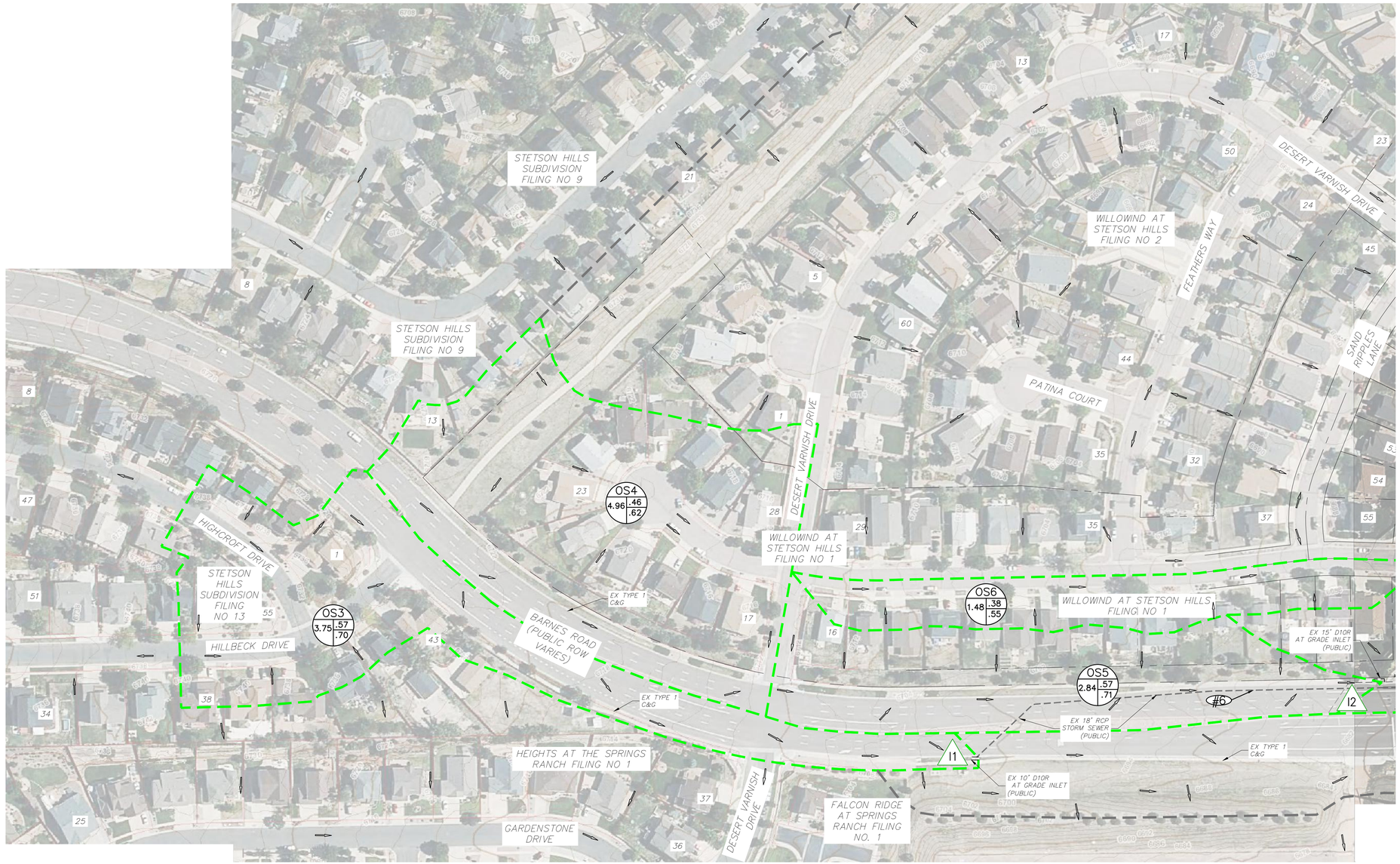
CIVIL CONSULTANTS, INC.
212 N. WAHSATCH AVE., STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

WILLOWIND COMMERICAL FILING NO. 4

EXISTING CONDITIONS DRAINAGE MAP

PROJECT NO. 10-021
DESIGNED BY: DLM
DRAWN BY: DLM
CHECKED BY: VAS
SCALE: HORIZONTAL: 1"=60' VERTICAL: N/A
DATE: 08-04-23
SHEET 3 OF 3
EDM3

Plotted: 9/11/2023 4:47 PM By: Dustin Lineback
File: V:\2021-WILLOWWIND-FILING4\Engineering\Drainage\dwg\EDM3 Existing Condition Drainage Plan.dwg



LEGEND

- BASIN DESIGNATION: G1, 2.35 (ACRES), .53 (C5), .66 (C100)
- 4 — PIPE RUN REFERENCE LABEL
- I1 — DESIGN POINT
- BASIN BOUNDARY
- (6920) — EXISTING CONTOUR
- 6920 — PROP CONTOUR
- SUBDIVISION BOUNDARY
- EXISTING STORM SEWER PIPE
- EXISTING FLOW DIRECTION ARROW
- H.P. — HIGH POINT
- L.P. — LOW POINT

1" = 40'

0 20 40 80

Scale in Feet

FOR LOCATING & MARKING GAS, ELECTRIC, WATER & TELEPHONE LINES

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NOTE
REFER TO SHEET 2 OR 2 FOR REMAINDER OF VALUES NOT PROVIDE ON SHEET 1

BASIN SUMMARY			
BASIN	AREA (ACRES)	Q_5	Q_{100}
A	1.71	7.1	12.9
B	0.76	2.4	4.6
C	0.75	3.2	5.7
D	0.80	2.9	5.6
E	0.29	1.2	2.3
F	0.64	1.8	3.8
F1	1.11	4.7	8.5
F2	0.67	2.8	5.1
G	0.18	0.7	1.4
H	1.03	4.3	6.1
I	0.87	3.7	6.7

BASIN SUMMARY			
BASIN	AREA (ACRES)	Q_5	Q_{100}
J	0.82	3.4	6.2
OS1	0.06	0.1	0.3
OS2	0.05	0.1	0.2
OS3	3.75	7.3	15.0
OS4	4.96	8.9	20.1
OS5	2.84	5.9	12.3
OS6	1.48	2.1	5.1
OS7	NOT	USED	
OS8	1.46	4.6	8.9
OS9	15.45	7.0	36.1
OS10	2.09	2.3	6.9
OS10A	0.16	0.7	1.3
OS10B	1.20	1.8	3.3
OS11	0.95	3.2	6.3

BASIN SUMMARY VALUES SHOWN PER RATIONAL CALCULATION ANALYSIS

JUNCTION SUMMARY			
JUNCT	Q_5	Q_{100}	CONTRIB. BASIN/DP/ REACH
1	106.7	233.3	A, R1
2	143.0	299.1	SHOWN
3	159.6	330.7	SHOWN
4	19.5	19.5	INLET 1/R5
5	187.2	387.5	R4, R5
6	188.0	387.5	R8, L
7	206.7	402.6	R7, R9, K
8	19.6	51.2	R11, P, Q, Q2
9	19.5	51.3	R12, R13
10	19.2	51.1	R14, POND 6
11	18.9	51.2	R15, POND 5
12	0.1	1.7	R17, POND 0
13	0.1	2.6	R18, PONDS 2&3
14	0.1	3.5	R18, POND 4
15	18.9	54.5	R16, R20
16	12.7	41.0	DIV2, H, M
17	31.5	95.2	R21, R22
18	236.8	495.5	R10, R23
19	10.6	23.1	DIV1, T
20	246.1	516.7	R24, J19

DESIGN POINT SUMMARY				
DESIGN POINT	Q_5	Q_{100}	BASIN	STRUCTURE
POND 0	7.2	13.2	B	SF POND 0
POND 1	3.2	6.0	OS2, C	SF POND 1
EX POND	2.9	5.6	D	EX AREA DRAIN/WQ POND
X	3.3	6.3	B, E	EX BARNES ROAD C&G
I1	7.3	15.0	OS3	EX 10' D10R AT-GRADE INLET
I2	14.2	31.0	OS4, OS5	EX 15' D10R AT-GRADE INLET
Y	10.2	28.8	OS2, OS6, OS8, DPX, FB DPI2	EX BARNES ROAD C&G
EX IN	1.8	3.8	F	EXISTING TYPE R 5' SUMP INLET
POND 4	4.7	8.5	F1	SF POND 4
POND 4A	3.5	6.4	10A, F2	SF POND 4A
POND 2	0.7	1.4	G	SF POND 2
POND 3	4.3	7.9	H	SF POND 3
CUL	2.3	6.9	OS10	PROP. 24" CULVERT
EX CUL	7.0	36.1	OS9	EX FES
POND 6	3.4	6.2	J	SF POND 6
POND 5	3.7	6.7	I	SF POND 5
Z	12.1	32.1	OS11, DPY	EX 20' D10R SUMP INLET

THE ABOVE DP VALUES WERE USED TO EVALUATE THE HEC-HMS MODEL AND ARE FOR INFORMATION PURPOSES ONLY.

STORM SEWER SUMMARY				
PIPE RUN/ REACH	Q_5	Q_{100}	PIPE SIZE	
#1	NOT	SHOWN	ON MAP	
#2	NOT	SHOWN	ON MAP	
#3	NOT	SHOWN	ON MAP	
#4	158.8	329.2	EX 54" RCP	
#5	28.4	56.6	EX 36" RCP	
#6	6.6	9.1	EX 18" RCP	
#7	19.5	19.5	EX 18" RCP	
#8	186.6	384.7	EX 60" RCP	
#9	185.5	383.1	EX 60" RCP	
#10	205.5	400.6	EX 60" RCP	
#11	3.4	7.5	7.5' BW TRAP	
#12	19.5	51.0	PROP 36" PP	
#13	0.0	0.3	PROP 15" PP	
#14	19.2	50.6	PROP 36" PP	

#X VALUES PROVIDED PER HEC-HMS MODEL OUTPUT
THESE VALUES WERE USED IN HYDRAULIC GRADE LINE MODELS

REFER TO WWCF4 HEC-HMS DEVELOPED CONDITION DRAINAGE MAP FOR REACHES AND JUNCTIONS NOT SHOWN ON MAP

STORM SEWER SUMMARY			
PIPE RUN	Q_5	Q_{100}	PIPE SIZE
#15	18.9	50.6	PROP 36" PP
#16	18.8	51.0	PROP 36" PP
#17	0.0	0.6	PROP 15" PP
#18	0.1	1.7	PROP 15" PP
#19	0.1	2.6	PROP 15" PP
#20	0.1	3.5	PROP 15" PP
#21	18.8	54.3	PROP 36" PP
#22	12.6	40.9	EX 24" RCP
#23	31.3	95.0	PROP 36" PP
#24	235.5	493.6	EX 6'X8.25'CBC

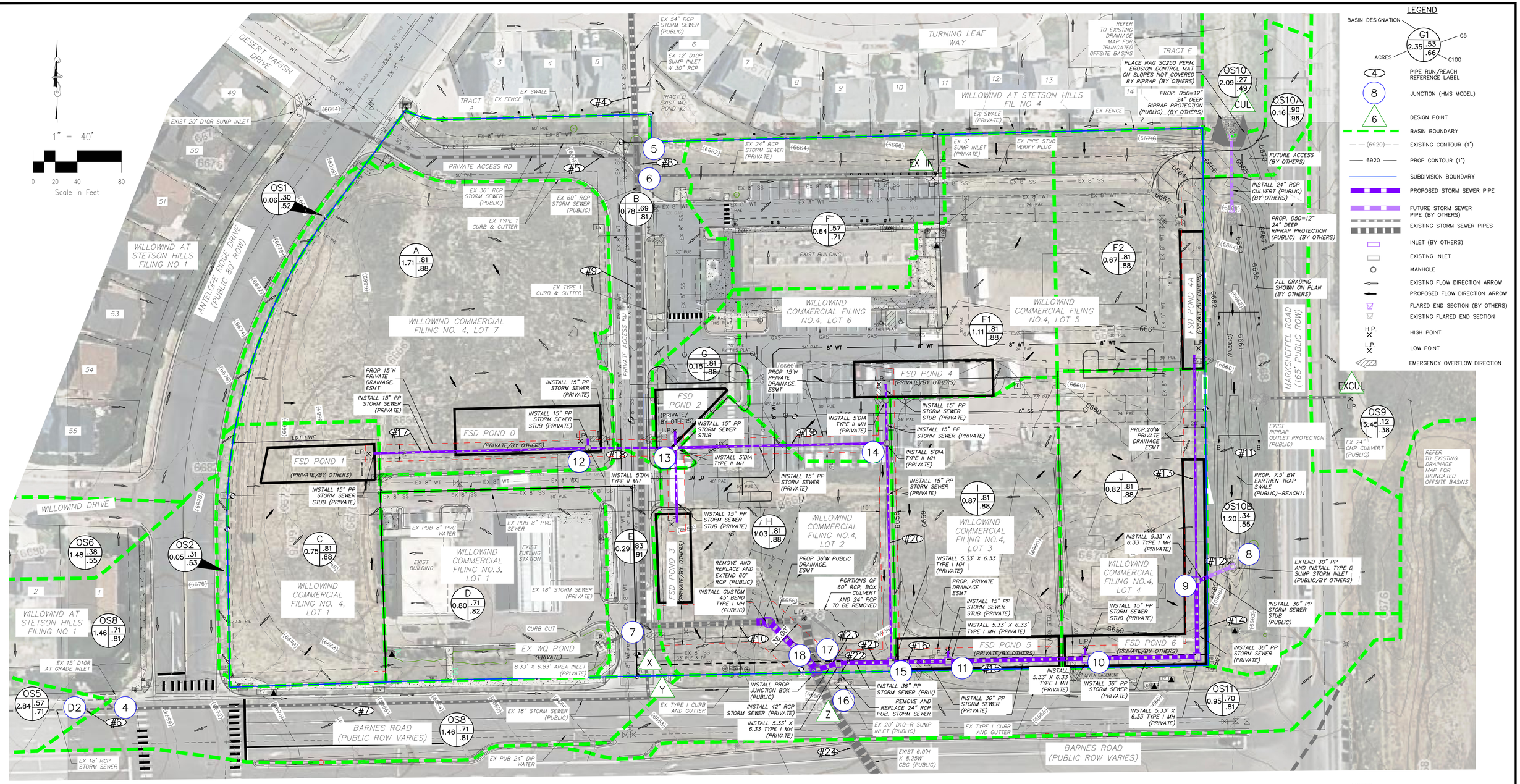
CIVIL CONSULTANTS, INC.
212 N. WAHSATCH AVE., STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

WILLOWIND COMMERICAL FILING NO.4

PROPOSED CONDITIONS DRAINAGE MAP

PROJECT NO. 10-021		DATE: 05-10-2023	
DESIGNED BY: DLM	SCALE: HORIZONTAL: 1"=80' VERTICAL: N/A	SHEET 2 OF 2	PDM2
DRAWN BY: DLM			
CHECKED BY: VAS			

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BASIN SUMMARY			
BASIN	AREA (ACRES)	Q_5	Q_{100}
A	1.71	7.1	12.9
B	0.76	2.4	4.6
C	0.75	3.2	5.7
D	0.80	2.9	5.6
E	0.29	1.2	2.3
F	0.64	1.8	3.8
F1	1.11	4.7	8.5
F2	0.67	2.8	5.1
G	0.18	0.7	1.4
H	1.03	4.3	6.1
I	0.87	3.7	6.7

BASIN SUMMARY			
BASIN	AREA (ACRES)	Q_5	Q_{100}
J	0.82	3.4	6.2
OS1	0.06	0.1	0.3
OS2	0.05	0.1	0.2
OS3	3.75	7.3	15.0
OS4	4.96	8.9	20.1
OS5	2.84	5.9	12.3
OS6	1.48	2.1	5.1
OS7	NOT	USED	
OS8	1.46	4.6	8.9
OS9	15.45	7.0	36.1
OS10	2.09	2.3	6.9
OS10A	0.16	0.7	1.3
OS10B	1.20	1.8	3.3
OS11	0.95	3.2	6.3

BASIN SUMMARY VALUES SHOWN PER RATIONAL CALCULATION ANALYSIS

JUNCTION SUMMARY			
JUNCT	Q_5	Q_{100}	CONTRIB. BASIN/DP/ REACH
1	106.7	233.3	A, R1
2	143.0	299.1	SHOWN
3	159.6	330.7	SHOWN
4	19.5	19.5	INLET 1/R5
5	187.2	387.5	R4, R5
6	188.0	387.5	R8, L
7	206.7	402.6	R7, R9, K
8	19.6	51.2	R11, P, Q, Q2
9	19.5	51.3	R12, R13
10	19.2	51.1	R14, POND 6
11	18.9	51.2	R15, POND 5
12	0.1	1.7	R17, POND 0
13	0.1	2.6	R18, PONDS 2&3
14	0.1	3.5	R18, POND 4
15	18.9	54.5	R16, R20
16	12.7	41.0	DIV2, H, M
17	31.5	95.2	R21, R22
18	236.8	495.5	R10, R23
19	10.6	23.1	DIV1, T
20	246.1	516.7	R24, J19

DESIGN POINT SUMMARY				
DESIGN POINT	Q_5	Q_{100}	RATIONAL BASIN	STRUCTURE
POND 0	7.2	13.2	OS1, A	SF POND 0
POND 1	3.2	6.0	OS2, C	SF POND 1
EX POND	2.9	5.6	D	EX AREA DRAIN/WQ POND
X	3.3	6.3	B, E	EX BARNES ROAD C&G
I1	7.3	15.0	OS3	EX 10' D10R AT-GRADE INLET
I2	14.2	31.0	OS4, OS5	EX 15' D10R AT-GRADE INLET
Y	10.2	28.8	OS2, OS6, OS8, DPX, FB DPI2	EX BARNES ROAD C&G
EX IN	1.8	3.8	F	EXISTING TYPE R 5' SUMP INLET
POND 4	4.7	8.5	F1	SF POND 4
POND 4A	3.5	6.4	10A, F2	SF POND 4A
POND 2	0.7	1.4	G	SF POND 2
POND 3	4.3	7.9	H	SF POND 3
CUL	2.3	6.9	OS10	PROP. 24" CULVERT
EX CUL	7.0	36.1	OS9	EX FES
POND 6	3.4	6.2	J	SF POND 6
POND 5	3.7	6.9	I	SF POND 5
Z	12.1	32.1	OS11, DPY	EX 20' D10R SUMP INLET

THE ABOVE DP VALUES WERE USED TO EVALUATE THE HEC-HMS MODEL AND ARE FOR INFORMATION PURPOSES ONLY.

STORM SEWER SUMMARY				
PIPE RUN/ REACH	Q_5	Q_{100}	PIPE SIZE	
#1	NOT	SHOWN	ON MAP	
#2	NOT	SHOWN	ON MAP	
#3	NOT	SHOWN	ON MAP	
#4	158.8	329.2	EX 54" RCP	
#5	28.4	56.6	EX 36" RCP	
#6	6.6	9.1	EX 18" RCP	
#7	19.5	19.5	EX 18" RCP	
#8	186.6	384.7	EX 60" RCP	
#9	185.5	383.1	EX 60" RCP	
#10	205.5	400.6	EX 60" RCP	
#11	3.4	7.5	7.5' BW TRAP	
#12	19.5	51.0	PROP 36" PP	
#13	0.0	0.3	PROP 15" PP	
#14	19.2	50.6	PROP 36" PP	

STORM SEWER SUMMARY				
PIPE RUN/ REACH	Q_5	Q_{100}	PIPE SIZE	
#15	18.9	50.6	PROP 36" PP	
#16	18.8	51.0	PROP 36" PP	
#17	0.0	0.6	PROP 15" PP	
#18	0.1	1.7	PROP 15" PP	
#19	0.1	2.6	PROP 15" PP	
#20	0.1	3.5	PROP 15" PP	
#21	18.8	54.3	PROP 36" PP	
#22	12.6	40.9	EX 24" RCP	
#23	31.3	95.0	PROP 36" PP	
#24	235.5	493.6	EX 6'X8.25'CBC	

#X VALUES PROVIDED PER HEC-HMS MODEL OUTPUT
THESE VALUES WERE USED IN HYDRAULIC GRADE LINE MODELS

REFER TO WWCF4 HEC-HMS DEVELOPED CONDITION DRAINAGE MAP FOR REACHES AND JUNCTIONS NOT SHOWN ON MAP

SAND FILTER FSD POND SUMMARY									
POND	CONTRIB. ACREAGE	CONTRIB. BASINS	IMPERVIOUS	EPC/URBAN DRAINAGE SAND FILTER BASIN–SEE STD. DET.		WQCV**	EURV**	100 YR**	TOTAL**	ASSUMED DISCHARGE***	
				SAND FILTER AREA	SQ FT*						
ID	(ACRES)	ID	%			(AC-FT)	(AC-FT)	(AC-FT)	(AC-FT)	Q5 (CFS)	Q100 (CFS)
0	1.77	OS1,A	93.1	REQUIRED	895	0.051	0227	0.184	0.267	0.1	1.1
1	0.81	OS2, C	91.7	(AT RIGHT)	400	0.022	0.079	0.040	0.141	0.0	0.6
2	0.18	G	95.0		92	0.005	0.018	0.009	0.033	0.0	0.1
3	1.03	H	95.0		576	0.031	0.104	0.051	0.186	0.0	0.8
4	1.11	F1	95.0		312	0.033	0.112	0.055	0.201	0.0	0.9
4A	0.67	F2	95.0		348	0.020	0.068	0.033	0.121	0.0	0.3
5	0.87	I	95.0		452	0.026	0.088	0.043	0.157	0.0	0.6
6	0.82	J	95.0		423	0.024	0.083	0.041	0.148	0.0	0.5

* BASED UPON MIN. FILTER AREA PER UD–BMP_V3.07, SUBJECT TO PONDING DEPTH OF WATER QUALITY EVENT, WQCV DEPTH OF AVG PRODUCING STORM
** BASED UPON DATA PROVIDED BY MHFD–DETENTION VERSION 4.06 WORKSHEET, BASIN TAB
*** BASED UPON DATA PROVIDED BY MHFD–DETENTION, VERSION 4.06 WORKSHEET, OUTLET STRUCTURE TAB

POTENTIAL POND LOCATION (SYMBOL SHOWN DOES NOT REFLECT REQUIRED SIZE, DEPENDENT UPON ACTUAL DEVELOPMENT)

NOTES:
1) ITEMS REFERENCED AS "BY OTHERS" IS NOT A PART OF 'INITIAL INFRASTRUCTURE'

NOTES:

1. ALL PROPOSED STORM SEWER WILL BE PRIVATELY OWNED AND MAINTAINED BY THE DISTRICT, EXCEPT FOR THE PROP. 60" RCP (INCL 45° BOX), THE PROP. JUNCTION BOX, AND THE PROP. STORM SEWER WITHIN THE BARNES AND MARKSHEFFEL RIGHTS OF WAY WHICH SHALL BE PUBLICLY OWNED AND MAINTAINED.

FOR LOCATING & MARKING GAS, ELECTRIC, WATER & TELEPHONE LINES
FOR BURIED UTILITY INFORMATION
48 HRS BEFORE YOU DIG
CALL 1-800-922-1987

CIVIL CONSULTANTS, INC.
212 N. WAHSATCH AVE., STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

WILLOWIND COMMERICAL FILING NO.4

PROPOSED CONDITIONS DRAINAGE MAP

PROJECT NO. 10-021	SCALE: HORIZONTAL: 1"=40' VERTICAL: N/A	DATE: 10-25-23	
DESIGNED BY: DLM		SHEET 1 OF 2	PDM1
DRAWN BY: DLM			
CHECKED BY: VAS			

File: O:\10021A-Willowind-Dunkin Donuts\Drainage\Drainage Map\10-021 Proposed Condition Drainage Plan Map.dwg Plotstamp: 11/2/2023 5:22 PM

WILLOWIND FILING NO.4
HEC-HMS DEVELOPED CONDITIONS
DRAINAGE MAP

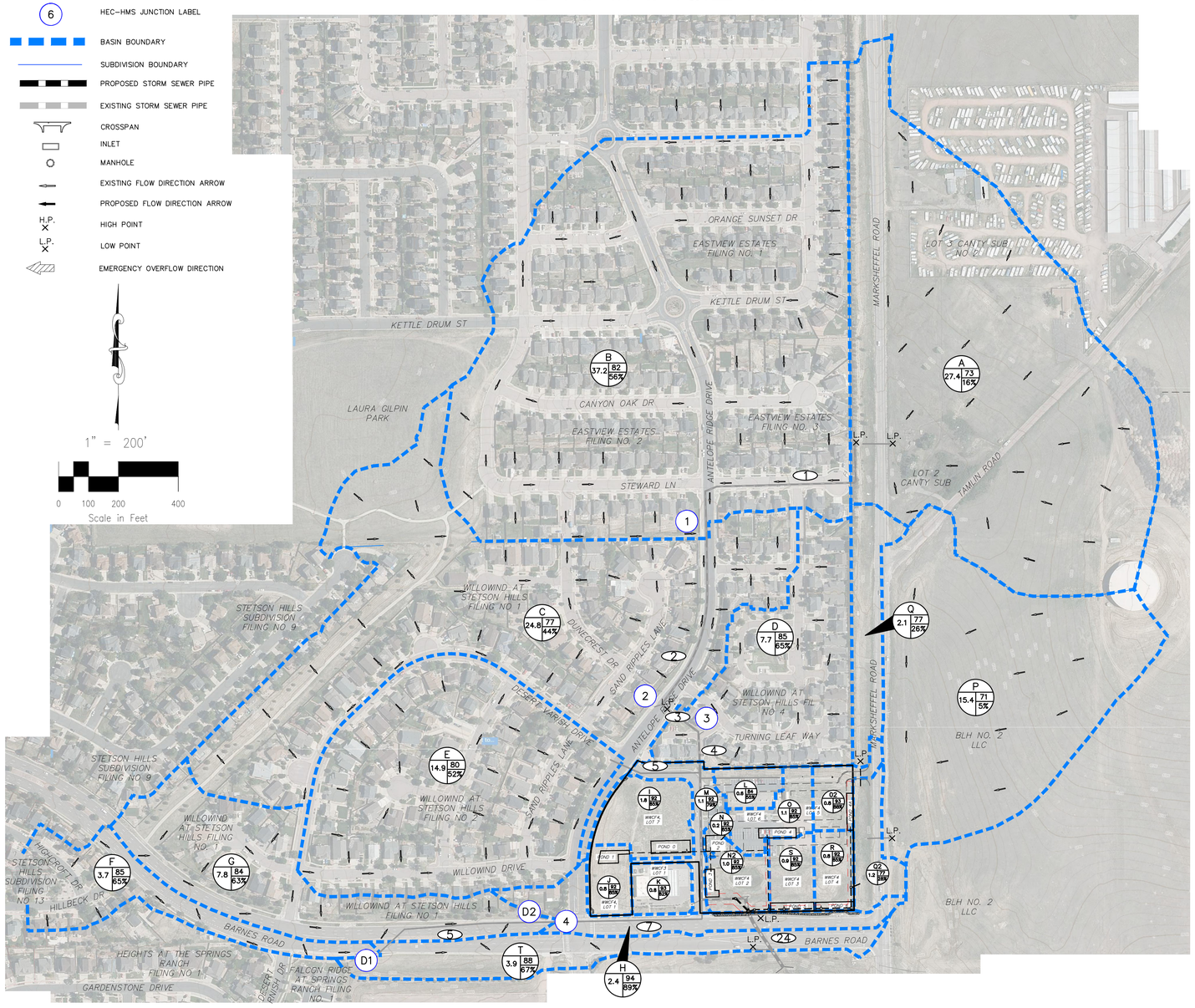
LEGEND

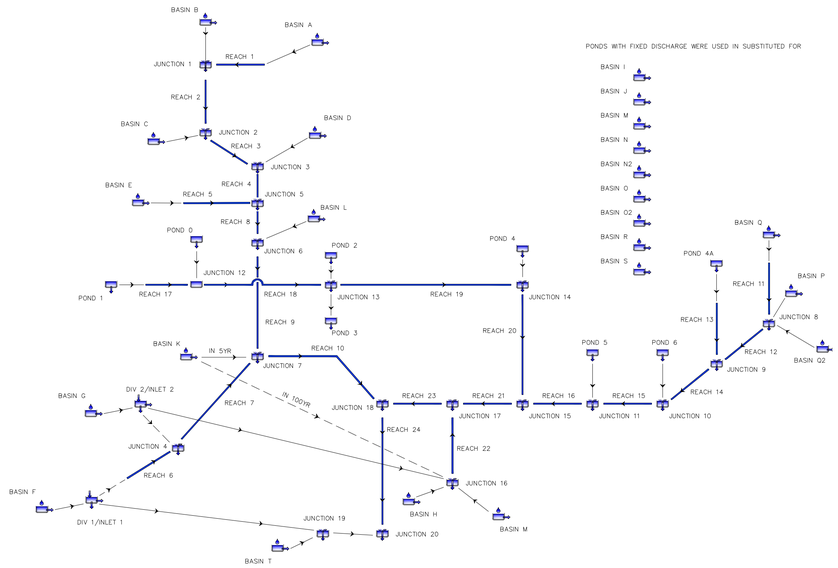
BASIN DESIGNATION — G1 — CN VALUE
SQUARE MILES — 2.4 — 78 — 82% — % IMPERVIOUS

- (4) HEC-HMS REACH REFERENCE LABEL
- (6) HEC-HMS JUNCTION LABEL
- BASIN BOUNDARY
- SUBDIVISION BOUNDARY
- PROPOSED STORM SEWER PIPE
- EXISTING STORM SEWER PIPE
- CROSSPAN
- INLET
- MANHOLE
- EXISTING FLOW DIRECTION ARROW
- PROPOSED FLOW DIRECTION ARROW
- H.P. HIGH POINT
- L.P. LOW POINT
- EMERGENCY OVERFLOW DIRECTION

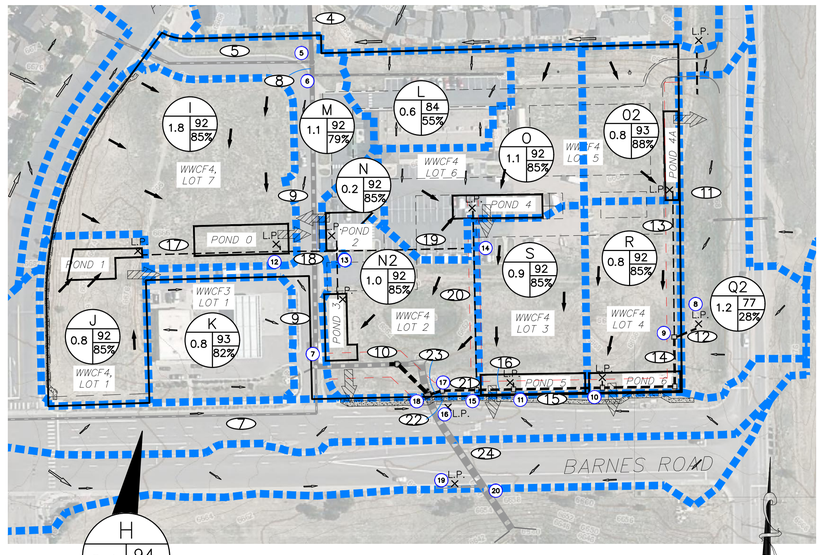
1" = 200'

0 100 200 400
Scale in Feet





HEC-HMS SCHEMATIC



DETAIL

NOTE:
THE IMPERVIOUS % VALUES SHOWN ON THIS MAP ARE STRICTLY UTILIZED IN THE HEC-HMS ANALYSIS. THE VALUES PROVIDED ON THIS MAP, ARE NOT INTENDED TO REPRESENT OR ALIGN WITH THE IMPERVIOUS VALUES ASSIGNED IN ESTIMATING SIZING THE WATER QUALITY AND DETENTION REQUIREMENTS, REFER TO RATIONAL METHOD PROPOSED CONDITIONS DRAINAGE MAP.

1" = 100'

0 50 100 200
Scale in Feet

BASIN SUMMARY			
BASIN	AREA (SQMI)	Q_5	Q_{100}
A	0.04274	29.3	72.0
B	0.05808	78.7	153.7
C	0.03869	39.0	80.2
D	0.01198	18.7	35.3
E	0.02321	28.8	57.3
F	0.00586	8.1	15.3
G	0.01218	16.1	30.7
H	0.00383	6.9	12.3
I	0.00279	5.4	9.7
J	0.00105	2.5	4.4
K	0.01242	2.4	4.4
L	0.00010	1.6	3.2

BASIN SUMMARY			
BASIN	AREA (ACRES)	Q_5	Q_{100}
M*	0.00165	3.0	5.5
N*	0.00028	0.5	1.0
N2*	0.00160	3.1	5.6
O*	0.00174	3.4	6.1
O2*	0.00130	2.6	4.6
P	0.02405	14.2	39.1
Q	0.00333	3.6	7.8
Q2	0.00191	2.1	4.5
R*	0.00128	2.5	4.5
S	0.00137	2.7	4.8
T	0.00605	9.1	17.0

*INDICATES RUNOFF PRODUCED, IN MODEL THESE BASINS WERE REPLACED WITH THE PONDS CALCULATED DISCHARGE

SOURCE SUMMARY		
SOURCE	Q_5	Q_{100}
POND 0	0.1	1.1
POND 1	0.0	0.6
POND 2	0.0	0.1
POND 3	0.0	0.8
POND 4	0.0	0.9
POND 4A	0.0	0.3
POND 5	0.0	0.6
POND 6	0.0	0.5

TAKEN FROM UD-DET V4.06 OUTLET WORKSHEET

DIVERSION SUMMARY								
DIVERSION	Q_5	Q_{100}	DOWNSTREAM	Q_5	Q_{100}	DIVERSION	Q_5	Q_{100}
INLET 1 (D1)	8.1	15.3	JUCTION-19	1.5	6.2	REACH-5	6.6	9.1
INLET 2 (D2)	16.1	30.7	JUNCTION-16	3.2	12.7	JUNCTION-4	12.9	18.0

JUNCTION SUMMARY			
JUNCT	Q_5	Q_{100}	CONTRIBUTING BASIN/PIPES/ DESIGN POINTS
1	106.7	233.3	A, R1
2	143.0	299.1	C, R2
3	159.6	330.7	R3, D
4	19.5	19.5	INLET 1, R5
5	187.2	385.8	R4, R5
6	188.0	387.5	R8, L
7	206.7	402.6	R7, R9, K
8	19.6	51.2	R11, P, Q2
9	19.5	51.3	R12, R13
10	19.2	51.1	R14, POND 6

JUNCTION SUMMARY			
JUNCT	Q_5	Q_{100}	CONTRIBUTING BASIN/PIPES/ DESIGN POINTS
11	18.9	51.2	R15, POND 5
12	0.1	1.7	R17, POND 0
13	0.1	2.6	R18, PONDS 2&3
14	0.1	3.5	R19, POND 4
15	18.9	54.5	R16, R20
16	12.7	41.0	DIV2, H, M
17	31.5	95.2	R21, R22
18	236.8	495.5	R10, R23
19	10.6	23.1	DIV 1, T
20	246.1	516.7	R24, J19

REACH SUMMARY				
REACH	Q_5	Q_{100}	PIPE SIZE	CONTRIBUTING BASIN/PIPES/ DESIGN POINTS
1	29.2	70.5	EX 30" RCP	A
2	104.4	219.1	EX 48" RCP	J1
3	140.9	295.4	EX 54" RCP	J2
4	158.8	329.2	EX 54" RCP	J3
5	28.4	56.6	EX 36" RCP	E
6	6.6	9.1	EX 18" RCP	INLET 1
7	19.5	19.5	EX 18" RCP	J4
8	186.6	384.7	EX 60" RCP	J5
9	185.5	383.1	EX 60" RCP	J6
10	205.5	400.6	EX 60" RCP	J7
11	3.4	7.5	7.5' BW TRAP	Q

REACH SUMMARY				
REACH	Q_5	Q_{100}	PIPE SIZE	CONTRIBUTING PIPES/DESIGN POINTS
12	19.5	51.0	36" PP	J8
13	0.0	0.3	15" PP	POND 4A
14	19.2	50.6	36" PP	J9
15	18.9	50.6	36" PP	J10
16	18.8	51.0	36" PP	J11
17	0.0	0.6	15" PP	POND 1
18	0.1	1.7	15" PP	J12
19	0.1	2.6	15" PP	J13
20	0.1	3.5	15" PP	J14
21	18.8	54.3	36" PP	J15
22	12.6	40.9	EX 24" RCP	J16
23	31.3	95.0	36" RCP	J17

REACH SUMMARY				
REACH	Q_5	Q_{100}	PIPE SIZE	CONTRIBUTING PIPES/DESIGN POINTS
24	235.5	493.6	EX 6.25'X8' RBC	J18

WILLOWIND FILING NO.4
HEC-HMS D.C. DRAINAGE MAP
DATE: 8-20-23
SHEET 1 OF 1
LSPDM
SCALE: HORIZONTAL: VARIES VERTICAL: N/A
PROJECT NO. 11-021
DESIGNED BY: DLM
DRAWN BY: DLM
CHECKED BY: VAS

212 N. WAHSATCH AVE., STE.305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485
CIVIL CONSULTANTS, INC.

FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.
VIRGIL A. SANCHEZ, COLORADO P.E. NO. 37160

REVISIONS:

NO.	DATE:	BY:	DESCRIPTION:	APRV'D	BY:	DATE:

THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE OR LIABLE FOR, UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES TO THE PLANS MUST BE IN WRITING AND MUST BE APPROVED BY THE PREPARER OF THESE PLANS.

CAUTION

File: O:\100021A-Willowwind-Dunkin Donuts\Dwg\Eng Exhibits\LargeScaleDrainageExhibit.dwg Plotstamp: 9/18/2023 12:52 PM

BACKGROUND INFORMATION

MASTER DEVELOPMENT DRAINAGE PLAN FOR STETSON HILLS ENCLAVE

September, 2000

Leigh & Whitehead & Associates, Inc.

CONSULTING CIVIL ENGINEERS & SURVEYORS
2720 EAST YAMPA STREET, SUITE 1
COLORADO SPRINGS, CO 80909-5061

LWA Project No. 99087.61

RETURN WITHIN 2 WEEKS TO:
CITY OF COLORADO SPRINGS
SUBDIVISION ENGINEERING
30 SOUTH NEVADA AVE., SUITE 702
COLORADO SPRINGS, CO 80903
(719) 385-5979

MASTER DEVELOPMENT DRAINAGE PLAN

Introduction:

Stetson Hills Enclave is located in the southeast quarter of Section 20, Township 13 South, Range 65 West of the 6th P.M. The property is located adjacent to Marksheffel Road on the east and Barnes Road on the south. Stetson Hills Filing No. 9 is located adjacent to this property on the west. Vacant property is located to the north of this site and is located within the County. Stetson Hills Enclave contains approximately 58 acres and is zoned R-1 6000 with conditions of record. This MDDP is being submitted in support of the development plan that is being presented to the City of Colorado Springs and is part of the criteria. The proposed use for this property is multi-family and commercial neighborhood business areas. These are delineated on the attached Proposed Conditions Drainage Plan. The property is located within the Sand Creek Drainage Basin. Preliminary indications show that this property will be phased. Anticipated phasing is that the single family will be developed first. This may develop in three stages, followed by the commercial and multi-family.

Soils:

The soils across the site are Truckton Sandy Loam, a deep well-drained soil formed in alluvial and residum, derived from arkosic sedimentary rock. The permeability of the Truckton soil is moderately rapid which gives it a Hydrologic Group B rating. The Group B rating will be used for current and developed conditions.

Existing Drainage Conditions:

The majority of this site drains in a southeasterly direction to a natural drainage channel that flows through the center of this property in a southerly direction toward Barnes Road. The south half of Barnes Road is currently developed with curb, gutter and asphalt. Located along the previously mentioned natural drainage channel under Barnes Road is a 6'x8' reinforced concrete box culvert that accepts flows from the north and conveys them southerly within the existing

drainage channel. The site has been divided into three sub-basins and one major basin. They are delineated on the attached Existing Conditions Drainage Plan. Offsite flow enters this site from the north and also from the northwest. These flows are conveyed through the site to the existing low point adjacent to Barnes Road on the south. The location of the basins along with peak 5-year and 100-year flows are shown on the attached existing conditions master development drainage plan. Runoff may also enter the site from the east. The D.B.P.S. for Sand Creek indicates that Basin 38 flows located on the east side of Marksheffel Road are directed to the existing 6'x8' R.C.B. the peak 10-year and 100-year flows obtained from the D.B.P.S. are shown on the Proposed Conditions Drainage Plan.

Offsite Basin OS-A1 is located to the north of this property, contains 45.7 acres, and generates a peak flow of 14.3 cfs for the 5-year event and 34.2 cfs for the 100-year event. The master drainage study for Stetson Hills, prepared by Greiner Engineering in 1985, showing this sub-basin delineated on their plan as OF-1, indicates that runoff enters this site from the east side of Marksheffel Road. Preliminary investigation indicates that flows on the east side of Marksheffel may enter this site. A more detailed analysis will be provided when the preliminary/final drainage report is prepared. Runoff enters this site at the northwest corner from offsite Sub-basin OS-A2. This area contains 3.8 acres and generates a peak flow of 4.1 cfs for the 5-year event and 9.0 cfs for the 100-year event. Located on the northwesterly edge of this property is an existing single family residential area where runoff is directed as sheetflow from the back of these lots onto this site. This area is also included in Sub-basin OS-A2.

Sub-basin OS-A3 contains 63.1 acres and generates a peak flow of 17.0 cfs for the 5-year event and 40.9 cfs for the 100-year event. The combined area confluencing at this location is 112.6 acres. Since this area is larger than 100 acres, the Hydrograph method utilizing the HEC-1 computer program was utilized to determine peak flow at this location. It generates 58.0 cfs for the 5-year event and 99.0 cfs for the 100-year event. Flows located at this point are conveyed southerly under Barnes Road via the previously mentioned 6'x8' reinforced concrete box culvert.

Developed Conditions:

The site contains one major basin which confluences the southerly portion of the property at the existing 6'x8' reinforced concrete box. The site was then divided into eighteen sub-basins which include four offsite basins, OS-A1, OS-A2, OS-A8 and OS-A14. For the purpose of this report, these four offsite basins were anticipated to be developed as an R-1 6000 single-family residential area. The interior site will be developed with a street system and an underground storm system with the peak flow shown at appropriate points to determine the street capacities and the location of proposed inlets that will collect street runoff when it meets the capacity that is allowed by the City of Colorado Springs drainage criteria manual. For the purpose of this report, these pertinent locations will be discussed in greater detail.

Offsite Sub-basin OS-A1 is located to the north of this property. It contains 34.8 acres and generates a peak flow of 69.5 cfs for the 5-year event and 150.4 cfs for the 100-year event. Located at the low point of the north boundary line, a 42" R.C.P. will be constructed to intercept runoff. The pipe system within this development has been sized to accept the 5-year flow and a portion of the 100-year flow. If Sub-basin OS-A1 develops as a higher density, this pipe may be able to intercept the higher 5-year flows. A detailed analysis of the storm drain system will be required when the upstream area develops. Located just south of Sub-basin OS-A1 is Design Point 2 (DP-2) which includes the Sub-basins OS-A1, OS-A2, and A3. It contains 47.91 acres and generates a peak flow of 87.7 cfs for the 5-year event and 190.1 cfs for the 100-year event. A proposed 12' D-10R is planned at this location to accept street runoff and direct it underground to a proposed storm drain system. From this point, a 42" R.C.P. will be proposed to run easterly and then southerly to a pipe approximately 555' south of this location. Two 15' D-10R inlets in a sump condition with a water depth of approximately 1.2' are proposed at this intersection to intercept flow and direct it to the proposed underground storm drain system. Peak runoff at this location, which is delineated on the attached Proposed Conditions Drainage Plan as DP-6 and contains 68.55 acres, is 125.6 cfs for the 5-year event and 266.0 cfs for the 100-year event. These flows will be routed within the street and the proposed 48" R.C.P. to a low point delineated on the attached Proposed Conditions Drainage Plan as DP-12, which contains 129.07

acres and generates a peak flow of 205.0 cfs for the 5-year event and 450.0 cfs for the 100-year event at the existing 6'x8' reinforced concrete box. The approximate capacity of this culvert is 1040 cfs. The location of this 6'x8' R.C.B. is shown on the attached Existing and Proposed Conditions Drainage Plans. The 48" R.C.P. will tie into the 6'x8' R.C.P. with a proposed junction box. The size of this junction box preliminarily is 6'x10'. New flows will then be conveyed southerly within this 6'x8' reinforced concrete box to the existing channel downstream of this area. Pipe size, location and slopes are shown on the attached Proposed Conditions Drainage Plan.

Calculations for existing and proposed conditions and the storm drain system are included in the back of this report along with plans showing existing and proposed peak runoff for this site. A preliminary analysis of the proposed storm drain system has been evaluated for the 5-year flow. This analysis indicates the storm drain can safely convey 5-year runoff. The excess for the 100-year flow can be conveyed within the street system.

Barnes Road is located on the southerly edge of this property. Currently, there are plans to construct this arterial. Also included within this street is an underground storm system and inlets. The location of these future inlets and storm drain pipe is shown on the attached Proposed Conditions Drainage Plan. Peak runoff for Structure 23 that exits this site is 305.1 cfs for the 10-year event and 903.2 cfs for the 100-year event. These flows were obtained from the approved D.B.P.S. for Sand Creek.

Proposed Improvements:

The proposed development of this site is to construct single-family residential, high density multi-family residential, and a neighborhood commercial area. This area is compatible for this type of development. The surface runoff will be directed to the proposed street system and conveyed to a proposed underground storm drain system and then to the existing reinforced concrete box. Overlot grading within this development should be anticipated to direct flow away from all proposed structures through various side lot and rear lot drainage swales conveyed to

the street system and underground storm drain system. Areas with grade or topographic restrictions will direct runoff to the proposed drainage system.

Facilities:

The drainage basin planning study for Sand Creek shows that there are no planned major drainage facilities for this area. Preliminary evaluation of this site indicates that an underground storm system is necessary for a portion of this property. These facilities will be evaluated in greater detail at the preliminary/final drainage report and plan stage.

Public Facilities (Non-Reimbursable):

6' D10R (1 @ $2,900.00)	$ 2,900.00
12' D10R (2 @ $3,900.00)	7,800.00
15' D10R (4 @ $4,600.00)	18,400.00
20' D10R (1 @ $5,300.00)	5,300.00
18" R.C.P. (470 LF @ $25.00/ft.)	11,750.00
30" R.C.P. (355 LF @ $40.00/ft.)	14,200.00
36" R.C.P. (210 LF @ $52.00/ft.)	10,920.00
42" R.C.P. (670 LF @ $59.00/ft.)	39,530.00
48" R.C.P. (890 LF @ $70.00/ft.)	62,300.00
Manhole (6 @ $5,100.00 each)	30,600.00
48"x42" R.C.P. Reducer (1 @ L.S.)	1,500.00
6'x10' Junction Structure (1 @ L.S.)	6,000.00
Subtotal:	$211,200.00
Engineering Contingencies (10%):	21,120.00
TOTAL:	$232,320.00

Leigh Whitehead & Associates, Inc. cannot and will not guarantee that the actual construction costs will not vary from this estimate of probable costs for constructing these facilities.

Fees:

Stetson Hills Enclave is located in the Sand Creek Drainage Basin. Currently, there is drainage, bridge and pond fee basin. The following is a breakdown of fees required for this development:

Drainage Fee ($6,394.00/acre)

Bridge Fee ($381.00/acre)

Pond Fee - Land ($414.00/acre)

Pond Fee - Facility ($1,426.00/acre)

Total Fee Per Acre ($8,615.00/acre)

This MDDP is part of the submittal requirements for the concept plan being submitted to the City of Colorado Springs Engineering Division and Planning Department. Construction of this development will not adversely affect the surrounding developments. With the proper design and construction of this project, runoff should be safely conveyed to the appropriate outlet points.

OS-A2
3.8 Ac.
4.1 | 9.0

OS-A1
45.7 Ac.
14.3 | 34.2

RI-6/CR/NP

RI-6/CR/NP

STETSON HILLS FILING NO. 6

(2.39 AC.)

SHEET FLOW

OPEN SPACE / TRAILS CONNECTION

TAMLIN RD

MARKSHEFFEL ROAD

A3
63.1 Ac.
17.0 | 40.9

A
112.6 Ac.
58.0 | 99.0
HEC-1 FLOW

POSSIBLE CULVERT LOCATION (HAS NOT BEEN FIELD VERIFIED) WILL VERIFY PRIOR TO PRELIMINARY/FINAL DRAINAGE REPORT APPROVAL

BARNES RD

EX. 6' X 8' RCB (LOCATION OBTAINED FROM TOPO. PREPARED BY LOC, NOT VERIFIED BY LWA.)

GRAPHIC SCALE
100 0 50 100 200 400
(IN FEET)
1 inch = 100 ft.

DESIGN POINT — DP – 1 | 14.4 — AREA
5 YR FLOW — 5.6 | 28.9 — 100 YR FLOW

OS-3B — BASIN
3.4 Ac. — AREA
5 YR FLOW — 22.0 | 51.0 — 100 YR FLOW

CONTOUR INTERVAL = (2)

LEGEND:
- MAIN BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- TIME OF CONCETRATION LINE
- DRAINAGE FLOW

VICINITY MAP
N.T.S.

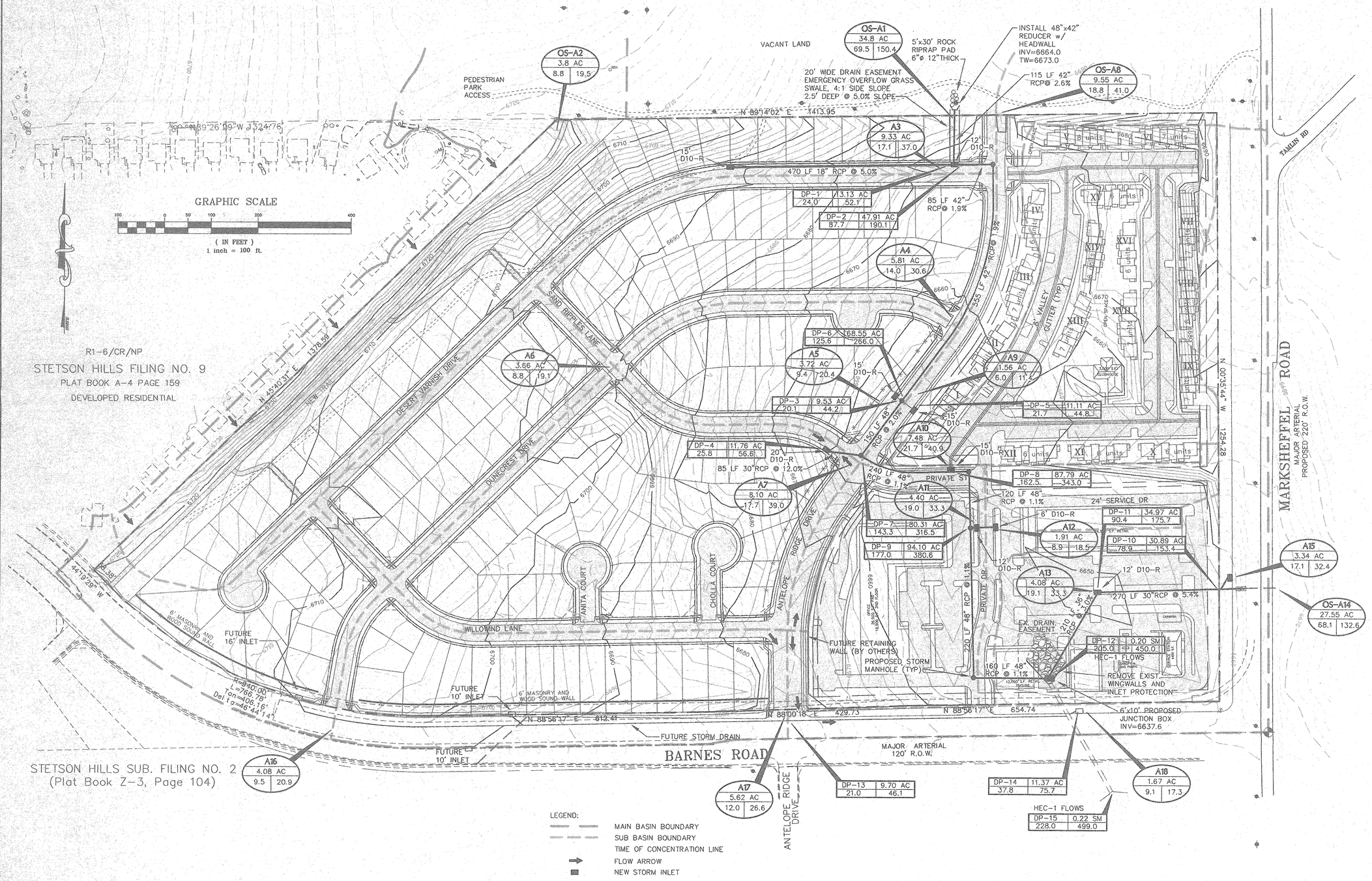
BENCHMARK:

REVISIONS:

LEIGH WHITEHEAD & ASSOCIATES, INC.
ENGINEERS, SURVEYORS & PLANNERS
2720 EAST YAMPA STREET, SUITE 1
COLORADO SPRINGS, CO 80909
TELEPHONE (719) 636-5179 FAX (719) 636-5199

DRAWING: MDDP-STET
SCALE: 1" = 100'
DATE: 12/14/00
DRAWN BY: CLB
CHECKED BY: LAB
PROJECT: 99087
SHEET NO. 1 OF 2

M.D.D.P.
EXISTING CONDITIONS
STETSON HILLS ENCLAVE



PUD MULTI-FAMILY: CPC DP 00-034

PUD SINGLE FAMILY: CPC DP 00-030

PBC COMMERCIAL: CPC DP 00-032

BENCHMARK:

REVISIONS:

LEIGH WHITEHEAD & ASSOCIATES, INC.
ENGINEERS, SURVEYORS & PLANNERS
2720 EAST YAMPA STREET, SUITE 1
COLORADO SPRINGS, CO 80909
TELEPHONE (719) 638-5179 FAX (719) 638-5389

DRAWING: STETP-P
SCALE: 1" = 100'
DATE: 8-8-00
DRAWN BY: CLB
CHECKED BY: CLL
PROJECT: 99087
SHEET NO. 1 OF 1

DRAINAGE PLAN
PROPOSED CONDITIONS
STETSON HILLS ENCLAVE

FINAL
DRAINAGE REPORT AND PLAN
FOR
WILLOWIND AT STETSON HILLS
FILING NOS. 1, 2 AND 3

March, 2001

Leigh
& Whitehead
Associates, Inc.

CONSULTING CIVIL ENGINEERS & SURVEYORS
2720 EAST YAMPA STREET, SUITE 1
COLORADO SPRINGS, CO 80909-5061

LWA Project No. 00085.30

RETURN WITHIN 2 WEEKS TO:
CITY OF COLORADO SPRINGS
STORM WATER & SUBDIVISION
101 W. COSTILLA, SUITE 113
COLORADO SPRINGS, CO 80903
(719) 385-5979

FINAL DRAINAGE REPORT

Project Description:

Willowind at Stetson Hills is a 38.64 acre, single family residential development that will be divided into three filings. Filing No. 1 contains 14.64 acres, Filing No. 2 contains 14.17 acres, and Filing No. 3 contains 9.83 acres. This drainage report encompasses all three filings and we are requesting approval for all three filings. Willowind at Stetson Hills Filing Nos. 1, 2 and 3 are located in the southeast quarter of Section 20, Township 13 South, Range 65 West of the 6th P.M. The property is located approximately 850 feet west of Marksheffel Road and adjacent to and north of Barnes Road. Located to the west of this site is Stetson Hills Filing No. 9. North of the project is undeveloped land located in the County. No planning has been done for this property.

Willowind at Stetson Hills Filing Nos. 1, 2 and 3 are zoned R1-6000 with conditions of record. The planned development for this project, which consists of 160 single family residential lots of approximately 6500 square feet, is compatible with zoning in this area. Filing No. 1 is proposed for development at this time. The attached Proposed Conditions Drainage Plan shows all three filings in their fully developed state. This was done to utilize the future conditions and to calculate developed runoff necessary to size the proposed inlets and pipes within this development. Since the layout will not change, we are requesting approval of all three filings at this time.

Methodology:

The methodology utilized by this report is in accordance with the City of Colorado Springs/El Paso County Drainage Criteria Manual. The rational method for computation of runoff was used. The equation used for determining this runoff is Q=cia where "Q" is the maximum rate of runoff in cubic feet per second; "c" is the runoff coefficient representing the drainage area characteristics; "i" is the rainfall in inches per hour for the duration of the storm; and "a" is the

drainage basin area in acres.

Floodplain Statement:

Willowind at Stetson Hills Filing Nos. 1, 2 and 3 are not located in a F.E.M.A. designated 100-year floodplain, as shown on F.I.R.M. Panel Nos. 08041C0539 F and 08041C0543 F, dated March 17, 1997.

Soils:

The soils across the site are Truckton Sandy Loam, a deep, well-drained soil formed in alluvial residuum, derived from arkosic sedimentary rock. The permeability of the Truckton soil is moderately rapid which gives it a Hydrologic Group B rating. This Group B rating will be used for the developed conditions of this project.

Existing Conditions:

The existing drainage conditions were evaluated in greater detail in the Master Development Drainage Plan for Stetson Hills Enclave prepared by this office and approved by the City of Colorado Springs on October 26, 2000. For this reason, a detailed analysis of the existing conditions will not be included with this report. Overall, the site drains in a southeasterly direction to a natural drainage channel that flows through the center of this property in a southerly direction toward Barnes Road. The south half of Barnes Road is currently developed with curb, gutter, asphalt, sidewalk and storm drain inlets. Located along the previously mentioned natural drainage channel under Barnes Road is a 6'x8' reinforced concrete box culvert. This culvert accepts flows from the north and conveys them southerly under Barnes Road. The site groundcover is sparse to average cover with grasses native to the area. Average slopes throughout the site range from 2% to steep areas of 10% or greater.

Developed Conditions:

The property was divided into four major basins, 33 sub-basins, with 17 design points. For purposes of this report, the property located to the north was anticipated to be single family

residential with 6000-7000 square foot lots. Willowind will be accepting those developed flows. Willowind will be developed with a street system and an underground storm system with peak flow shown at appropriate points to determine street capacities and the location of proposed inlets. These inlets will collect street runoff when it meets the street capacity as allowed by the City of Colorado Springs Drainage Criteria Manual. The development to the north contains approximately 39.56 acres that will contribute runoff to this site. This offsite area generates a peak flow of 68.9 cfs for the 5-year event and 153.6 cfs for the 100-year event. This basin is designated on the attached Proposed Conditions Drainage Plan as Sub-basin OS-B12 and flows will be entering this site within the area of Antelope Ridge Drive. An underground storm system is proposed for Willowind. The requirement was dictated by the amount of flow entering this site from the north in a developed state. For this reason, an underground storm pipe will be constructed within Antelope Ridge Drive and the commercial area and will connect to the existing 6'x8' reinforced concrete box that will convey it southerly under Barnes Road. Current conditions for Sub-basin OS-B12 generate approximately 21.0 cfs for the 5-year event and 53.0 cfs for the 100-year event. These flows can be intercepted at the property boundary by the proposed 42" R.C.P. when it is constructed. The H.W. depth required for the 53.0 cfs is approximately 3.5 feet. The proposed 42" R.C.P. is capable of intercepting and conveying these flows. If the pipe is plugged and surface flows are directed to Antelope Ridge Road, these offsite flows will not exceed the street capacities.

Basin A was divided into seven sub-basins as delineated on the attached Proposed Conditions Drainage Plan as A1 through A7. These flows are directed to a low point within Barnes Road located 300 feet west of Marksheffel Road. An existing inlet (OS-1) on the south side of Barnes Road will intercept runoff and convey it underground to an existing 18" R.C.P. which runs in a northeasterly direction to the north side of the road. These flows currently outlet into an existing drainage ditch that flows parallel to Barnes to the previously mentioned reinforced concrete box. Development of the north half of Barnes Road will eliminate this ditch. Improvements for Barnes Road within this area will include an 18" R.C.P. extending from the existing R.C.P. and connecting it to the proposed 60" R.C.P. as shown on the plan. Located in Sub-basin A3 is a 15'

D-10R (Inlet-1) on a continuous grade. Flows will be intercepted by this inlet and conveyed by the previously mentioned 18" R.C.P. Located immediately downstream from Basin A3 is Design Point 1 (DP-1). This area is 9.85 acres and generates a peak flow of 20.0 cfs for the 5-year event and 43.7 cfs for the 100-year event. Of this peak flow, 7.5 cfs for the 5-year event and 11.6 cfs for the 100-year event has been intercepted by Inlet-1. Carryover (12.5 cfs and 32.1 cfs) will continue easterly in the street to the low point in Barnes Road.

Sub-basin OS-A6 includes Marksheffel Road in its fully developed width as well as an area to the north contributing runoff to Marksheffel Road. This basin contains approximately 6.95 acres and generates a peak flow of 27.0 cfs for the 5-year event and 50.6 cfs for the 100-year event. A future 15' D-10R is anticipated in Marksheffel Road to intercept approximately 16.5 cfs for the 5-year event and 24.1 cfs for the 100-year event. This proposed future storm drain is for information only. Future plans indicate that when Marksheffel Road is fully developed, this storm drain system will be connected to the existing 6'x8' reinforced concrete box. Carryover (10.5 cfs and 26.5 cfs) will continue south within Marksheffel Road to Barnes Road and then continue west within Barnes to the low point. This low point is shown on the attached Proposed Conditions Drainage Plan as DP-16 at the low point of Basin A. Basin A, which contains 18.93 acres, generates a peak flow of 49.5 cfs for the 5-year event and 99.0 cfs for the 100-year event. The surface flows that peak at DP-16 will be intercepted by a 20' D-10R in a sump condition. These flows will then be conveyed to the proposed 6'x10' junction box via the proposed 24" R.C.P. The peak surface flow at this location is 25.5 cfs for the 5-year event and 63.3 cfs for the 100-year event. This 20' D-10R will require a water depth of .55 feet to intercept the 5-year flow and a depth of 1.29 feet to intercept the 100-year flow. This is based on a 1.25 clog factor.

Basin B was divided into 23 sub-basins with 13 design points. These design points were located at pertinent street intersections to determine the peak flow, capacity of the street and if an inlet would be required. Design points 2, 3 and 4 indicate that inlets are not required. The peak flow at these locations is less than the allowable street flow for the 5-year and 100-year events. This is based on Type II curb and gutter. DP-5, which receives runoff from Sub-basins B1 through

B10, contains 19.81 acres. Peak flows are 32.0 cfs for the 5-year event and 76.4 cfs for the 100-year event. This design point is located at the intersection of Sand Ripples Lane and Desert Varnish Drive. The peak flow at this location is higher than the allowable capacity for a Type II curb and gutter. For this reason, vertical curb and gutter (Type I) will be required along Desert Varnish Drive between Sand Ripples Lane and Antelope Ridge Drive. The maximum capacity for vertical curb within this area is 34.0 cfs. The 32.0 cfs generated at DP-5 is less than the maximum allowable, therefore, an inlet is not required at this location. DP-6 receives runoff from Sub-basin B1 through B11. DP-6 is at the low point within Antelope Ridge Drive and has a tributary area of 20.46 acres. The peak flow at DP-6 is 31.2 cfs for the 5-year event and 74.2 cfs for the 100-year event. DP-7 receives runoff from Sub-basins OS-B12 and B13. These sub-basins contain a total area of 41.15 acres of which 39.56 acres is offsite. The peak flow generated at this design point is 68.0 cfs for the 5-year event and 150.6 cfs for the 100-year event. Peak flow at this proposed inlet (DP-8) is the combination of DP-6 and DP-7. Flows are 101.3 cfs for the 5-year event and 228.4 cfs for the 100-year event. A 42" R.C.P. will be constructed to the north within Antelope Ridge Drive. This proposed storm drain is for the purpose of intercepting peak runoff from the property to the north based on R-1-6000 development. Of the 101.3 cfs, 68.9 cfs will be collected and conveyed underground prior to the flow reaching this property. Of the 228.4 cfs for the 100-year event, 143.0 cfs will be intercepted by the upstream storm system. The carryover will continue within Antelope Ridge Drive to the low point. The 25' D-10R in a sump condition is planned for this location. This inlet has been sized to intercept the 5-year flow of 44.4 cfs at a depth of .74 feet and 77.2 cfs for the 100-year event at a depth of 1.23 feet. A portion of this 100-year flow will top the crown and be intercepted by a proposed 22' D-10R inlet in a sump condition on the east side of the road. This inlet is noted on the attached Proposed Conditions Drainage Plan as DP-9. This inlet will intercept 13.3 cfs in the 5-year event at a depth of 0.27 feet and 67.9 cfs in the 100-year event at a depth of 1.23 feet. Peak flow generated at DP-9, which has a tributary area of 62.46 acres, is 102.7 cfs in the 5-year event and 231.5 cfs in the 100-year event. The total flow in the 5-year event and the 100-year event will be intercepted and conveyed underground. An emergency overflow swale will be constructed from the inlet at DP-9 southeasterly and southerly to the

proposed private drive located in the commercial area. This swale will be improved and have a minimum slope of 1.0% Detail of this swale is shown on the attached Proposed Conditions Drainage Plan.

DP-10, DP-11, DP-12, and DP-13 are shown on the attached Proposed Conditions Drainage Plan. These locations at pertinent intersections indicate that the peak flow generated at these points are below the maximum allowable street capacities. Therefore, inlets and storm drain systems are not required at these locations.

DP-14 receives runoff from Sub-basins B15 through B23 with a tributary area of 13.43 acres. Peak flows are 27.9 cfs in the 5-year event and 60.7 cfs in the 100-year event. These flows are directed to a low point at the intersection of Antelope Ridge Drive and Desert Varnish Drive. A 20' D-10R inlet in a sump condition will intercept and convey these flows to the proposed underground storm system. The peak flow of 27.9 cfs for the 5-year event will require a depth of 0.6 feet. The 100-year peak flow of 60.7 cfs will require a water depth of 1.19 feet. All of the 5-year event and the 100-year event will be intercepted and conveyed underground.

Basin B contains 75.89 acres and generates a peak flow of 123.7 cfs for the 5-year event and 272.9 cfs for the 100-year event. Of these flows, all of the 5-year and 100-year flows will be conveyed underground within the proposed storm drain system. This system will connect to the existing 6'x8' reinforced concrete box located just north of Barnes Road and west of Marksheffel Road. A proposed 6'x10' junction box will connect the systems. This low point and concrete box is located within the commercial area and is not included with this drainage study. For further information regarding the commercial area, please review the Master Development Drainage Plan for Stetson Hills Enclave prepared by this firm and approved by the City of Colorado Springs on October 26, 2000.

Basin C is the east one-half of Antelope Ridge Drive between Willowind Lane and Desert Varnish Drive. This small basin contains 0.36 acres and generates a peak flow of 1.7 cfs for the

5-year event and 3.1 cfs for the 100-year event. These flows will be directed easterly and southerly to the previously mentioned 6'x8' reinforced concrete box via street flow.

Basin OS-D represents the existing facilities and basins on the south side of Barnes Road.

Proposed Improvements:

Willowind Subdivision Filing No. 1 and No. 2 consists of the construction of 18", 24", 30", 36", 42", 54" and 60" R.C.P. with an approximate total pipe length of 2964 lineal feet of concrete pipe. Also proposed are seven Type I Manholes, five D-10R inlets, 42"x36" and 36"x24" reducers, and a 6'x10' junction box. Construction of Willowind at Stetson Hills Filing Nos. 1, 2 and 3 will require the installation of all the storm drain facilities with the exception of the 42" R.C.P. This storm drain will be constructed when Filing No. 3 is developed or when Antelope Ridge Road is constructed, whichever comes first. All filings are graded at this time. Approximately 72.0 cfs for the 100-year undeveloped flow will reach this location. This storm drain system is adequate to intercept and safely convey these offsite flows at this time. The proposed future 15' D-10R located along Marksheffel Road was for information only to determine the size of the inlet in Barnes Road. It is not to be included as a part of this development. Future plans indicate that when Marksheffel Road is fully developed, a storm drain system will be installed within the roadway that will collect surface flows and some offsite flows to the east and conveyed underground within a storm drain system in Marksheffel Road. This 15' D-10R future plans are to connect the flows from this inlet to the previously mentioned 6'x8' reinforced concrete box. Also on Marksheffel Road located north of this site is an existing 42" R.C.P. Based on observation, it appears that this pipe does not collect runoff from the east. It appears that runoff is directed southerly on the east side of Marksheffel Road to a low point just north of Barnes Road. For this reason, offsite flows at this location were not included in any offsite flows contributing runoff to this development.

Street Capacities:

Following are the street capacities and maximum allowable flow that have been evaluated to

determine location of the catch basins. These flows are for both the 5-year and 100-year events.

CATCH BASIN LOCATION ANALYSIS (5-YEAR STORM)						
BASIN	**STREET TYPE**	**STREET SLOPE**	**ALLOWABLE FLOW**	**Q_5**	**INLET**	**TYPE**
A1	Arterial	3.14%	30.4	10.5	none required	
A3	Arterial	3.14%	30.4	16.1	15' D10R	Continuous
OS-A6	Arterial	0.60%	13.3	27.0	15' D10R	Continuous
A	Arterial	sump		25.5	20' D10R	Sump
OS-D1	Arterial	3.14%	30.4	13.1	10' D10R	Continuous
D	Arterial	sump		14.6	16' D10R	Sump
B1	Residential	4.0%	20.0	17.6	none required	
DP-2	Residential	4.0%	20.0	19.9	none required	
DP-3	Residential	4.0%	20.0	7.4	none required	
DP-4	Residential	2.0%	15.9	12.2	none required	
DP-5	Residential	3.6%	32.3	32.0	none required	
DP-8	Collector	sump		44.4	25' D10R	Sump
B14	Collector	sump		13.3	22' D10R	Incl. 20 cfs offsite flow, sump
DP-10	Residential	4.0%	20.0	11.6	none required	
DP-11	Residential	3.6%	20.0	18.3	none required	
B20	Residential	4.0%	20.0	7.2	none required	
DP-12	Residential	4.0%	20.0	8.6	none required	
DP-13	Collector	4.0%	34.0	10.0	none required	
DP-14	Residential	sump		27.9	20' D10R	Sump
C	Collector	4.0%	20.0	1.7	none required	

CATCH BASIN LOCATION ANALYSIS (100-YEAR STORM)						
BASIN	STREET TYPE	STREET SLOPE	ALLOWABLE FLOW	Q_{100}	INLET	TYPE
A1	Arterial	3.14%	107.6	23.0	none required	
A3	Arterial	3.14%	107.6	35.1	15' D10R	Continuous
OS-A6	Arterial	0.60%	47.1	50.6	15' D10R	Continuous
A	Arterial	sump		63.3	20' D10R	Sump
OS-D1	Arterial	3.14%	107.6	26.8	10' D10R	Continuous
D	Arterial	sump		32.2	16' D10R	Sump
B1	Residential	4.0%	60.7	38.4	none required	
DP-2	Residential	4.0%	60.7	43.3	none required	
DP-3	Residential	4.0%	60.7	20.9	none required	
DP-4	Residential	2.0%	42.9	31.9	none required	
DP-5	Residential	3.6%	103.2	76.4	none required	
DP-8	Collector	sump		77.2	25' D10R	Sump
B14	Collector	sump		67.9	22' D10R	Sump
DP-10	Residential	4.0%	60.7	25.7	none required	
DP-11	Residential	3.6%	57.6	40.2	none required	
B20	Residential	4.0%	60.7	16.0	none required	
DP-12	Residential	4.0%	60.7	19.0	none required	
DP-13	Collector	4.0%	155.9	21.9	none required	
DP-14	Residential	sump		60.7	20' D10R	Sump
C	Collector	4.0%	155.9	3.1	none required	

Grading and Erosion Control:

The Grading and Erosion Control Plan has been approved by the City of Colorado Springs Stormwater & Subdivision Department.

Facilities:

The Drainage Basin Planning Study for Sand Creek shows that there are no planned major drainage facilities for this area. This analysis and evaluation indicates that a storm drain system is necessary to convey offsite flows to this site to the existing 6'x8' reinforced concrete box. This site, as it stands alone, does not generate the amount of runoff that would require an extensive storm drain system. This system has been designed to intercept and convey underground the 100-year event. For these reasons, we are recommending that these storm drain facilities be submitted to the drainage board for their approval to consider these facilities a reimbursable item. It is also recommended that financial assurances for the cost of constructing these storm drain facilities be submitted to the City of Colorado Springs in lieu of drainage fees. Following is a breakdown of the drainage facilities costs along with the drainage basin fees for this site.

Summary:

The platting of this subdivision will not adversely affect the surrounding developments. Drainage calculations were developed in accordance with the 1991 City of Colorado Springs drainage criteria, as amended and revised. Runoff from this development should be safely conveyed to adequate outfalls. Willowind at Stetson Hills Filing Nos. 1, 2 and 3 are in general conformance with the Sand Creek Drainage Basins Study. At this time, we are also requesting approval of this final drainage report and plan for all three filings.

DRAINAGE FEES:

Willowind at Stetson Hills is located in the Sand Creek Drainage Basin. This property has not been previously platted, therefore, is subjected to drainage, bridge and pond fees. The pond surcharge fee does not apply to this development. The following is a breakdown of the drainage fees and drainage facilities cost for each filing:

Filing No. 1 Drainage Fees:

14.64 Acres ($6,714.00 per acre Drainage Fee) $98,292.96

14.64 Acres ($400.00 per acre Bridge Fee) . . . . . $ 5,856.00

14.64 Acres ($427.00 per acre Pond Land Fee)	6,251.28
14.64 Acres ($1,498.00 per acre Pond Facilities Fee)	21,930.72
Filing No. 1 Total Fee Obligation	**$132,330.96**

Filing No. 1 Public Storm Drain Facilities (Non-Reimbursable):

15' D10R (1 @ $4,800.00/ea.)	$ 4,800.00
20' D10R (2 @ $6,500.00/ea.)	13,000.00
18" R.C.P. (1086 L.F. @ $28.00/ft.)	30,408.00
24" R.C.P. (72 L.F. @ $38.00/ft.)	2,736.00
30" R.C.P. (314 L.F. @ $46.00/ft.)	14,444.00
Subtotal	$65,388.00
15% Engineering & Contingencies	9,808.20
Filing No. 1 Total (Non-Reimbursable)	**$75,196.20**

Filing No.1 Public Storm Drain Facilities

(Reimbursable - Subject to Drainage Board approval):

54" R.C.P. (255 L.F. @ $104.00/ft.)	$26,520.00
60" R.C.P. (561 L.F. @ $132.00/ft.)	74,052.00
Manhole (3 @ $4,500.00/ea.)	13,500.00
Manhole (2 @ $5,700.00/ea.)	11,400.00
24"x36" Reducer (1 @ $500.00/ea.)	500.00
6'x10'x13' Junction Box (LS)	22,500.00
Subtotal:	148,472.00
15% Engineering & Contingencies	22,270.80
Filing No. 1 Total (Reimbursable Subject to Drainage Board Approval)	**$ 170,742.80**

Filing No. 2 Drainage Fees:

14.17 Acres ($6,714.00 per acre Drainage Fee)	$95,137.38
14.17 Acres ($400.00 per acre Bridge Fee)	5,668.00
14.17 Acres ($427.00 per acre Pond Land Fee)	6,050.59
14.17 Acres ($1,498.00 per acre Pond Facilities Fee)	21,226.66
Filing No. 2 Total Fee Obligation	**$128,082.63**

Filing No. 2 Public Storm Drain Facilities (Reimbursable):

No storm drain facilities required for Filing No. 2.

Filing No. 3 Drainage Fees:

9.83 Acres ($6714.00 per acre Drainage Fee)	$65,998.62
9.83 Acres ($400.00 per acre Bridge Fee)	3,932.00
9.83 Acres ($427.00 per acre Pond Land Fee)	4,197.41
9.83 Acres ($1498.00 per acre Pond Facilities Fee)	14,725.34
Filing No.3 Total Fee Obligation	**$88,853.37**

Filing No. 3 Public Storm Drain Facilities (Non-reimbursable):

22' D10R (1 @ $6,750.00/ea.)	$6750.00
25' D10R (2 @ 7,200.00/ea.)	14400.00
36" R.C.P. (35 L.F. @ $58.00/ft.)	2,030.00
Subtotal	23,180.00
15% Engineering & Contingencies	3,477.00
Filing No. 3 Total (Non-reimbursable)	**$26,657.00**

Filing No. 3 Public Storm Drain Facilities

(Reimbursable - Subject to Drainage Board Approval):

42" R.C.P. (607 L.F. @ $64.00/ft.)	$38,848.00
54" R.C.P. (35 L.F. @ $104.00/ft.)	3,640.00
Manhole (1 @ $4,800.00/ea.)	4,800.00
36"x42" Reducer (1 @ $550.00/ea.)	550.00
Subtotal	47,838.00
15% Engineering & Contingencies	7,175.70
Filing No. 3 Total (Reimbursable Subject to Drainage Board Approval)	**$55,013.70**

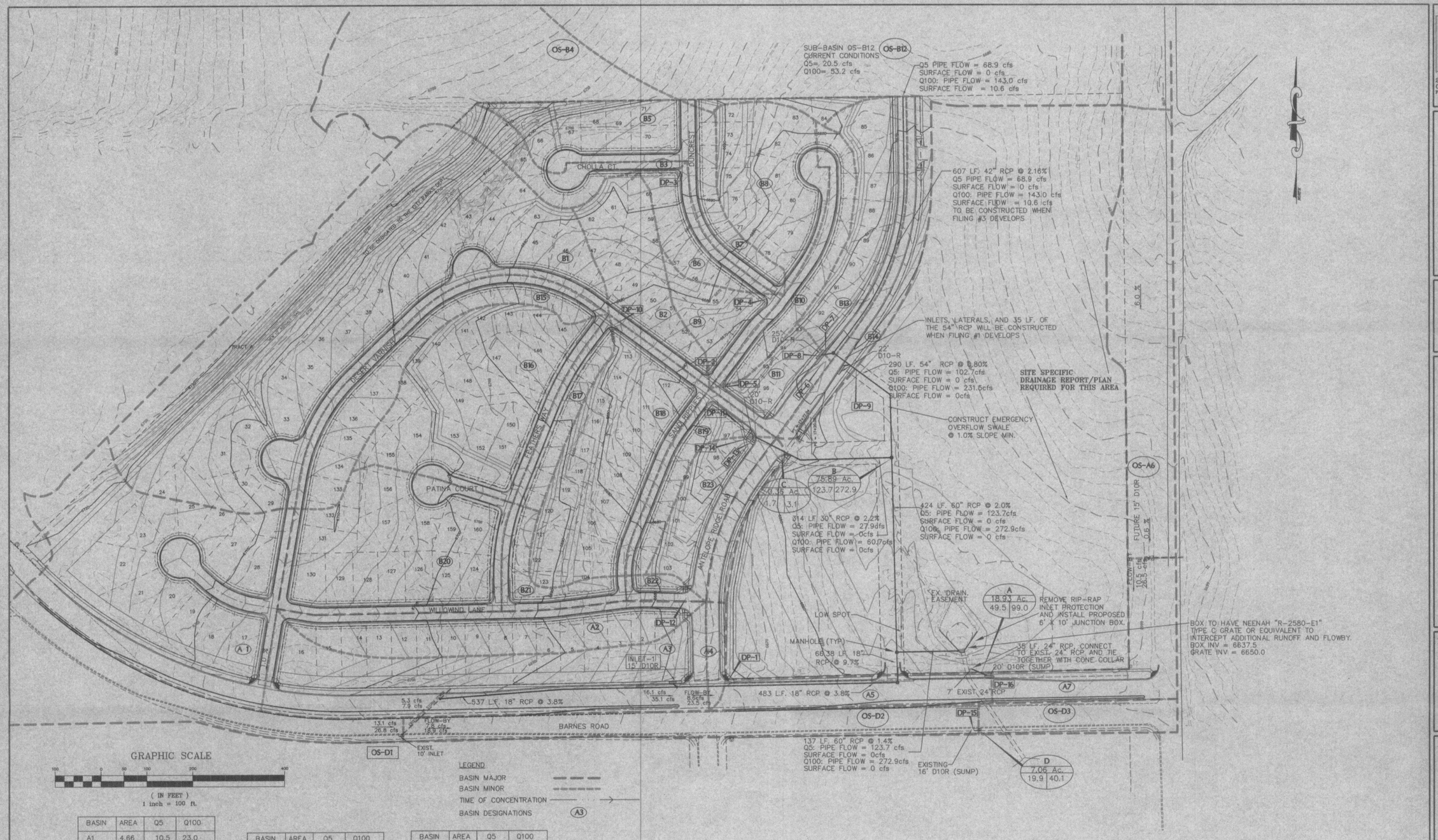
Drainage, Bridge and Pond Fee Summary (Filing No.'s 1,2&3):

38.64 Acres @ $6,714.00/Acre Drainage Fee	$259,428.96
38.64 Acres @ $400.00/Acre Bridge Fee	15,456.00
38.64 Acres @ 427.00/Acre Pond Land Fee	16,499.28
38.64 Acres @ 1498.00/Acre Pond Facilities Fee	57,882.72
Drainage, Bridge and Pond Fee Summary Total	**$349,266.96**

DRAINAGE FEES AND COSTS FOR WILLOWIND AT STETSON HILLS:

38.64 Acres @ $6,714.00 /Acre Drainage Fee	$259,428.96
Storm Drain Facilities (Reimbursable- Subject to Drainage Board Approval)	225,756.50
Drainage Fee	$33,672.46

The owner will post the appropriate financial assurances to cover the cost of constructing these drainage improvements for Filing No.s 1 and 3. These assurances will be submitted to the City in lieu of drainage fees. $33,672.46 in drainage fees will be paid prior to the recordation of Filing No. 2. The appropriate bridge and pond fee, for each Filing, will be paid prior to the recordation of that Filing. Leigh Whitehead & Associates, Inc. cannot and will not guarantee that the actual construction costs will not vary from this estimate of probable costs for constructing these facilities.



GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

LEGEND

BASIN MAJOR
BASIN MINOR
TIME OF CONCENTRATION
BASIN DESIGNATIONS (A3)

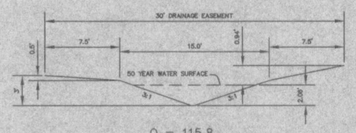
BASIN	AREA	Q5	Q100
A1	4.66	10.5	23.0
A2	1.82	4.8	10.3
A3	3.15	7.9	17.1
A4	0.22	1.0	1.9
A5	0.93	4.4	8.0
OS-A6	6.95	27.0	50.6
A7	1.20	5.6	10.3
A	18.93	49.5	99.0
B1	8.10	17.6	38.4
B2	1.29	3.3	7.2
B3	0.66	1.8	3.9
OS-B4	3.99	3.9	13.1
B5	1.22	3.1	6.8

BASIN	AREA	Q5	Q100
B6	0.67	1.8	3.9
B7	0.60	1.6	3.6
B8	1.73	4.3	9.5
B9	0.67	1.7	3.8
B10	0.88	2.2	4.8
B11	0.65	2.0	4.1
OS-B12	39.56	68.9	153.6
B13	1.59	4.3	9.2
B14	0.85	4.4	8.3
B15	1.59	4.0	8.7
B16	3.09	6.8	15.1
B17	0.59	1.7	3.7

BASIN	AREA	Q5	Q100
B18	2.67	6.6	14.5
B19	0.65	1.8	3.9
B20	3.05	7.2	16.0
B21	0.58	1.7	3.6
B22	0.20	0.6	1.0
B23	1.0	2.4	5.2
B	75.89	123.7	272.9
C	0.36	1.7	3.1
OS-D1	4.55	13.1	26.8
OS-D2	1.84	8.6	15.7
OS-D3	0.67	3.1	5.7
D	7.06	19.9	40.1

DESIGN POINT	AREA	Q5	Q100
OS-D1	4.55	13.1	26.8
DP-1	9.85	20.1	43.7
DP-2	9.39	19.9	43.3
DP-3	5.87	7.4	20.9
DP-4	9.87	12.2	31.9
DP-5	19.81	32.0	76.4
DP-6	20.46	31.2	74.2
DP-7	41.15	68.0	150.6
DP-8	61.61	101.3	228.4
DP-9	62.46	102.7	231.5
DP-10	5.27	11.6	25.7
DP-11	8.59	18.3	40.2
DP-12	3.85	8.6	19.0
DP-13	4.84	10.0	21.9
DP-14	13.43	27.9	60.7
DP-15	6.39	17.7	35.7
DP-16	18.93	49.5	99.0

EMERGENCY OVERFLOW SWALE



Q = 115.8
S = 1.00% (MIN)
n = 0.016
d = 2.06'
v = 9.1fps

ENGINEERS
PLANNERS
SURVEYORS
LEIGH WHITEHEAD & ASSOCIATES
2720 EAST YAMPA STREET, SUITE 1
COLORADO SPRINGS, CO 80909
PHONE (719) 636-0179 * FAX (719) 636-0199

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DESIGN AND DRAWINGS NOT TO BE REUSED WITHOUT WRITTEN PERMISSION OF ENGINEER

SHEET TITLE: FINAL DRAINAGE PLAN

PROJECT NAME: WILLOWIND AT STETSON HILLS

BENCHMARK:
AS SHOWN ON PLAN BY BOUNDARY AND PHOTO CONTROL MONUMENTATION. NGVD 1929 DATUM (CSDU FIMS)

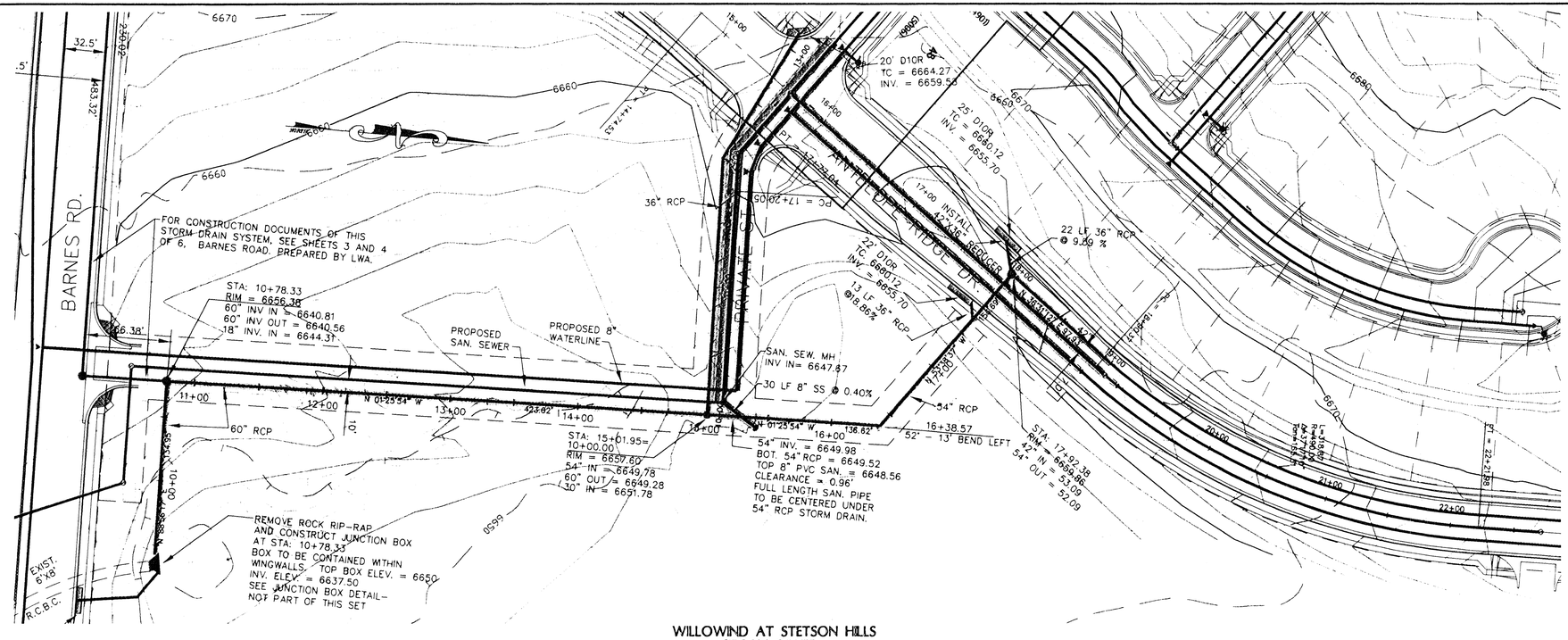
REVISIONS:

SCALE: 1" = 100'
DATE: 1/18/01
DRAWN BY: CLB
CHECKED BY: LAB

SHEET NO:
1 OF 1

PROJECT NO: 00085
DRAWING NAME: 01-01-SS-COMM.DWG
VIEW: DRAIN

WILLOWIND AT STETSON HILLS
STORM SEWER PLANS
AND
BOX CULVERT CONVERSION EXHIBIT

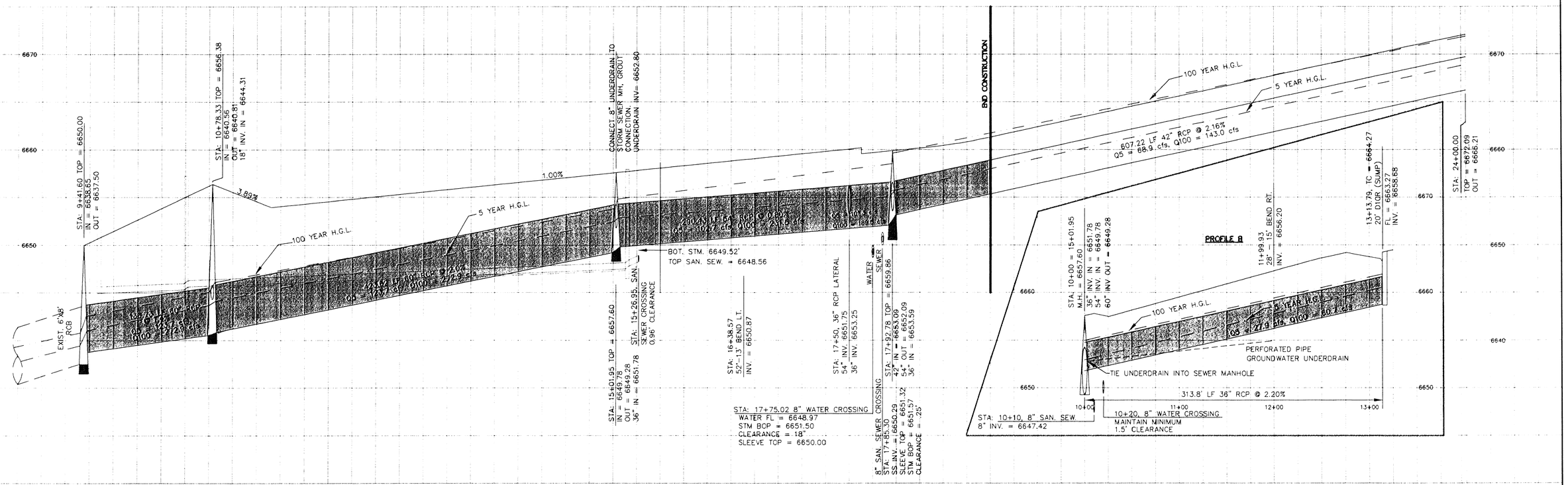


GRAPHIC SCALE

50 0 25 50 100 200

(IN FEET)
1 inch = 50 ft.

WILLOWIND AT STETSON HILLS
STORM SEWER
ON COMMERCIAL ACCESS



STATEMENT:
THE CITY OF COLORADO SPRINGS RECOGNIZES THE DESIGN ENGINEER AS HAVING RESPONSIBILITY FOR THE DESIGN. THE CITY HAS LIMITED SCOPE OF REVIEW ACCORDINGLY.
RESUBMITTAL REQUIRED IF CONSTRUCTION HAS NOT COMMENCED WITHIN 180 DAYS AFTER REVIEW DATE.

DRAINAGE REVIEW:
FILED IN ACCORDANCE WITH SECTION 15-3-906 (DRAINAGE ORDINANCE), OF THE CITY OF COLORADO SPRINGS, 1980, AS AMENDED.

FOR THE CITY ENGINEER — DATE 4/2/01

DESIGN DATA:
SIDEWALKS: WIDTH ____ LOCATION: ☐ ATTACHED ☐ DETACHED, 6"FROM P/L
CURB TYPE ☐ 1 ☐ 2 ☐ 3
R.O.W. WIDTH ____ F/C-F/C ____
STREET TYPE ____ HVEEM ____
ASPHALT THICKNESS: AC SURFACE ____ AC BASE ____
AGGR. BASE THICKNESS: CLASS 6 ____ CLASS 5 ____ CLASS 2 ____

SCALE: HORIZ. 1" = 50' VERT. 1" = 5'
BENCH MARK: AS SHOWN ON PLAN BY BOUNDARY AND PHOTO CONTROL MONUMENTATION NGVD 1929 DATUM (CSDU FIMS)

REVISIONS:

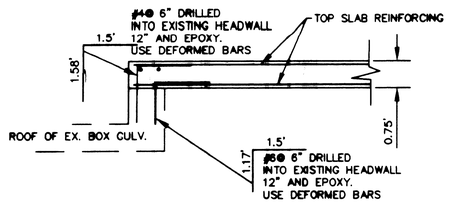
NO.	DESCRIPTION	DATE

LEIGH WHITEHEAD & ASSOCIATES
ENGINEERS SURVEYORS PLANNERS
[illegible] JAMES STREET, SUITE A COLORADO SPRINGS, CO 80909

DESIGNED BY LB DATE 3/12/01
DRAWN BY DDP DATE 3/12/01
CHECKED BY DW/LB DATE 3/12/01

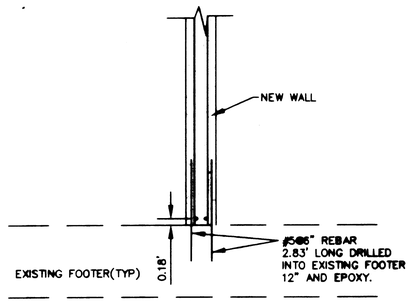
PROJECT WILLOWIND AT STETSON HILLS
STREET STORM SEWER ON COMMERCIAL ACCESS
FROM STA: 9+44.00 TO STA: 24+00.00
DRAWING/VIEW 3-2-01-WILLOW/ANTRG-STORM-PP
SUBDIVISION WILLOWIND AT STETSON HILLS
DRAINAGE BASIN ____
PROJECT NO. 00085 SHEET 5 OF 5

WMD Map: ON 1:2,148.31 2001



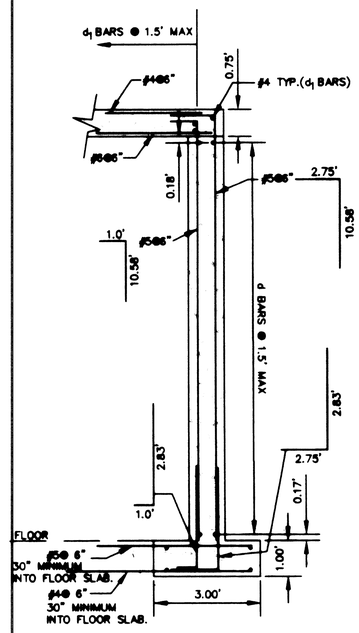
SECTION B-B

ROOF TO EXISTING BOX HEADWALL
SCALE: 1" = 2'



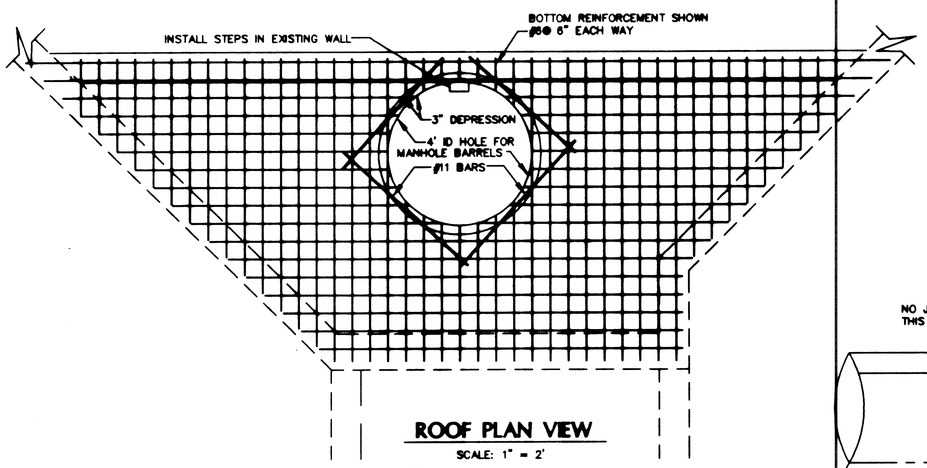
SECTION C-C

SCALE: 1" = 2'



SECTION A-A

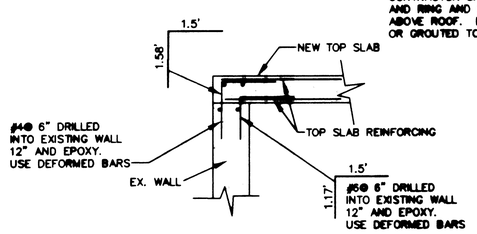
SCALE: 1" = 2'



ROOF PLAN VIEW

SCALE: 1" = 2'

NOTE:
CONTRACTOR SHALL INSTALL 4' MANHOLE BARRELS AND RING AND COVER TO MATCH FINISHED GRADE ABOVE ROOF. BARRELS SHALL BE JOINT SEALED OR GROUTED TO ROOF OF BOX.



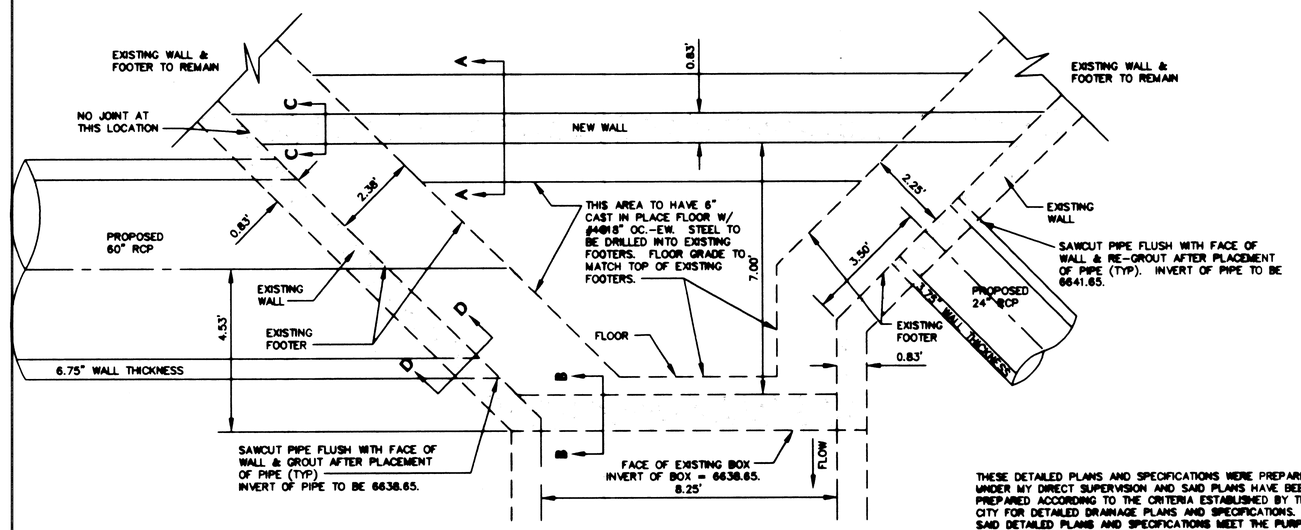
SECTION D-D

SCALE: 1" = 2'

DRAINAGE REVIEW

Filed in accordance with Section 15-3-905 (Drainage Ordinance), of the Code of the City of Colorado Springs, 1980, as amended.

for the City Engineer — Date 6/5/01



PLAN VIEW

SCALE: 1" = 2'

NOTES:

1. MUST COMPLY WITH CITY STANDARD SPECIFICATION MANUAL CURRENT AT THE TIME OF CONSTRUCTION.
2. GRADE 60 REINFORCING STEEL IS REQUIRED.
3. ALL CONCRETE SHALL BE CLASS D (BOX CULVERT)(CDOT).
4. ALL CONSTRUCTION JOINTS SHALL BE THOROUGHLY CLEANED BEFORE FRESH CONCRETE IS POURED.
5. ALL CONSTRUCTION JOINTS NOT SHOWN ON THE PLANS SHALL BE APPROVED BY THE ENGINEER.
6. THE CONTRACTOR IS RESPONSIBLE FOR THE STABILITY OF THE STRUCTURE DURING CONSTRUCTION.
7. DO NOT BACK FILL UNTIL TOP SLAB HAS REACHED DESIGN STRENGTH.
8. THE MINIMUM LAP SPLICE LENGTH FOR REINFORCING BARS SHALL BE:

BAR SIZE	#4	#5	#6	#7
SPLICE LENGTH	1'-3"	1'-6"	1'-10"	2'-2"

9. SHOP DRAWINGS SHALL BE SUBMITTED FOR REVIEW BY THE ENGINEER PRIOR TO STEEL FABRICATION.
10. ALL SOIL BELOW NEW WALL AND FLOOR SHALL BE REMOVED TO A DEPTH OF 18" AND RECOMPACTED TO 95% MODIFIED PROCTOR DENSITY.
11. ALL JOINT GROUT MUST BE 3,000 PSI MINIMUM.

DESIGN DATA:

SERVICE LOADS:

Fs = 24,000psi Fy = 60,000psi

Fc = 1,800psi F'c = 4,500psi

LOADING DATA:

LIVE LOAD = AASHTO, HS 20-44

DEAD LOAD CASE 1: VERTICAL EARTH LOAD = 120 LBS/CF
HORIZONTAL EARTH LOAD = 30 LBS/CF

DEAD LOAD CASE 2: VERTICAL EARTH LOAD = 120 LBS/CF
HORIZONTAL EARTH LOAD = 60 LBS/CF

FUTURE ASPHALT OVERLAY: 48 LBS/SF

LIVE LOAD SURCHARGE ON EXTERIOR WALLS = 2' OF EARTH

MAX DEPTH OF COVER = 8'

THESE DETAILED PLANS AND SPECIFICATIONS WERE PREPARED UNDER MY DIRECT SUPERVISION AND SAID PLANS HAVE BEEN PREPARED ACCORDING TO THE CRITERIA ESTABLISHED BY THE CITY FOR DETAILED DRAINAGE PLANS AND SPECIFICATIONS. SAID DETAILED PLANS AND SPECIFICATIONS MEET THE PURPOSES FOR WHICH THE PARTICULAR DRAINAGE FACILITY IS DESIGNED. I ACCEPT RESPONSIBILITY FOR ANY LIABILITY CAUSED BY NEGLIGENT ACTS, ERRORS OR OMISSIONS ON MY PART IN THE PREPARATION OF THESE DETAILED PLANS AND SPECIFICATIONS.

DAVID J. WHITEHEAD, P.E. COLORADO# 25118

LEIGH WHITEHEAD & ASSOCIATES
3720 EAST YAMPA STREET, SUITE 1
COLORADO SPRINGS, CO 80909
PHONE: (719) 630-8470 • FAX (719) 630-8480

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SHEET TITLE: BOX CULVERT CONVERSION EXHIBIT

PROJECT NAME: WILLOWIND AT STETSON HILLS

BENCHMARK:
STORM MANHOLE LID, S. SIDE BARNES ROAD, 640' WEST OF ANTELOPE RIDGE DRIVE.
ELEVATION = 6696.87

REVISIONS:

SCALE: 1" = 2'
DATE: 3/28/01
DRAWN BY: CLB
CHECKED BY: DW

SHEET NO: 1 OF 1

PROJECT NO: 0106
DRAWING NAME: BOX-CUL-EXH.DWG
VIEW: 1

0106-11-1

Collector RCP's, Channel Wing Walls
0106-11
Sheet 1 of 1

\Land Projects\0006\dwg\BOX-CUL-EXH.dwg
0106-11
Family D
Sheet 1 of 1

FINAL
DRAINAGE REPORT AND PLAN
FOR
WILLOWIND COMMERCIAL FILING NO. 1

April, 2003

Leigh & Whitehead Associates, Inc.

CONSULTING CIVIL ENGINEERS & SURVEYORS
2720 EAST YAMPA STREET, SUITE 1
COLORADO SPRINGS, CO 80909-5061

LWA Project No. 02034.62

FINAL DRAINAGE REPORT

Project Description:

Willowind Commercial Filing No. 1 is a 9.63 acre P.B.C. (Planned Business Center) development that will be divided into five lots. This development is located in the southeast one-quarter of Sec 20, T13S, R65W of the 6th P.M. The property is located adjacent to Marksheffel Road on the east, Barnes Road on the south and Antelope Ridge Road on the west. The property located to the north of this site is currently unplatted and undeveloped.

Willowind Commercial Filing No. 1 is located in the Sand Creek Drainage Basin. This drainage basin planning study along with the Master Development Drainage Plan for Stetson Hills Enclave prepared by Leigh Whitehead & Associates, Inc., September 2000, and the Final Drainage Report and Plan for Willowind at Stetson Hills, Filing No's. 1, 2, and 3 by Leigh Whitehead & Associates, Inc., dated March 2001 was used in the preparation of this Report.

Methodology:

The methodology used by this report is in accordance with the City of Colorado Springs, El Paso County, Drainage Criteria Manual. The rational method for computation of runoff was used. The equation used for determining this runoff was Q=cia, where "Q" is a maximum rate of runoff in cubic feet per second, "c" is the runoff coefficient representing the drainage area characteristics, "i" is the rainfall in inches per hour for the duration of the storm, and "a" is the drainage basin area in acres.

Floodplain Statement:

Willowind Commercial Filing No. 1 is not located in a F.E.M.A. designated 100-year floodplain, as shown on F.I.R.M. Panel No. 08041CO543 F dated March 17, 1997.

Soils:

The soils across the site are Truckton Sandy Loam, a deep well-drained soil formed in alluvial residuum derived from arkosic sedimentary rock. The permeability of the Truckton soil is moderately rapid which gives it a hydrologic Group B rating, which will be used for the Developed Conditions of this project.

Existing Conditions:

The existing drainage conditions were evaluated in greater detail in the Master Development Drainage Plan for Stetson Hills Enclave, prepared by this office and approved by the City of Colorado Springs on October 26, 2000. For this reason, a detailed analysis of the existing conditions will not be included with this report.

Antelope Ridge Road to the west is fully developed with curb, gutter, sidewalk and utilities in existence. Barnes Road on the south is fully developed with curb and gutter. Marksheffel Road is an existing asphalt roadway, with no curb or gutter.

Willowind Commercial Filing No. 1 and the property to the north has had some minor grading to control erosion and sediment buildup. The site groundcover is sparse grasses native to the area. Average slopes through the site range from 2% to 6%.

Overall, the site drains in a southerly direction to an existing junction box located just north of Barnes Road. Drainage facilities in Antelope Ridge Road and Willowind Commercial Filing No. 1 have been installed and are functioning as designed.

The MDDP for Stetson Hills Enclave prepared by Leigh Whitehead & Associates, Inc., and approved by the City of Colorado Springs on October 26, 2000, indicates an area of 0.22 square miles or 140.44 acres contributes flow that exits to the existing 6' x 8' reinforced concrete box. This peak flow generated from onsite and offsite areas total 228 cfs for the 5-year event, and 499 cfs for the 100-year event. These flows are less than the 620 cfs and 903 cfs that were calculated

at design point 23 in the Sand Creek Drainage Basin Planning Study prepared by Kiowa Engineering in 1995. Subsequent to this drainage basin planning study a Master Development Drainage Plan for Hilltop Subdivision was prepared by URS-Greiner in September, 1998. This MDDP shows developed flows of 420 cfs exiting this box culvert, which is less than the 499 cfs that was developed and shown on the MDDP for Stetson Hills Enclave. The developed flow that may eventually exit Willowind is 499 cfs. URS-Greiner had, at the request of the County, reviewed the existing channel that had been accepted by El Paso County Department of Transportation and was designed for an ultimate flow of 420 cfs. Upon further investigation by URS, their calculation indicate that the increase in flow of 79 cfs would approximately increase the flow depth within the channel from 0.5' at the end of the existing concrete box culvert to 0.2' further downstream. The statement made in the URS report, and the final Drainage Report and Erosion Control Amendment for Chateau at Antelope Ridge in El Paso County, Colorado, approved by the El Paso County on September 12, 2002, states that, "**the increase in flow depth and velocity is minimal, and where critical velocities exist, the flow remains within the reinforced section of the channel.**

The Chateau at Antelope Ridge Marksheffel Channel was not designed for the increased flow. The flow increase imposed by the City of Colorado Springs does not appear to have significant impact on the channel. However, the factors of safety employed in the design of the channel have been reduced."

Based on the evaluation by URS, it appears that the downstream integrity of the channel is not compromised although some freeboard in the channel may be lessened. It appears from the comments in their report that the increase of ultimate flows will remain within the channel.

Marksheffel Road, located on the east edge of Willowind Commercial is currently a city/county asphalt road. Also located at this point is an existing 18" CMP that has been collecting upstream flows of approximately 27.55 acres. This is designated on our attached Proposed Drainage Plan as Sub-basin OS-B1. The existing condition peak flow is19.9 cfs for the 5-year event and 49.3

cfs for the 100-year event. Currently the existing 18" CMP has a capacity to discharge 9.6 cfs through the culvert. The remaining 39.8 cfs for the 100-year event tops the road and continues westerly into the Willowind Commercial area. This existing culvert at one time was capable of handling flows that were generated offsite from the east and northeast of this property. Due to the increased development, these runoff flows are currently increasing. Flows overtopping the road are considered unacceptable by the city and county in new development. Future plans for Marksheffel Road are to develop it as an arterial divided highway. Based on this information and preliminary input from personnel at The City of Colorado Springs, and El Paso County, a storm drain system, sometime in the future may be incorporated in the development of Marksheffel Road. When or if this occurs, a storm drain system will be designed and constructed, and these facilities will intercept runoff from the east and convey them southerly within Marksheffel Road to an appropriate outlet, and the 499 cfs will be substantially reduced. Marksheffel Road has a low point at the existing 18"cmp. The capacity of this culvert without road overtopping is 9.6 cfs. Any development of the property to the east will need to evaluate this situation to eliminate road overtopping as required by the city/county drainage criteria. Among the options that could be used are: straight grade Marksheffel Road when it is fully developed and incorporate an underground storm system with some runoff being conveyed within the curbs; allow the low spot to remain and construct a storm drain system to carry the fully developed flows; direct interior runoff easterly and southerly away from Marksheffel Road; or construction of detention facilities which would to eliminate any road overtopping. These flows will then be more in concurrence with the ultimate developed flows that URS has designed for the existing channel to accept.

Developed Conditions:

The site was divided into four major basins, three offsite sub-basins, six onsite sub-basins and three design points. These major basins are delineated on the attached Proposed Conditions Drainage Plan as A, B, C and D. For the purpose of this report, offsite basins were calculated for peak flow, based on the current conditions. This was used to determine on-site drainage facilities. It is felt that these offsite basins may have an underground storm system that will

connect to facilities that may be developed for Marksheffel Road. Currently it is unknown if or when a major storm drain system will be developed for Marksheffel Road.

Basin A is adjacent to Antelope Ridge Road and Barnes Road, and is Lot 5 of this platting. This area contains 4.04 acres and generates a peak flow of 17.1 cfs for the 5-year event and 31.9 cfs for the 100-year event. The runoff calculation was determined by the site being developed as commercial, which gives a "c" factor of 0.9 for the 5-year event and 0.95 for the 100-year event. Although this basin is not part of the development plan, these flows will not change. Therefore no further evaluation is necessary for Basin A. Runoff for Basin A is directed southerly and southeasterly to a proposed12' D-10-R located near the southerly drive entrance to Lot 5. Runoff from this 12' D-10-R will be conveyed underground via a proposed 24" RCP that will connect to the existing storm drain system, located east of Lot 5.

Basin B was divided into six sub-basins which include the three previously mentioned off-site basins. Also included within this area are three design points. Flows from OS-B1 and OS-B2 are combined at the southeast corner of the site and is delineated on the attached proposed drainage plan as DP-1. This area contains 34.50 acres and generates a peak flow of 24.7 cfs for the 5-year event and 60.4 cfs for the 100-year event. These are current conditions flows. These flows are then directed westerly to a proposed 10' D10R located at DP-2.

Basin B-3 contains 1.59 acres and generates a peak flow of 7.4 cfs for the 5-year flow and 13.6 cfs for the 100-year flow. This area consists of the easterly and southeasterly portion of the property adjacent to Marksheffel Road. Runoff is directed by curb, gutter, and sheet flow to the southwest corner of lot 1, to a proposed 10' D10R, which is also designated as DP-2.

The peak flow entering this 10' D10R at DP-2 which contains 36.09 acres is 28.1 cfs for the 5-year event and 65.3 cfs for the 100-year event. Of these flows for the 5-year event, 24.7 cfs will be conveyed underground via 24" RCP at 6.98%, the remaining 3.9 cfs will be conveyed overland within a proposed overflow swale to a 20' radial D10R at DP-3. The 100-year flow will

have 33.6 cfs conveyed underground and 31.7 cfs conveyed within the overflow swale . The overland flows and headwater elevation is 6655.80 and should not encroach into the finished floor of the proposed building as long as the finished floor is set at 6656.3. The overland flows are then directed to proposed 20' radial D10R in sub-basin B5 at design point 3. DP-3 contains offsite Basin OS-B4 and onside Basin B5, contains 10.67 acres and generates a peak flow of 13.6 cfs for the 5-year event and 29.9 cfs for the 100-year event. The proposed 20' radial D10R in Basin B-5 located at Design Point 3 has a peak flow of 20.7 cfs for the 5-year event. The flowline elevation of the proposed inlet is 6653.41. The headwater depth at this location is 6653.95. The 100-year flow is 54.3 cfs and the headwater elevation at this inlet is 6654.38. Flows are then conveyed to the existing junction structure via a 36" RCP at 9.8 % slope. Peak flow at DP-3 includes overland flow from DP-2.

Basin B-6 consists of 0.39 acres and generates a peak flow of 4.2 cfs for the 5-year event and 7.7 cfs for the 100-year event. This is located in the center portion of the property, and runoff flows in a southwesterly direction to a proposed 5' D10R. Runoff from this proposed 5' D10R will be conveyed to the existing junction structure via a 15" RCP at 4.41% slope.

Basin B contains 47.66 acres and generates a peak flow of 40.8 cfs for the 5-year event and 95.6 cfs for the 100-year event. Proposed at this location the previously mentioned 20' radial D10R with a capacity of 20.7 cfs at a depth of 0.54', and a capacity of 54.3 cfs at a depth of 0.97'. This results in a water surface elevation of 6653.95 for the 5-year event and 6654.38 for the 100-year event. These flows are contained within the parking area and will not encroach into the finished floor of either building. Flows will then continue southerly within the existing 8' x 6' reinforced concrete box.

Basin C is a small area located on the westerly edge of lot 3. These flows are directed westerly to the private drive, then conveyed southerly to Barnes Road. Basin C contains 0.17 acres and generates a peak flow of 0.8 cfs for the 5-year event and 1.5 cfs for the 100-year event.

Basin D is a small area on the southerly edge of lots 1, 2, and 3. This area contains approximately 0.12 acres and is part of the landscaped berm along Barnes Road. This small area sheetflows runoff southerly to Barnes Road and has a peak flow of 0.2 cfs 5-year event and 0.4 cfs for the 100-year event.

Proposed Improvements:

Willowind Commercial Filing No. 1 for Phase I consists of the construction of 15", 24", and 36" RCP, one 5' D-10-R, one 10' D-10-R and one 20' radial D10R. The onsite facilities were designed utilizing developed conditions for Willowind Commercial Filing No. 1, and current conditions for the offsite areas to the north and east of this property. If the offsite flow from OS-B1 and OS-B2 is directed in the future to Marksheffel Road, the onsite facilities installed are adequate to intercept and convey safely the interior runoff.

Grading and Erosion Control:

The Grading and Erosion Control Plan is being submitted separately from this Drainage Report and Plan to the City of Colorado Springs, Stormwater and Subdivision Department.

Facilities:

The Drainage Basin Planning Study for Sand Creek shows that there are no planned major drainage facilities for this area.

Summary:

This final drainage study is for Willowind Commercial area, and includes the existing development to the west of the site. Also included are the undeveloped area to the north and the partial development on the east side of Marksheffel Road. The peak runoff flows shown on this plan are based on the previously mentioned criteria. The Master Development Drainage Plan that was used as a referenced in preparation of this report indicate areas to the north of the property and on the east side of Marksheffel Road as developing within the criteria shown on the available zoning maps. The potential of these properties developing differently than is shown

on these zoning maps is a possibility. Based on this criteria for future development of these areas, the Master Development Drainage Plan for Stetson Hills Enclave was prepared to show an ultimate peak flow exiting at Barnes Road. If the adjacent properties do not develop as anticipated, these overall flows may increase or decrease as development progresses. The Master Development Drainage Plan was prepared as a guide to help utilize final drainage reports within this area. The recommendation would be that as future development occurs, these properties should be evaluated in greater detail to determine the viability of routing flows through this property or other alternate means to alleviate any possible increase in the maximum allowable flow to the existing channel downstream of Barnes Road.

The platting of this subdivision will not adversely affect the surrounding developments. Drainage calculations were developed in accordance with the 1991 City of Colorado Springs Drainage Criteria Manual as amended and revised. Runoff from this development should be safely conveyed to adequate outfalls. Willowind Commercial Filing No. 1 is in general conformance with the Sand Creek Drainage Basin Study.

Phase I Proposed Storm Drain Facilities (Non-Reimbursable):

Following is a breakdown of the drainage facilities and estimate of probable costs.

15" RCP (98 LF@ $23.00 per foot)	$2,254.00
24" RCP (114 LF @ $38.00 per foot)	$4,332.00
36" RCP (5 LF @ $60.00 per foot)	$300.00
5' D-10-R (1 @ $2,900.00)	$2,900.00
10' D-10-R (1@ $3,600.00)	$3,600.00
20' radial D10R (1@$5,500.00)	$5,500.00
Miscellaneous (LS)	$1,000.00
Storm Drain Facilities Total:	**$19,886.00**

Leigh Whitehead & Associates, Inc., cannot and will not guarantee that the actual construction costs will not vary from this estimate of probably costs for constructing these facilities.

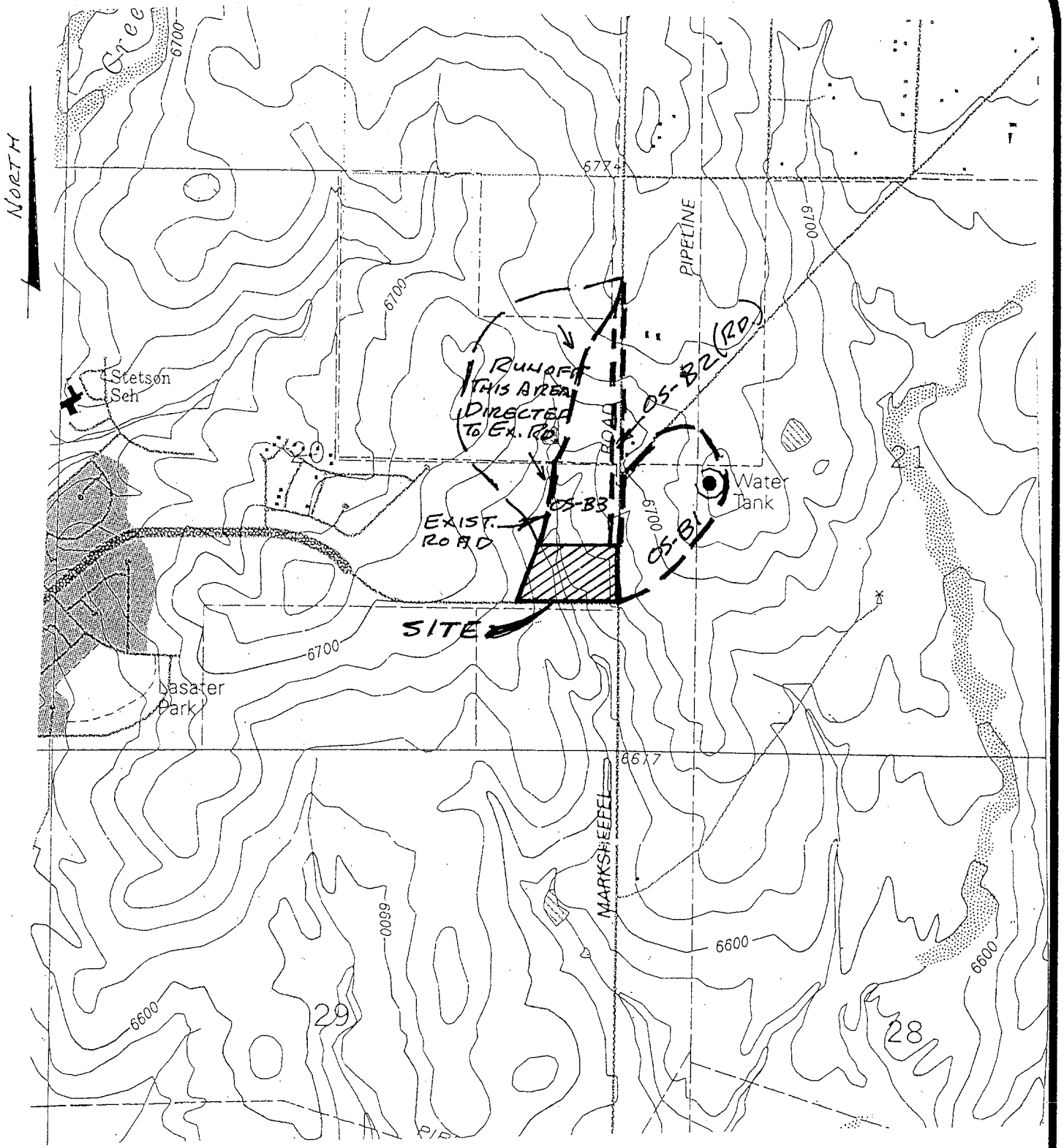
Drainage Bridge and Pond Fees:

Willowind Commercial filing No. 1 is located in the Sand Creek Drainage Basin, Code No. 01. This site contains 9.63 acres, is unplatted, therefore subject to drainage, bridge and pond fees. The following is a breakdown of these fees based on the drainage fee schedule distributed by the City of Colorado Springs Land Development Administration, dated 2003.

Drainage Bridge and Pond Fees Summary:

9.63 acres ($7,148.00 per acre drainage fee)	$68,835.24
9.63 acres ($424.00 per acre bridge fee)	$4,083.12
9.63 acres ($470.00 per acre pond land fee)	$4,526.10
9.63 acres ($1,589.00 per acre pond facilities fees)	$15,302.07
Drainage Bridge and Pond Fee Total:	**$92,746.53**

The drainage, bridge and pond fees will be paid prior to recordation of Willowind Commercial Filing No. 1.



OFFSITE DRAINAGE

Leigh & Whitehead Associates, Inc.

CONSULTING CIVIL ENGINEERS & SURVEYORS
2720 EAST YAMPA STREET, SUITE 1
COLORADO SPRINGS, CO 80909-5061

FUTURE S/W IMPROVEMENT

OS-B4 | 7.48 Ac. | 5.6 | 14.5

EX. STORM M.H. RIM = 6657.21 INV. OUT (S) = 6649.08 INV. IN (N) = 6649.83

UNPLATTED
ZONED PUD

FUTURE FENCE LOCATION TO BE DETERMINED WITH PROJECT ON THIS SITE.

PROPERTY LINE

CONC. CROSSPAN

WILLOWIND @ STETSON HILLS FILING NO. 1
ZONED R-1
REC. # 201045072

ANTELOPE RIDGE DRIVE (80' R.O.W.)

LOT 4
130,505 sq. ft.
F.F.=59.50
F.F.=61.50
PHASE I

PHASE LINE (TYP.)

EX. ROW

MARKSHEFFEL ROAD (±110' R.O.W.)

OS-B1 | 27.55 Ac. | 19.9 | 49.3

WILLOWIND COMMERCIAL SUB. NO. II

LOT 5
167,166± S.F.

A1 | 0.60 Ac. | 2.8 | 5.1

B5 | 3.19 Ac. | 12.4 | 23.2

B6 | 0.90 Ac. | 4.2 | 7.7

EX. 18" CMP INV. OUT 6161 (TO REMAIN)

5' D10R
TC = 6654.74
FL = 6654.07
INV. = 6650.32

LOT 1
51,745 sq.ft.

DP - 1 | 34.5 Ac. | 24.7 cfs | 60.4

LOT 3
34,803 sq.ft.
F.F.=55.75

LOT 2
34,097 sq.ft.
98' 15" RCP @ 11.30%
F.F.=56.30

B3 | 1.59 Ac. | 7.4 | 13.6

A2 | 0.14 Ac. | 0.7 | 1.2

A | 4.04 Ac. | 17.1 | 31.9

A3 | 3.30 Ac. | 14.0 | 26.0

OS-B | 47.66 Ac. | 40.8 | 95.6

15' D10R, TC = 6658.65
FL = 6657.82
INV. = 6653.65

24" INV. = 6642.65
114' 24" RCP @ 6.98%

10' D10R
TC = 6655.83
FL = 6654.03
INV. = 6650.63

PHASE II

BENCHMARK NO. 5, REBAR ELEV=6657.65

OS-B2 | 6.95 Ac. | 7.1 | 16.8

DP - 3 | 10.67 Ac. | 13.8 cfs | 28.9 cfs

DP - 2 | 24.09 Ac. | 24.1 cfs | 65.3 cfs

EXIST. 60" RCP

EXIST. 24" RCP

SHEET FLOW

54 LF 24" RCP @ 18.69%
(W) INV. = 6653.65
(E) INV. = 6643.56

PIPE FLOW
Q=123.7 CFS
Q=222.9 CFS

EX. 22' INLET (TO REMAIN)

5'-36" RCP @ 12.80%
(N) INV. = 6647.90
(S) INV. = 6641.50

CONSTRUCT GRASS EMERGENCY OVERFLOW SWALE, (10' BOTTOM, 6.4:1 N. & 15:1 S.) 3.9 cfs, 5 YR. & 31.7 cfs, 100 YR. WILL BE CONVEYED OVERLAND TO DP-3

BARNES ROAD
(R.O.W. VARIES)

20' D 11 (13' WIDE) RADIAL INLET, R=6.5'
TC = 6653.91
FL = 6652.91
INV. = 6647.90

EX. 22' INLET (TO REMAIN)

C | 0.17 Ac. | 0.8 | 1.5

D | 0.12 Ac. | 0.2 | 0.4

EXIST. 6' X 8' R.C.B.

Q5 = 145 cfs
Q100 = 294 cfs

RUNOFF EXITING EXISTING BOX CULVERT, WITH COMMERCIAL AREA DEVELOPED AND REMAINING OFFSITE & UPSTREAM AREA IN CURRENT CONDITION

LEGEND:

DESIGN POINT — DP - 1 | 14.4 — AREA
5 YR FLOW — 5.6 | 28.9 — 100 YR FLOW

OS-3B — BASIN AREA
3.4 Ac.
5 YR FLOW — 25 | 250 — 100 YR FLOW

CONTOUR INTERVAL = (2')

MAIN BASIN BOUNDARY

SUB BASIN BOUNDARY

EXISTING STORM DRAIN PIPE

PROPOSED STORM DRAIN PIPE

GRAPHIC SCALE
(IN FEET)
1 inch = 40 ft.

AR DP 02-500

LEIGH WHITEHEAD & ASSOCIATES
2780 EAST YAMPA STREET, UNITS 1
COLORADO SPRINGS, CO 80909
PHONE (719) 634-0707 • FAX (719) 634-0405

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SHEET TITLE: PROPOSED DRAINAGE PLAN

PROJECT NAME: WILLOWIND COMMERCIAL SITE FILING NO. 1

BENCHMARK:
AS SHOWN ON PLAN BY BOUNDARY AND PHOTO CONTROL MONUMENTATION. NGVD 1929 DATUM (CSDU FIMS)

REVISIONS:
5/7/03-PER CITY

SCALE: 1" = 40'
DATE: 01/30/03
DRAWN BY: KEM
CHECKED BY: SCJ/LAB

SHEET NO:
1 OF 1

PROJECT NO: 02034
DRAWING NAME: COMMGRADE
VIEW: PROP. DRAINAGE PLAN

FINAL
DRAINAGE REPORT AND PLAN
FOR
WILLOWIND FILING AT STETSON HILLS
FILING NO. 4

September, 2004

Leigh & Whitehead Associates, Inc.
CONSULTING CIVIL ENGINEERS & SURVEYORS
2720 EAST YAMPA STREET, SUITE 1
COLORADO SPRINGS, CO 80909-5061

LWA Project No. 03012.64

Soils:

The soils across the site are the Truckton Sandy Loam, a deep well drained soil formed alluvial residuum derived from arkosic sedimentary rock. The permeability of the Truckton soil is moderately rapid which gives it a Hydrologic Group "B" rating. The site currently slopes to the southwest and groundcover is stabilized with grasses native to the area.

Existing Conditions:

The existing drainage conditions were evaluated in greater detail in the Master Development Drainage Plan for Stetson Hills Enclave, prepared by this office and approved by the City of Colorado Springs on October 26, 2000. For this reason, a detailed analysis of the existing conditions will not be included with this report.

Marksheffel Road located to the east is an existing asphalt roadway, with no curb or gutter.

The north part of the property has had some minor grading to direct runoff to Antelope Ridge Drive. The site groundcover is sparse grasses native to the area. Average slopes through the site range from 2% to 6%

Overall, the site drains in a southerly direction to Willowind Commercial Filing No. 1.

The City of Colorado Springs has raised concerns regarding runoff overtopping Marksheffel Road at an inadequate culvert located approximately 0.5 miles south of this property. This portion of the road is located in El Paso County. The MDDP amendment for Hilltop Subdivision, prepared by URS in April of 2002 and approved by El Paso County on Sept. 11, 2002, states: The existing facility (a 24" CMP) was found to be inadequate during historical conditions in the original MDDP.

Existing facilities: 24" CMP across Marksheffel Road downstream of the stock pond. Poor condition. Design point 1C. This culvert is not adequate to convey the historic

100-year flow, and therefore will not be adequate to convey flows after development. This culvert will need to be upgraded when Marksheffel Road is improved.

Based on this statement we would defer to El Paso County for improvements at this location. Peak 100 year developed runoff that is directed to this existing 24" cmp is 796 cfs. This flow is for a fully developed upstream area with the existing temporary detention facility functioning as designed. Peak historical runoff at this existing 24" cmp is 852 cfs. The peak developed runoff at this culvert location is less than the historic flows, these flows were obtained from the final drainage report for the "Chateau at Antelope Ridge", dated Dec. 18, 1998, prepared by URS Greiner Woodward Clyde, Inc., Colorado Springs, Colorado.

The depth of water crossing Marksheffel Road during a 100 year developed event would be 2.3' deep, the depth for a 5 year developed event would be 1.9'. We acknowledge that a problem exists at this location and we are adding additional flow, but we feel the flow impact from Willowind at Stetson Hills Filing No. 4 is minimal and would have only a minor increase in water depth. Our recommendation is to place signage at the crossing advising motorists not to cross when water is overtopping the roadway until such time as a permanent design solution is implemented by El Paso County.

Proposed Conditions:

The proposed conditions for this development are in general conformance with the existing condition drainage patterns. The proposed conditions plan was divided into four onsite basins, one offsite basin, eight sub-basins and six design points (DP-1 through DP-6) delineated on the Proposed Conditions Drainage Plan as Basins A, B, C, D, OS-E and DP-1, DP-2, DP-3, DP-4, DP-5 and DP-6.

Basin A contains 1.08 acres and generates a peak flow of 2.9 cfs for the 5-year event, and 6.4 cfs for the 100-year event.

RUNOFF COMPUTATIONS RATIONAL METHOD

WILLOWIND FILING NO. 4
MARKSHEFFEL ROAD and BARNES ROAD
COLORADO SPRINGS, COLORADO

LEIGH WHITEHEAD & ASSOCIATES,INC.
Engineers, Surveyors & Planners
2720 EAST YAMPA STREET, SUITE 1
COLORADO SPRINGS, COLORADO
(719) 636-5179

TABLE A: LWA # 03012.62
PROPOSED CONDITIONS

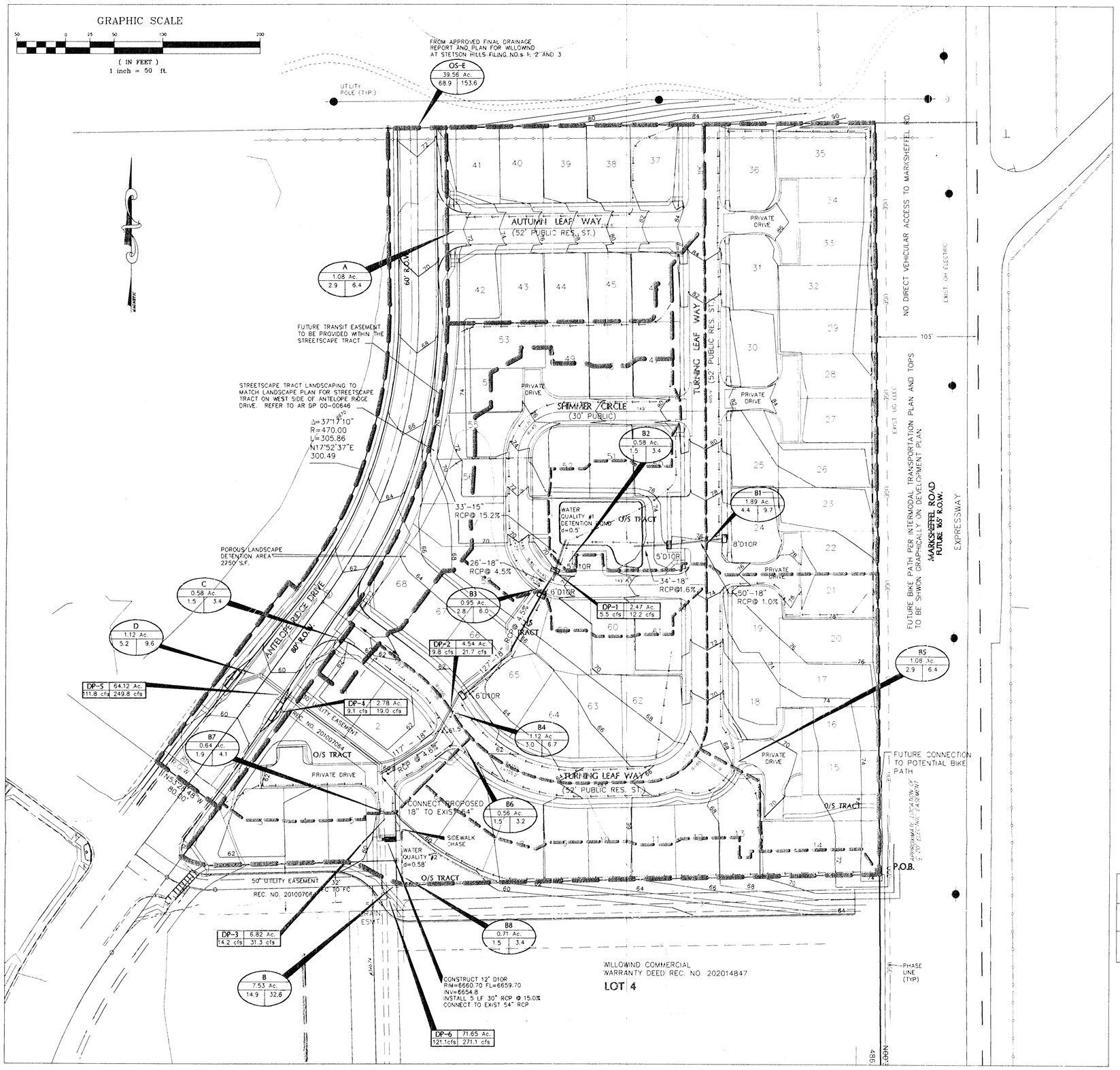
27-Apr-04

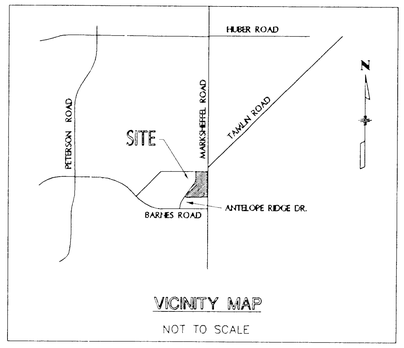
BASIN	AREA	SOIL TYPE	C 5 / C 100	GEOMETRY LENGTH / SLOPE	GEOMETRY HEIGHT	Tt 5 / Tt 100	V / Tt	tc 5 / tc 100	i 5 / i 100	Q5	Q100	COMMENTS
D	1.12	B	0.90	10.0	0.2	0.94	2.94	4.34	5.20	5.2		
		97	0.95	2.00		0.71	3.40	4.11	9.00		9.6	
DP-4	2.78	B	0.72	115.0	3.0	5.55	Varies	7.46	4.55	9.1		
		8	0.80	2.61		4.38	1.91	6.29	8.53		19.0	
OS - E	39.56	B	0.60	250.0	2.0	15.91	Varies	20.13	2.90	68.8		Basin OS-B12 From
		8	0.70	0.80		12.73	4.22	16.95	5.55		153.7	Willowind # 1, 2 & 3
DP-5	64.12	B	0.59	300.0	5.0	13.96	Varies	20.80	2.95	111.8		
		8	0.69	1.67		11.22	6.84	18.06	5.65		249.8	
DP-6	71.65	B	0.59	300.0	4.0	15.02	Varies	22.09	2.86	121.1		
		8	0.69	1.33		12.08	7.07	19.15	5.48		271.1	

GRAPHIC SCALE

50 0 25 50 100 200

(IN FEET)
1 inch = 50 ft.





VICINITY MAP

NOT TO SCALE

LEGEND

PROPOSED FIRE HYDRANT	EXISTING FIRE HYDRANT
PROPOSED LIGHT	EXISTING LIGHT
PROPOSED ELECT. TRANSFORMER	EXISTING ELECT. TRANSFORMER
PROPOSED CONC. PAD	EXISTING CONC. PAD
PROPOSED WATER VALVE	EXISTING WATER VALVE
PROPOSED SAN. SEWER MANHOLE	EXISTING SAN. SEWER MANHOLE
SS	EXISTING SAN. SEWER
W	EXISTING WATER
UGE	EXISTING UNDERGROUND ELECTRIC
UGT	EXISTING UNDERGROUND TELEPHONE
OHE	EXISTING OVERHEAD ELECTRIC
T	EXISTING TELEPHONE
E	EXISTING ELECTRIC
PROPOSED WATER	
PROPOSED STORM	
PROPOSED SAN.SEWER	
MAIN BASIN BOUNDARY	
SUB BASIN BOUNDARY	
DRAINAGE FLOW	

DESIGN POINT — CP - 1 | 14.4 — AREA
5 YR FLOW — 5.6 | 28.9 — 100 YR FLOW

OS-3B — BASIN
3.4 Ac. — AREA
5 YR FLOW — 25 | 250 — 100 YR FLOW

CONTOUR INTERVAL = 2 FT

TOPOGRAPHIC SURVEY SHOWN HAS NOT BEEN FIELD VERIFIED BY LEIGH WHITEHEAD & ASSOC.

DETENTION POND DATA

Q5 IN CFS	Q5 OUT CFS	DETAINED CFS	MAX W.S. ELEVATION	Q100 IN CFS	Q100 OUT CFS	DETAINED CFS	MAX W.S. ELEVATION
5.5	1.1	4.4	6671.13	12.2	3.6	8.6	6671.72

PLANNERS ENGINEERS SURVEYORS
LEIGH WHITEHEAD & ASSOCIATES
2720 EAST YAMPA STREET, SUITE 1
COLORADO SPRINGS, CO 80909
PHONE (719) 636-5179 * FAX (719) 636-5199

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SHEET TITLE: PROPOSED DRAINAGE PLAN

PROJECT NAME: WILLOWIND AT STETSON HILLS FILING NO. 4 COLORADO SPRINGS, CO.

BENCHMARK:

REVISIONS:

SCALE: 1" = 50'

DATE: 7-28-04

DRAWN BY: SCJ/LJ

CHECKED BY: LAB

SHEET NO: 1 OF 1

PROJECT NO: 03012

DRAWING NAME: WW4-TOPO082803

VIEW: PP-COND. DRAIN

J·R ENGINEERING
A Westrian Company

PRELIMINARY/FINAL DRAINAGE REPORT
FOR
EASTVIEW ESTATES FILING NO. 2

April 2005

Prepared For:

LENNAR COMMUNITIES COLORADO
7222 Commerce Center Drive, Suite 118
Colorado Springs, CO 80919
(719) 593-8583

Prepared By:

JR ENGINEERING
4310 ArrowsWest Drive
Colorado Springs, CO 80907-3449
(719) 593-2593

Job No. 8965.04

PRELIMINARY/FINAL DRAINAGE REPORT FOR EASTVIEW ESTATES FILING NO. 2

PURPOSE

This document is the Preliminary/Final Drainage Report for Eastview Estates Filing No. 2. The purpose of this report is to analyze the drainage patterns, peak rates of storm water runoff, recommend solutions for drainage concerns resulting from development, and identify necessary improvements to safely route storm water runoff to adequate outfall facilities.

GENERAL DESCRIPTION

Eastview Estates Filing No. 2 is located in the northeast corner of Sections 20, Township 13 South, Range 65 West of the Sixth Principal Meridian in the City of Colorado Springs, County of El Paso. The 43.06-acre parcel is included in the " M.D.D.P. for Eastview Estates and Final Drainage Report for Eastview Estates Filing No. 1. The parcel is bounded to the north by Eastview Estates Filing No. 1, to the west by proposed Stetson Hills South Filings No. 2 and a City of Colorado Spring Park site. To the south the site is bounded by future Eastview Estates Filing No. 3 and by existing Willowind at Stetson Hills Filing No. 1, 2, 3, and future filing 4. To the east of Eastview Estates Filing No. 2 is Marksheffel Road and undeveloped land located within El Paso County. The 43.06 acre development contains two planned single residential subdivisions zoned R1-6000/DFOZ, a proposed 35.79 acre Eastview Estates Filing No. 2, and a future 7.27 acre Eastview Estates Filing No. 3. Eastview Estates Filing No. 3 shall be discussed in greater detail within a future drainage report.

EXISTING DRAINAGE CONDITIONS

Eastview Estates is divided by an existing east to west ridgeline that separates the parcel into a northern and southern half. This ridgeline separates the regional sub-basins of Sand Creek into the Main Sand Creek Drainage Basin and Upper Sand Creek Drainage Basin as indicated by the "Sand Creek Drainage Basin Planning Study," revised March 1996 by Kiowa Engineering Corporation. The northern portion of the parcel lies within Basin 27 of the Upper Sand Creek

Drainage Basin. This portion slopes westward at a varying grade from 2% to 3:1 toward proposed Stetson Ridge South Subdivision Filing Nos. 1, 2 and 3. The southern portion of the parcel lies within Basin 38 of the East Fork of Sand Creek Drainage Basin and slopes southerly at a varying grade of 2% to 10% to existing Willowind at Stetson Hills Subdivision. Eastview Estates is currently vegetated with native grass. The soils across the site are Truckton Sandy Loam, a deep well-drained soil formed in alluvial residuum derived from arkosic sedimentary rock. The soil has a moderately rapid permeability, which reflects a condition Hydrologic Group "B" soils as determined by the "Soil Survey of El Paso County Area," prepared by S.C.S. (see appendix). In addition, the Sand Creek D.B.P.S. indicated that the aforementioned sub-basins have not been studied in detail and do not require any major drainage facilities.

As stated above, Eastview Estates lies within two regional sub-basins of the Sand Creek Drainage Basin; East Fork and Upper Sand Creek Drainage Basins. The proposed Eastview Estates Filing No. 2 lies within the east fork of Sand Creek Basin with a small area within the Upper Sand Creek Drainage Basin. Existing drainage runoff for this portion of proposed Eastview Estates within the East Fork of Sand Creek has been previously studied within the "Master Development Drainage Plan for Stetson Hills Enclave," dated September 2000 by Leigh Whitehead & Associates, Inc., and the "Final Drainage Report and Plan for Willowind at Stetson Hills Filing Nos. 1, 2 and 3" dated March 2001 by Leigh Whitehead & Associates, Inc. This report anticipated the development of the adjacent site (Eastview Estates Filing No. 2) into a single-family residential area, and utilized corresponding C-values used to determine the peak runoff.

Further area study revealed a 42" cmp located under Marsheffel Road, which deposits flow onto the future Eastview Estates Filing No. 3. Investigation has lead us to believe that the offsite basin, approximately 23 acres, shown as WW-13 will maintain at historic level, Q_5 = 14.8 cfs and Q_{100} = 36.9 cfs. These flows will be intercepted by a future sub-surface system included in the development of Eastview Estates Filing No. 3.

The anticipated developed runoff from the 39.56 acres of Eastview Estates Filing No. 2 and future Filing No. 3, is expected to reach the now existing Willowind at Stetson Hills Subdivision

site to the south, producing runoff totaling Q_5 = 68.9 cfs, Q_{100} = 153.6 cfs. Runoff is to be directed to Antelope Ridge Drive where it is to be collected as surface and subsurface flows. The majority of the collected runoff (Q_5 = 68.9 cfs, Q_{100} = 143.0 cfs) is to be intercepted by a subsurface proposed 42" R.C.P. located within existing roadway, while the remaining (Q_{100} = 10.6 cfs) is allowed to be conveyed as surface flow atop the roadway where it would be intercepted by downstream inlets. The previously mentioned off-site basin across Marksheffel Road was not included in the "Final Drainage Report and Plan for Willowind at Stetson Hills Filing Nos. 1, 2 and 3" dated March 2001 by Leigh Whitehead & Associates, Inc., but based upon routing the existing system has adequate capacity.

The remaining 3.99 acres of the 43.55 acres (shown within in the enclosed drainage map as Basins WW-B4) produced anticipated flows totaling Q_5 = 3.9cfs and Q_{100} = 13.1 cfs. Flows will be confined within a drainage swale and deposited and collected within Duncrest Drive.

PROPOSED DRAINAGE CHARACTERISTICS

Upper Sand Creek Drainage Basin

Eastview Estates Filing No. 1 is being developed at the time of this writing. The single-family development of the northern portion of the Upper Sand Creek Drainage Basin is a residential subdivision zoned R1-6000/DFOZ to the west of Marksheffel Road and south of Stetson Hill Boulevard. Surface runoff from the residential area will be collected within the proposed interior streets and storm drain systems and directed to existing collection systems located within the easterly filings of the adjacent Stetson Ridge South Subdivisions. Refer to " Master Development Drainage Plan for Eastview Estates and Final Drainage Report for Eastview Estates Filing No. 1", dated August 2004 for a more thorough drainage analysis.

Upper Sand Creek Drainage Basin Detailed Description

Runoff flows from Basin B (2.91 acres) are routed to DP-3 (Q_5 = 5.4 cfs, Q_{100} = 11.3 cfs). These flows collect in a proposed 4' D-10-R sump inlet located within the northeast corner of a roundabout within Antelope Ridge Drive. These flows are conveyed to SD-0 via an existing 18" R.C.P. storm system. At SD-0 (Q_5 = 51 cfs, Q_{100} = 87 cfs) per the "M.D.D.P. for Eastview

Estates and Final Drainage Report for Eastview Estates Filing No. 1", flows are directed west through a 42" R.C.P. to tie into the Stetson Ridge South Filing No. 3 storm system located within Steward Lane. The "Final Drainage Report for Eastview Estates Filing No. 1" anticipated these flows and no adverse effects will be encountered by tying into this system.

Basin K is 0.82 acres of residential lots. The peak runoff from this basin is estimated to be Q_5 = 2.2 cfs and Q_{100} = 4.6 cfs which will be conveyed as surface flow to the back of the residential lots 1-6 and collected in a permanent rock swale, located inside a proposed private 15' drainage easement with surface maintenance by lot owner, along the west boundary line of Eastview Estates Filing No. 2 and the east boundary line of Stetson Ridge South Filing No. 3. Flows are routed north within the rock swale to a concrete curb chase in proposed Statute Drive at DP-6. At DP-6, these flows combine with flows from Basin A, 4.91 acres (Q_5 = 10.3 cfs, Q_{100} = 21.5 cfs) of residential lots and streets producing total surface flows of (Q_5 = 12.0 cfs, Q_{100} = 25.1 cfs) which are acceptable to the anticipated release rates of Q_5 = 17.1 cfs, Q_{100} = 27.6 cfs established within the "Final Drainage Report and Plan for Stetson Ridge South Filing No. 1, 2 and 3."

East Fork Sand Creek Drainage Basin

Planned development for Eastview Estates Filing No. 2 is to construct, 35.79 acres of planned single-family residential subdivision zoned R1-6000/DFOZ/NP, located north of Willowind at Stetson Hills Filings No. 1, 2, 3, and 4 and west of Marksheffel Road. Flows from the single-family subdivision will be collected within the proposed interior streets and storm drain systems and directed to existing collection systems located within the northern filing of Willowind at Stetson Hills. Future development within this basin will include Eastview Estates Filing No. 3, a 7.27-acre single-family development located at the southeastern corner of Eastview Estates. Eastview Estates Filing No. 3 will be included as preliminary in this report, with a further discussion in a future drainage report.

Runoff from future Marksheffel Road, located to the east of the site, will be considered to comply with the assumptions made within the Final Drainage Report and Plan for Willowind at Stetson Hills Filing No. 1, 2 and 3, which states runoff from future roadway will be conveyed to

a planned inlet located within Marksheffel Road and conveyed to the existing box culvert, with carryover conveyed to the low point within Barnes Road.

East Fork Sand Creek Drainage Basin Detailed Description

Basin C consists of 7.19 acres of residential lots and streets of Eastview Estates Filing No. 2. The runoff from this basin will be conveyed within the internal streets to DP-7 (Q_5 = 14.2 cfs, Q_{100} = 29.7 cfs). This runoff will be collected in a proposed 20' D-10-R sump inlet located in the northeast corner of the roundabout on Antelope Ridge Drive. It will be conveyed through a 30" R.C.P. pipe to a City Standard Type 1 storm manhole at SD-1 (Q_5= 21 cfs, Q_{100}= 44 cfs).

Basin D produces minor and major storm flows of 8.9 cfs and 18.6 cfs from its 5.27 acres of residential lots and streets. These flows are collected at DP-8 by a 10' D-10-R sump inlet located in the northwest corner of the roundabout on Antelope Ridge Drive. Flows are to be conveyed to a city standard type storm manhole at SD-1 (Q_5 = 21 cfs, Q_{100} = 44 cfs) through a 24" R.C.P. storm pipe. The combined flows from Basin C and D will be routed southerly via a 30" R.C.P. storm sewer within Antelope Ridge Drive to SD-2.

At SD-2 (Q_5 = 26 cfs, Q_{100} = 52 cfs) flows from SD-1 combine with flows from Basin E (3.85 acres) that are collected by a 20' at-grade inlet at DP-9 (Q_5 = 6.2 cfs, Q_{100} = 13.1 cfs). Analysis has been done to ensure that this flow does not overtop the top of curb flow into surrounding lots (see Appendix: Hydraulic Calculations). The surface flow-by and subsurface flows continue south down Antelope Ridge Drive towards Willowind Filing No. 3.

The single-family site, discussed earlier in this section as Eastview Estates Filing No. 3, is contained within Basins F-1 and F-2. Basin F-1 produces flows of Q_5 = 5.3 cfs, Q_{100} = 11.0 cfs for the 4.27 acres of residential lots and streets.

Off site basin WW-13, located on the east side of Marksheffel Road is comprised of approximately 23 acres of undeveloped land producing historic flows of (Q_5 = 14.8 cfs, Q_{100} = 36.9 cfs) that is collected within the existing 42" CMP under Marsheffel Road. These flows are intercepted by a future City Standard Type 1 storm manhole and then conveyed within a future

30" RCP storm pipe located within the right-of-way and a defined 15' drainage easement. Flows are directed west and connect to the proposed Eastview Estates Filing No. 2 storm sewer system plug, located near the Antelope Ridge Drive and Steward Lane intersection. Flows are routed to the proposed 36" RCP storm sewer main located in Antelope Ridge Drive. Surface runoff from Basin F-1 along with flow-by from DP-9 are collected at Design Point DP-9B (Q_5 = 6.3 cfs, Q_{100} = 14.3 cfs) by a 20' D-10-R at-grade inlet. These flows are then routed via a 24" R.C.P. storm sewer pipe where they combine with SD-2 in the 30" R.C.P. storm main line at SD-3 (Q_5 = 31 cfs, Q_{100} = 63 cfs). Produced flows from Basin WW-13 intercept SD-3 at SD-3A (Q_5= 40 cfs, Q_{100}= 88 cfs).

The second half of the future single-family site is Basin F-2 (4.02 acres, Q_5 = 6.4 cfs, Q_{100} = 13.4 cfs). Basin F-2 is comprised of residential lots and streets. Runoff flows are collected at DP-11B (Q_5 = 6.7 cfs, Q_{100} = 15.7 cfs) by a 30' D-10-R at-grade inlet. Flow-by from above mentioned DP-9B is also intercepted at DP-11B. Flows are conveyed through a 24" R.C.P. storm pipe into the 42" R.C.P. located in Antelope Ridge Drive where they combine with SD-4 at Sd-5 (Q_5= 56 cfs, Q_{100}= 117cfs).

Basin H produces flows of Q_5 = 5.2 cfs, Q_{100} = 11.0 cfs from its 3.45 acres of residential lots and streets. These flows are collected at Design Point DP-10A (Q_5 = 5.2 cfs, Q_{100} = 11.0 cfs) by a 14' D-10-R at-grade inlet. Flow-by from DP-10A will continue easterly down Steward Lane, eventually collecting in a 30' D-10-R at Design Point DP-11A.

Design Point DP-10B (Q_5 = 9.7 cfs, Q_{100} = 20.3 cfs) collects flows from DP-10A via an 18" R.C.P. storm pipe and runoff flows from Basin I (2.99 acres, Q_5 = 5.5 cfs, Q_{100} = 11.5 cfs). Basin I consists of residential lots and streets, as well as a portion of the park site located to the west of Steward Lane and south of Kettle Drum Street. Flows are then routed easterly via a 24" R.C.P. storm sewer to storm Design Point SD-8 (Q_5 = 10.0 cfs, Q_{100} = 18.0 cfs) where flows continue to flow east to a 24" x 36" wye in connection with the 36" R.C.P. storm main in Antelope Ridge Drive at SD-4. At SD-4 (Q_5 = 50 cfs, Q_{100} = 104 cfs) flows from SD-3A combine with flows from SD-8 with subsurface flows continuing south down Antelope Ridge Drive towards Willowind Filing No. 3.

Basin J, 0.67 acres of residential lots and streets, produces flows of Q_5 = 1.3 cfs, Q_{100} = 2.8 cfs which runoff to the backs of the residential lots of Willowind Filing No. 3 and within Dunecrest Drive. This water sheet flows onto the lots of Willowind Filing No. 3 and drain into the existing streets per the lot drainage patterns. The amount of flow that runs onto Willowind No. 3 from Basin J is (Q_5 = 1.3 cfs, Q_{100} = 2.8 cfs). Surface flows within the street at DP-14 are negligible, but the total amount contributing to the existing subdivision is less than the allowable surface runoff established in the "Final Drainage Report and Plan for Willowind at Stetson Hills Filing Nos. 1, 2 and 3," of Q_5 = 7.4 cfs and Q_{100} = 20.9 cfs.

Surface runoff from Basin J1, (1.25 acres, Q_5= 2.2 cfs, Q_{100}= 4.5 cfs) is collected in the rear of the proposed lots 152-156 within a permanent rock swale and a concrete channel (less than 2% grade), located in a proposed private 15' drainage easement with surface maintenance by lot owner, along the north property of Willowind at Stetson Hills Filing No. 3. Flows continue east and are directed through a concrete curb chase and connect into the back of the proposed 30' D-10-R at-grade inlet at DP-11A.

Basin G (5.32 acres, Q_5 = 10.4 cfs, Q_{100} = 21.8 cfs) consists of residential lots and streets. Runoff flows are carried down south along the west side of Antelope Ridge Drive and are intercepted at DP-11A by a 30' D-10-R at-grade inlet. Flow-by from Design Points DP-10A and DP-10B are also collected at Design Point DP-11A. Conveyed flows are routed via a 24" R.C.P. storm pipe into the 42" R.C.P. on Antelope Ridge Drive where they combine with SD-5 at SD-6. Combined flows intersect with the flows mentioned from Basin J1 and discharge into the existing 42" R.C.P. storm drain within the existing portion of Antelope Ridge Drive at SD-6 (Q_5 = 66 cfs, Q_{100} = 138 cfs). These cumulative flows are less than the allowable subsurface flows established in the "Final Drainage Report and Plan for Willowind at Stetson Hills Filing Nos. 1, 2 and 3," of Q_5 = 68.9 cfs, Q_{100} = 143.0 cfs.

BASIN	AREA (ACRES)	Q_5 (CFS)	Q_{100} (CFS)
A	4.9	10.3	21.5
B	2.9	5.4	11.3
C	7.2	14.2	29.7
D	5.3	8.9	18.6
E	3.9	6.3	13.1
F-1	4.3	5.3	11.0
F-2	4.0	6.4	13.4
G	5.3	10.4	21.8
H	3.5	5.2	11.0
I	3.0	5.5	11.5
J	0.67	1.3	2.8
J1	1.25	2.2	4.5
K	0.82	2.2	4.6
WW-13	23.42	14.8	36.9

DESIGN POINTS	Q_5 (CFS)	Q_{100} (CFS)
DP-3	5.4	11.3
DP-6	12.0	25.1
DP-7	14.2	29.7
DP-8	8.9	18.6
DP-9	6.2	13.1
DP-9-B	6.3	14.3
DP-10-A	5.2	11.0
DP-10-B	9.7	20.3
DP-11-A	12.6	30.2
DP-11-B	6.7	15.7
DP-13	3.1	12.4
DP-14	1.3	2.8

STORM DRAIN	Q_5 (CFS)	Q_{100} (CFS)
SD-0	51	87
SD-1	21	44
SD-2	26	52
SD-3	31	63
SD-3A	40	88
SD-8	10	18
SD-4	50	104
SD-5	56	117
SD-6	66	138

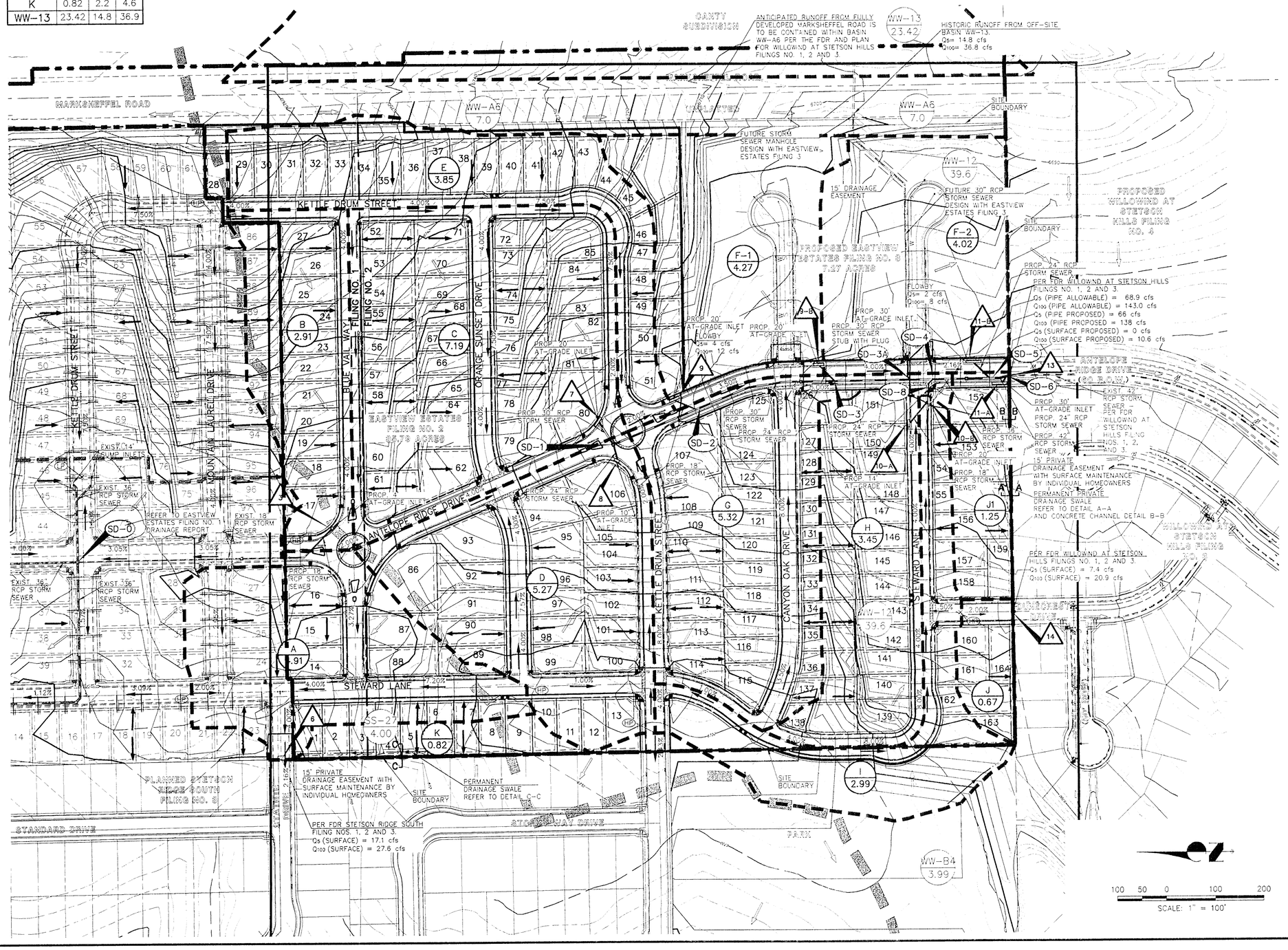
EASTVIEW FILING NO. 2

CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO

DRAINAGE PLAN

UTILITIES

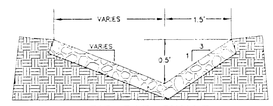
NOVEMBER 2004



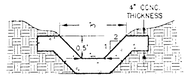
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DESCRIPTION	SYMBOL
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EXISTING GRADE NOMINAL CONTOUR	
PROPOSED FINISH INDEX CONTOUR	6900
PROPOSED FINISH NOMINAL CONTOUR	
PROPOSED OFFSITE FINISH INDEX CONTOUR	6900
PROPOSED OFFSITE FINISH NOMINAL CONTOUR	
PROPOSED STORM SEWER	
FUTURE STORM SEWER	
SITE BOUNDARY	
HIGH POINT ELEVATION	HP
LOW POINT ELEVATION	LP
DIRECTION OF FLOW WITH PERCENT GRADE	1.00%
PROPOSED BASIN BOUNDARY	
PREVIOUSLY STUDIED DRAINAGE BASIN BOUNDARY	
MAJOR BASIN BOUNDARY LINE PER SAND CREEK DBPS	
PROPOSED FLOW DIRECTION	
PROPOSED OFFSITE SWALE	
PROPOSED OFFSITE FLOW DIRECTION	
NATURAL CONDITION FLOW DIRECTION	
BASIN IDENTIFIER / AREA IN ACRES	X / 3.5
OTHER FILING BASIN IDENTIFIER / AREA IN ACRES	29-X / 4.1
DESIGN POINT	1
STORM DRAIN DESIGN POINT	SD-1
PROPOSED CROSSPAN	

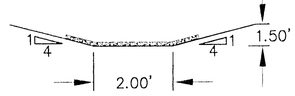
CONTOUR INTERVAL = 2 FEET



RIP RAP SWALE
N.T.S.
DETAIL A-A



CONCRETE CHANNEL
N.T.S.
DETAIL B-B



ROCK DRAINAGE SWALE
N.T.S.
DETAIL C-C

THE LOCATIONS OF EXISTING ABOVE GROUND AND UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK. THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE CAUSED BY HIS FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL ABOVE GROUND AND UNDERGROUND UTILITIES.

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CALL UTILITY LOCATORS
1-800-922-1987
CITY OF COLORADO SPRINGS DEPT. OF UTILITIES
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PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF JR ENGINEERING

AARON B. EGBERT, COLORADO P.E. #34208 DATE

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY THE APPROPRIATE ENGINEERING AGENCIES, JR ENGINEERING APPROVES THEIR USE ONLY FOR THE PURPOSES DESIGNATED BY WRITTEN AUTHORIZATION.

PREPARED FOR
LENNAR COMMUNITIES COLORADO
7222 COMMERCE CENTER DRIVE
SUITE 107
COLORADO SPRINGS, CO 80919
(719) 593-8583

J·R ENGINEERING
A Westrian Company
430 Arrowswest Drive • Colorado Springs, CO 80907
719-593-2593 • Fax: 719-528-6133
www.jrengineering.com

No.	REVISION	BY	DATE
1	CHANGES PER CITY ENGINEERING COMMENTS	TJO	4-28-05

H-SCALE	1" = 100'
V-SCALE	N/A
DATE	11/19/04
DESIGNED BY	TJO
DRAWN BY	JAB
CHECKED BY	

EASTVIEW FILING NO. 2
DRAINAGE PLAN

SHEET 1 OF 1
JOB NO. 28965.04

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J·R ENGINEERING
A Westrian Company

PRELIMINARY/FINAL DRAINAGE REPORT FOR EASTVIEW ESTATES FILING NO. 3

January 2005
Revised November 2005

Prepared For:

LENNAR COMMUNITIES COLORADO
7222 Commerce Center Drive, Suite 118
Colorado Springs, CO 80919
(719) 593-8583

Prepared By:

JR ENGINEERING
4310 ArrowsWest Drive
Colorado Springs, CO 80907-3449
(719) 593-2593

Job No. 8965.08

EASTVIEW FILING NO. 3

CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO

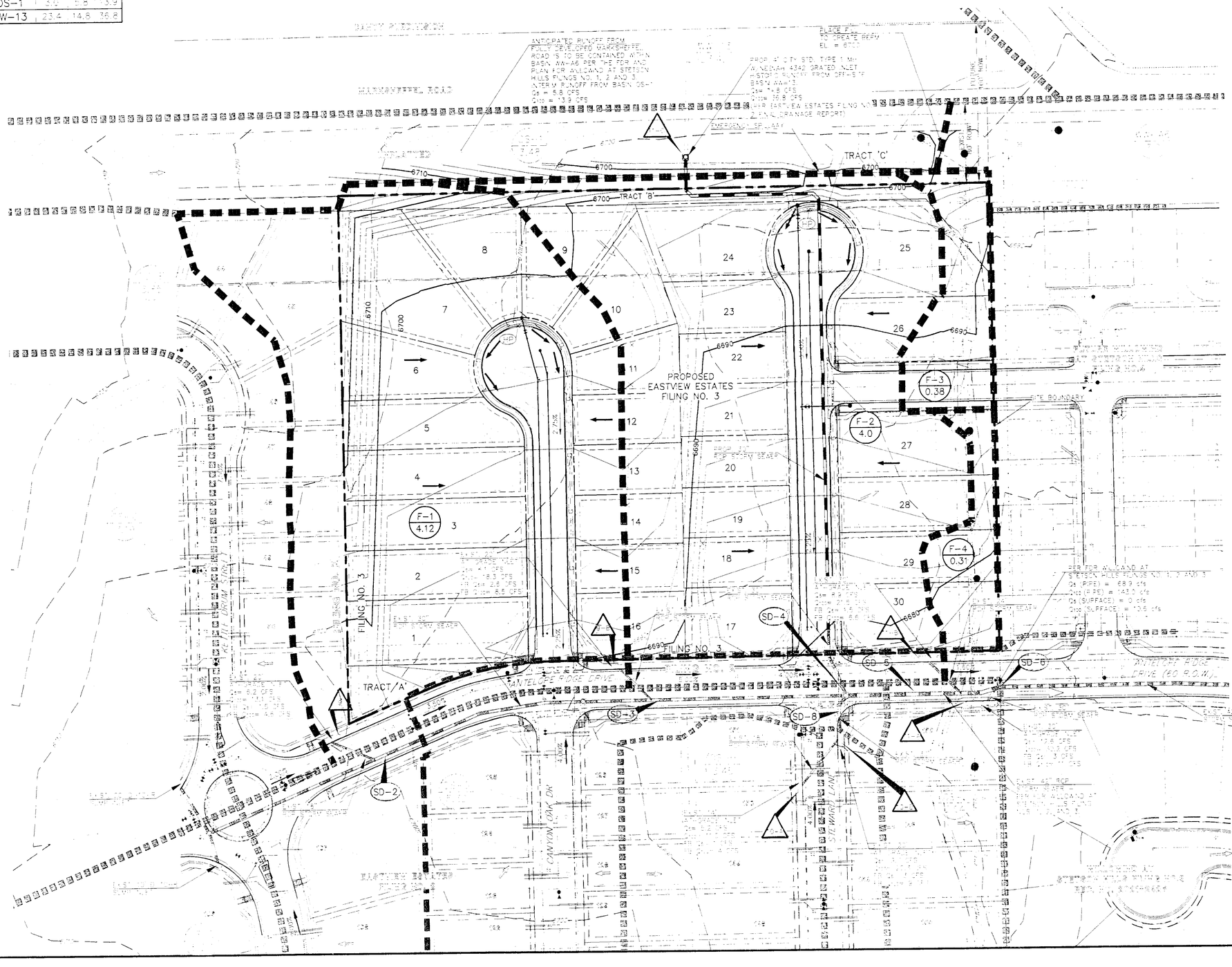
DRAINAGE PLAN

JANUARY 2005

BASIN	AREA (ACRES)	Q_5 (CFS)	Q_{100} (CFS)
OS-C	7.0	14.2	29.7
OS-D	5.3	8.9	18.6
OS-E	3.9	6.3	13.1
OS-G	5.3	10.4	21.8
OS-H	3.5	5.2	11.0
OS-I	3.0	5.5	11.5
OS-J1	1.3	2.2	4.5
F-1	4.1	10.1	21.1
F-2	4.0	12.0	25.0
F-3	0.4	1.0	2.2
F-4	0.3	0.8	1.7
OS-1	3.0	6.8	13.9
WW-13	23.4	14.8	36.8

DESIGN POINTS	Q_5 (CFS)	Q_{100} (CFS)
DP-9	6.2	13.1
DP-9-B	8.1	18.3
DP-10-A	5.2	11.0
DP-10-B	9.7	20.3
DP-11-A	12.6	30.2
DP-11-B	8.9	21.5
DP-11-C	17.6	43.5

STORM DRAIN	Q_5 (CFS)	Q_{100} (CFS)
SD-2	28	52
SD-3	22.8	52.7
SD-8	10	18
SD-4	52.3	109.6
SD-5	56.3	122.7
SD-6	69	143



LEGEND

DESCRIPTION	SYMBOL
EXISTING GRADE INDEX CONTOUR	
EXISTING GRADE NOMINAL CONTOUR	
PROPOSED FINISH INDEX CONTOUR	6900
PROPOSED FINISH NOMINAL CONTOUR	
PROPOSED OFFSITE FINISH INDEX CONTOUR	
PROPOSED OFFSITE FINISH NOMINAL CONTOUR	
PROPOSED STORM SEWER	
EXISTING STORM SEWER	
SITE BOUNDARY	
HIGH POINT ELEVATION	HP
LOW POINT ELEVATION	LP
DIRECTION OF FLOW WITH PERCENT GRADE	1.00%
PROPOSED BASIN BOUNDARY	
PREVIOUSLY STUDIED DRAINAGE BASIN BOUNDARY	
MAJOR BASIN BOUNDARY LINE PER SAND CREEK DBPS	
PROPOSED FLOW DIRECTION	
PROPOSED OFFSITE SWALE	
PROPOSED OFFSITE FLOW DIRECTION	
NATURAL CONDITION FLOW DIRECTION	
BASIN IDENTIFIER / AREA IN ACRES	X / 3.5
OTHER FILING BASIN IDENTIFIER / AREA IN ACRES	2.0-A / 4
DESIGN POINT	1
STORM DRAIN DESIGN POINT	SD-1
PROPOSED CROSSPAN	

CONTOUR INTERVAL = 2 FEET

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PREPARED FOR:
LENNAR COMMUNITIES COLORADO
7222 COMMERCE CENTER DRIVE
SUITE 107
COLORADO SPRINGS, CO 80919
(719) 593-8483

JR ENGINEERING
A Westrian Company
20 Boulder Crescent • Colorado Springs, CO 80903
719-955-5485 • Fax 719-635-0150
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No.	BY	DATE
1	KH	01/20/05

HORIZ SCALE: 1"=50' | DESIGNED BY: N/A
VERT SCALE: N/A | DRAWN BY: LJG
DATE: 01/20/05 | CHECKED BY: Proc

EASTVIEW FILING NO. 3
DRAINAGE PLAN

SHEET 1 OF 1
JOB NO. 28965.08

Final Drainage Letter
Willowind Commercial Subdivision Filing No. 2
Replat of Lot 4
Willowind Commercial Subdivision Filing No. 1
Colorado Springs, Colorado

Prepared for:
High Gate Farms, LLC
154 Del Oro Circle
Colorado Springs, Colorado 80919

Prepared by:
Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904

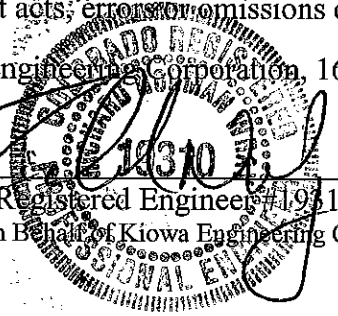
Kiowa Project No. 08044

July 7, 2008

ENGINEER'S STATEMENT:

The attached drainage letter was prepared under my direction and supervision and is correct to the best of my knowledge and belief. Said drainage letter has been prepared according to the criteria established by the City/County for drainage reports and said letter is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Kiowa Engineering Corporation, 1604 South 21st Street, Colorado Springs, Colorado 80904



Registered Engineer #19310
For and on Behalf of Kiowa Engineering Corporation

7/7/08
Date

OWNER'S STATEMENT:

I, the Owner, have read and will comply with all of the requirements specified in this drainage letter.

BY: _____
Ronald Waldthausen, Managing Partner

7/8/08
Date

ADDRESS: High Gate Farms, LLC
154 Del Oro Circle
Colorado Springs, Colorado 80919

CITY OF COLORADO SPRINGS:

Filed in accordance with Section 7-7-906 of the code of the City of Colorado Springs, 2001, as amended.

_____
For the City Engineer

7/10/08
Date

July 7, 2008

Ms. Elizabeth Nijkamp
City of Colorado Springs
Subdivision Engineering Review Team
30 South Nevada Avenue Suite 702
Colorado Springs, Colorado 80903

RE: Final Drainage Letter for Willowind Commercial Subdivision Filing No. 2, a Replat of Lot 4, Willowind Commercial Filing No. 1 (Kiowa Project No. 08044)

Ms. Nijkamp:

Following is the Final Drainage Letter for the Willowind Commercial Subdivision Filing No. 2. Filing No. 2 is a replat of Lot 4 of the Willowind Commercial Subdivision Filing No. 1. This letter addresses the replatting of Lot 4. The final drainage report was prepared by Leigh Whitehead and Associates and approved by the City in 2003. The approved final drainage report showed Lot 4 as having one commercial building. Subsequent to the approval of the final drainage report for Filing No. 1, the proposed structure on the lot was changed from a single building to two buildings of roughly the same total square footage and similar site parking and drainage characteristics. The site is located northwest corner of Barnes Road and Marksheffel Road in the City of Colorado Springs.

The purpose of replatting Lot 4 into two lots is so that each of the two commercial structures can be contained within its own lot. As such no increase in runoff is anticipated. The drainage patterns and associated drainage facilities as required for this subdivision will not be changed from what was shown on the approved final drainage report for Filing 1 or as shown on the approved site development plans for Lot 4.

If there are any questions or if we may be of further assistance, please feel free to call at any time.

Respectfully submitted,
Kiowa Engineering Corporation

Richard N. Wray, P.E.
Principal

1604 South 21st Street, Colorado Springs, CO 80904
(719) 630-7342 (719) 630-0406 FAX
Kiowa Engineering Corporation

I. Location and Description

The proposed re-platting of this commercial subdivision is a part of the Willowind Commercial Subdivision Filing 1. This drainage letter is for the re-platting of Lot 4, Filing 1 into two lots. The project site is located at the northwest corner of the intersection of Barnes Road and Marksheffel Road. Lot 4 covers approximately 3 acres and was anticipated to have two 9,800 square foot commercial buildings. The building addressed as 7702 Barnes Road is presently under construction. Construction of the building addressed as 7722 is anticipated in the future.

II. Site Drainage

The site was previously studied in a report entitled *Final Drainage Report Willowind Commercial Site Filing 1* and was prepared by Leigh Whitehead and Associates in 2002 and approved by the City in 2003. This report covered the entire subdivision five lot, including Lot 4. .

The layout for Lot 4 will not change once it is re-platted into two lots. In fact the total impervious area for Lot 4 has been reduced slightly as a result of building two structures and because more area is dedicated for landscaping from what was envisioned when the drainage report referenced above was prepared and subsequently approved by the City. With the re-platting of Lot 4 into two lots, the proposed drainage patterns as shown in the previous reports and design plans are to remain the same.

April 2, 2012

SMALL SUBDIVISION DRAINAGE REPORT

FOR

7-ELEVEN

5600 S. Quebec St, Ste. #400
Greenwood Village, CO 8011
Chris Nolte 303-740-2907

Site No. 1030072
within
Willowind Commercial Filing No. 3, Lot 1
Barnes Rd
Colorado Springs, CO

HFA ARCHITECTS ENGINEERS INTERIORS
HARRISON FRENCH & ASSOCIATES, LTD

13721 W 87th Dr
Arvada, Colorado 80005
www.hfa-ae.com

Phone: 720.315.5063
Fax: 888.520.9685

1. Purpose

The following report is a Small Subdivision Drainage Report/Drainage Letter. The subject property has been previously studied and this report is to provide information on how the previous study applies along with adjustments made to better suit the development. Along with previous documentation, drainage patterns, storm sewer, channels, inlets, and how the storm water is routed to appropriate outfalls will be identified.

2. General Site Description

The subject property is located along Barnes Road, east of Antelope Ridge Drive in Colorado Springs, Colorado. The property is part of the Willowind Commercial Development located in the southeast one-quarter of Sec 20, T13S, R65W of the 6th P.M. This property is adjacent to Barnes Road to the south, Antelope Ridge Road to the west, undeveloped property to the north (proposed commercial), and existing commercial development to the east.

The Willowind Commercial Filing No. 1 prepared by Leigh Whitehead & Associates, Inc., April 2003 was used in the preparation of this report.

3. Soils Conditions

The soils of the subject property are Truckton Sandy Loam, obtained from the National Resource Conservation Service. The permeability is fairly high and is categorized under hydrologic group B. The soils map can be found in Appendix B.

4. Drainage Criteria

The Colorado Springs Drainage Criteria Manual Volume 1 was used in the Hydrologic and hydraulic calculations of this report. The rational method was used due to size and reference to previous calculations done to size the existing and proposed storm sewer systems. The Colorado Springs Drainage Criteria Manual Volume 2 was used in the water quality calculations of this report.

5. Existing Drainage Conditions

The proposed development is part of the Fountain Creek watershed. It is currently undeveloped with slightly overgrown pasture land. The site generally slopes from north to south with a 3% slope. The stormwater drains to an existing inlet at the southeast corner of the site. See Appendix G.

6. Proposed Drainage Conditions

The proposed development is for a convenience store with fueling services that will consist of a 3,010 SF building with associated parking lot and drives and a six dispenser fueling canopy. Since this site is part of an overall development, the stormwater calculations produced have already been accounted for. Leigh Whitehead & Associates, Inc. produced the Final Drainage Report ("*Whitehead Report*") and Plan for Willowind Commercial Filing No 1. The subject site was accounted for as a portion of Lot 5 in the *Whitehead Report*. Lot 5 is now known as Lots 1, 2, and 3 of Willowind Commercial Filing No. 3. Lots 1, 2, and 3 (Areas 1, 2, and 3) of Willowind Commercial Filing No. 1 is comprised of 4.04 acres and has a peak flow 17.1 cfs for the 5 year event and 31.9 cfs for the 100 year event. These numbers were based on commercial development with c values of 0.9 for the 5 year event and 0.95 for the 100 year event. The Lot 5 basin from

the *Whitehead Report* drains to the southeast of the lot to an inlet which ties into the Willowind Filing 4 storm sewer system.

For this proposed development the existing inlet in the southeast corner of the area 3 will not be receiving the entire 4.04 acres stated in the *Whitehead Report*. Lot 5 of the *Whitehead Report* will be split and the lower 1.45 acres (Areas 1 & 2) will drain to that existing inlet at the southeast. The remaining 2.59 acres (Area 3) will be routed east down the shared access to an existing inlet on Barnes Rd to the east via curb and gutter flow in the shared private drive. The undeveloped flows are minor in nature (7.5 cfs pre-developed and 9 cfs post developed) and are not expected to overtop the curb. Future analysis by the master developer may be required upon future development. In order to keep the Area 3 from entering the 7-Eleven site, a temporary berm will be created. All adjacent grading work has been approved by the adjacent land owner (see Appendix I).

The 7-Eleven (Area 1, Q10- 4.2cfs, Q100- 7.68cfs) site will accommodate the flows from the west at design point 2 via a temporary swale to be constructed by the master developer (Area 2, Q10- 2.52cfs, Q100- 4.5cfs) at design point 2. Flows for Area 2 were provided by the master developer's engineer as shown in appendix H. The master developer will provide design calculations, swale sizing, and grading to convey the undeveloped flows to design point 2 from Area 2 as required by the City. A small portion of Area 2 (less than. 0.2 cfs developed 100 year flow) may enter Area 1 at the northwest corner of the property at the fully developed condition.

Combined runoff from areas 1, 2 and 3 will be 12.17 cfs for the 100 year and 6.72 cfs for the 10 year. This will enter the existing storm sewer inlet at the southeast corner of Area 3 to the existing inlet. Appendix G shows the drainage map for the proposed conditions and Appendix D & E include the calculations for the drainage areas and conveyance channels.

The Whitehead report states the resulting flows from Lot 5, which is the entire 4.04 acres, are a Q5 of 17.1cfs and a Q100 of 31.9cfs. The Whitehead report used Q5 calculations, but the proposed development discussed in this report is based on the requirements of the current drainage manual which is Q10 and Q100. The post flows from area 1 are a Q10 of 4.20cfs and a Q100 of 7.67cfs. Flows from areas 2 and 3 were produced from the developer and are a Q10 of 2.52cfs and a Q100 of 4.50cfs for area 2 and a Q10 of 6.12cfs and a Q100 of 9cfs for area 3. These numbers show that this proposed design is producing less flow than was accounted for in the previous report. This qualifies the existing storm sewer system as adequate.

7. Water Quality

The Drainage Criteria Manual Volume II was used to incorporate water quality on this site. Porous Landscape Detention (PLD) was chosen and is sized to treat the 7-Eleven site along with the adjacent west property, amounting to 1.45 acres (Areas 1 and 2) . The composite impervious area for that being treated is 80%, see appendix F. This is based on assumption that the western lot will be 80% impervious as provided by the master developer engineer as shown in appendix H. The Water Quality Capture Volume required to treat these parameters is a minimum of 0.031 acre-ft (1382.49 cubic feet). The private PLD is intended for low flows, less than the 2 year storm. When large storm events occur the private PLD has an overflow grate inlet. Calculations for the PLD can be found in Appendix F.

8. Floodplain Statement

"No portion of the site is located within a 100 year floodplain as determined by the Flood Insurance Rate Map (FIRM) number 08041C0543 F effective date, March 17, 1997 (see appendix C)"

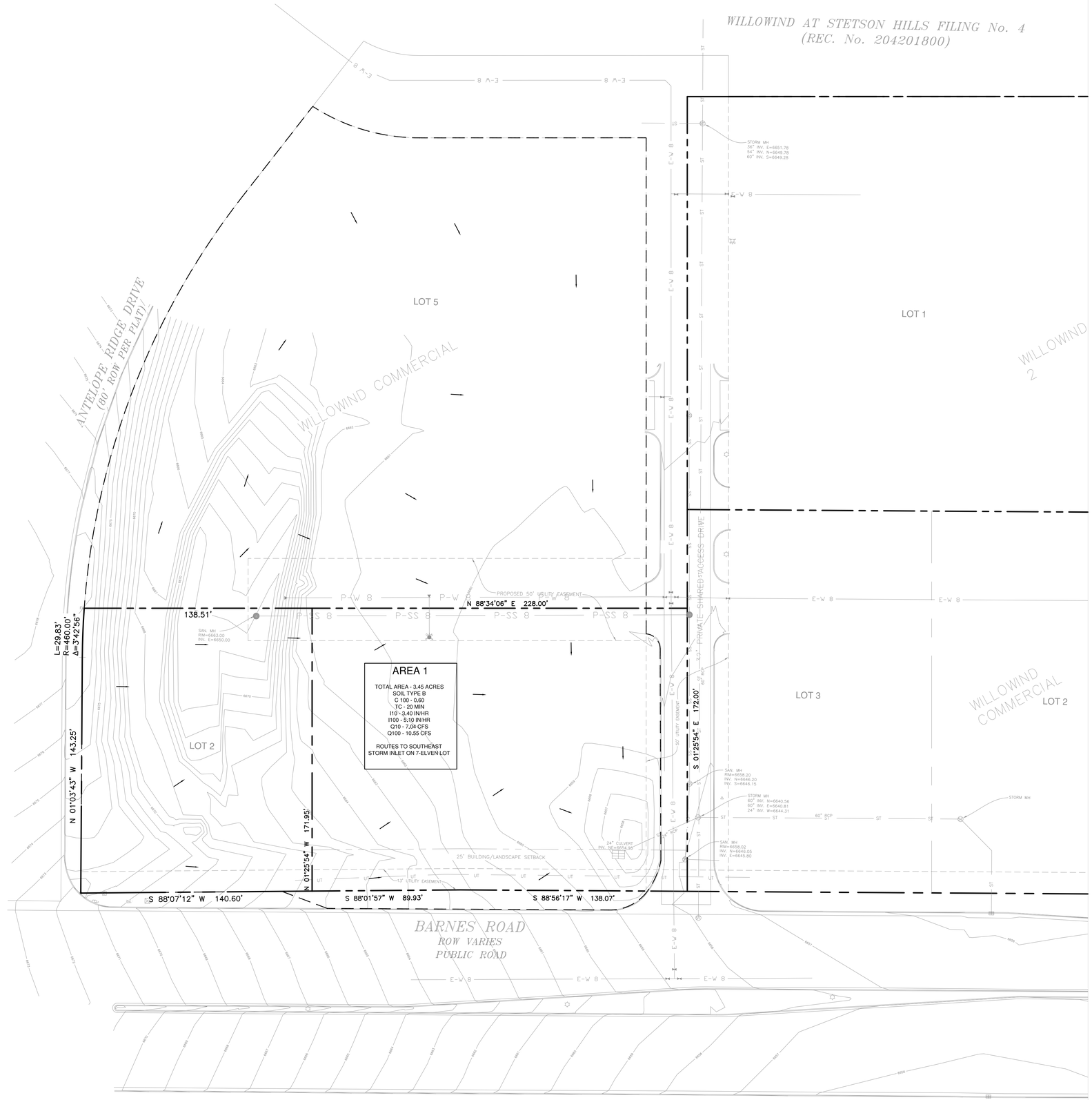
9. Summary

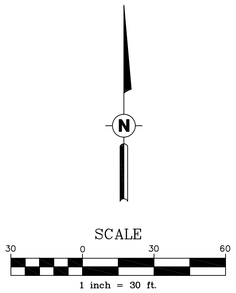
The findings of this report for the 7-Eleven development are in conformance with the guidelines set forth by Colorado Springs and with the infrastructure provided and calculated by Leigh Whitehead & Associates, Inc.,

this development will have no adverse affect downstream and surrounding developments. The comparing numbers show this. The Whitehead report states the resulting flows from Lot 5, which is the entire 4.04 acres, are a Q5 of 17.1cfs and a Q100 of 31.9cfs. The Whitehead report used Q5 calculations, but the proposed development discussed in this report is based on the requirements of the current drainage manual which is Q10 and Q100. The post flows from area 1 are a Q10 of 4.20cfs and a Q100 of 7.67cfs. Flows from areas 2 and 3 were produced from the developer and are a Q10 of 2.52cfs and a Q100 of 4.50cfs for area 2 and a Q10 of 6.12cfs and a Q100 of 9cfs for area 3. These numbers show that this proposed design is producing less flow than was accounted for in the previous report. This qualifies the existing storm sewer system as adequate.

10. Drainage Fees

This lot was previously platted as Willowind filing 1 lot 5 and drainage fees were paid at that time, therefore no fees are due.





PROPOSED

PROPERTY LINE

DRAINAGE AREA

GENERAL DRAINAGE NOTES

1. THE 7-ELEVEN SITE IS A PHASE OF THE WILLOWIND COMMERCIAL DEVELOPMENT. THE DRAINAGE CALCULATIONS FOR THIS SITE HAVE BEEN PREVIOUSLY CALCULATED AND INCLUDED IN THE FINAL DRAINAGE REPORT AND PLAN FOR WILLOWIND COMMERCIAL FILING NO. 1. THIS REPORT WAS PRODUCED BY LEIGH WHITEHEAD & ASSOCIATES, INC. DATED APRIL 2003.
2. THIS DRAINAGE PLAN IS HAS BEEN PREPARED FOR THE 7-ELEVEN LOT. THE ADJACENT LOTS TO THE NORTH AND WEST ARE BEING DESIGNED BY CTR ENGINEERING, INC. ALL CALCULATIONS FOR THESE ADJACENT LOTS HAVE BEEN COORDINATED WITH CTR FOR PROPER DRAINAGE ANALYSIS AND CONVEYANCE.

THIS DRAWING IS FOR "REVIEW" PURPOSES ONLY AND SHOULD NOT BE USED FOR CONSTRUCTION.

City File No.: (AR DP 11-00633)

City File No.: (AR FP 11-00635)

HFA
ARCHITECTS
ENGINEERS
INTERIORS

HARRISON FRENCH
& ASSOCIATES, LTD

809 S.W. A Street, Suite 201
Bentonville, Arkansas 72712
t 479.273.7780
f 479.273.9436
www.hfa-ac.com

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DATE ON: 4/2/2012
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7-ELEVEN

BARNES ROAD
COLORADO SPRINGS, COLORADO

PROJ NUMBER: 12-11-01090

ISSUE BLOCK

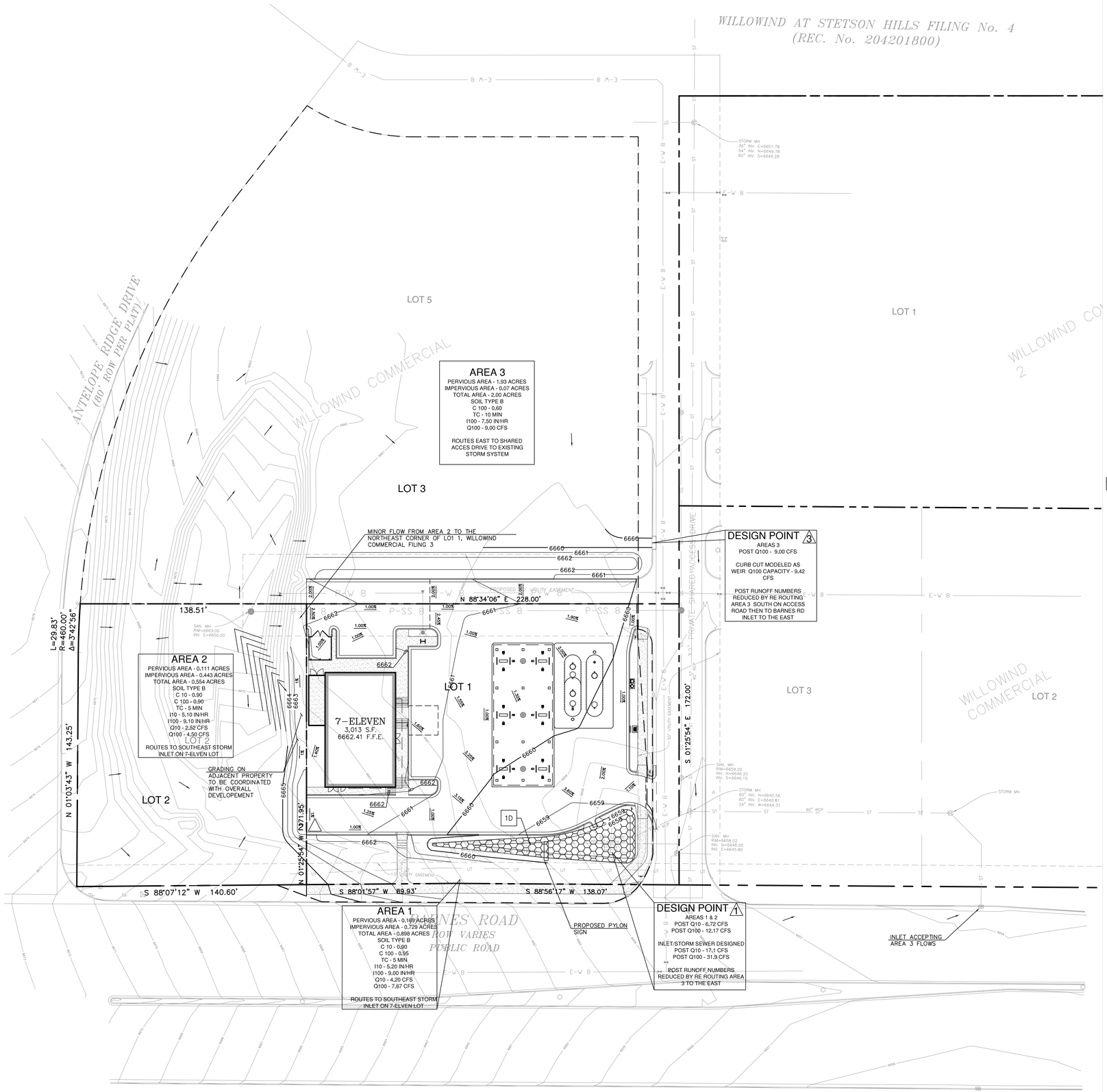
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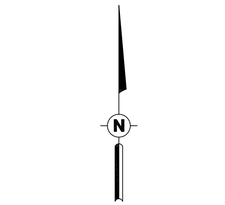
PRE DEVELOPMENT DRAINAGE MAP

REV-3

SHEET:
4 OF 16

Apr02,2012-10:48am - User: tom.burry
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PROPOSED

PROPERTY LINE

DRAINAGE AREA

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DETAILS

1D. POROUS LANDSCAPE DETENTION

HFA
ARCHITECTS
ENGINEERS
INTERIORS

HARRISON FRENCH
& ASSOCIATES, LTD

809 S.W. A Street, Suite 201
Bentonville, Arkansas 72712
t 479.273.7780
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7-ELEVEN

BARNES ROAD
COLORADO SPRINGS, COLORADO

PROJ NUMBER: 12-11-01090

ISSUE BLOCK

STORE NO.: 35610
DOCUMENT DATE: 4/2/2012
CHECKED BY: MTP
DRAWN BY: CSJ

POST DEVELOPMENT DRAINAGE MAP

REV-3

THIS DRAWING IS FOR "REVIEW" PURPOSES ONLY AND SHOULD NOT BE USED FOR CONSTRUCTION.

City File No.: (AR DP 11-00633)
City File No.: (AR FP 11-00635)

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5 OF 16

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SAND CREEK DRAINAGE BASIN PLANNING STUDY

FINAL REPORT

JANUARY 2021

Prepared for:

COLORADO SPRINGS
OLYMPIC CITY USA

STORMWATER ENTERPRISE

Prepared by:

Stantec

HDR Dewberry

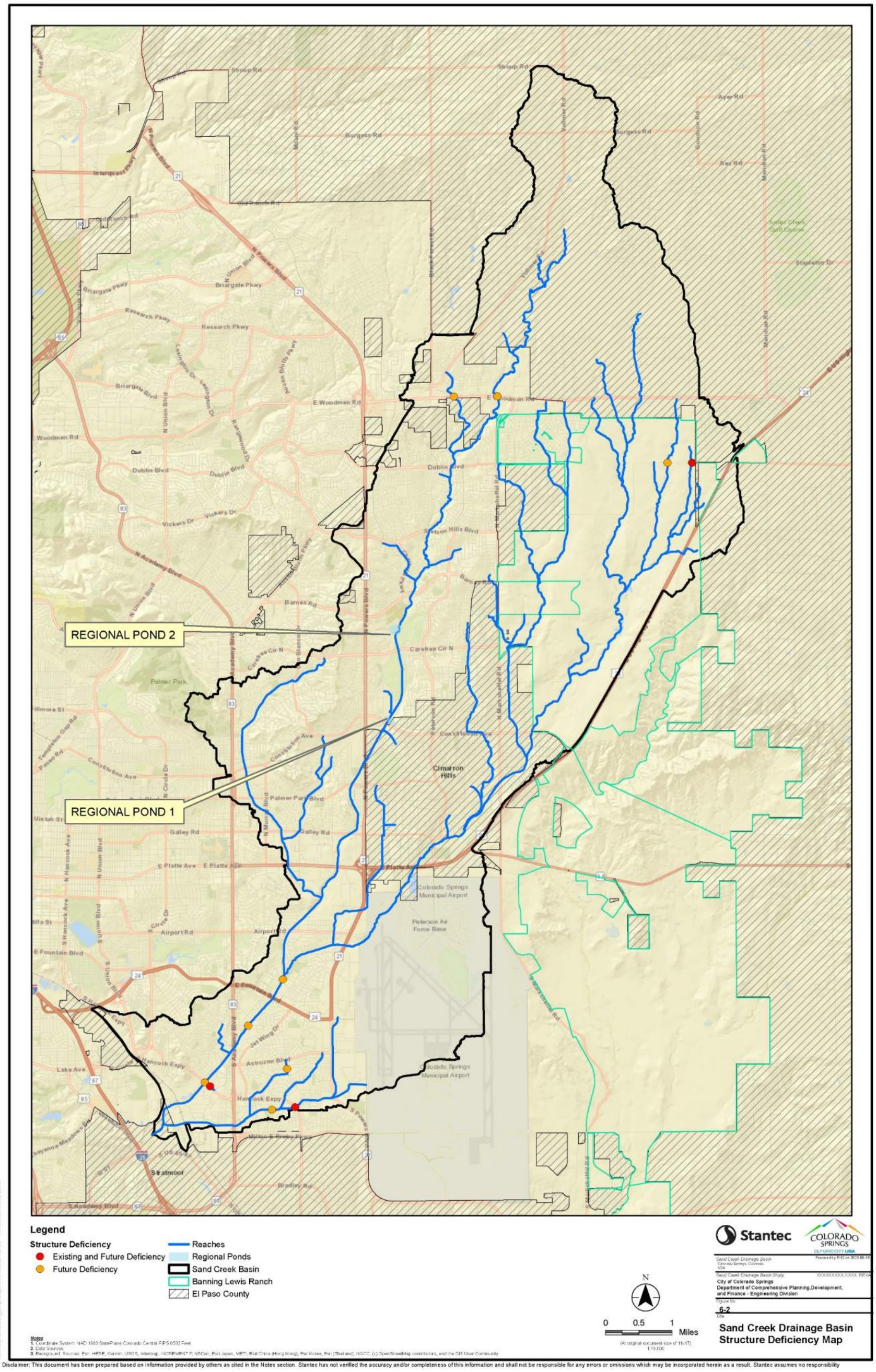


Figure 6-2. Sand Creek Drainage Basin Structure Deficiency Map

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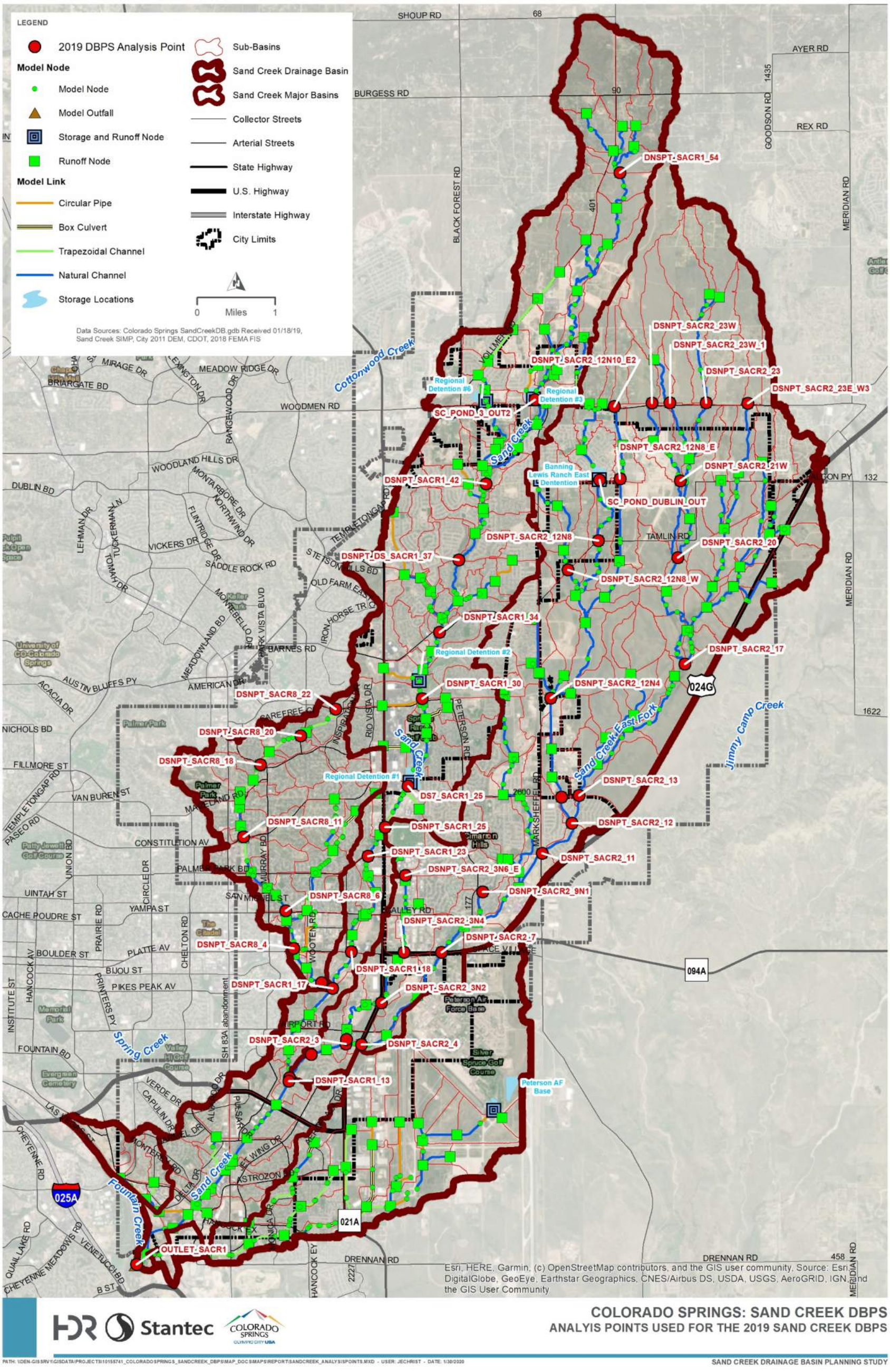


Figure 3-7. Analysis Points used in the Sand Creek DBS for the Presentation of Peak Flow Rates

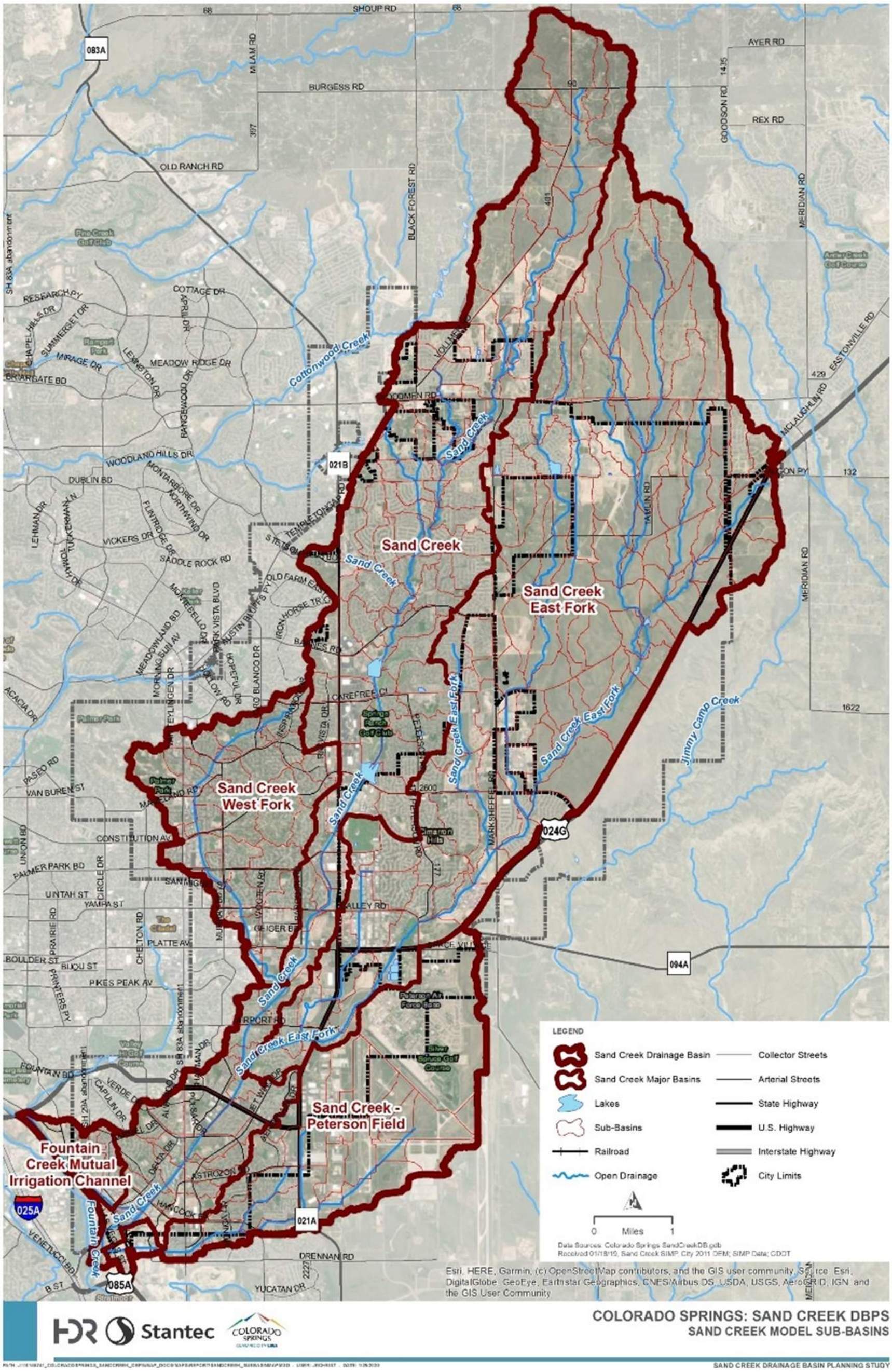


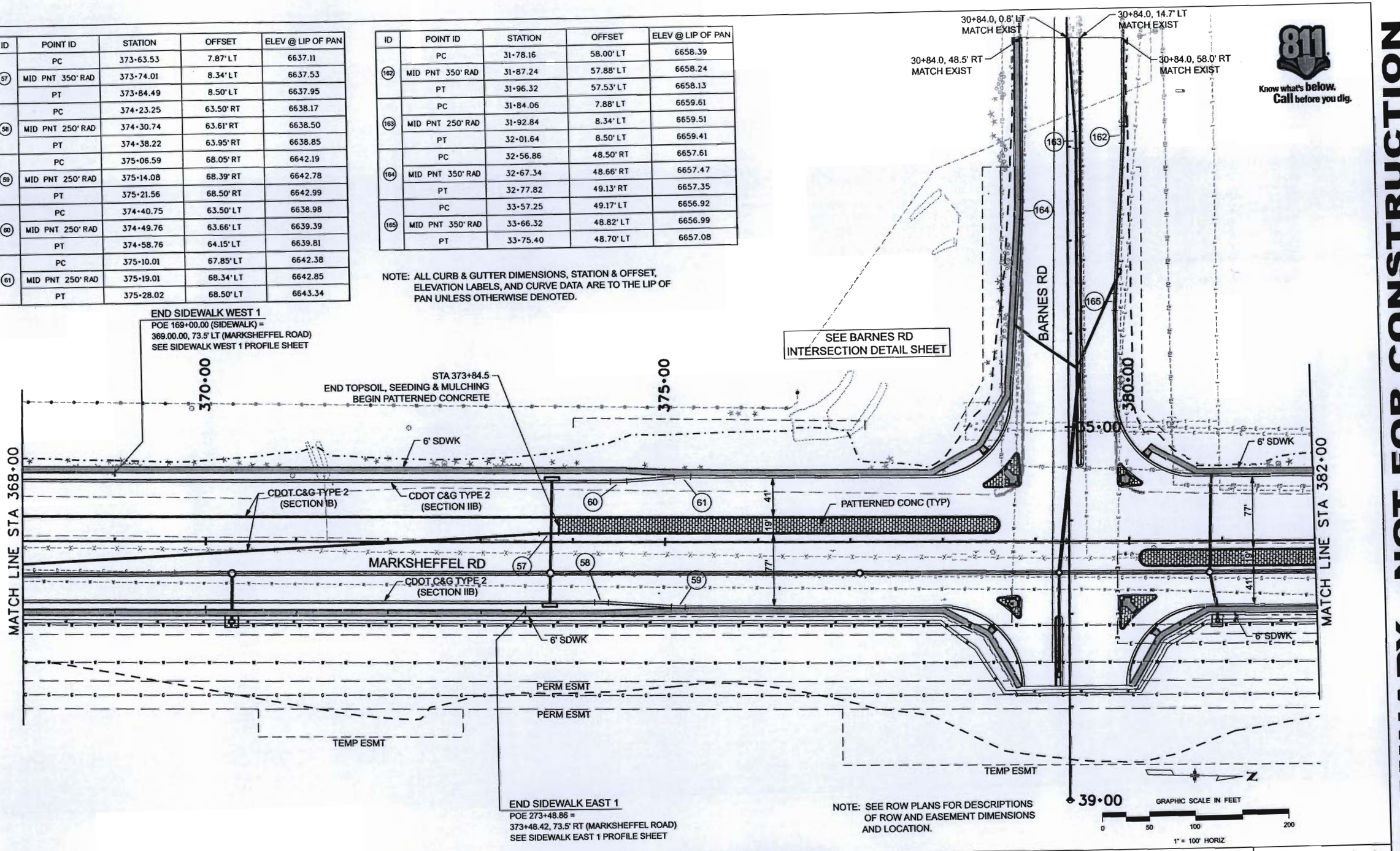
Figure 3-1. Major Sub-basin Map

MARKSEFFEL ROAD FINAL DRAINAGE REPORT EXCERPTS

ID	POINT ID	STATION	OFFSET	ELEV @ LIP OF PAN
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	MID PNT 350' RAD	373+74.01	8.34' LT	6637.53
	PT	373+84.49	8.50' LT	6637.95
58	PC	374+23.25	63.50' RT	6638.17
	MID PNT 250' RAD	374+30.74	63.61' RT	6638.50
	PT	374+38.22	63.95' RT	6638.85
59	PC	375+06.59	68.05' RT	6642.19
	MID PNT 250' RAD	375+14.08	68.39' RT	6642.78
	PT	375+21.56	68.50' RT	6642.99
60	PC	374+40.75	63.50' LT	6638.98
	MID PNT 250' RAD	374+49.76	63.66' LT	6639.39
	PT	374+58.76	64.15' LT	6639.81
61	PC	375+10.01	67.85' LT	6642.38
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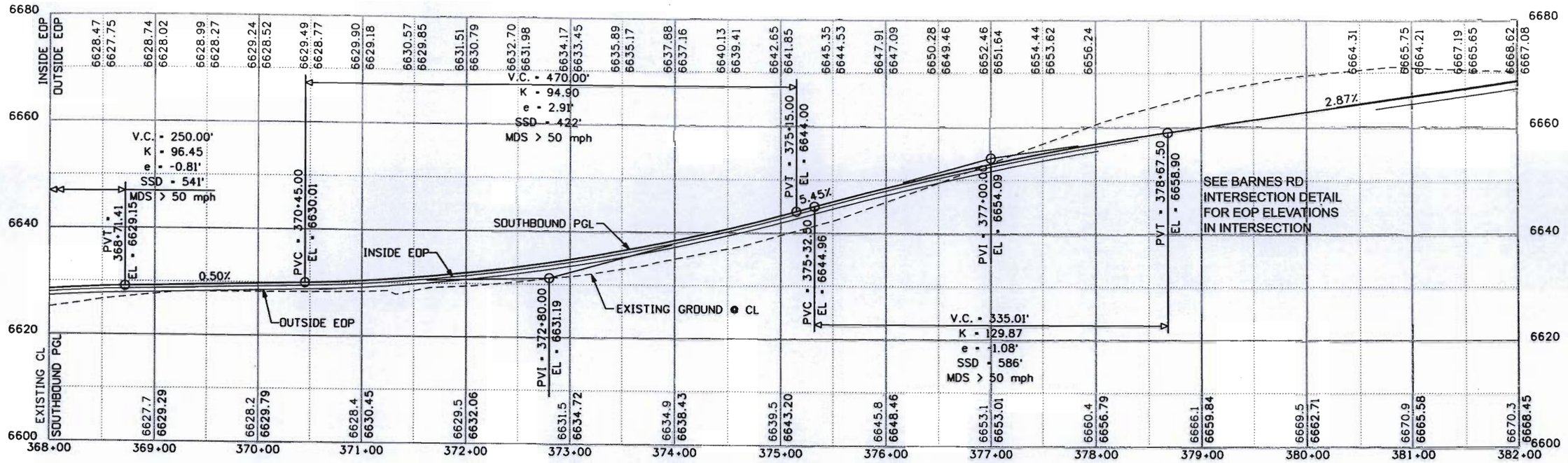
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	PT	31+96.32	57.53' LT	6658.13
163	PC	31+84.06	7.88' LT	6659.61
	MID PNT 250' RAD	31+92.84	8.34' LT	6659.51
	PT	32+01.64	8.50' LT	6659.41
164	PC	32+56.86	48.50' RT	6657.61
	MID PNT 350' RAD	32+67.34	48.66' RT	6657.47
	PT	32+77.82	49.13' RT	6657.35
165	PC	33+57.25	49.17' LT	6656.92
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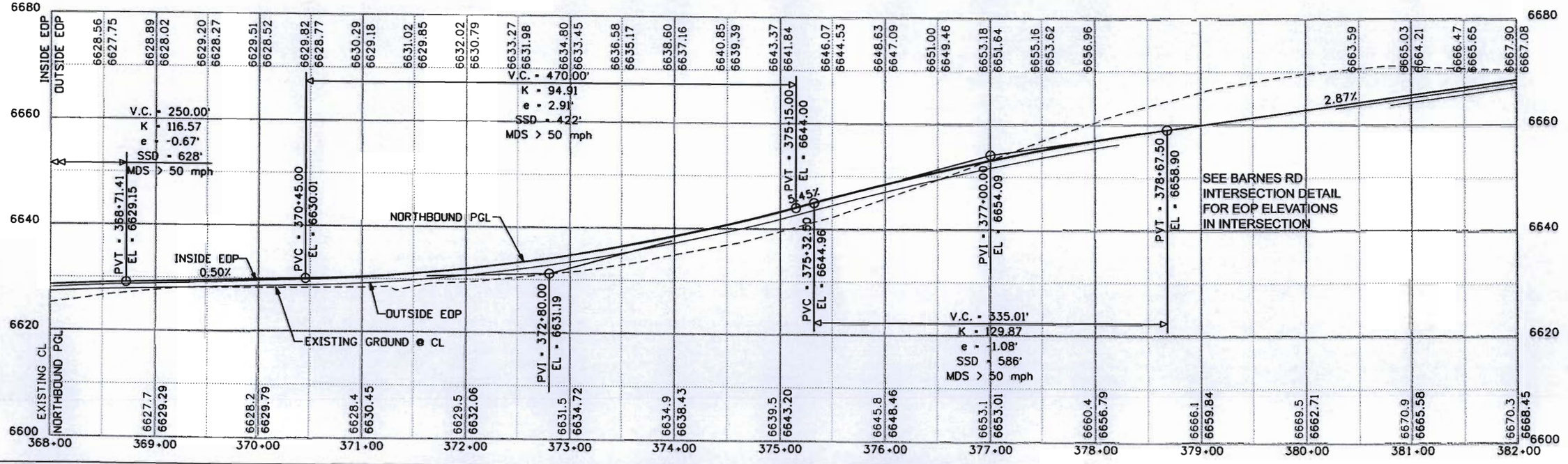
NOTE: ALL CURB & GUTTER DIMENSIONS, STATION & OFFSET, ELEVATION LABELS, AND CURVE DATA ARE TO THE LIP OF PAN UNLESS OTHERWISE DENOTED.



PRELIMINARY - NOT FOR CONSTRUCTION

Computer File Information		Sheet Revisions			WILSON & COMPANY Engineers & Architects	As Constructed	Markshieffel Road Roadway Plan		Project No./Code
Creation Date: 03/21/07	Initials: DVD	Date:	Comments	Init.	5755 Mark Dabling Blvd. Ste. 220 Colorado Springs, CO 80919 Phone: 719-520-5800 Fax: 719-520-0108	No Revisions:	Designer: JJW	Structure Numbers: N/A	PPRTA 75174
Print Date: 2/27/2008	Initials: DVD					Revised:	Detailer: DVD	N/A	
File Name: Plan-10.dgn						Void:	Sheet Subset: P & P	Subset Sheets: 19 of 34	Sheet Number 85





PRELIMINARY - NOT FOR CONSTRUCTION

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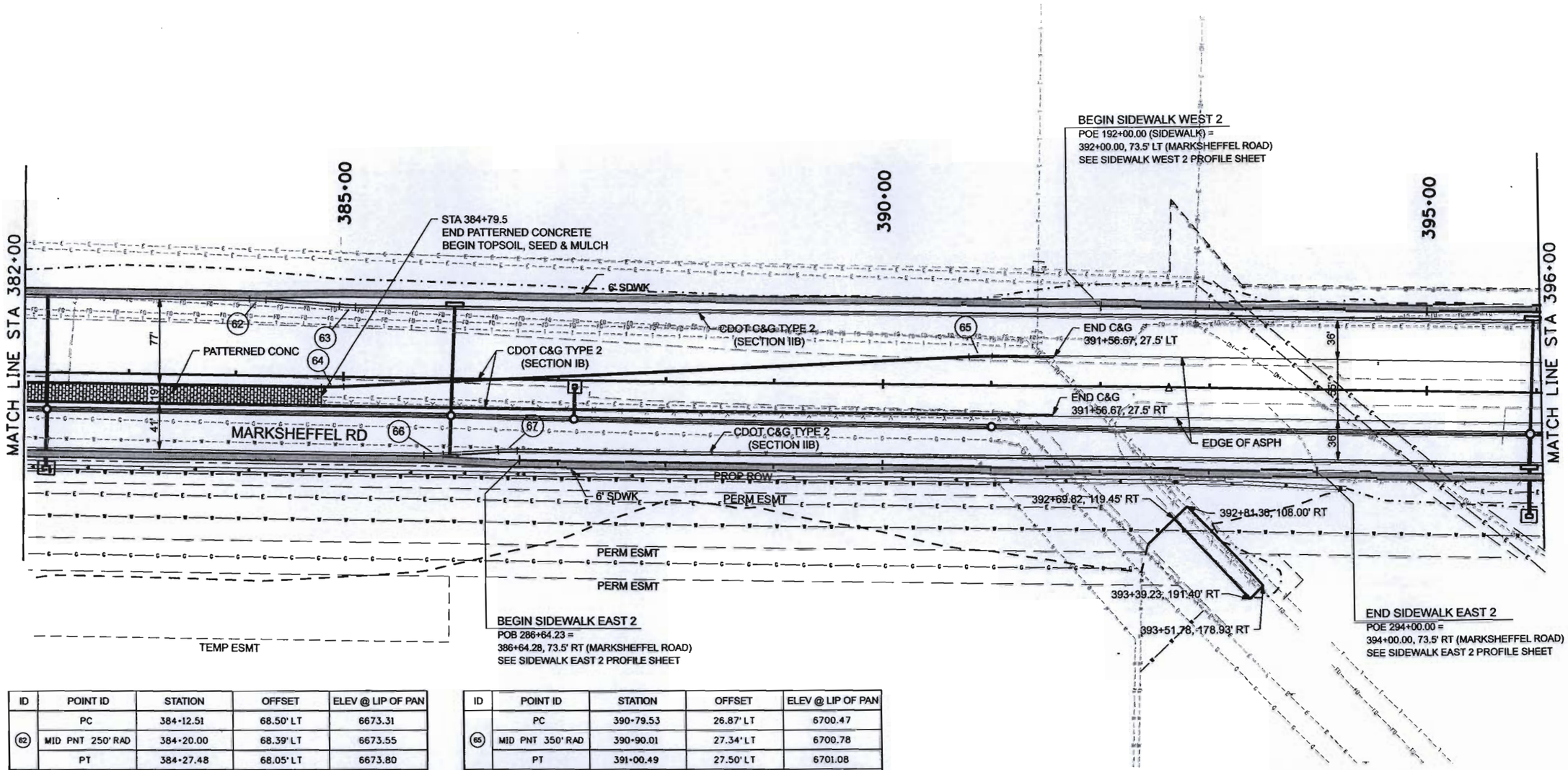
Sheet Revisions		
Date:	Comments	Init.

EL PASO COUNTY DEPARTMENT OF TRANSPORTATION
PPRTA
WILSON & COMPANY
Engineers & Architects
5755 Mark Dabling Blvd.
Ste. 220
Colorado Springs, CO 80919
Phone: 719-520-5800
Fax: 719-520-0108

As Constructed	
No Revisions:	
Revised:	
Void:	

Marksheffel Road Profile			
Designer: JJW		Structure Numbers	N/A
Detailer: JJW			N/A
Sheet Subset: P & P		Subset Sheets: 20 of 34	

Project No./Code
PPRTA 75174
Sheet Number 8@



ID	POINT ID	STATION	OFFSET	ELEV @ LIP OF PAN
62	PC	384+12.51	68.50' LT	6673.31
	MID PNT 250' RAD	384+20.00	68.39' LT	6673.55
	PT	384+27.48	68.05' LT	6673.80
63	PC	384+95.85	63.95' LT	6676.20
	MID PNT 250' RAD	385+03.34	63.61' LT	6676.46
	PT	385+10.83	63.50' LT	6676.74
64	PC	384+79.51	8.50' RT	6677.23
	MID PNT 350' RAD	384+90.00	8.34' RT	6677.59
	PT	385+00.47	7.87' RT	6677.90

ID	POINT ID	STATION	OFFSET	ELEV @ LIP OF PAN
65	PC	390+79.53	26.87' LT	6700.47
	MID PNT 350' RAD	390+90.01	27.34' LT	6700.78
	PT	391+00.49	27.50' LT	6701.08
66	PC	385+74.98	68.50' RT	6679.02
	MID PNT 250' RAD	385+83.99	68.34' RT	6679.37
	PT	385+83.99	67.85' RT	6679.73
67	PC	386+44.24	64.15' RT	6681.87
	MID PNT 250' RAD	386+53.24	63.66' RT	6682.24
	PT	386+62.25	63.50' RT	6682.63

NOTE: ALL CURB & GUTTER DIMENSIONS, STATION & OFFSET, ELEVATION LABELS, AND CURVE DATA ARE TO THE LIP OF PAN UNLESS OTHERWISE DENOTED.

NOTE: SEE ROW PLANS FOR DESCRIPTIONS OF ROW AND EASEMENT DIMENSIONS AND LOCATION.

GRAPHIC SCALE IN FEET
0 50 100 200
1" = 100' HORIZ

Know what's below. Call before you dig.

PRELIMINARY - NOT FOR CONSTRUCTION

Computer File Information	
Creation Date: 03/21/07	Initials: DVD
Print Date: 2/27/2008	Initials: DVD
File Name: Plan-11.dgn	

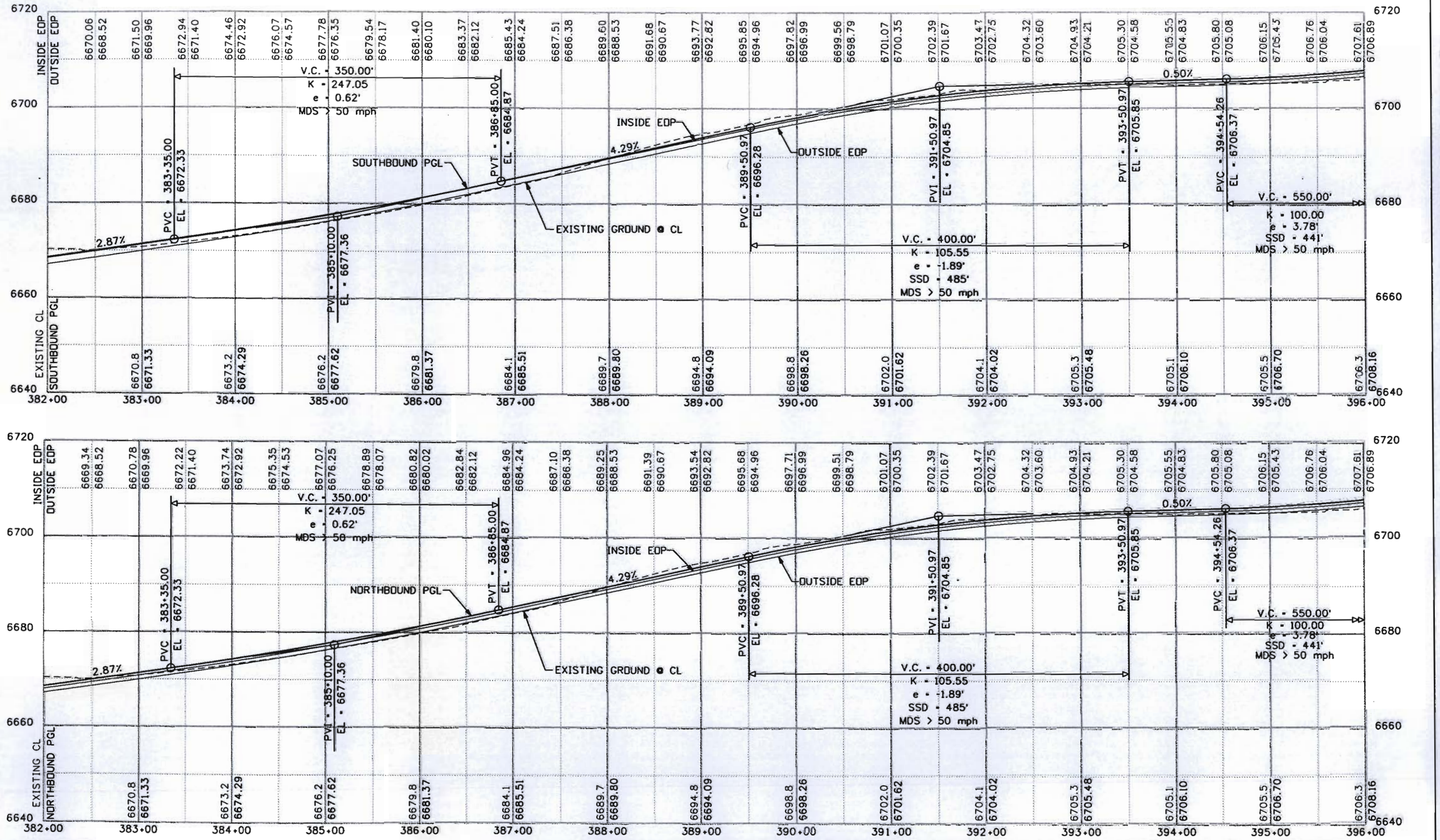
Sheet Revisions		
Date:	Comments	Init.

EL PASO COUNTY DEPARTMENT OF TRANSPORTATION
PPRTA
WILSON & COMPANY
Engineers & Architects
5755 Mark Dabling Blvd.
Ste. 220
Colorado Springs, CO 80919
Phone: 719-520-5800
Fax: 719-520-0108

As Constructed	
No Revisions:	
Revised:	
Void:	393+39.23, 191.39' RT

Markshaffel Road Roadway Plan			
Designer: JJW	Structure Numbers	N/A	
Detailer: DVD		N/A	
Sheet Subset: P & P	Subset Sheets: 21 of 34		

Project No./Code
PPRTA 75174
Sheet Number 87



PRELIMINARY - NOT FOR CONSTRUCTION

Computer File Information		Sheet Revisions		
Creation Date: 03/01/07	Initials: JJW	Date:	Comments	Init.
Print Date: 2/26/2008	Initials: DVD			
File Name: Prof-11.dgn				

0000

EL PASO COUNTY DEPARTMENT OF TRANSPORTATION

PPRTA

WILSON & COMPANY
Engineers & Architects
5755 Mark Dabling Blvd.
Ste. 220
Colorado Springs, CO 80919
Phone: 719-520-5800
Fax: 719-520-0108

As Constructed
No Revisions:
Revised:
Void:

Marksheffel Road Profile

Designer: JJW		Structure Numbers	N/A
Detailer: JJW			N/A
Sheet Subset: P & P		Subset Sheets:	22 of 34

Project No./Code
PPRTA 75174
Sheet Number 88

PLAT/RE-PLAT
(FOR INFORMATION PURPOSES ONLY)

WILLOWIND COMMERCIAL FILING NO. 4

A REPLAT OF LOTS 1, 2, & 3, "WILLOWIND COMMERCIAL FILING NO. 1" UNDER RECEPTION NO. 204048326, AND LOTS 1 & 2, "WILLOWIND COMMERCIAL FILING NO. 2" UNDER RECEPTION NO. 208712846, AND LOTS 2 & 3, "WILLOWIND COMMERCIAL FILING NO. 3" UNDER RECEPTION NO. 212713209, BEING A PARCEL OF LAND IN THE NORTH HALF OF THE SOUTHEAST QUARTER (N 1/2, SE 1/4) OF SECTION 20, TOWNSHIP 13 SOUTH, RANGE 65 WEST OF THE SIXTH PRINCIPAL MERIDIAN, EL PASO COUNTY, COLORADO

BE IT KNOWN BY THESE PRESENTS:

THAT CD MARKSHEFFEL & BARNES LLC, AN ARIZONA LIMITED LIABILITY COMPANY, BEING THE OWNER OF THE FOLLOWING DESCRIBED TRACTS OF LAND:

LEGAL DESCRIPTION:

PARCEL A:

LOT 1, WILLOWIND COMMERCIAL FILING NO. 1, CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO

PARCEL B:

LOT 2, WILLOWIND COMMERCIAL FILING NO. 1, CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO

PARCEL C:

LOT 3, WILLOWIND COMMERCIAL FILING NO. 1, CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO

PARCEL D:

LOT 1, WILLOWIND COMMERCIAL FILING NO. 2, CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO

PARCEL E:

LOT 2, WILLOWIND COMMERCIAL FILING NO. 2, CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO

PARCEL F:

LOT 2, WILLOWIND COMMERCIAL FILING NO. 3, CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO

PARCEL G:

LOT 3, WILLOWIND COMMERCIAL FILING NO. 3, CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO

SAID PARCELS CONTAIN A CALCULATED COMBINED AREA OF 380,547 SQUARE FEET (8.736 ACRES), MORE OR LESS.

DEDICATION:

THE UNDERSIGNED OWNER HAS CAUSED SAID TRACT OF LAND TO BE REPLATTED INTO LOTS AND PUBLIC EASEMENTS, AS SHOWN ON THE PLAT. THE UNDERSIGNED DOES HEREBY DEDICATE, GRANT AND CONVEY TO THE CITY OF COLORADO SPRINGS THOSE PUBLIC EASEMENTS AS SHOWN ON THE PLAT; AND FURTHER RESTRICTS THE USE OF ALL PUBLIC EASEMENTS TO THE CITY OF COLORADO SPRINGS AND/OR ITS ASSIGNS, PROVIDED HOWEVER, THAT THE SOLE RIGHT AND AUTHORITY TO VACATE, RELEASE, OR QUITCLAIM ALL OR ANY DEDICATED PUBLIC EASEMENTS SHALL REMAIN EXCLUSIVELY VESTED IN THE CITY OF COLORADO SPRINGS. THIS TRACT OF LAND AS PLATTED HEREIN SHALL BE KNOWN AS "WILLOWIND COMMERCIAL FILING NO. 4", IN THE CITY OF COLORADO SPRINGS, EL PASO COUNTY, COLORADO.

THE AFOREMENTIONED, CD MARKSHEFFEL & BARNES, LLC, AN ARIZONA LIMITED LIABILITY COMPANY, HAS EXECUTED THIS INSTRUMENT THIS _____ DAY OF _____, 2023, A.D.

BY: _____

NAME: BRIAN ZUREK

TITLE: MANAGER, CD MARKSHEFFEL & BARNES, LLC

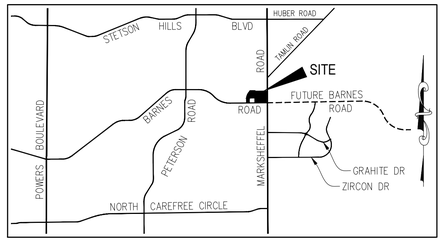
STATE OF COLORADO)
) SS
COUNTY OF EL PASO)

THE ABOVE AND AFOREMENTIONED INSTRUMENT WAS ACKNOWLEDGED BEFORE ME THIS _____ DAY OF _____, 2023, A.D., BY BRIAN ZUREK, AS MANAGER, CD MARKSHEFFEL & BARNES, LLC, AN ARIZONA LIMITED LIABILITY COMPANY.

WITNESS MY HAND AND OFFICIAL SEAL:

MY COMMISSION EXPIRES: _____

NOTARY PUBLIC: _____



VICINITY MAP

N.T.S.

NOTICE IS HEREBY GIVEN:

THAT THE AREA INCLUDED IN THE PLAT DESCRIBED HEREIN IS SUBJECT TO THE CODE OF THE CITY OF COLORADO SPRINGS, 2001, AS AMENDED.

NO BUILDING PERMITS SHALL BE ISSUED FOR BUILDING SITES WITHIN THIS PLAT UNTIL ALL REQUIRED FEES HAVE BEEN PAID AND ALL REQUIRED PUBLIC AND PRIVATE IMPROVEMENTS HAVE BEEN INSTALLED AS SPECIFIED BY THE CITY OF COLORADO SPRINGS OR, ALTERNATIVELY, UNTIL ACCEPTABLE ASSURANCES, INCLUDING BUT NOT LIMITED TO LETTERS OF CREDIT, CASH, SUBDIVISION BONDS OR COMBINATIONS THEREOF, GUARANTEEING THE COMPLETION OF ALL REQUIRED PUBLIC IMPROVEMENTS, INCLUDING, BUT NOT LIMITED TO, DRAINAGE, STREET AND EROSION CONTROL, HAVE BEEN PLACED ON FILE WITH THE CITY OF COLORADO SPRINGS.

EASEMENTS:

EASEMENTS ARE AS SHOWN ON THE AS REPLATTED EXHIBIT. THE SOLE RESPONSIBILITY FOR SURFACE MAINTENANCE OF EASEMENTS IS HEREBY VESTED WITH THE INDIVIDUAL PROPERTY OWNER.

ALL EASEMENTS THAT ARE DEDICATED HEREON FOR PUBLIC UTILITY PURPOSES SHALL BE SUBJECT TO THOSE TERMS AND CONDITIONS AS SPECIFIED IN THE INSTRUMENT RECORDED AT RECEPTION NO. 212112548 OF THE RECORDS OF EL PASO COUNTY, COLORADO. ALL OTHER EASEMENTS OR INTERESTS OF RECORD AFFECTING ANY OF THE PLATTED PROPERTY DEPICTED HEREON SHALL NOT BE AFFECTED AND SHALL REMAIN IN FULL FORCE AND EFFECT.

LIEN HOLDER STATEMENT:

GOLDWATER BANK N.A. OWNER AND HOLDER OF A LIEN AGAINST THE PROPERTY DESCRIBED IN THE PLAT KNOW AS WILLOWIND COMMERCIAL FILING NO. 4 SAID LIEN BEING EVIDENCED BY A DEED OF TRUST OF RECORD UNDER RECEPTION NO. 222148759 OF THE REAL PROPERTY RECORDS OF EL PASO COUNTY, COLORADO, DO HEREBY RATIFY AND CONFIRM SAID SUBDIVISION AND DEDICATION, AND DO HEREBY IN ALL THINGS SUBJECT TO SAID PLAT SAID LIENS. I HEREBY CONFIRM THAT I AM THE PRESENT OWNER OF SAID LIENS AND HAVE NOT ASSIGNED THE SAME NOR ANY PART THEREOF.

_____ _____
CHRIS ORLOWSKI, SVP & PHOENIX REGIONAL PRESIDENT DATE

GOLDWATER BANK, N.A.

NOTARIAL:

STATE OF _____)
) SS
COUNTY OF _____)

THE ABOVE AND AFOREMENTIONED INSTRUMENT WAS ACKNOWLEDGED BEFORE ME THIS THIS _____ DAY OF _____ 2023, A.D. BY _____, AS _____ _____ OF GOLDWATER BANK N.A.

WITNESS MY HAND AND OFFICIAL SEAL:

MY COMMISSION EXPIRES: _____

NOTARY PUBLIC: _____

PLAT NOTES:

1. BASIS OF BEARINGS: AS MEASURED [AM] BEARINGS SHOWN HEREON ARE BASED ON STATE PLANE COORDINATES (COLORADO CENTRAL 0502). THE NORTH LINE OF BARNES ROAD, MONUMENTED AT ITS INTERSECTION OF THE WEST LINE OF MARKSHEFFEL ROAD WITH A NO. 5 REBAR AND 1.25" ALUMINUM CAP STAMPED PLS 28658, AND AT THE SOUTHEAST CORNER OF LOT 1 "WILLOWIND COMMERCIAL FILING NO. 3" WITH A NAIL AND WASHER STAMPED PLS 32439 BEARS S88°55'38"W [AM], A DISTANCE OF 516.75 FEET [AM]. THE UNIT OF MEASUREMENT IS THE U.S. SURVEY FOOT.
2. THE FLOOD INSURANCE RATE MAP (FIRM) PANEL NO. 08041C0543 G WITH AN EFFECTIVE DATE OF DECEMBER 7, 2018 HAS BEEN EXAMINED AS IT RELATES TO THE PROPERTY BEING PLATTED. THE PROPERTY LIES WITHIN ZONE X, AREA OF MINIMAL FLOOD HAZARD.
3. THIS SURVEY DOES NOT CONSTITUTE A TITLE SEARCH BY M&S CIVIL CONSULTANTS, INC. TO DETERMINE OWNERSHIP OR EASEMENTS OF RECORD. FOR ALL INFORMATION REGARDING TITLE OF RECORD, EASEMENTS, AND RIGHTS-OF-WAY, M&S CIVIL CONSULTANTS, INC. RELIED UPON TITLE COMMITMENT FILE NO. SC55098557-12, EFFECTIVE DATE OF DECEMBER 4, 2021 AT 5:00 P.M., AS PREPARED BY LAND TITLE GUARANTEE COMPANY AS AGENT FOR OLD REPUBLIC NATIONAL TITLE INSURANCE COMPANY.
4. ALL LOTS ARE SUBJECT TO CROSS ACCESS AND PARKING AGREEMENTS IN THE CCRS FOR WILLOWIND COMMERCIAL FILING NO. 4 RECORDED UNDER RECEPTION NO. _____ __.
5. THE OWNER OF LAND WITHIN DEDICATED PUBLIC IMPROVEMENT EASEMENTS SHALL BE RESPONSIBLE FOR SURFACE MAINTENANCE.
6. AN AVIGATION EASEMENT AFFECTING THE SUBJECT PROPERTY AND DEVELOPMENT HAS BEEN ESTABLISHED BY THE INSTRUMENT RECORDED UNDER RECEPTION NO. 201028182 OF THE RECORDS OF EL PASO COUNTY, COLORADO.
   A. NO ELECTROMAGNETIC, LIGHT, ANY PHYSICAL EMISSIONS WHICH MAY INTERFERE WITH AIRCRAFT, AVIATION, COMMUNICATIONS OR NAVIGATIONAL AIDS ARE ALLOWED.
   B. NOTICE: THIS PROPERTY MAY BE IMPACTED BY NOISE CAUSED BY AIRCRAFT OPERATING INTO AND OUT OF THE COLORADO SPRINGS MUNICIPAL AIRPORT. THE BUYER SHOULD FAMILIARIZE HIMSELF/HERSELF WITH THE POTENTIALITY AND THE RAMIFICATIONS THEREOF.
   C. NO MAN-MADE OR NON-MAN MADE OBSTRUCTIONS ARE ALLOWED TO PENETRATE THE 40:1 APPROACH SURFACE.
   D. IF USE OF EQUIPMENT (PERMANENT OR TEMPORARY) WILL EXCEED 180 FEET ABOVE GROUND LEVEL IN HEIGHT AT THIS SITE, THE APPLICANT IS TO FILE AN AIRSPACE EVALUATION CASE WITH THE FEDERAL AVIATION ADMINISTRATION (FAA) AND PROVIDE THE RESULTS TO THE AIRPORT BEFORE THE COMMENCEMENT OF CONSTRUCTION ACTIVITIES; FAA'S WEBSITE (https://oeaaa.faa.gov/oeaaa/external/portal.jsp)
7. THE PROPERTY IS SUBJECT TO THE CERTIFICATE OF ADDITION TO THE FOUNTAIN VALLEY SOIL CONSERVATION DISTRICT RECORDED MAY 7, 1951 IN BOOK 1294 AT PAGE 221.
8. THE PROPERTY IS SUBJECT TO TERMS, CONDITIONS AND PROVISIONS AS CONTAINED IN ANNEXATION AGREEMENT RECORDED SEPTEMBER 17, 1984 IN BOOK 3918 AT PAGE 581. ANNEXATION ORDINANCE RECORDED JUNE 12, 1984 IN BOOK 3881 AT PAGE 1418.
9. THE PROPERTY IS SUBJECT TO THE EFFECT OF INCLUSION OF SUBJECT PROPERTY IN THE METEX METROPOLITAN DISTRICT, AS EVIDENCED BY ORDER AND DECREE RECORDED JANUARY 8, 1986, IN BOOK 5112 AT PAGE 285 AND OCTOBER 14, 1986 IN BOOK 5253 AT PAGE 273.
10. THE PROPERTY IS SUBJECT TO THE EFFECT OF INCLUSION OF SUBJECT PROPERTY IN THE STETSON HILLS SPECIAL IMPROVEMENT MAINTENANCE DISTRICT AS DISCLOSED BY INSTRUMENT RECORDED AUGUST 15, 1986, IN BOOK 5219 AT PAGE 1137. ORDINANCE EXPANDING THE BOUNDARIES RECORDED OCTOBER 25, 2000 UNDER RECEPTION NO. 200129557.
11. DECLARATION OF COVENANTS, CONDITIONS, RESTRICTIONS AND EASEMENTS FOR WILLOWIND COMMERCIAL CENTER, WHICH DO NOT CONTAIN A FORFEITURE OR REVERTER CLAUSE, BUT OMITTING ANY COVENANTS OR RESTRICTIONS, IF ANY, BASED UPON RACE, COLOR, RELIGION, SEX, SEXUAL ORIENTATION, FAMILIAL STATUS, MARITAL STATUS, DISABILITY, HANDICAP, NATIONAL ORIGIN, ANCESTRY, OR SOURCE OF INCOME, AS SET FORTH IN APPLICABLE STATE OR FEDERAL LAWS, EXCEPT TO THE EXTENT THAT SAID COVENANT OR RESTRICTION IS PERMITTED BY APPLICABLE LAW, AS CONTAINED IN INSTRUMENT RECORDED JUNE 02, 2008, UNDER RECEPTION NO. 208062281. FIRST AMENDMENT TO SAID DECLARATION RECORDED APRIL 25, 2012 UNDER RECEPTION NO. 212047077
12. THE APPROVAL OF THIS REPLAT VACATES ALL PRIOR PLATS FOR THE AREA DESCRIBED BY THIS REPLAT.

SURVEYORS STATEMENT

THE UNDERSIGNED PROFESSIONAL LAND SURVEYOR, LICENSED IN THE STATE OF COLORADO, HEREBY STATES AND DECLARES THAT THE ACCOMPANYING PLAT WAS SURVEYED AND DRAWN UNDER HIS RESPONSIBLE CHARGE AND ACCURATELY SHOWS THE DESCRIBED TRACT OF LAND AND SUBDIVISION THEREOF, AND THAT THE REQUIREMENTS OF TITLE 38 OF THE COLORADO REVISED STATUTES, 1973, AS AMENDED, HAVE BEEN MET TO THE BEST OF HIS KNOWLEDGE AND BELIEF.

_____
VERNON P. TAYLOR, COLORADO PLS NO. 25966
FOR AND ON BEHALF OF:
M&S CIVIL CONSULTANTS, INC.

COLORADO REGISTERED VERNON P. TAYLOR 25966 PROFESSIONAL LAND SURVEYOR

NOTICE:
ACCORDING TO COLORADO LAW, YOU **MUST** COMMENCE ANY LEGAL ACTION BASED UPON ANY DEFECT IN THIS SURVEY WITHIN **THREE** YEARS AFTER YOU FIRST DISCOVER SUCH DEFECT. IN NO EVENT, MAY ANY ACTION BASED UPON ANY DEFECT IN THIS SURVEY BE COMMENCED MORE THAN **TEN** YEARS FROM THE DATE OF THE CERTIFICATION SHOWN HEREON.

CITY APPROVALS:

ON BEHALF OF THE CITY OF COLORADO SPRINGS, THE UNDERSIGNED HEREBY APPROVE FOR FILING THE ACCOMPANYING PLAT OF "WILLOWIND COMMERCIAL FILING NO. 4"

_____ _____
CITY ENGINEER DATE

_____ _____
CITY PLANNING DIRECTOR DATE

_____ _____
CITY CLERK DATE

CLERK AND RECORDER:

STATE OF COLORADO)
) SS
COUNTY OF EL PASO)

I HEREBY CERTIFY THAT THIS INSTRUMENT WAS FILED FOR RECORD AT MY OFFICE AT _____ O'CLOCK __.M., THIS _____ DAY OF _____, 2023, A.D., AND IS DULY RECORDED UNDER RECEPTION NUMBER _____ OF THE RECORDS OF EL PASO COUNTY, COLORADO.

FEE: _____ STEVE SCHLEIKER, RECORDER

SURCHARGE: _____ BY: _____
DEPUTY

FEES:

DRAINAGE FEE: _____
BRIDGE FEE: _____
SCHOOL FEE: _____
PARK FEE: _____

SUMMARY:

7 LOTS 8.736 ACRES 100.00%

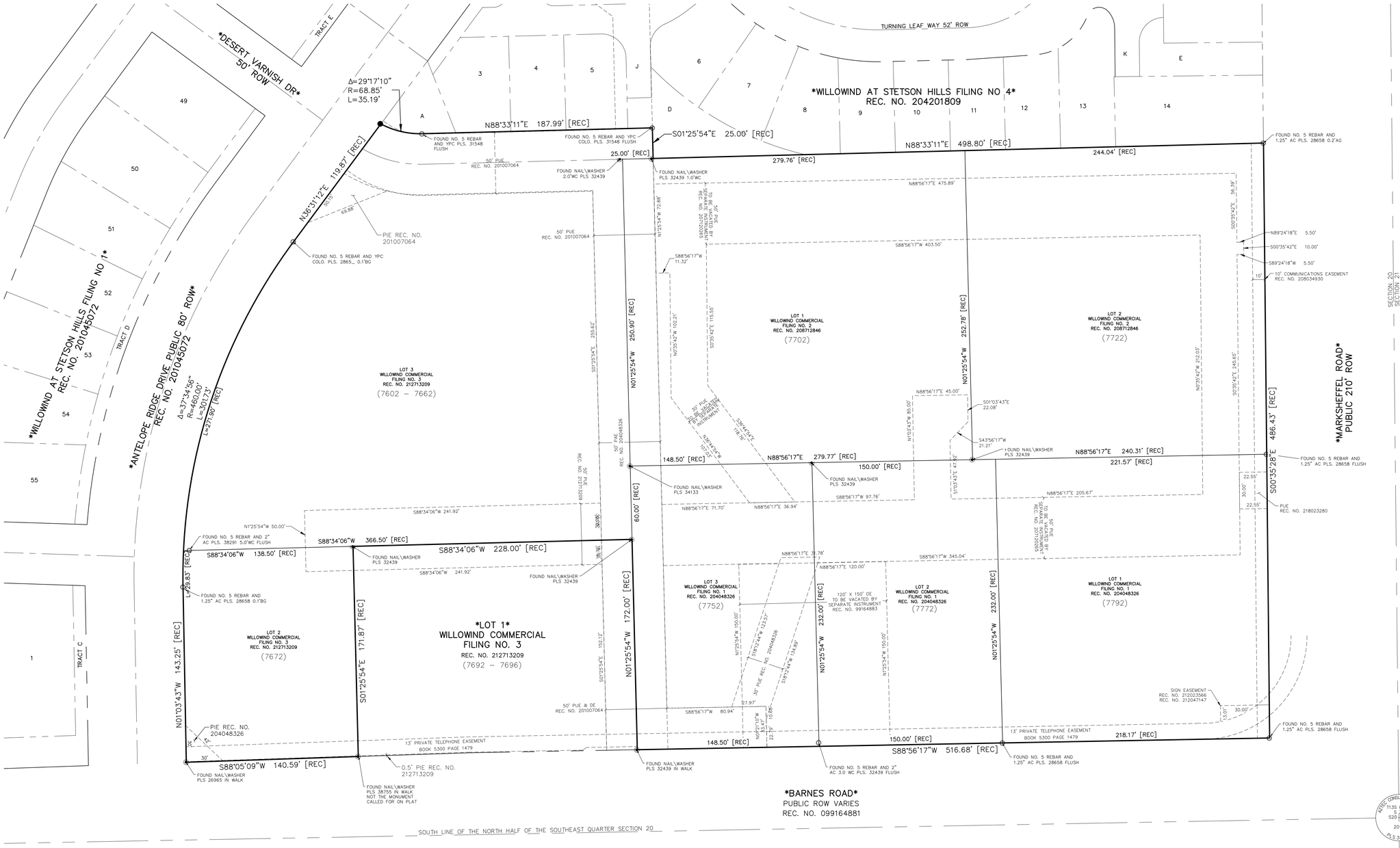
FINAL PLAT
WILLOWIND COMMERCIAL FILING NO. 4
JOB NO. 08-054
DATE PREPARED: 10/04/2022
DATE REVISED: 12/20/2022
DATE REVISED: 02/01/2023
DATE REVISED: 02/27/2023
DATE REVISED: 03/23/2023
DATE REVISED: 04/19/2023
DATE REVISED: 06/08/2023
DATE REVISED: 09/07/2023
FILE NO. SUBD-22-0090

CIVIL CONSULTANTS, INC.
212 N. WAHSATCH AVE., STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

File: C:\100271A-Willowwind-Dunkin Donuts\Survey\Plat\100271PLAT.dwg Plotstamp: 9/7/2023 8:36 AM

WILLOWIND COMMERCIAL FILING NO. 4

A REPLAT OF LOTS 1, 2, & 3, "WILLOWIND COMMERCIAL FILING NO. 1" UNDER RECEPTION NO. 204048326, AND LOTS 1 & 2, "WILLOWIND COMMERCIAL FILING NO. 2" UNDER RECEPTION NO. 208712846, AND LOTS 2 & 3, "WILLOWIND COMMERCIAL FILING NO. 3" UNDER RECEPTION NO. 212713209, BEING A PARCEL OF LAND IN THE NORTH HALF OF THE SOUTHEAST QUARTER (N 1/2, SE 1/4) OF SECTION 20, TOWNSHIP 13 SOUTH, RANGE 65 WEST OF THE SIXTH PRINCIPAL MERIDIAN, EL PASO COUNTY, COLORADO



LEGEND:

SF	SQUARE FEET
(0000)	ADDRESS
●	SET No 5 REBAR AND 1.25" ORANGE CAP STAMPED "M&S CIVIL PLS 25966" FLUSH W/ EXISTING GRADE UNLESS NOTED OTHERWISE
○	FOUND No 5 REBAR AND 1.25" ORANGE CAP STAMPED "M&S CIVIL PLS 25966" FLUSH W/ EXISTING GRADE UNLESS NOTED OTHERWISE
———	BOUNDARY LINE
———	PROPERTY LINE
- - - -	EASEMENT LINE
PUE	PUBLIC UTILITY EASEMENT
PIE	PUBLIC IMPROVEMENT EASEMENT
PAE	PUBLIC ACCESS EASEMENT
DE	DRAINAGE EASEMENT
— — — —	EXISTING/ADJACENT SUBDIVISION LINES, PROPERTY LINES, AND RIGHTS-OF-WAY
— — — —	EXISTING CENTERLINES
- - - -	EXISTING EASEMENT LINES
NOT A PART	PARCELS INDICATED WITH ASTERISK "*" ARE NOT A PART OF THIS SUBDIVISION
[BEARING DIST]	PAE BEARING AND DISTANCE

AS PLATTED

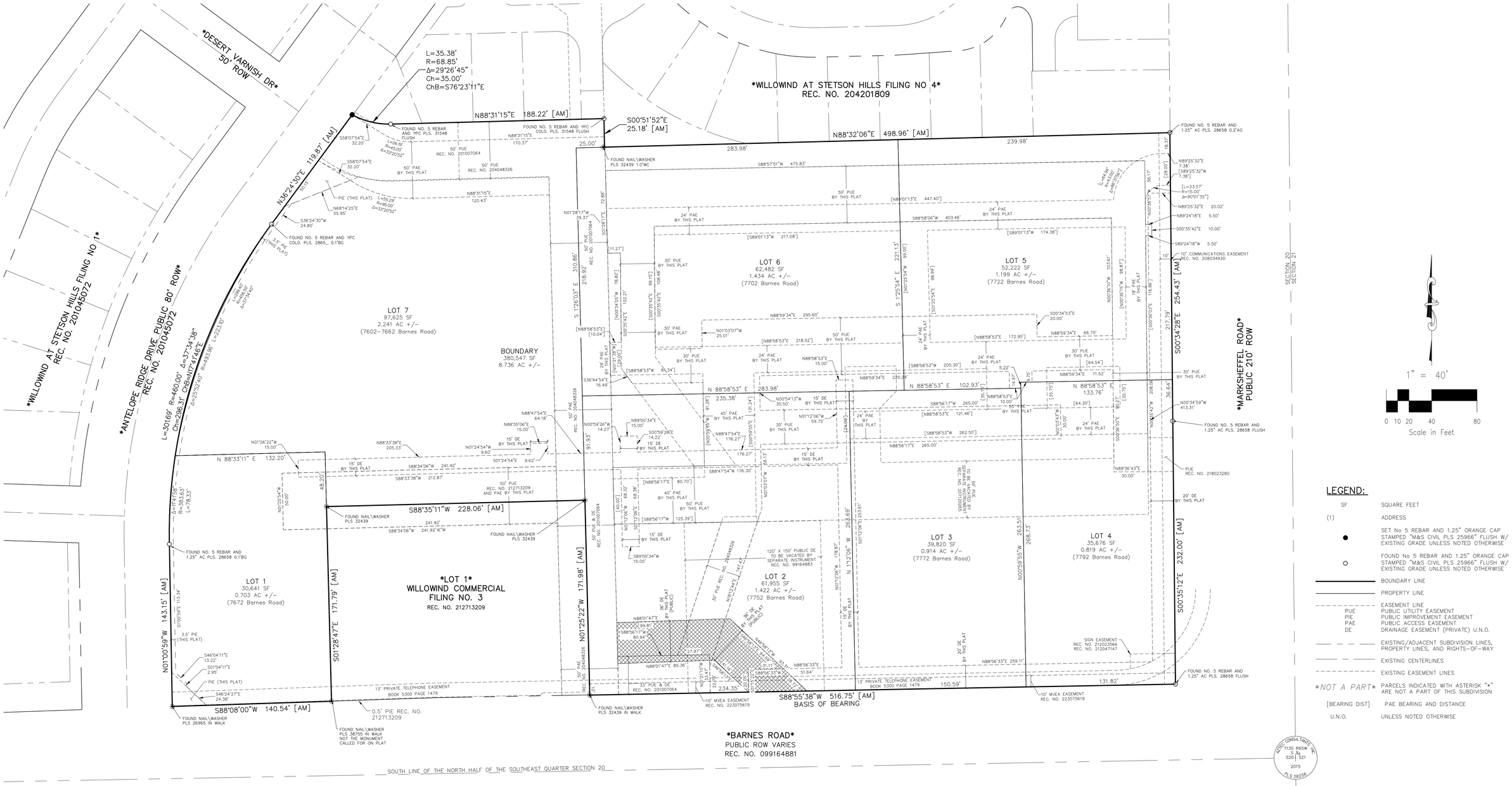
FINAL PLAT
WILLOWIND COMMERCIAL FILING NO. 4
JOB NO. 08-054
DATE PREPARED: 10/04/2022
DATE REVISED: 12/20/2022
DATE REVISED: 02/01/2023
DATE REVISED: 02/27/2023
DATE REVISED: 03/23/2023
DATE REVISED: 04/19/2023
DATE REVISED: 06/08/2023
DATE REVISED: 09/07/2023
FILE NO. SUBD-22-0090

CIVIL CONSULTANTS, INC.
212 N. WAHSATCH AVE., STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

File: G:\100214--Willowwind-Dunkin Donuts\Dunkin Donuts\Survey\Plat\100214PLAT.dwg Plotstamp: 9/7/2023 6:42 AM

WILLOWIND COMMERCIAL FILING NO. 4

A REPLAT OF LOTS 1, 2, & 3, "WILLOWIND COMMERCIAL FILING NO. 1" UNDER RECEPTION NO. 204048326, AND LOTS 1 & 2, "WILLOWIND COMMERCIAL FILING NO. 2" UNDER RECEPTION NO. 208712846, AND LOTS 2 & 3, "WILLOWIND COMMERCIAL FILING NO. 3" UNDER RECEPTION NO. 212713209, BEING A PARCEL OF LAND IN THE NORTH HALF OF THE SOUTHEAST QUARTER (N 1/2, SE 1/4) OF SECTION 20, TOWNSHIP 13 SOUTH, RANGE 65 WEST OF THE SIXTH PRINCIPAL MERIDIAN, EL PASO COUNTY, COLORADO



1" = 40'

0 10 20 40 80

Scale in Feet

LEGEND:

SF	SQUARE FEET
(1)	ADDRESS
●	SET No 5 REBAR AND 1.25" ORANGE CAP STAMPED "M&S CIVIL PLS 25966" FLUSH W/ EXISTING GRADE UNLESS NOTED OTHERWISE
○	FOUND No 5 REBAR AND 1.25" ORANGE CAP STAMPED "M&S CIVIL PLS 25966" FLUSH W/ EXISTING GRADE UNLESS NOTED OTHERWISE
———	BOUNDARY LINE
———	PROPERTY LINE
- - - -	EASEMENT LINE
PUE	PUBLIC UTILITY EASEMENT
PIE	PUBLIC IMPROVEMENT EASEMENT
PAE	PUBLIC ACCESS EASEMENT
DE	DRAINAGE EASEMENT (PRIVATE) U.N.O.
——— ———	EXISTING/ADJACENT SUBDIVISION LINES, PROPERTY LINES, AND RIGHTS-OF-WAY
——— — ———	EXISTING CENTERLINES
- - - -	EXISTING EASEMENT LINES
NOT A PART	PARCELS INDICATED WITH ASTERISK "*" ARE NOT A PART OF THIS SUBDIVISION
[BEARING DIST]	PAE BEARING AND DISTANCE
U.N.O.	UNLESS NOTED OTHERWISE

AZTEC CONSULTANTS, INC. T13S R65W S 20 & 21 2015 PLS 38255

AS REPLATTED

FINAL PLAT
WILLOWIND COMMERCIAL FILING NO. 4
JOB NO. 08-054
DATE PREPARED: 10/04/2022
DATE REVISED: 12/20/2022
DATE REVISED: 02/01/2023
DATE REVISED: 02/27/2023
DATE REVISED: 03/23/2023
DATE REVISED: 04/19/2023
DATE REVISED: 06/08/2023
DATE REVISED: 09/07/2023
DATE REVISED: 11/02/2023
FILE NO. SUBD-22-0090

212 N. WAHSATCH AVE., STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485
CIVIL CONSULTANTS, INC.

File: G:\100214-Willowind-Dunkin Donuts\Survey\Plat\100214PLAT.dwg Plotstamp: 11/2/2023 10:15 AM

VARIANCES

CIVIL CONSULTANTS,INC.

212 N.Wahsatch Avenue, Ste. 305
Colorado Springs, CO 80901
(719) 955-5485

September 18, 2023

Storm Water Variance Review Committee
Public Works/Water Resources Engineering
30 South Nevada Avenue, Suite 401
Colorado Springs, Colorado 80903

RE: Willowind Commercial Filing No.4 – Variance Request
Minimum Velocity in Minor event and Drop Manhole/Inlet.

Dear Committee,

This letter requests a variance from the City of Colorado Springs Drainage Criteria Manual. This request is for the storm sewer construction plans, for the **Willowind Commercial Filing No.4** project, on behalf of CD Marksheffel & Barnes, LLC.

GENERAL LOCATION AND DESCRIPTION

The Willowind Commercial Filing No. 4 (WWCF4) is a proposed commercial development. The site is located in the southeast one-quarter of Section 20, Township 13 South, Range 65 West of the Sixth Principal Meridian, Colorado Springs, El Paso County, Colorado. (Refer to the Vicinity map in the appendix for additional details).

The 8.74 AC site is currently divided into eight (8) separate lots and zoned PBC AO. Two (2) of the existing lots; Lot 1 Willowind Commercial Filing No. 3 (currently 7-11 convenience store) and Lot 1 Willowind Commercial Filing No. 2 (currently a mixed-use commercial building) have been developed in accordance with the approved 2007 development plan. The concept plan has since expired.

The proposed concept plan will redevelop the seven (7) lots, of which six (6) are vacant. No proposed changes to the existing commercial buildings are associated with this concept plan. A final plat is proposed alongside the concept plan, incorporating utility easements and lot area changes.

All remaining seven (7) vacant lots and the existing mixed-use commercial building are proposed as a commercial center. All lots will benefit from a shared access and parking agreement, which will be implemented through the Property Owners Association convents. Site specific details for the redevelopment of the seven (7) lots will be provided in future development plans.

The site is bounded by an existing public roadway of Antelope Ridge Drive and Willowind at Stetson Hills Filing No. 1 to the west, an existing public street of Barnes Road and Chateau at Antelope Ridge Filing No. 1 to the south, an existing public roadway of Marksheffel Road to the east and Willowind at Stetson Hills Filing No. 4 to the north. The County records indicate that BLH No. 2, LLC owns the property to the east.

The subject property is located within the Tributary to East Fork Sand Creek Basin Drainage flows from this site are tributary East Fork Sand Creek Sub-tributary (EFSCST) which discharges into Sand Creek. Site vegetation for the

undeveloped areas is sparse, consisting primarily of native grasses. Existing site terrain generally slopes from north to south, with existing slopes varying between 1 and 10%. Per the Colorado Springs Streamside Overlay Map, no portion of the site lies within a streamside overlay area.

It should be noted that at the time of the preparation of this variance request, specific site plans for each lot are unknown; as such, the total disturbance by the future developments are unknown. The total area of the undeveloped lots (1-5, and 7) is approximately 7.3 acres. The total disturbance, anticipated based upon the installation of the initial infrastructure (gas, water sanitary and storm sewer totals approximately 70,500 square feet or 1.62 acres. The proposed disturbed areas for future lot development will be discussed in the individual final drainage reports.

An 'initial' private storm sewer system, (shown in dark purple on the provided proposed drainage map) will be housed within private storm sewer easements. The system will be extended throughout the subdivision and provide suitable storm outfalls for all the future privately owned FSD ponds and provide adequate outfalls for the existing Marksheffel corridor. In addition the private storm system the 'initial' infrastructure drainage improvements will also include the re-routing of the public 60" RCP storm sewer system and construct a public junction box connection to the existing public 6.25' x 8' RCBC. The only grading to occur with the 'initial' infrastructure will what is required to install and remove storm sewer, gas, water and sanitary sewer mains for future development.

The "initial infrastructure" project covered by this Final Drainage Report consists entirely of utility installations, and therefore falls under the 4 Step Process exclusion for Aboveground and Underground Utilities (I.E.4.a.i.A of COS000004). The ultimate development covered by the Master Development Drainage Report will comply with all applicable 4 Step Process and detention criteria in place at the time of development.

REQUESTED VARIANCES FROM CRITERIA

Minimum Velocity in Minor Event

Per Volume 1, Chapter 9 Storm Sewers, Section 7.1.2 Minimum Velocity.

"The need to maintain a self-cleaning storm sewer system is recognized as a goal to minimize the costs for maintenance of storm sewer facilities. Sediment deposits, once established, are generally difficult to remove even with pressure cleaning equipment. Maintaining minimum velocities for frequently occurring flows will reduce the potential for sediment and debris accumulation. 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."

The initial infrastructure storm sewer system was designed to provide adequate outfalls for future commercial based developments. Given the vertical constraints between the existing storm sewer system and proposed/existing utilities and the anticipated Full Spectrum Detention facilities and the minimal amount of flow being released 0.1 cfs into the cited storm pipes (refer to attached pond worksheets), we are requesting a variance of the low discharge velocities of 2.94 ft/s, 1.52 ft/s, 1.51 ft/s (Conduit Flex Table STORM 3-1, 4-1, 4-1, 5-yr, respectively) and low discharge velocities of less than 0.0 ft/s (Conduit Flex Table STORM 1-7, 3-2, 3-3, 4-3, 5-1, 5-2, LAT-1, LAT-3, LAT-4, 5-yr) be allowed for the sections of storm sewer.

Alternatives evaluated and limiting factors; increasing slope of storm sewer pipe was not a viable solution due to the topography of the site with relation to the existing storm sewer system, the proposed utilities, coupled with the anticipated depths of the future Full Spectrum Detention facilities (Sand filters and other options often requiring around 7' of depth). Decreasing the pipe size was not a viable solution, all pipes cited above are 15" diameter pipes. We feel a smaller pipe size would have the potential of clogging and require flushing on a repeated basis, becoming a maintenance issue.

The above deviation from the design criteria does not affect Sand Creek or Fountain Creek peak flows or water quality.

Drop Manhole/Inlet

Per Volume 1, Chapter 9 Storm Sewers, Section 6.4 Drop Manholes, "The drop within a manhole from the upstream to downstream pipe invert should normally not exceed 1 foot. There are cases when a drop larger than 1 foot may be necessary to avoid a utility conflict, reduce the slope of the downstream pipe, match crowns of the upstream and downstream pipes or to account for the energy losses in the manhole. Drops that exceed 1 foot will be evaluated on a case-by-case bases and additional analysis may be required." The following justification is provided in support of a variance.

Storm 3 (STM MH-7) has a drop of greater than 1' is proposed between the upstream 15" HP and downstream 15" HP pipe within the system. A drop of 1.72' is proposed to avoid conflicts with proposed utilities. Due to the topography of the site with relation to the existing/proposed storm sewer system and the existing/proposed utility tie in's, this measure would minimize impacts to the storm system.

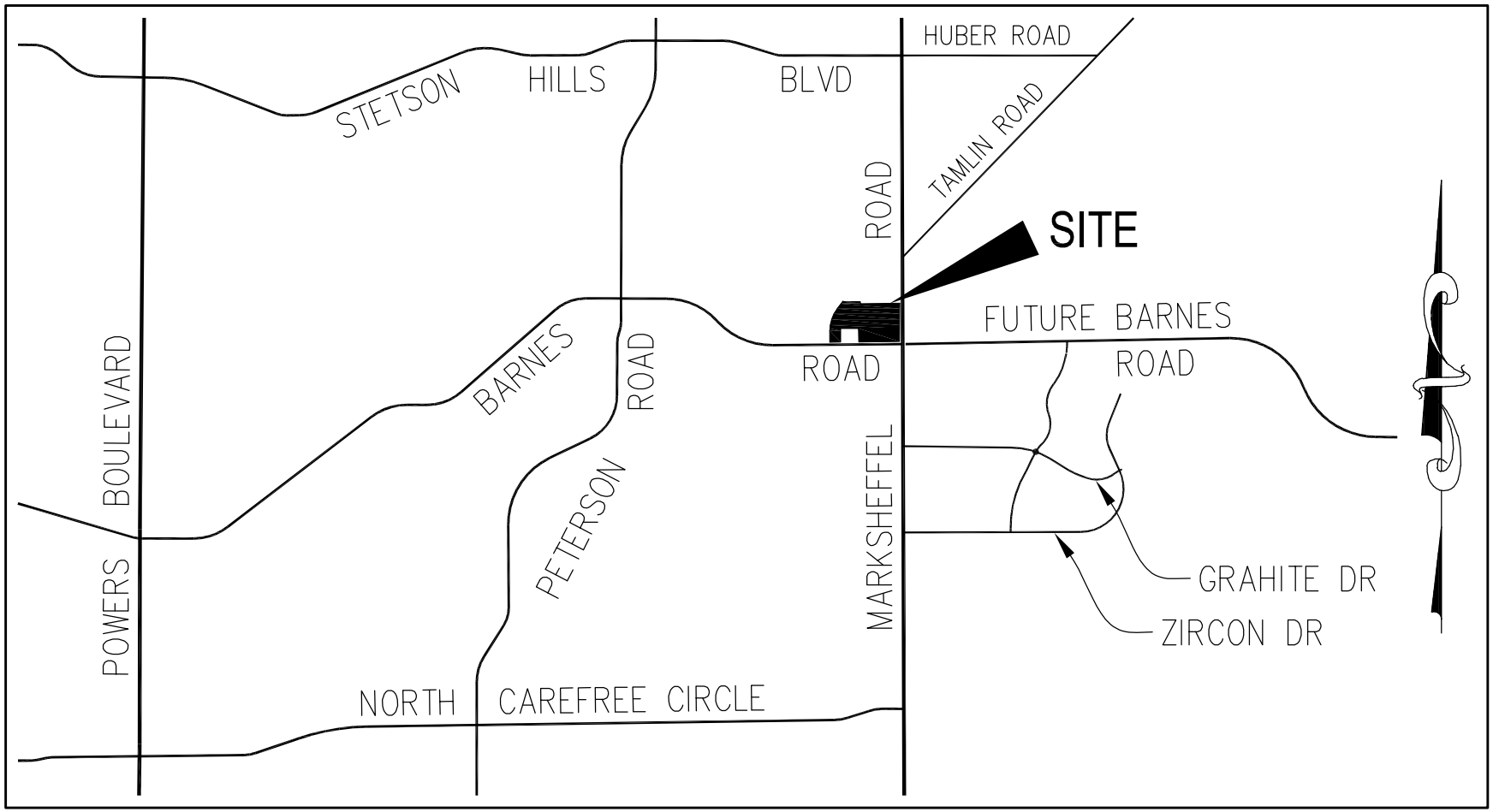
Alternatives evaluated and limiting factors; revising the storm sewer vertically to eliminate drop height. This resulted in inadequate clearance from the various utility crossings when coupled with the issue of providing adequate depth to service the proposed ponds. Proposing larger pipes to reduce the drop height was also evaluated, but with low flows and low velocities the alternative was not desirable.

The deviations from the design criteria do not affect peak flows or water quality of Fountain Creek.

Respectfully,



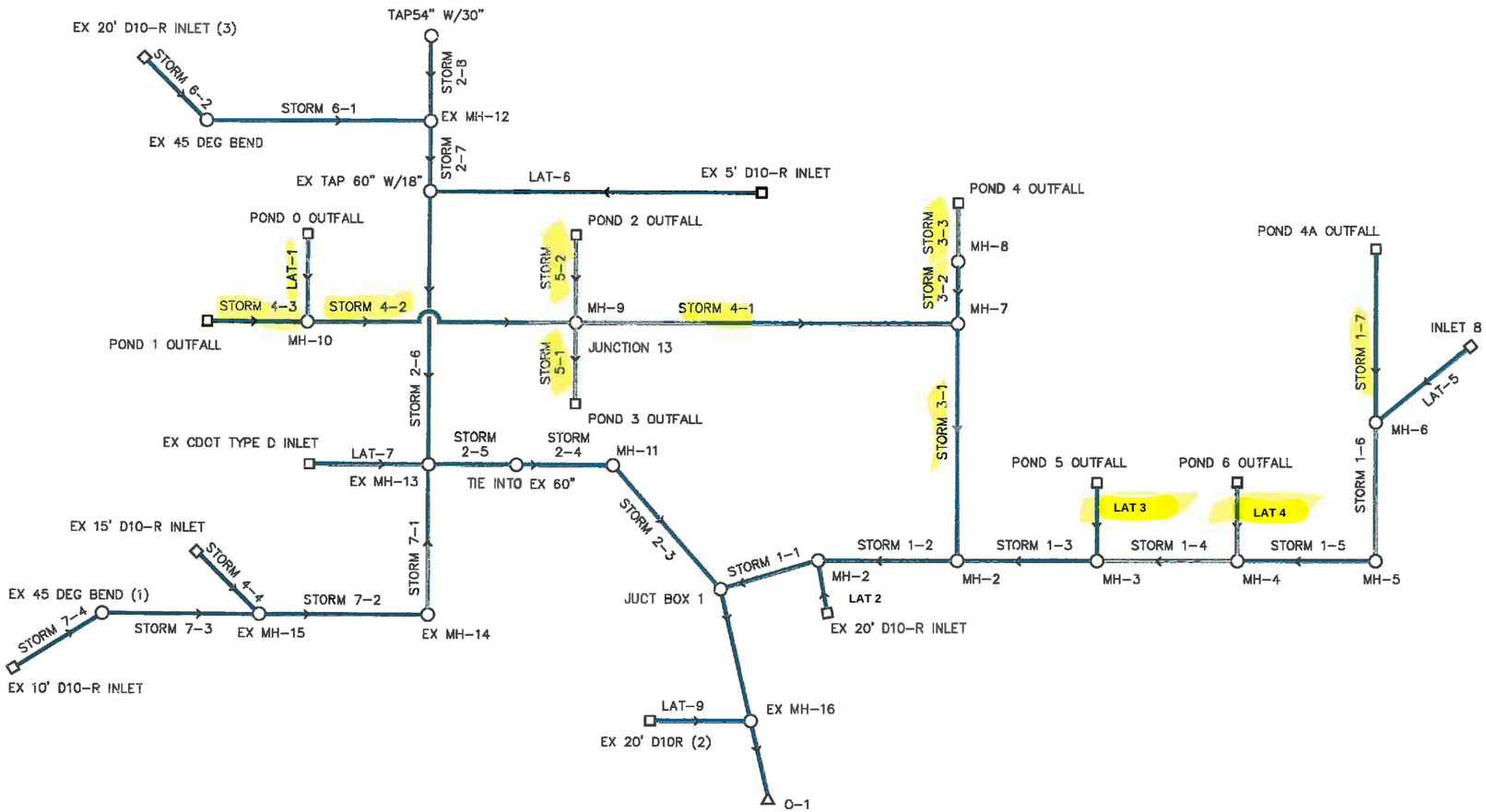
Virgil A. Sanchez, P.E.
M&S Civil Consultants, Inc.



VICINITY MAP

N.T.S.

STORMCAD SCHEMATIC



212 N. WAHSATCH AVE., STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

CIVIL CONSULTANTS, INC.

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Conduit FlexTable: STRM - 5YR

Label	ID	Upstream Structure	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number	Depth (Normal) (ft)	Depth (Critical) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
LAT-1	220	POND 0 OUTFALL	0.00	0.0	6.0	0.00	(N/A)	(N/A)	0.00	6,651.98	6,651.92	6,651.98	6,651.92
LAT-2	99	EX 20' D10-R	12.70	14.1	9.9	20.27	(N/A)	0.51	1.28	6,653.54	6,653.29	6,652.98	6,650.85
LAT-3	247	POND 5 OUTFALL	0.00	0.0	6.0	0.00	(N/A)	(N/A)	0.00	6,645.67	6,645.55	6,645.67	6,645.55
LAT-4	245	POND 6 OUTFALL	0.00	0.0	6.4	0.00	(N/A)	(N/A)	0.00	6,648.38	6,648.12	6,648.38	6,648.12
LAT-5	242	INLET 8	19.60	23.9	25.5	13.72	(N/A)	0.83	1.50	6,651.16	6,650.80	6,650.53	6,649.00
LAT-6	125	EX 5' D10-R INLET	1.60	14.0	269.9	4.57	(N/A)	0.38	0.48	6,655.26	6,653.47	6,655.08	6,653.45
LAT-7	115	EX CDOT TYPE D INLET	2.40	1.1	36.0	14.68	(N/A)	0.18	0.51	6,655.14	6,648.06	6,654.97	6,648.06
LAT-8	111	EX 15' D10-R INLET	12.90	49.6	11.6	7.30	(N/A)	0.75	1.35	6,673.17	6,673.00	6,672.34	6,672.17
LAT-9	305	EX 20' D10R (2)	10.60	14.9	30.0	28.91	(N/A)	0.39	1.25	6,653.66	6,648.44	6,652.95	6,638.36
STORM 1-1	97	MH-1	31.50	15.7	14.3	15.23	(N/A)	0.94	1.74	6,641.43	6,641.42	6,641.21	6,641.25
STORM 1-2	225	MH-2	18.90	14.2	42.8	13.34	(N/A)	0.76	1.39	6,642.51	6,641.72	6,641.97	6,641.60
STORM 1-3	227	MH-3	18.90	14.2	46.1	13.35	(N/A)	0.76	1.39	6,644.66	6,642.88	6,644.12	6,642.52
STORM 1-4	229	MH-4	19.20	21.1	118.9	10.20	(N/A)	0.94	1.40	6,647.96	6,646.33	6,647.42	6,644.74
STORM 1-5	231	MH-5	19.50	42.3	100.3	6.25	(N/A)	1.36	1.42	6,648.75	6,648.34	6,648.21	6,647.97
STORM 1-6	235	MH-6	19.50	41.1	63.3	6.38	(N/A)	1.34	1.42	6,649.38	6,649.22	6,648.86	6,648.93
STORM 1-7	237	POND 4A OUTFALL	0.00	0.0	201.1	0.00	(N/A)	(N/A)	0.00	6,650.17	6,649.16	6,650.17	6,649.16
STORM 2-1	302	EX MH-16	246.10	22.2	67.0	17.53	(N/A)	1.70	3.02	6,640.47	6,639.96	6,638.95	6,636.79
STORM 2-2	303	JUCT BOX 1	236.80	32.0	106.0	13.13	(N/A)	2.19	2.95	6,641.22	6,640.36	6,639.75	6,639.01
STORM 2-3	194	MH-11	206.70	96.0	55.2	12.48	(N/A)	3.93	4.10	6,644.01	6,643.65	6,641.77	6,641.26
STORM 2-4	202	TIE INTO EX 60"	206.70	51.5	8.0	20.59	(N/A)	2.54	4.10	6,644.53	6,644.48	6,642.48	6,642.67
STORM 2-5	199	EX MH-13	206.70	51.5	100.7	20.60	(N/A)	2.54	4.10	6,646.90	6,644.53	6,644.66	6,642.48
STORM 2-6	208	EX TAP 60" W/18"	188.00	50.7	403.6	18.95	(N/A)	2.52	3.92	6,654.92	6,649.48	6,652.91	6,648.06
STORM 2-7	123	EX MH-12	187.20	50.5	14.4	18.93	(N/A)	2.51	3.92	6,655.20	6,655.04	6,653.20	6,653.45
STORM 2-8	42	TAP54" W/30"	159.60	90.4	55.8	10.04	(N/A)	3.35	3.70	6,657.17	6,656.80	6,655.60	6,655.24
STORM 3-1	276	MH-7	0.10	0.8	192.5	2.94	(N/A)	0.08	0.12	6,649.18	6,642.85	6,649.14	6,642.71
STORM 3-2	282	MH-8	0.00	0.0	33.9	0.00	(N/A)	(N/A)	0.00	6,651.45	6,650.74	6,651.45	6,650.74
STORM 3-3	283	POND 4 OUTFALL	0.00	0.0	12.0	0.00	(N/A)	(N/A)	0.00	6,651.81	6,651.75	6,651.81	6,651.75
STORM 4-1	211	MH-9	0.10	2.2	186.3	1.52	(N/A)	0.13	0.12	6,650.42	6,649.48	6,650.39	6,649.44
STORM 4-2	214	MH-10	0.10	2.2	74.1	1.51	(N/A)	0.13	0.12	6,651.08	6,650.71	6,651.05	6,650.67
STORM 4-3	216	POND 1 OUTFALL	0.00	0.0	191.4	0.00	(N/A)	(N/A)	0.00	6,652.88	6,651.92	6,652.88	6,651.92
STORM 5-1	203	POND 3 OUTFALL	0.00	0.0	64.9	0.00	(N/A)	(N/A)	0.00	6,651.13	6,650.80	6,651.13	6,650.80
STORM 5-2	205	POND 2 OUTFALL	0.00	0.0	10.4	0.00	(N/A)	(N/A)	0.00	6,651.21	6,651.10	6,651.21	6,651.10
STORM 6-1	119	EX 45 DEG BEND	28.30	28.3	195.8	12.16	(N/A)	1.09	1.72	6,658.60	6,655.49	6,657.89	6,655.24
STORM 6-2	120	EX 20' D10-R INLET (3)	28.30	23.8	111.8	13.77	(N/A)	1.00	1.72	6,662.14	6,658.60	6,661.43	6,657.92
STORM 7-1	102	EX MH-14	19.50	59.6	65.3	19.32	(N/A)	0.83	1.46	6,654.02	6,649.95	6,652.10	6,648.06
STORM 7-2	108	EX MH-15	19.50	95.2	483.0	11.03	(N/A)	1.17	1.46	6,673.17	6,656.53	6,671.28	6,654.63

Conduit FlexTable: STRM - 5YR

Label	ID	Upstream Structure	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number	Depth (Normal) (ft)	Depth (Critical) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
STORM 7-3	109	EX 45 DEG BEND (1)	6.60	32.2	519.8	10.33	(N/A)	0.59	0.99	6,690.57	6,672.39	6,690.13	6,672.17
STORM 7-4	106	EX 10' D10-R INLET	6.60	32.2	114.4	10.33	(N/A)	0.59	0.99	6,694.92	6,690.62	6,694.48	6,690.31

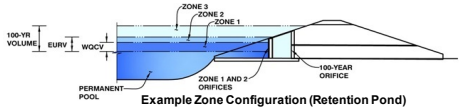
Headloss (ft)	Upstream Structure Hydraulic Grade Line (In) (ft)	Upstream Structure Velocity (In-Governing) (ft/s)	Upstream Structure Headloss Coefficient	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Conduit Description
0.06	6,651.98	0.00	1.500	0.00	6,659.99	6,660.00	6,651.92	6,651.98	Circle - 15.0 in
2.13	6,653.81	5.97	1.500	0.83	6,657.09	6,656.33	6,650.13	6,651.70	Circle - 24.0 in
0.12	6,645.67	0.00	1.500	0.00	6,657.75	6,659.00	6,645.55	6,645.67	Circle - 15.0 in
0.25	6,648.38	0.00	1.500	0.00	6,659.33	6,659.00	6,648.12	6,648.38	Circle - 15.0 in
1.53	6,651.47	6.36	1.500	0.94	6,659.21	6,658.50	6,648.01	6,649.03	Circle - 30.0 in
1.63	6,655.34	3.33	1.500	0.26	6,661.50	6,659.60	6,651.40	6,654.61	Circle - 18.0 in
6.91	6,655.23	3.37	1.500	0.27	6,657.78	6,660.00	6,644.31	6,654.46	Circle - 30.0 in
0.17	6,673.59	7.30	1.500	1.24	6,675.30	6,675.80	6,669.29	6,670.00	Circle - 18.0 in
14.59	6,654.01	6.73	1.500	1.06	6,656.75	6,658.33	6,637.93	6,651.70	Circle - 18.0 in
-0.04	6,641.60	2.80	1.770	0.39	6,657.01	6,657.09	6,637.80	6,638.37	Circle - 42.0 in
0.37	6,642.52	4.79	1.020	0.55	6,657.09	6,657.41	6,638.87	6,640.58	Circle - 36.0 in
1.60	6,644.67	10.10	1.020	0.55	6,657.41	6,657.75	6,640.88	6,642.73	Circle - 36.0 in
2.67	6,647.97	4.86	1.020	0.55	6,657.75	6,659.33	6,643.80	6,646.01	Circle - 36.0 in
0.24	6,648.93	4.29	1.320	0.72	6,659.33	6,661.34	6,646.31	6,646.79	Circle - 36.0 in
-0.07	6,649.10	10.74	0.470	0.24	6,661.34	6,659.21	6,647.09	6,647.41	Circle - 36.0 in
1.01	6,650.17	0.00	1.500	0.00	6,659.21	6,660.00	6,649.16	6,650.17	Circle - 15.0 in
2.17	6,639.01	25.47	0.040	0.06	6,640.70	6,656.75	6,634.70	6,635.93	Box - 8.3 x 6.0 ft
0.73	6,641.25	3.28	1.020	1.50	6,656.75	6,657.01	6,635.93	6,636.80	Box - 8.3 x 6.0 ft
0.52	6,642.67	10.80	0.400	0.90	6,657.01	6,655.00	6,637.30	6,637.68	Circle - 60.0 in
-0.19	6,642.48	11.48	0.000	0.00	6,655.00	6,656.50	6,637.98	6,638.17	Circle - 60.0 in
2.18	6,648.06	11.03	1.520	3.40	6,656.50	6,657.78	6,638.17	6,640.56	Circle - 60.0 in
4.85	6,653.45	10.11	0.270	0.54	6,657.78	6,661.50	6,640.81	6,648.99	Circle - 60.0 in
-0.26	6,655.24	4.00	1.020	2.04	6,661.50	6,661.82	6,648.99	6,649.28	Circle - 60.0 in
0.37	6,657.20	10.04	1.020	1.60	6,661.82	6,660.70	6,649.78	6,650.23	Circle - 54.0 in
6.43	6,649.18	1.64	1.020	0.04	6,657.41	6,658.26	6,642.63	6,649.02	Circle - 15.0 in
0.71	6,651.45	0.00	0.050	0.00	6,658.26	6,659.34	6,650.74	6,651.45	Circle - 15.0 in
0.06	6,651.81	0.00	1.500	0.00	6,659.34	6,659.83	6,651.75	6,651.81	Circle - 15.0 in
0.95	6,650.42	1.64	1.020	0.04	6,658.26	6,660.68	6,649.32	6,650.26	Circle - 15.0 in
0.38	6,651.08	0.00	1.020	0.04	6,660.68	6,659.99	6,650.55	6,650.92	Circle - 15.0 in
0.96	6,652.88	0.00	1.500	0.00	6,659.99	6,662.00	6,651.92	6,652.88	Circle - 15.0 in
0.33	6,651.13	0.00	1.500	0.00	6,660.00	6,660.68	6,651.13	6,650.80	Circle - 15.0 in
0.11	6,651.21	0.00	1.500	0.00	6,661.00	6,660.68	6,651.21	6,651.10	Circle - 15.0 in
2.65	6,657.92	6.61	0.040	0.03	6,661.82	6,664.00	6,651.78	6,656.17	Circle - 36.0 in
3.51	6,662.49	6.74	1.500	1.06	6,664.00	6,664.83	6,656.17	6,659.71	Circle - 36.0 in
4.04	6,654.63	11.03	1.320	2.53	6,657.78	6,657.80	6,644.31	6,650.64	Circle - 18.0 in
16.65	6,672.17	7.30	0.470	0.89	6,657.80	6,675.30	6,650.84	6,669.19	Circle - 18.0 in
17.96	6,690.31	4.47	0.400	0.18	6,675.30	6,698.00	6,669.39	6,689.14	Circle - 18.0 in
4.17	6,695.14	5.31	1.500	0.66	6,698.00	6,701.00	6,689.14	6,693.49	Circle - 18.0 in

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Willowind Commercial

Basin ID: Pond 0



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	SF	
Watershed Area =	1.77	acres
Watershed Length =	350	ft
Watershed Length to Centroid =	192	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	93.10%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	12.0	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) =	0.051	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.226	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.150	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.52 in.) =	0.196	acre-feet	1.52	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.228	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.264	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.300	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.340	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.431	acre-feet		inches
Approximate 2-yr Detention Volume =	0.149	acre-feet		
Approximate 5-yr Detention Volume =	0.196	acre-feet		
Approximate 10-yr Detention Volume =	0.229	acre-feet		
Approximate 25-yr Detention Volume =	0.270	acre-feet		
Approximate 50-yr Detention Volume =	0.293	acre-feet		
Approximate 100-yr Detention Volume =	0.313	acre-feet		

Define Zones and Basin Geometry

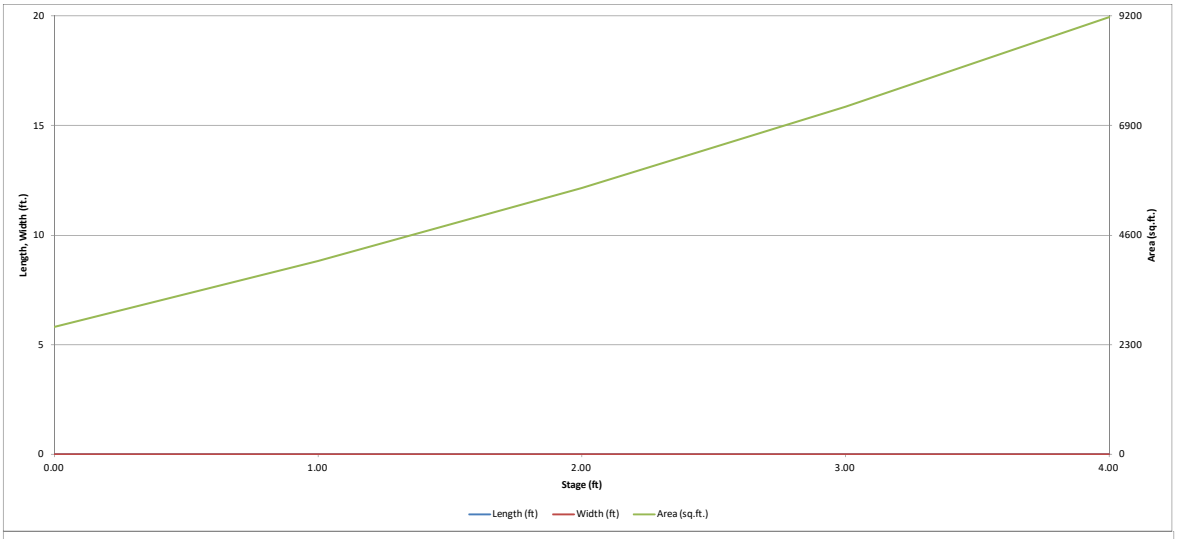
Zone 1 Volume (WQCV) =	0.051	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.175	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.087	acre-feet
Total Detention Basin Volume =	0.313	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	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

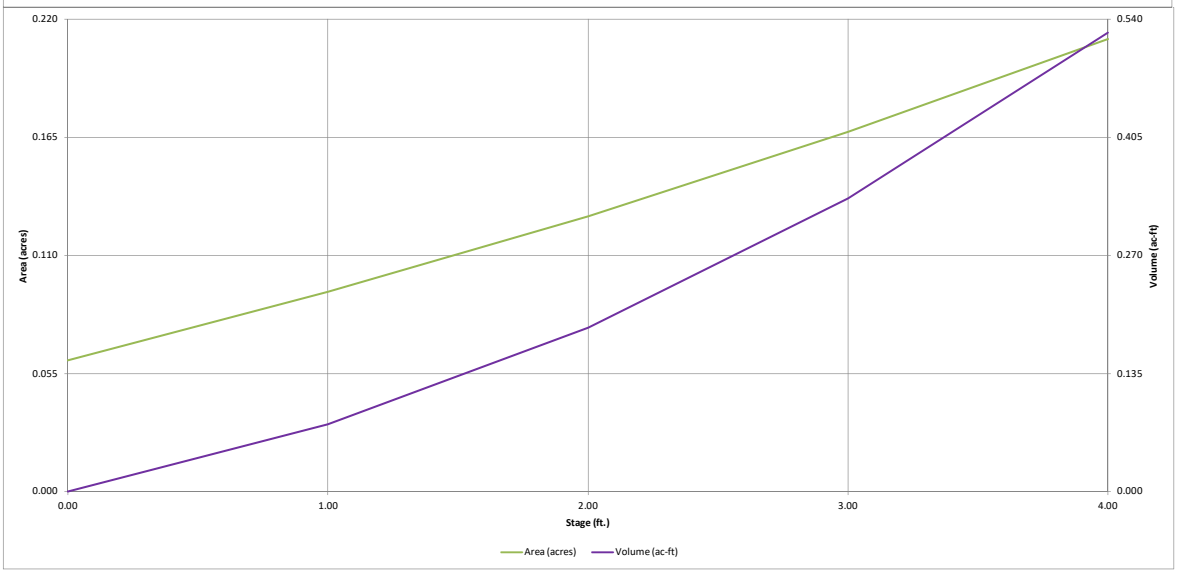
Depth Increment = ft

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)
Media Surface	--	0.00	--	--	--	2,666	0.061		
	--	1.00	--	--	--	4,050	0.093	3,358	0.077
	--	2.00	--	--	--	5,585	0.128	8,175	0.188
	--	3.00	--	--	--	7,296	0.167	14,616	0.336
	--	4.00	--	--	--	9,179	0.211	22,853	0.525

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



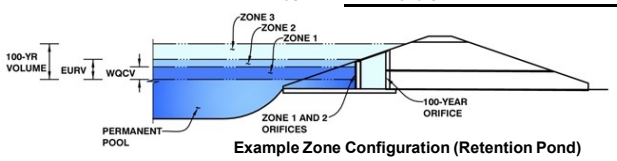


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Willowind Commercial**

Basin ID: **Pond 0**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.71	0.051	Filtration Media
Zone 2 (EURV)	2.29	0.175	Filtration Media
Zone 3 (100-year)	2.87	0.087	Weir&Pipe (Restrict)
Total (all zones)		0.313	

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

Underdrain Orifice Invert Depth =	2.50	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	1.08	inches	Underdrain Orifice Centroid =	0.05	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	N/A	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 =	N/A	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

Calculated Parameters for Plate

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

	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected				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
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
Vertical Orifice Diameter =	N/A	N/A	inches				

Calculated Parameters for Vertical Orif

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			Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	2.40	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	2.40	N/A
Overflow Weir Front Edge Length =	2.91	N/A	feet	Overflow Weir Slope Length =	2.91	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	56.44	N/A
Horiz. Length of Weir Sides =	2.91	N/A	feet	Overflow Grate Open Area w/o Debris =	5.89	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	2.95	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow W

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected
Depth to Invert of Outlet Pipe =	2.75	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.10	N/A
Outlet Pipe Diameter =	15.00	N/A	inches	Outlet Orifice Centroid =	0.10	N/A
Restrictor Plate Height Above Pipe Invert =	2.10		inches	Half-Central Angle of Restrictor Plate on Pipe =	0.77	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.75	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.44 feet
Spillway Crest Length =	6.00	feet	Stage at Top of Freeboard =	4.19 feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.21 acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.52 acre-ft

Calculated Parameters for Spillway

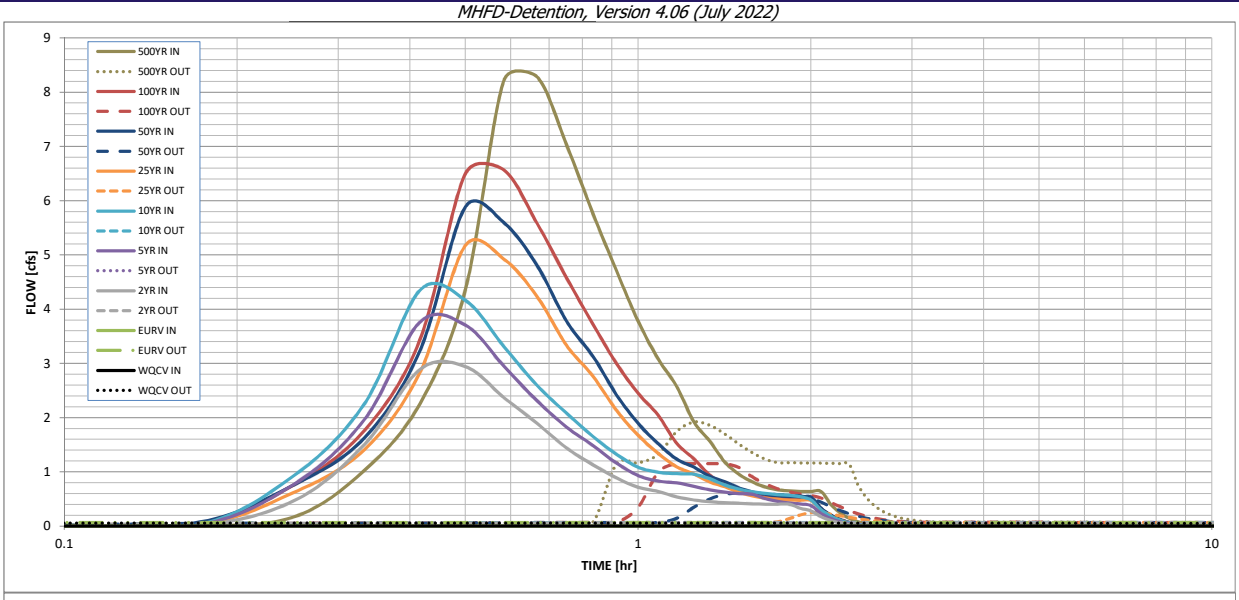
Routed Hydrograph Results

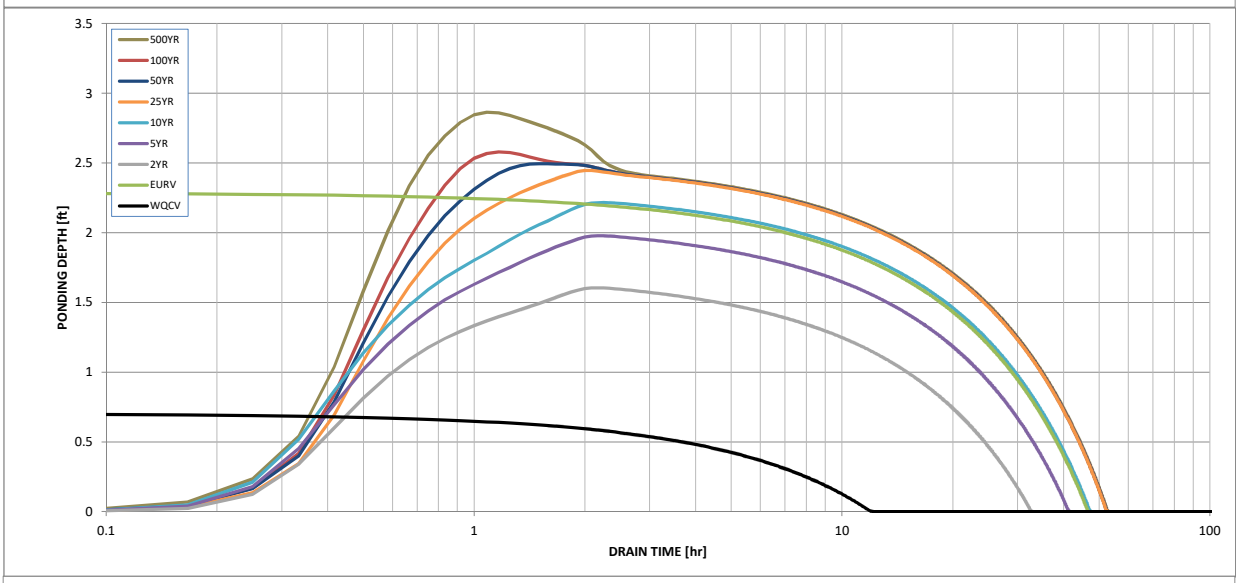
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AI

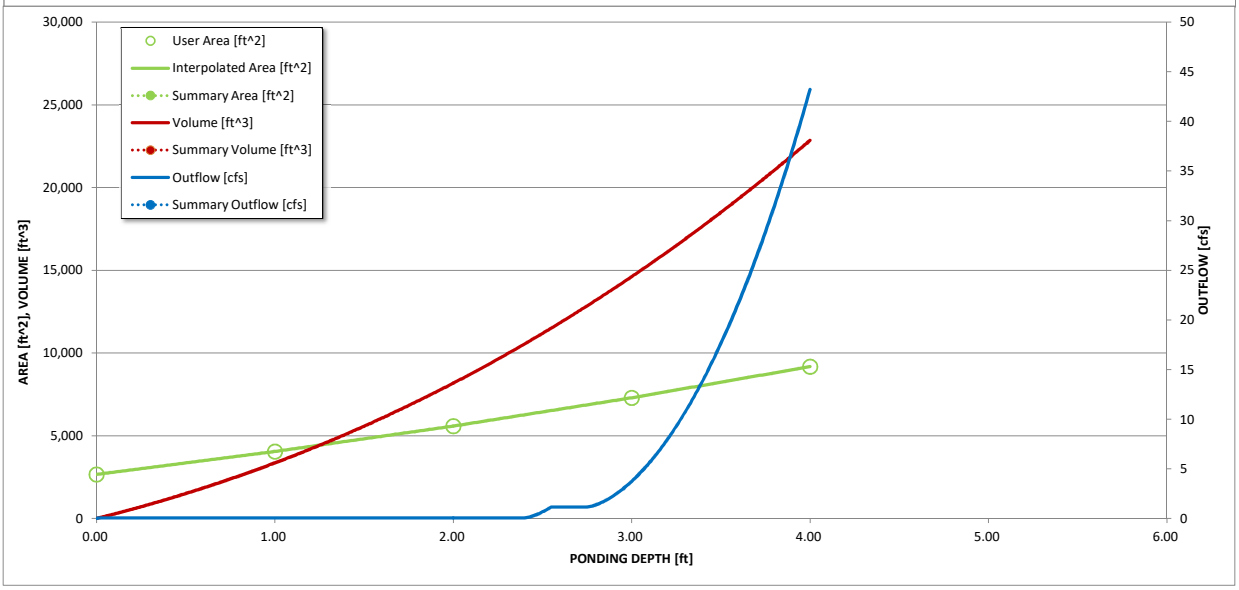
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.52	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.051	0.226	0.150	0.196	0.228	0.264	0.300	0.340
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.150	0.196	0.228	0.264	0.300	0.340
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.4	0.7	1.2
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	0.02	0.20	0.40	0.66
Peak Inflow Q (cfs) =	N/A	N/A	2.9	3.8	4.3	5.2	5.9	6.6
Peak Outflow Q (cfs) =	0.1	0.1	0.1	0.1	0.1	0.2	0.6	1.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.1	1.7	0.7	0.9	1.0
Structure Controlling Flow =	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.1	0.2
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	12	45	32	40	46	51	50	50
Time to Drain 99% of Inflow Volume (hours) =	**12**	46	32	41	47	52	52	52
Maximum Ponding Depth (ft) =	0.71	2.29	1.60	1.98	2.22	2.45	2.49	2.58
Area at Maximum Ponding Depth (acres) =	0.08	0.14	0.11	0.13	0.14	0.15	0.15	0.15
Maximum Volume Stored (acre-ft) =	0.051	0.227	0.139	0.184	0.215	0.248	0.255	0.267

DETENTION BASIN OUTLET STRUCTURE DESIGN

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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.

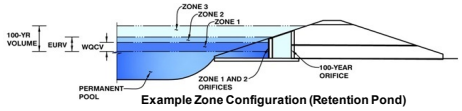
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.01	0.16
	0:15:00	0.00	0.00	0.46	0.76	0.91	0.61	0.75	0.74	1.03
	0:20:00	0.00	0.00	1.50	1.97	2.26	1.41	1.63	1.76	2.26
	0:25:00	0.00	0.00	2.89	3.76	4.35	2.84	3.24	3.44	4.36
	0:30:00	0.00	0.00	2.94	3.70	4.16	5.17	5.88	6.50	8.22
	0:35:00	0.00	0.00	2.37	2.95	3.31	4.92	5.59	6.57	8.28
	0:40:00	0.00	0.00	1.89	2.31	2.59	4.23	4.80	5.58	7.04
	0:45:00	0.00	0.00	1.44	1.83	2.08	3.33	3.78	4.58	5.77
	0:50:00	0.00	0.00	1.13	1.49	1.66	2.77	3.14	3.73	4.71
	0:55:00	0.00	0.00	0.89	1.16	1.32	2.14	2.42	3.00	3.78
	1:00:00	0.00	0.00	0.72	0.93	1.09	1.67	1.89	2.45	3.08
	1:05:00	0.00	0.00	0.64	0.83	0.99	1.34	1.52	2.05	2.58
	1:10:00	0.00	0.00	0.54	0.80	0.97	1.10	1.24	1.53	1.93
	1:15:00	0.00	0.00	0.48	0.74	0.96	0.96	1.09	1.24	1.56
	1:20:00	0.00	0.00	0.45	0.67	0.87	0.81	0.92	0.94	1.18
	1:25:00	0.00	0.00	0.43	0.63	0.76	0.73	0.82	0.76	0.95
	1:30:00	0.00	0.00	0.42	0.60	0.68	0.62	0.70	0.65	0.81
	1:35:00	0.00	0.00	0.41	0.59	0.63	0.56	0.63	0.58	0.72
	1:40:00	0.00	0.00	0.40	0.51	0.60	0.52	0.58	0.54	0.67
	1:45:00	0.00	0.00	0.40	0.46	0.58	0.50	0.56	0.52	0.65
	1:50:00	0.00	0.00	0.40	0.43	0.57	0.48	0.54	0.51	0.64
	1:55:00	0.00	0.00	0.33	0.41	0.54	0.48	0.54	0.51	0.64
	2:00:00	0.00	0.00	0.28	0.38	0.48	0.47	0.53	0.51	0.64
	2:05:00	0.00	0.00	0.17	0.23	0.30	0.30	0.33	0.32	0.40
	2:10:00	0.00	0.00	0.10	0.14	0.18	0.18	0.21	0.20	0.25
	2:15:00	0.00	0.00	0.06	0.08	0.11	0.11	0.12	0.12	0.14
	2:20:00	0.00	0.00	0.03	0.05	0.06	0.06	0.07	0.07	0.08
	2:25:00	0.00	0.00	0.01	0.02	0.03	0.03	0.04	0.03	0.04
	2:30:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Willowind Commercial

Basin ID: Lot 1 Pond1



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	SF	
Watershed Area =	0.80	acres
Watershed Length =	190	ft
Watershed Length to Centroid =	100	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	91.70%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	12.0	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) =	0.022	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.100	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.064	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.52 in.) =	0.083	acre-feet	1.52	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.097	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.113	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.128	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.146	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.185	acre-feet		inches
Approximate 2-yr Detention Volume =	0.066	acre-feet		
Approximate 5-yr Detention Volume =	0.087	acre-feet		
Approximate 10-yr Detention Volume =	0.102	acre-feet		
Approximate 25-yr Detention Volume =	0.120	acre-feet		
Approximate 50-yr Detention Volume =	0.130	acre-feet		
Approximate 100-yr Detention Volume =	0.139	acre-feet		

Define Zones and Basin Geometry

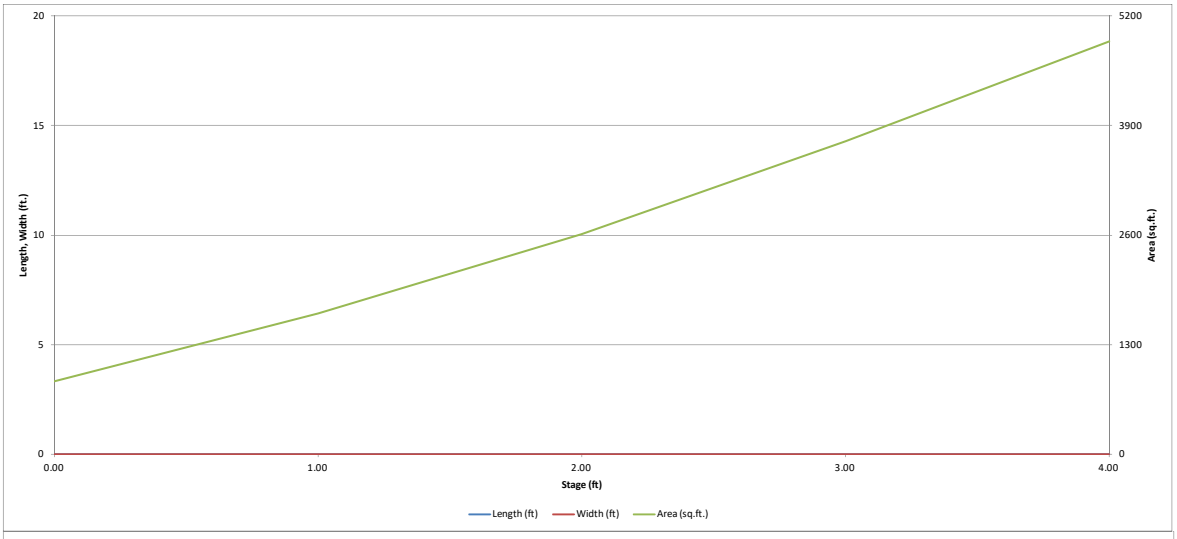
Zone 1 Volume (WQCV) =	0.022	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.078	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.039	acre-feet
Total Detention Basin Volume =	0.139	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	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

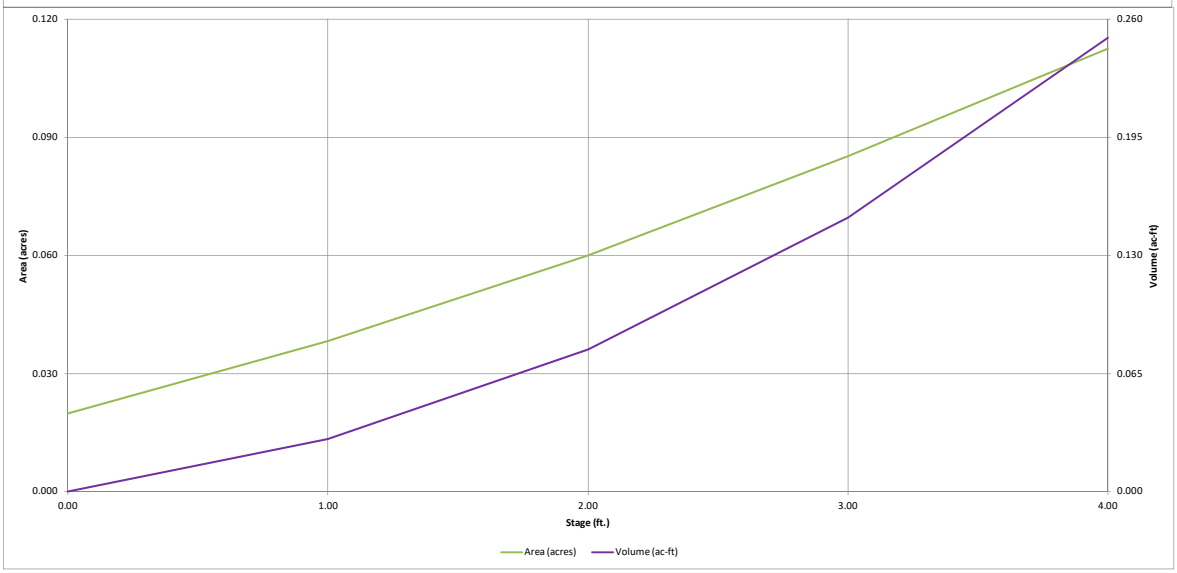
Depth Increment = ft

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)
Media Surface	--	0.00	--	--	--	865	0.020		
	--	1.00	--	--	--	1,668	0.038	1,266	0.029
	--	2.00	--	--	--	2,614	0.060	3,407	0.078
	--	3.00	--	--	--	3,716	0.085	6,572	0.151
	--	4.00	--	--	--	4,900	0.112	10,880	0.250

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



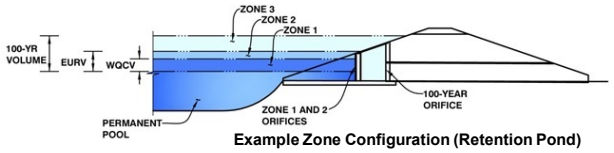


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Willowind Commercial**

Basin ID: **Pond1**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.82	0.022	Filtration Media
Zone 2 (EURV)	2.37	0.079	Filtration Media
Zone 3 (100-year)	2.89	0.040	Weir&Pipe (Restrict)
Total (all zones)		0.141	

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

Underdrain Orifice Invert Depth =	2.50	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.70	inches	Underdrain Orifice Centroid =	0.03	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	N/A	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 =	N/A	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

Calculated Parameters for Plate

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

	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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)	Vertical Orifice Area =	N/A	N/A
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
Vertical Orifice Diameter =	N/A	N/A	inches			

Calculated Parameters for Vertical Orif

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 =	2.37	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	2.37	N/A
Overflow Weir Front Edge Length =	2.91	N/A	feet	Overflow Weir Slope Length =	2.91	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	113.89	N/A
Horiz. Length of Weir Sides =	2.91	N/A	feet	Overflow Grate Open Area w/o Debris =	5.89	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	2.95	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow W

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 =	2.75	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.05	N/A
Outlet Pipe Diameter =	15.00	N/A	inches	Outlet Orifice Centroid =	0.06	N/A
Restrictor Plate Height Above Pipe Invert =	1.30		inches	Half-Central Angle of Restrictor Plate on Pipe =	0.60	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.65	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.16	feet
Spillway Crest Length =	15.00	feet	Stage at Top of Freeboard =	3.81	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.11	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.23	acre-ft

Calculated Parameters for Spillway

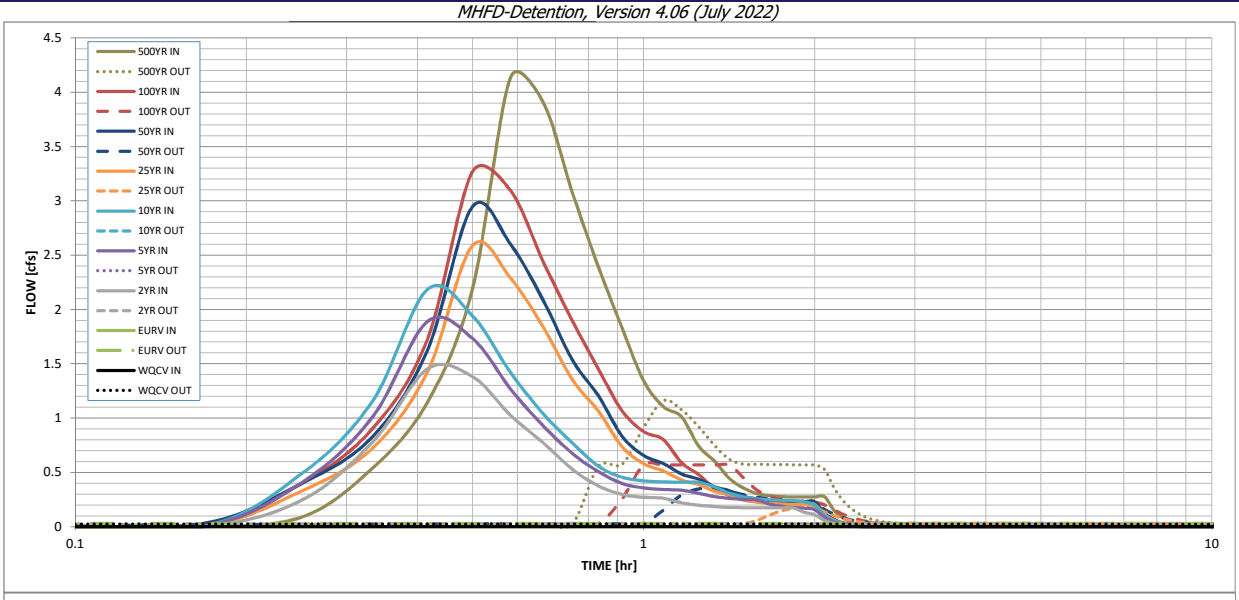
Routed Hydrograph Results

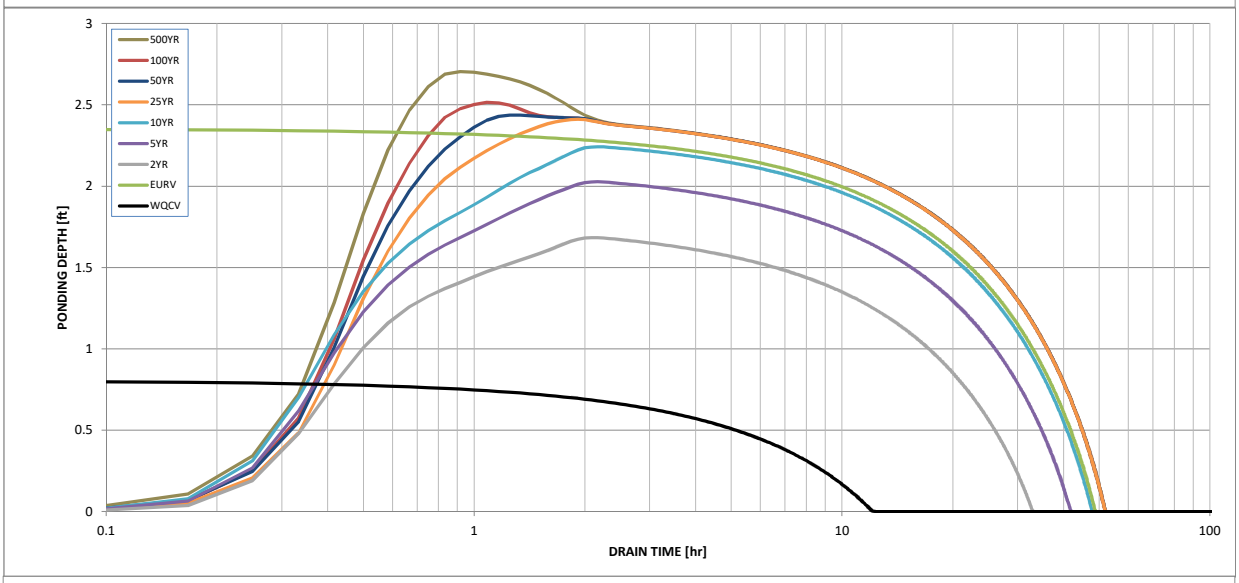
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AI

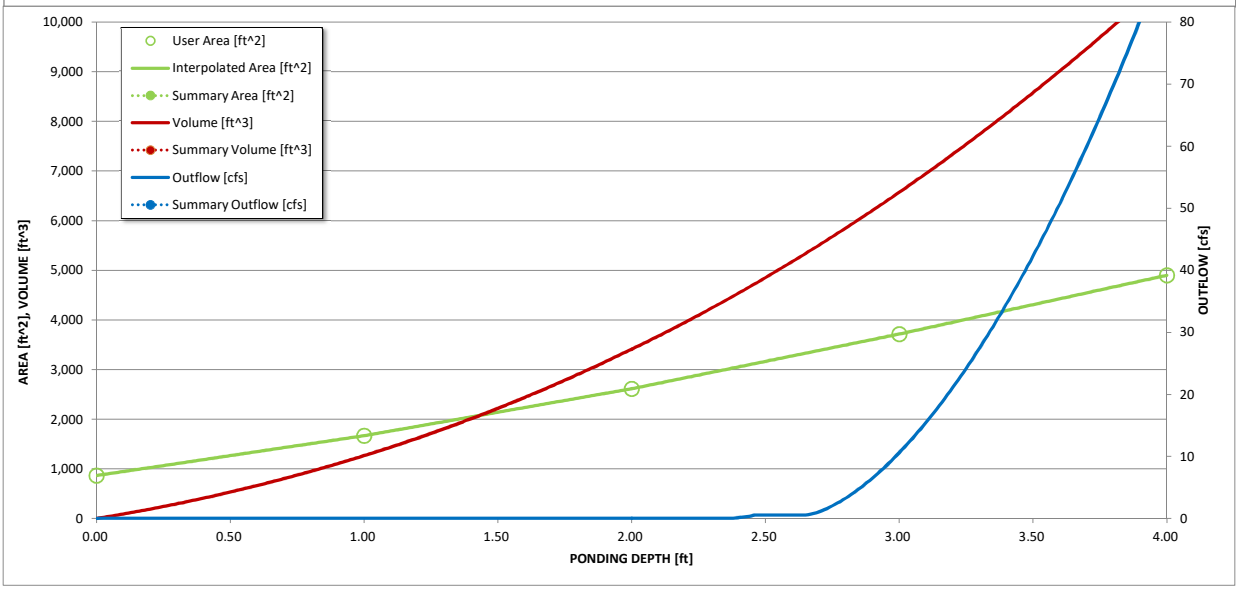
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.52	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.022	0.101	0.065	0.084	0.098	0.114	0.130	0.147
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.065	0.084	0.098	0.114	0.130	0.147
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.2	0.4	0.6
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	0.03	0.25	0.48	0.79
Peak Inflow Q (cfs) =	N/A	N/A	1.5	1.9	2.2	2.6	2.9	3.3
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.6	1.2	0.9	0.9	0.9
Structure Controlling Flow =	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.1	0.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	12	47	32	40	46	50	50	49
Time to Drain 99% of Inflow Volume (hours) =	**12**	48	33	41	47	51	51	51
Maximum Ponding Depth (ft) =	0.81	2.36	1.68	2.03	2.24	2.41	2.44	2.51
Area at Maximum Ponding Depth (acres) =	0.03	0.07	0.05	0.06	0.07	0.07	0.07	0.07
Maximum Volume Stored (acre-ft) =	0.022	0.101	0.060	0.079	0.093	0.105	0.106	0.112

DETENTION BASIN OUTLET STRUCTURE DESIGN

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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.

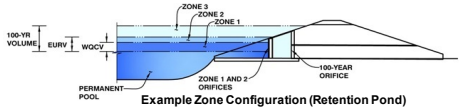
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.09
	0:15:00	0.00	0.00	0.24	0.40	0.49	0.33	0.40	0.40	0.54
	0:20:00	0.00	0.00	0.78	1.01	1.15	0.72	0.83	0.90	1.15
	0:25:00	0.00	0.00	1.45	1.89	2.19	1.42	1.62	1.72	2.19
	0:30:00	0.00	0.00	1.38	1.73	1.94	2.59	2.95	3.26	4.14
	0:35:00	0.00	0.00	1.03	1.27	1.42	2.29	2.60	3.09	3.90
	0:40:00	0.00	0.00	0.77	0.93	1.04	1.83	2.08	2.44	3.07
	0:45:00	0.00	0.00	0.53	0.67	0.77	1.35	1.53	1.89	2.39
	0:50:00	0.00	0.00	0.37	0.51	0.56	1.06	1.20	1.45	1.83
	0:55:00	0.00	0.00	0.30	0.40	0.46	0.74	0.83	1.07	1.35
	1:00:00	0.00	0.00	0.27	0.36	0.42	0.58	0.66	0.88	1.11
	1:05:00	0.00	0.00	0.26	0.34	0.41	0.51	0.58	0.80	1.01
	1:10:00	0.00	0.00	0.22	0.34	0.41	0.43	0.49	0.59	0.74
	1:15:00	0.00	0.00	0.20	0.31	0.41	0.39	0.44	0.48	0.60
	1:20:00	0.00	0.00	0.19	0.28	0.37	0.33	0.37	0.35	0.44
	1:25:00	0.00	0.00	0.18	0.26	0.31	0.29	0.33	0.28	0.36
	1:30:00	0.00	0.00	0.17	0.25	0.28	0.25	0.28	0.24	0.31
	1:35:00	0.00	0.00	0.17	0.25	0.26	0.23	0.25	0.23	0.29
	1:40:00	0.00	0.00	0.17	0.21	0.25	0.21	0.24	0.22	0.28
	1:45:00	0.00	0.00	0.17	0.19	0.24	0.21	0.23	0.22	0.27
	1:50:00	0.00	0.00	0.17	0.18	0.24	0.20	0.23	0.22	0.27
	1:55:00	0.00	0.00	0.13	0.17	0.23	0.20	0.23	0.22	0.27
	2:00:00	0.00	0.00	0.11	0.16	0.20	0.20	0.23	0.22	0.27
	2:05:00	0.00	0.00	0.06	0.08	0.11	0.11	0.12	0.12	0.15
	2:10:00	0.00	0.00	0.03	0.04	0.06	0.06	0.06	0.06	0.08
	2:15:00	0.00	0.00	0.01	0.02	0.03	0.03	0.03	0.03	0.04
	2:20:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02
	2:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Willowind Commercial

Basin ID: Pond 2



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	SF	
Watershed Area =	0.18	acres
Watershed Length =	175	ft
Watershed Length to Centroid =	90	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	95.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	12.0	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) =	0.005	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.024	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.016	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.52 in.) =	0.021	acre-feet	1.52	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.024	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.028	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.032	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.036	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.045	acre-feet		inches
Approximate 2-yr Detention Volume =	0.016	acre-feet		
Approximate 5-yr Detention Volume =	0.020	acre-feet		
Approximate 10-yr Detention Volume =	0.024	acre-feet		
Approximate 25-yr Detention Volume =	0.028	acre-feet		
Approximate 50-yr Detention Volume =	0.031	acre-feet		
Approximate 100-yr Detention Volume =	0.033	acre-feet		

Define Zones and Basin Geometry

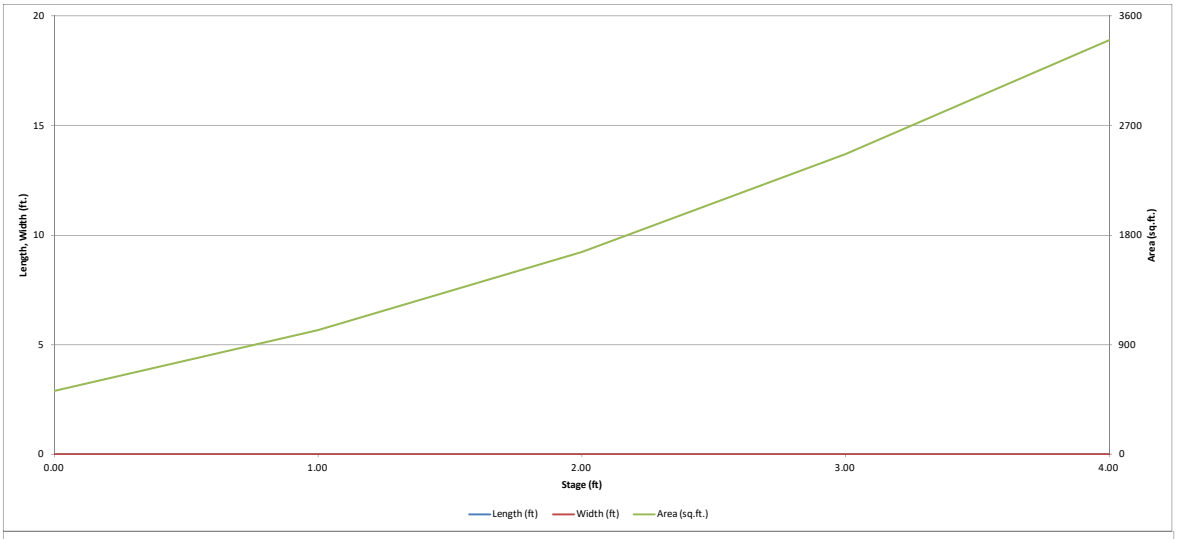
Zone 1 Volume (WQCV) =	0.005	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.018	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.009	acre-feet
Total Detention Basin Volume =	0.033	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	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

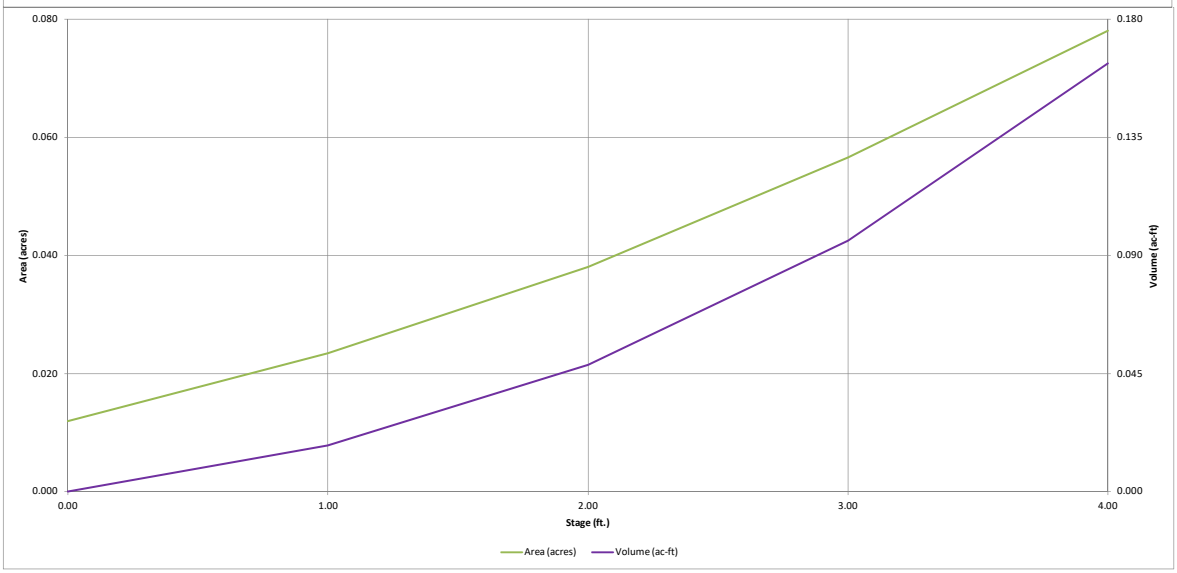
Depth Increment = ft

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)
Media Surface	--	0.00	--	--	--	522	0.012		
	--	1.00	--	--	--	1,019	0.023	770	0.018
	--	2.00	--	--	--	1,660	0.038	2,110	0.048
	--	3.00	--	--	--	2,465	0.057	4,172	0.096
	--	4.00	--	--	--	3,400	0.078	7,105	0.163

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



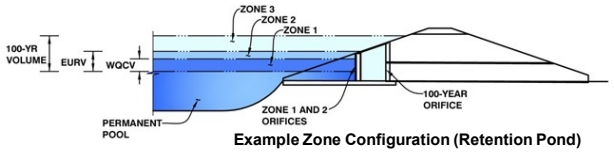


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Willowind Commercial**

Basin ID: **Pond 2**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.38	0.005	Filtration Media
Zone 2 (EURV)	1.24	0.018	Filtration Media
Zone 3 (100-year)	1.55	0.009	Circular Orifice
Total (all zones)		0.033	

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

Underdrain Orifice Invert Depth =	2.50	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.34	inches	Underdrain Orifice Centroid =	0.01	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	N/A	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 =	N/A	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

Calculated Parameters for Plate

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

	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 3 Circular	Not Selected				Zone 3 Circular	Not Selected
Invert of Vertical Orifice =	1.24	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =		0.09	N/A
Depth at top of Zone using Vertical Orifice =	2.00	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =		0.17	N/A
Vertical Orifice Diameter =	4.00	N/A	inches				

Calculated Parameters for Vertical Orif

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

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

Calculated Parameters for Overflow W

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

	Not Selected	Not Selected				Not Selected	Not Selected
Depth to Invert of Outlet Pipe =	N/A	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =		N/A	N/A
Circular Orifice Diameter =	N/A	N/A	inches	Outlet Orifice Centroid =		N/A	N/A
				Half-Central Angle of Restrictor Plate on Pipe =		N/A	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	1.60	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.07	feet
Spillway Crest Length =	10.00	feet	Stage at Top of Freeboard =	2.67	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.05	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.08	acre-ft

Calculated Parameters for Spillway

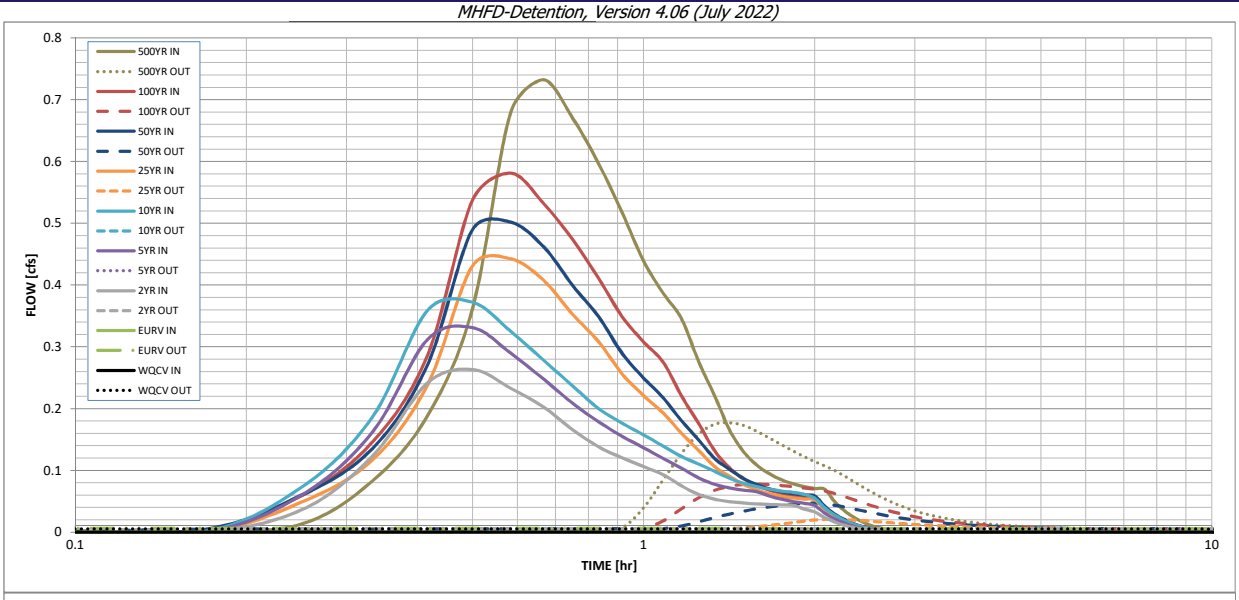
Routed Hydrograph Results

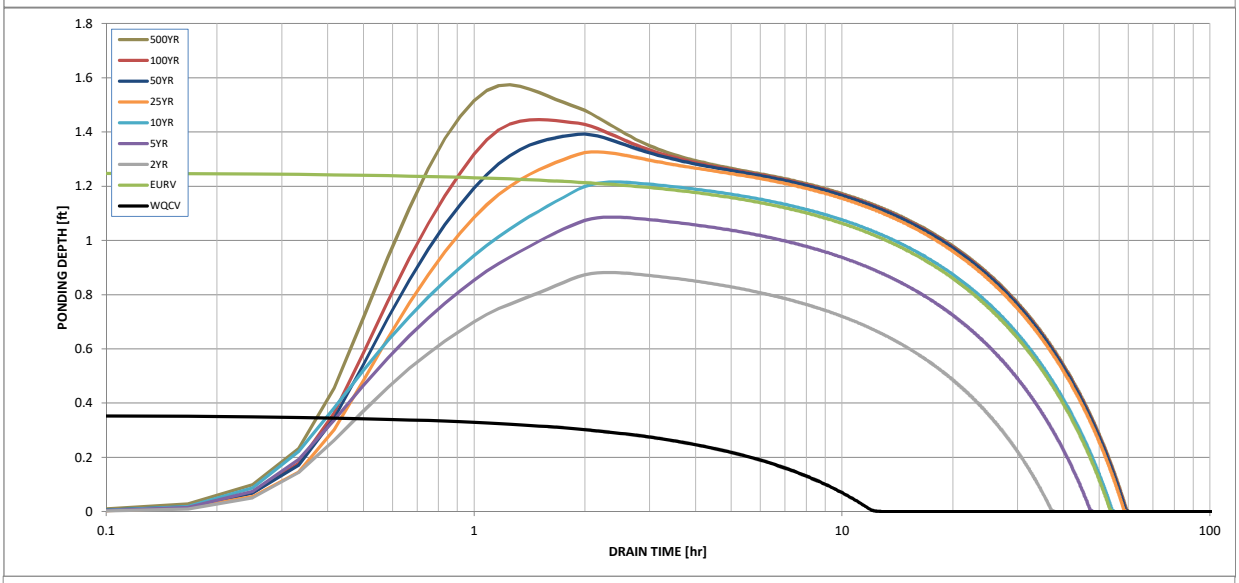
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AI

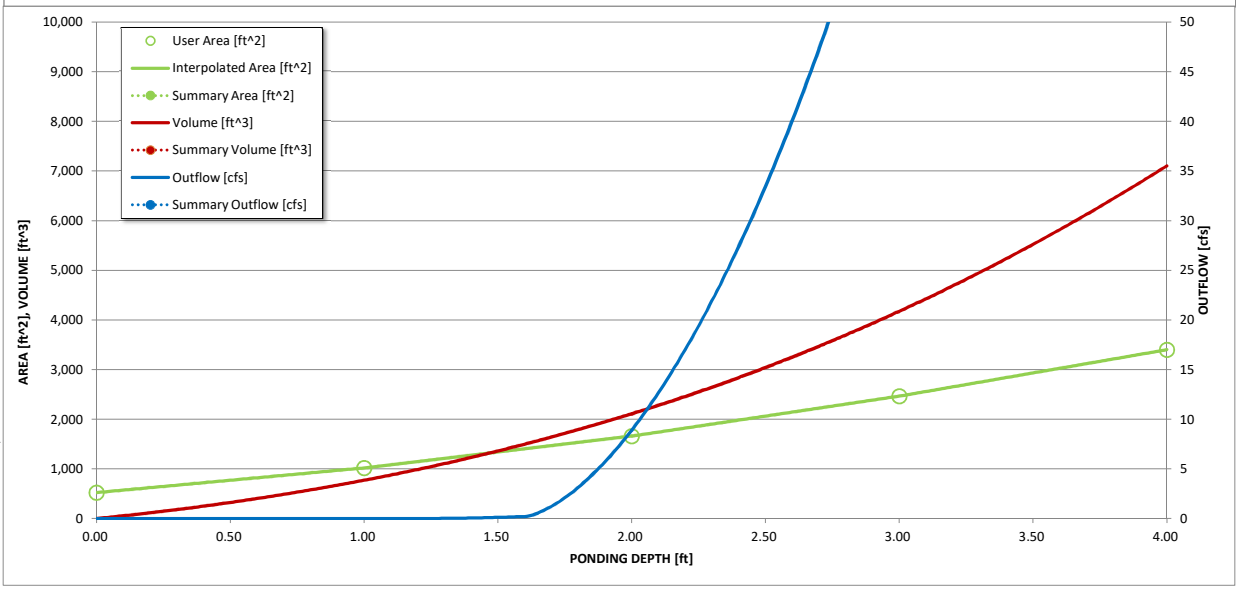
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.52	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.005	0.024	0.016	0.021	0.024	0.028	0.032	0.036
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.016	0.021	0.024	0.028	0.032	0.036
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.0	0.0	0.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.00	0.00	0.13	0.27	0.46
Peak Inflow Q (cfs) =	N/A	N/A	0.3	0.3	0.4	0.4	0.5	0.6
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	#DIV/0!	#DIV/0!	0.9	1.0	0.9
Structure Controlling Flow =	Filtration Media	Vertical Orifice 1	Filtration Media	Filtration Media	Filtration Media	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	12	52	36	46	53	57	57	57
Time to Drain 99% of Inflow Volume (hours) =	**12**	53	37	47	54	58	58	59
Maximum Ponding Depth (ft) =	0.36	1.26	0.88	1.09	1.22	1.33	1.39	1.45
Area at Maximum Ponding Depth (acres) =	0.02	0.03	0.02	0.02	0.03	0.03	0.03	0.03
Maximum Volume Stored (acre-ft) =	0.005	0.024	0.015	0.020	0.023	0.026	0.028	0.029

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







1

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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

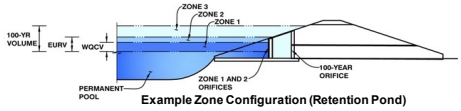
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	0:15:00	0.00	0.00	0.04	0.06	0.07	0.05	0.06	0.06	0.08
	0:20:00	0.00	0.00	0.12	0.16	0.19	0.12	0.14	0.15	0.19
	0:25:00	0.00	0.00	0.24	0.31	0.36	0.24	0.27	0.29	0.36
	0:30:00	0.00	0.00	0.26	0.33	0.37	0.43	0.49	0.54	0.68
	0:35:00	0.00	0.00	0.23	0.29	0.33	0.44	0.50	0.58	0.73
	0:40:00	0.00	0.00	0.20	0.25	0.28	0.41	0.46	0.53	0.67
	0:45:00	0.00	0.00	0.17	0.21	0.24	0.35	0.40	0.47	0.60
	0:50:00	0.00	0.00	0.14	0.18	0.20	0.31	0.35	0.41	0.52
	0:55:00	0.00	0.00	0.12	0.16	0.18	0.26	0.29	0.35	0.44
	1:00:00	0.00	0.00	0.11	0.14	0.16	0.22	0.25	0.31	0.39
	1:05:00	0.00	0.00	0.09	0.12	0.14	0.19	0.22	0.28	0.35
	1:10:00	0.00	0.00	0.07	0.10	0.12	0.16	0.18	0.22	0.28
	1:15:00	0.00	0.00	0.06	0.09	0.11	0.13	0.15	0.18	0.22
	1:20:00	0.00	0.00	0.05	0.08	0.10	0.11	0.12	0.13	0.17
	1:25:00	0.00	0.00	0.05	0.07	0.09	0.09	0.10	0.10	0.13
	1:30:00	0.00	0.00	0.05	0.07	0.08	0.08	0.09	0.09	0.11
	1:35:00	0.00	0.00	0.05	0.07	0.07	0.07	0.08	0.08	0.09
	1:40:00	0.00	0.00	0.04	0.06	0.07	0.06	0.07	0.07	0.08
	1:45:00	0.00	0.00	0.04	0.05	0.07	0.06	0.07	0.06	0.08
	1:50:00	0.00	0.00	0.04	0.05	0.06	0.06	0.06	0.06	0.07
	1:55:00	0.00	0.00	0.04	0.05	0.06	0.05	0.06	0.06	0.07
	2:00:00	0.00	0.00	0.03	0.04	0.06	0.05	0.06	0.06	0.07
	2:05:00	0.00	0.00	0.02	0.03	0.04	0.04	0.04	0.04	0.05
	2:10:00	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.03	0.04
	2:15:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	2:20:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	2:25:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	2:30:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Willowind Commercial**

Basin ID: **Pond 3**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**SF**	
Watershed Area =	1.03	acres
Watershed Length =	220	ft
Watershed Length to Centroid =	110	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	95.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	12.0	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) =	0.031	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.135	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.086	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.52 in.) =	0.112	acre-feet	1.52	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.130	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.151	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.171	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.194	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.244	acre-feet		inches
Approximate 2-yr Detention Volume =	0.089	acre-feet		
Approximate 5-yr Detention Volume =	0.117	acre-feet		
Approximate 10-yr Detention Volume =	0.137	acre-feet		
Approximate 25-yr Detention Volume =	0.161	acre-feet		
Approximate 50-yr Detention Volume =	0.175	acre-feet		
Approximate 100-yr Detention Volume =	0.186	acre-feet		

Define Zones and Basin Geometry

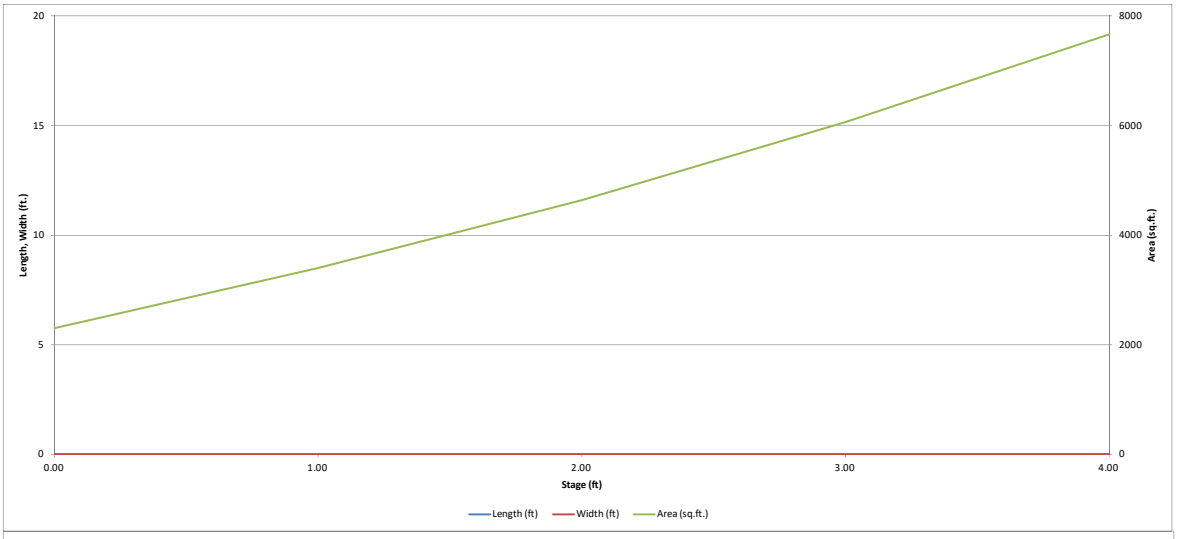
Zone 1 Volume (WQCV) =	0.031	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.104	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.051	acre-feet
Total Detention Basin Volume =	0.186	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	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

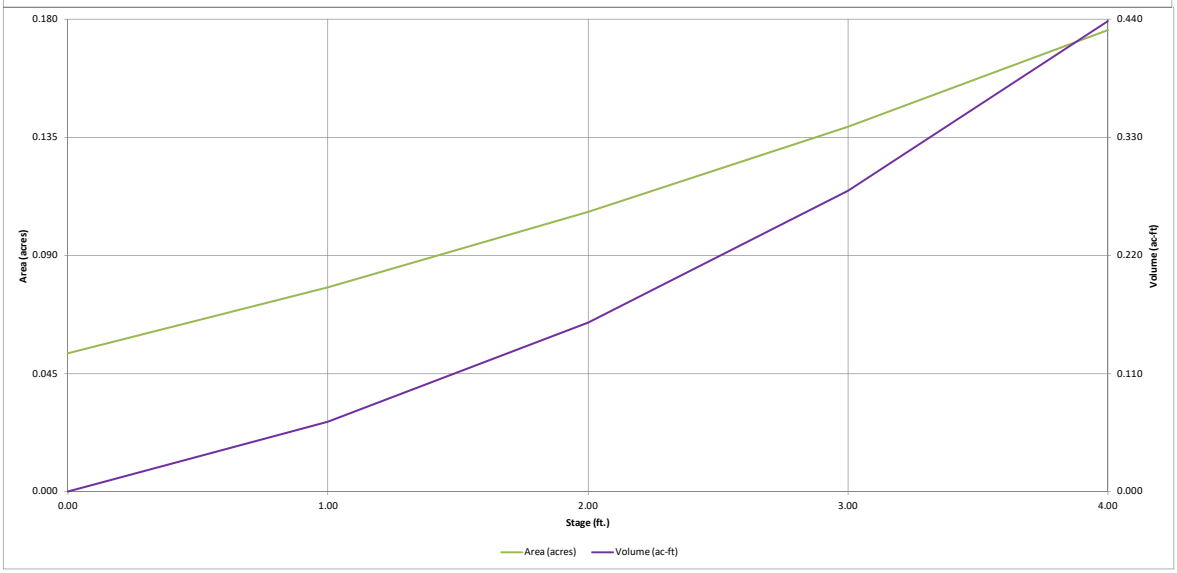
Depth Increment = ft

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)
Media Surface	--	0.00	--	--	--	2,300	0.053		
	--	1.00	--	--	--	3,396	0.078	2,848	0.065
	--	2.00	--	--	--	4,641	0.107	6,866	0.158
	--	3.00	--	--	--	6,063	0.139	12,218	0.280
	--	4.00	--	--	--	7,667	0.176	19,083	0.438

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



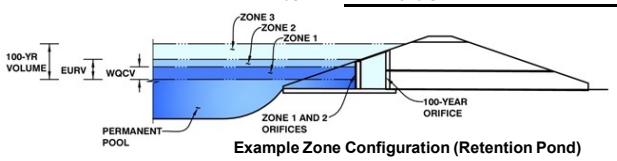


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Willowind Commercial**

Basin ID: **Pond 3**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.52	0.031	Filtration Media
Zone 2 (EURV)	1.79	0.104	Filtration Media
Zone 3 (100-year)	2.26	0.051	Weir&Pipe (Restrict)
Total (all zones)		0.186	

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

Underdrain Orifice Invert Depth =	2.50	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.84	inches	Underdrain Orifice Centroid =	0.04	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	N/A	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 =	N/A	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

Calculated Parameters for Plate

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

	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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)	Vertical Orifice Area =	N/A	N/A
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
Vertical Orifice Diameter =	N/A	N/A	inches			

Calculated Parameters for Vertical Orif

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			Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	1.79	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	1.79	N/A
Overflow Weir Front Edge Length =	2.91	N/A	feet	Overflow Weir Slope Length =	2.91	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	72.82	N/A
Horiz. Length of Weir Sides =	2.91	N/A	feet	Overflow Grate Open Area w/o Debris =	5.89	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	2.95	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow W

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected
Depth to Invert of Outlet Pipe =	2.75	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.08	N/A
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.08	N/A
Restrictor Plate Height Above Pipe Invert =	1.65		inches	Half-Central Angle of Restrictor Plate on Pipe =	0.62	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.20	feet
Spillway Crest Length =	15.00	feet	Stage at Top of Freeboard =	3.20	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.15	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.31	acre-ft

Calculated Parameters for Spillway

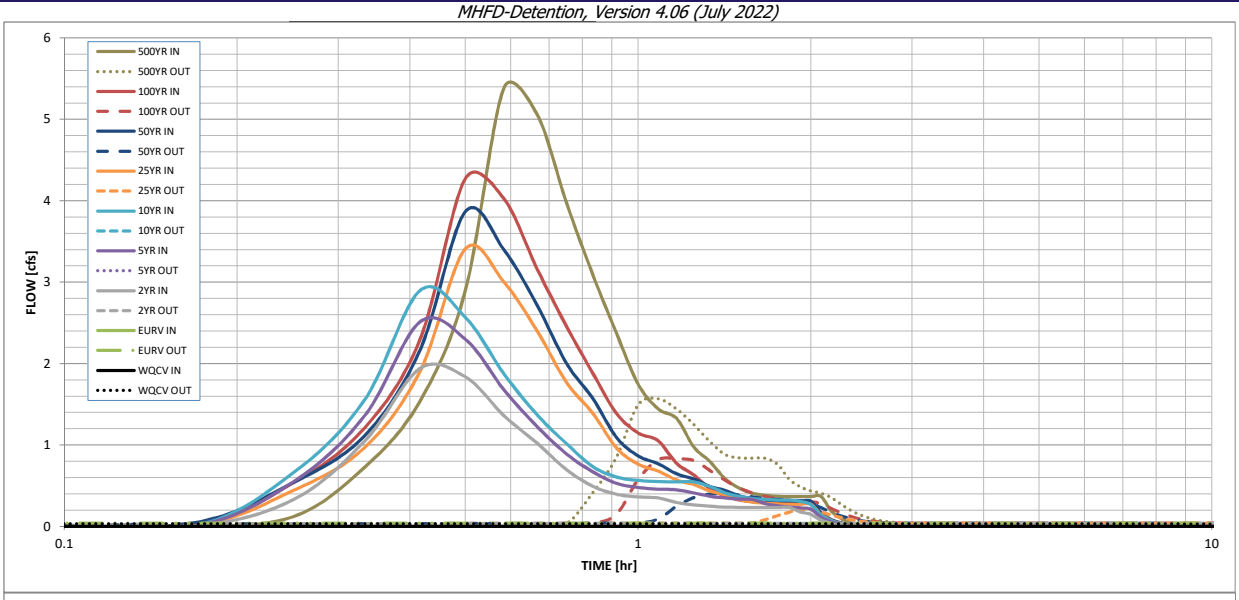
Routed Hydrograph Results

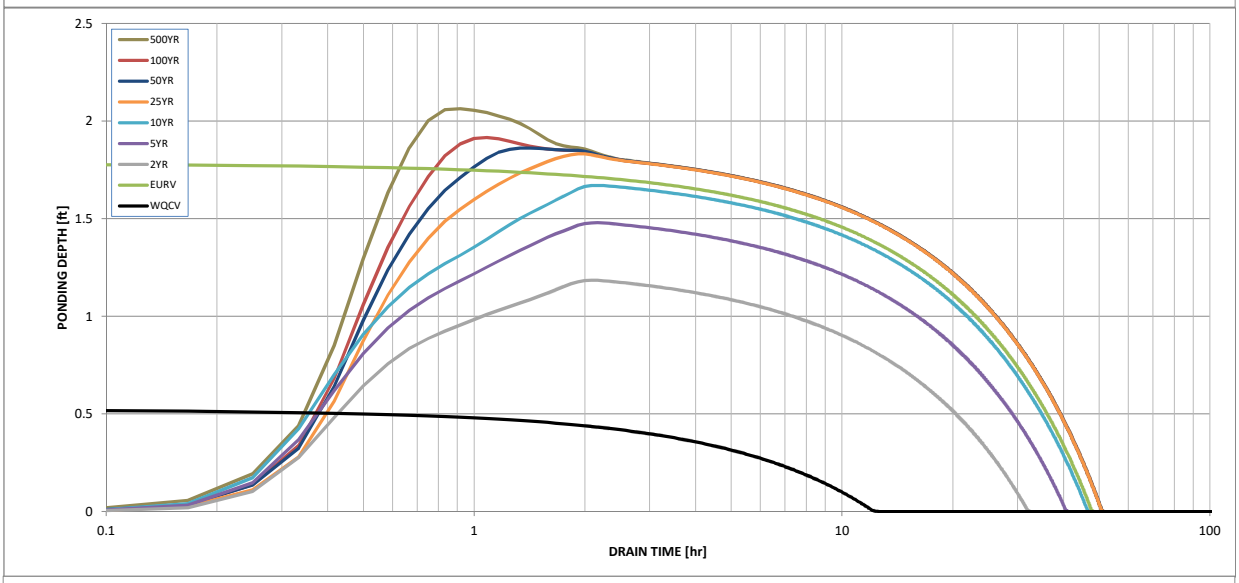
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AI

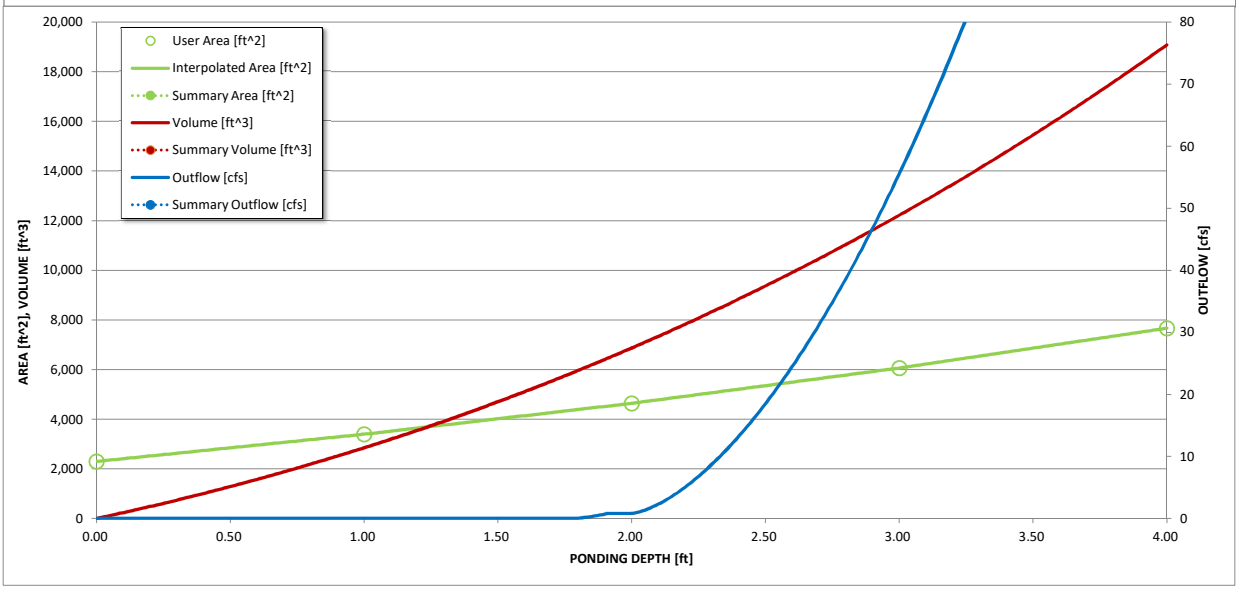
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.52	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.031	0.135	0.086	0.112	0.130	0.151	0.171	0.194
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.086	0.112	0.130	0.151	0.171	0.194
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.3	0.5	0.8
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	0.03	0.25	0.48	0.78
Peak Inflow Q (cfs) =	N/A	N/A	1.9	2.5	2.9	3.4	3.9	4.3
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.7	1.3	0.8	0.8	1.0
Structure Controlling Flow =	Filtration Media	Overflow Weir 1	Filtration Media	Filtration Media	Filtration Media	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.1	0.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	12	46	31	39	45	49	49	49
Time to Drain 99% of Inflow Volume (hours) =	**12**	47	32	40	46	50	50	50
Maximum Ponding Depth (ft) =	0.53	1.79	1.18	1.48	1.67	1.83	1.86	1.92
Area at Maximum Ponding Depth (acres) =	0.07	0.10	0.08	0.09	0.10	0.10	0.10	0.10
Maximum Volume Stored (acre-ft) =	0.032	0.136	0.080	0.105	0.124	0.140	0.143	0.148

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.

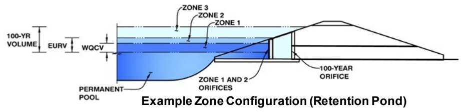
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.12
	0:15:00	0.00	0.00	0.33	0.54	0.65	0.44	0.53	0.53	0.72
	0:20:00	0.00	0.00	1.05	1.35	1.55	0.97	1.11	1.21	1.54
	0:25:00	0.00	0.00	1.94	2.51	2.90	1.91	2.17	2.30	2.90
	0:30:00	0.00	0.00	1.84	2.30	2.57	3.41	3.87	4.27	5.38
	0:35:00	0.00	0.00	1.36	1.68	1.88	3.00	3.40	4.03	5.06
	0:40:00	0.00	0.00	1.02	1.23	1.37	2.40	2.72	3.17	3.97
	0:45:00	0.00	0.00	0.70	0.89	1.02	1.77	2.00	2.46	3.09
	0:50:00	0.00	0.00	0.49	0.67	0.73	1.39	1.57	1.89	2.37
	0:55:00	0.00	0.00	0.40	0.53	0.61	0.97	1.09	1.39	1.75
	1:00:00	0.00	0.00	0.36	0.48	0.57	0.77	0.86	1.15	1.44
	1:05:00	0.00	0.00	0.35	0.46	0.55	0.68	0.77	1.05	1.33
	1:10:00	0.00	0.00	0.29	0.45	0.55	0.57	0.64	0.78	0.98
	1:15:00	0.00	0.00	0.26	0.41	0.55	0.51	0.58	0.63	0.80
	1:20:00	0.00	0.00	0.25	0.37	0.49	0.43	0.49	0.47	0.59
	1:25:00	0.00	0.00	0.24	0.35	0.41	0.39	0.44	0.38	0.47
	1:30:00	0.00	0.00	0.23	0.34	0.37	0.33	0.37	0.33	0.41
	1:35:00	0.00	0.00	0.23	0.33	0.34	0.30	0.34	0.31	0.38
	1:40:00	0.00	0.00	0.23	0.28	0.33	0.28	0.32	0.30	0.37
	1:45:00	0.00	0.00	0.23	0.25	0.32	0.28	0.31	0.29	0.37
	1:50:00	0.00	0.00	0.23	0.24	0.32	0.27	0.31	0.29	0.37
	1:55:00	0.00	0.00	0.18	0.23	0.31	0.27	0.31	0.29	0.37
	2:00:00	0.00	0.00	0.15	0.21	0.27	0.27	0.31	0.29	0.37
	2:05:00	0.00	0.00	0.08	0.11	0.14	0.14	0.16	0.16	0.19
	2:10:00	0.00	0.00	0.04	0.06	0.07	0.08	0.09	0.08	0.10
	2:15:00	0.00	0.00	0.02	0.03	0.03	0.04	0.04	0.04	0.05
	2:20:00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02
	2:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Willowind Commercial

Basin ID: Pond 4



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	SF	
Watershed Area =	1.11	acres
Watershed Length =	250	ft
Watershed Length to Centroid =	125	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	95.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	12.0	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) =	0.033	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.146	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.094	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.52 in.) =	0.123	acre-feet	1.52	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.142	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.165	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.187	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.212	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.267	acre-feet		inches
Approximate 2-yr Detention Volume =	0.096	acre-feet		
Approximate 5-yr Detention Volume =	0.126	acre-feet		
Approximate 10-yr Detention Volume =	0.148	acre-feet		
Approximate 25-yr Detention Volume =	0.173	acre-feet		
Approximate 50-yr Detention Volume =	0.188	acre-feet		
Approximate 100-yr Detention Volume =	0.201	acre-feet		

Define Zones and Basin Geometry

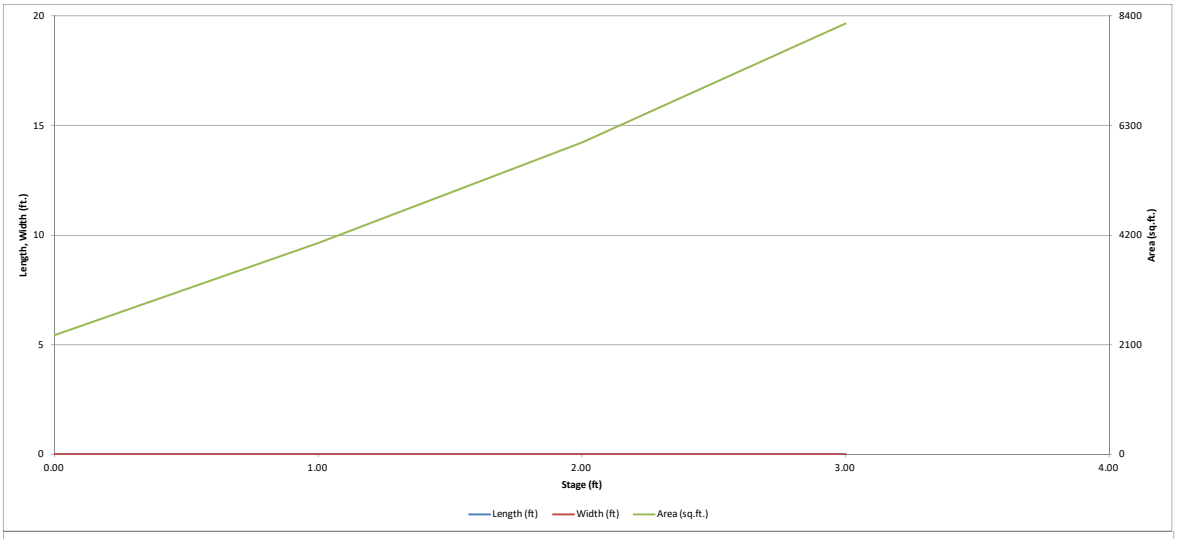
Zone 1 Volume (WQCV) =	0.033	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.112	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.055	acre-feet
Total Detention Basin Volume =	0.201	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	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

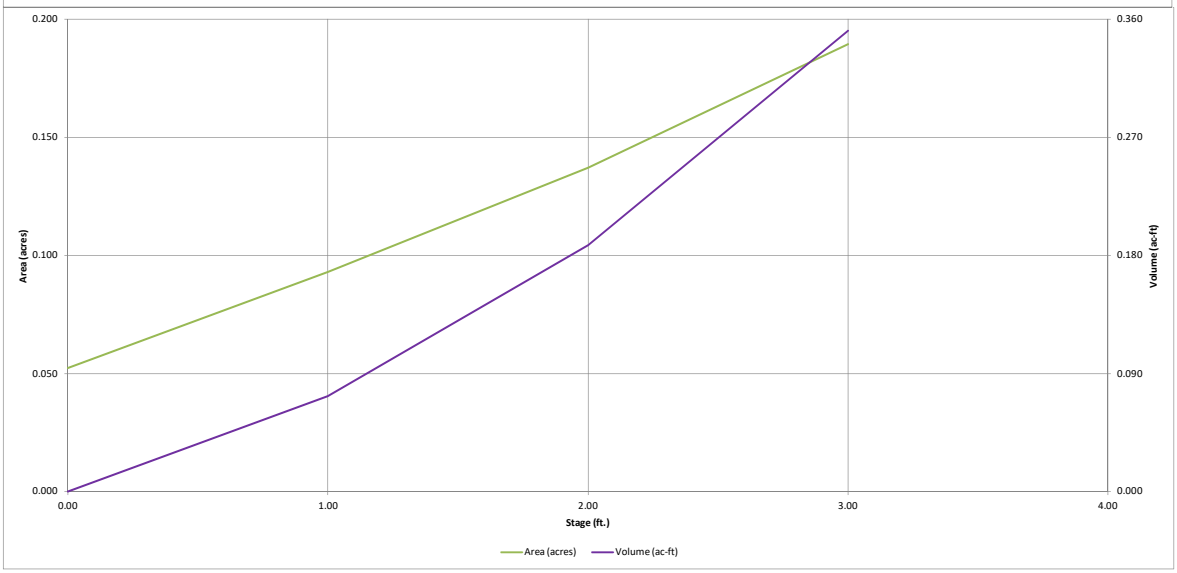
Depth Increment = ft

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)
Media Surface	--	0.00	--	--	--	2,281	0.052		
	--	1.00	--	--	--	4,053	0.093	3,167	0.073
	--	2.00	--	--	--	5,975	0.137	8,181	0.188
	--	3.00	--	--	--	8,256	0.190	15,296	0.351
	--		--	--	--				
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DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



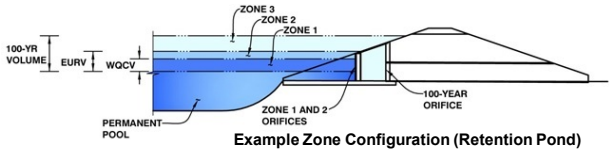


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Willowind Commercial**

Basin ID: **Pond 4**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.53	0.033	Filtration Media
Zone 2 (EURV)	1.68	0.112	Filtration Media
Zone 3 (100-year)	2.10	0.055	Weir&Pipe (Restrict)
Total (all zones)		0.201	

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

Underdrain Orifice Invert Depth =	2.50	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.87	inches	Underdrain Orifice Centroid =	0.04	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	N/A	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 =	N/A	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

Calculated Parameters for Plate

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

	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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)	Vertical Orifice Area =	N/A	N/A
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
Vertical Orifice Diameter =	N/A	N/A	inches			

Calculated Parameters for Vertical Orif

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			Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	1.68	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	1.68	N/A
Overflow Weir Front Edge Length =	2.91	N/A	feet	Overflow Weir Slope Length =	2.91	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	83.79	N/A
Horiz. Length of Weir Sides =	2.91	N/A	feet	Overflow Grate Open Area w/o Debris =	5.89	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	2.95	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow W

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected
Depth to Invert of Outlet Pipe =	2.75	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.07	N/A
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.07	N/A
Restrictor Plate Height Above Pipe Invert =	1.50		inches	Half-Central Angle of Restrictor Plate on Pipe =	0.59	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	1.95	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.20	feet
Spillway Crest Length =	15.00	feet	Stage at Top of Freeboard =	3.15	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.19	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.35	acre-ft

Calculated Parameters for Spillway

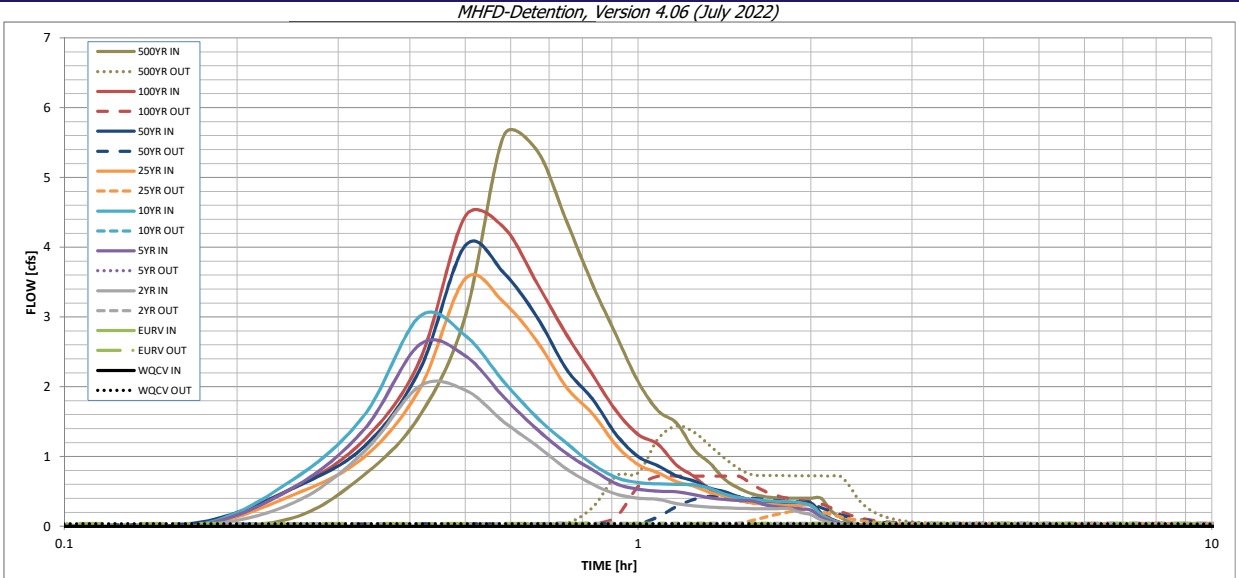
Routed Hydrograph Results

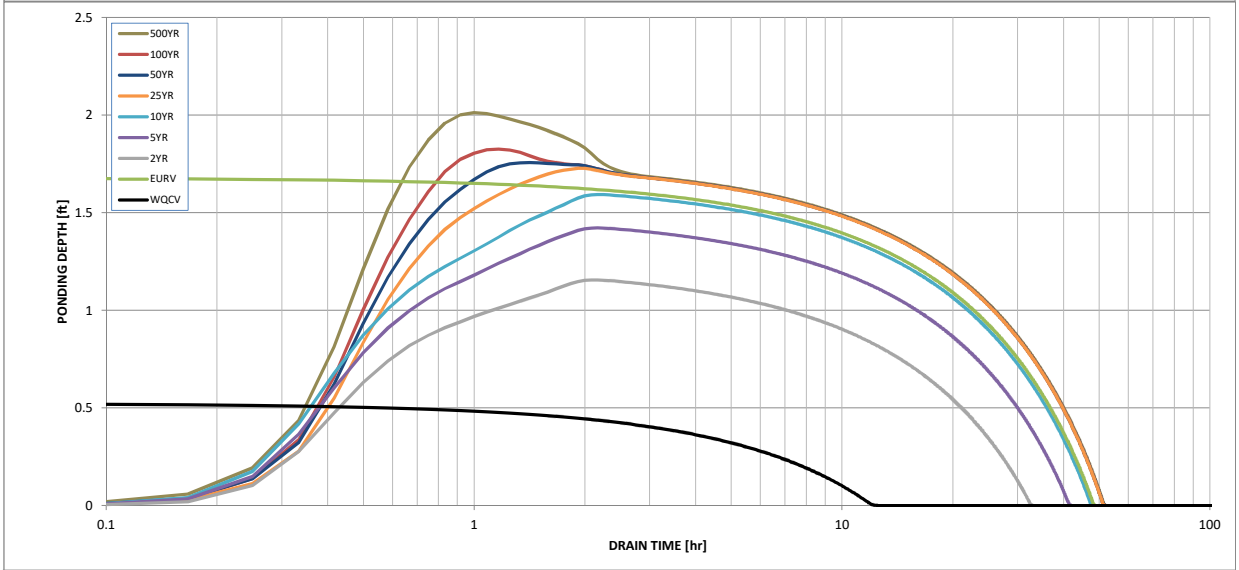
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AI

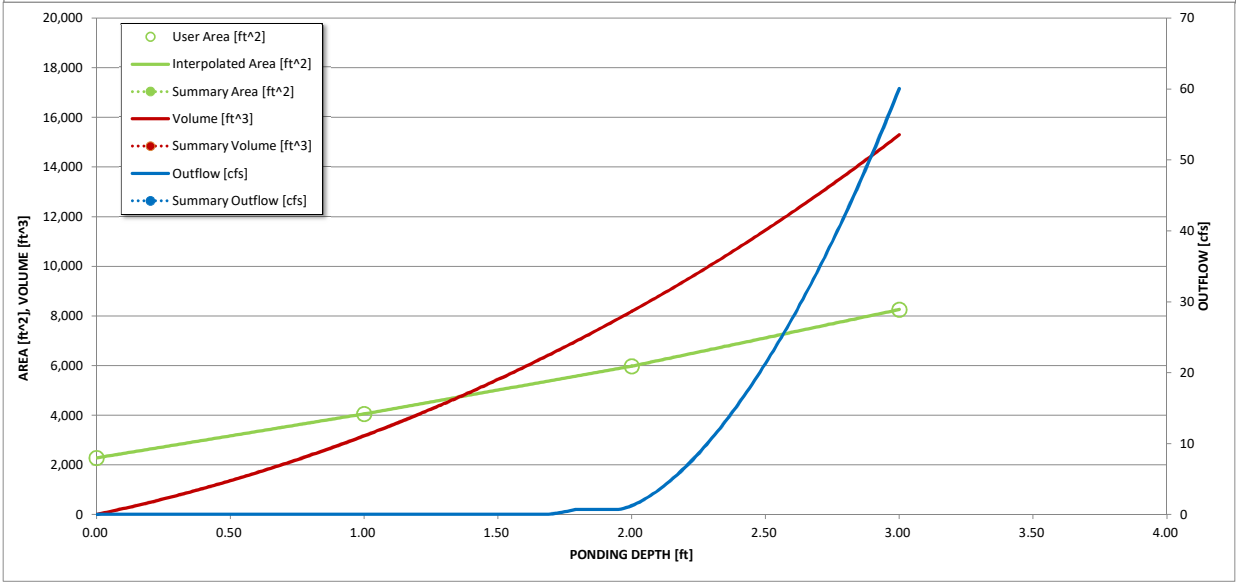
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.52	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.033	0.146	0.094	0.123	0.142	0.165	0.187	0.212
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.094	0.123	0.142	0.165	0.187	0.212
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.3	0.5	0.8
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	0.03	0.23	0.45	0.73
Peak Inflow Q (cfs) =	N/A	N/A	2.0	2.6	3.0	3.6	4.0	4.4
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.8	1.4	0.9	0.9	0.9
Structure Controlling Flow =	Filtration Media	Overflow Weir 1	Filtration Media	Filtration Media	Filtration Media	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.1	0.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	12	47	32	40	46	50	49	49
Time to Drain 99% of Inflow Volume (hours) =	**12**	48	32	41	47	51	51	51
Maximum Ponding Depth (ft) =	0.53	1.68	1.16	1.42	1.59	1.73	1.76	1.83
Area at Maximum Ponding Depth (acres) =	0.07	0.12	0.10	0.11	0.12	0.12	0.13	0.13
Maximum Volume Stored (acre-ft) =	0.033	0.146	0.087	0.116	0.135	0.151	0.155	0.164

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.

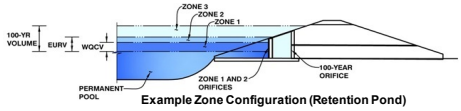
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.12
	0:15:00	0.00	0.00	0.33	0.55	0.67	0.45	0.54	0.54	0.74
	0:20:00	0.00	0.00	1.07	1.39	1.60	1.00	1.15	1.24	1.59
	0:25:00	0.00	0.00	2.01	2.61	3.01	1.98	2.25	2.39	3.02
	0:30:00	0.00	0.00	1.95	2.44	2.73	3.55	4.03	4.45	5.60
	0:35:00	0.00	0.00	1.49	1.85	2.07	3.21	3.63	4.28	5.38
	0:40:00	0.00	0.00	1.15	1.39	1.55	2.65	3.00	3.49	4.37
	0:45:00	0.00	0.00	0.82	1.04	1.19	1.99	2.25	2.75	3.46
	0:50:00	0.00	0.00	0.60	0.81	0.89	1.61	1.82	2.17	2.73
	0:55:00	0.00	0.00	0.46	0.61	0.70	1.16	1.31	1.65	2.07
	1:00:00	0.00	0.00	0.40	0.53	0.63	0.88	1.00	1.32	1.65
	1:05:00	0.00	0.00	0.39	0.50	0.61	0.77	0.86	1.18	1.48
	1:10:00	0.00	0.00	0.32	0.49	0.60	0.64	0.72	0.88	1.10
	1:15:00	0.00	0.00	0.29	0.45	0.60	0.58	0.65	0.72	0.90
	1:20:00	0.00	0.00	0.27	0.41	0.54	0.48	0.54	0.53	0.67
	1:25:00	0.00	0.00	0.26	0.38	0.46	0.44	0.49	0.43	0.54
	1:30:00	0.00	0.00	0.26	0.37	0.41	0.37	0.42	0.37	0.46
	1:35:00	0.00	0.00	0.25	0.36	0.38	0.34	0.38	0.34	0.42
	1:40:00	0.00	0.00	0.25	0.31	0.37	0.32	0.35	0.33	0.41
	1:45:00	0.00	0.00	0.25	0.28	0.36	0.30	0.34	0.32	0.40
	1:50:00	0.00	0.00	0.25	0.26	0.35	0.30	0.34	0.32	0.40
	1:55:00	0.00	0.00	0.20	0.25	0.34	0.30	0.34	0.32	0.40
	2:00:00	0.00	0.00	0.17	0.23	0.30	0.30	0.34	0.32	0.40
	2:05:00	0.00	0.00	0.09	0.13	0.17	0.17	0.19	0.18	0.23
	2:10:00	0.00	0.00	0.05	0.07	0.09	0.09	0.11	0.10	0.13
	2:15:00	0.00	0.00	0.02	0.04	0.05	0.05	0.06	0.05	0.07
	2:20:00	0.00	0.00	0.01	0.02	0.02	0.02	0.03	0.03	0.03
	2:25:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Willowind Commercial

Basin ID: Lot 5 Pond 4A



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	SF	
Watershed Area =	0.83	acres
Watershed Length =	215	ft
Watershed Length to Centroid =	110	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	95.90%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	12.0	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) =	0.025	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.110	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.071	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.52 in.) =	0.092	acre-feet	1.52	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.107	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.124	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.141	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.159	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.200	acre-feet		inches
Approximate 2-yr Detention Volume =	0.073	acre-feet		
Approximate 5-yr Detention Volume =	0.096	acre-feet		
Approximate 10-yr Detention Volume =	0.112	acre-feet		
Approximate 25-yr Detention Volume =	0.131	acre-feet		
Approximate 50-yr Detention Volume =	0.142	acre-feet		
Approximate 100-yr Detention Volume =	0.152	acre-feet		

Define Zones and Basin Geometry

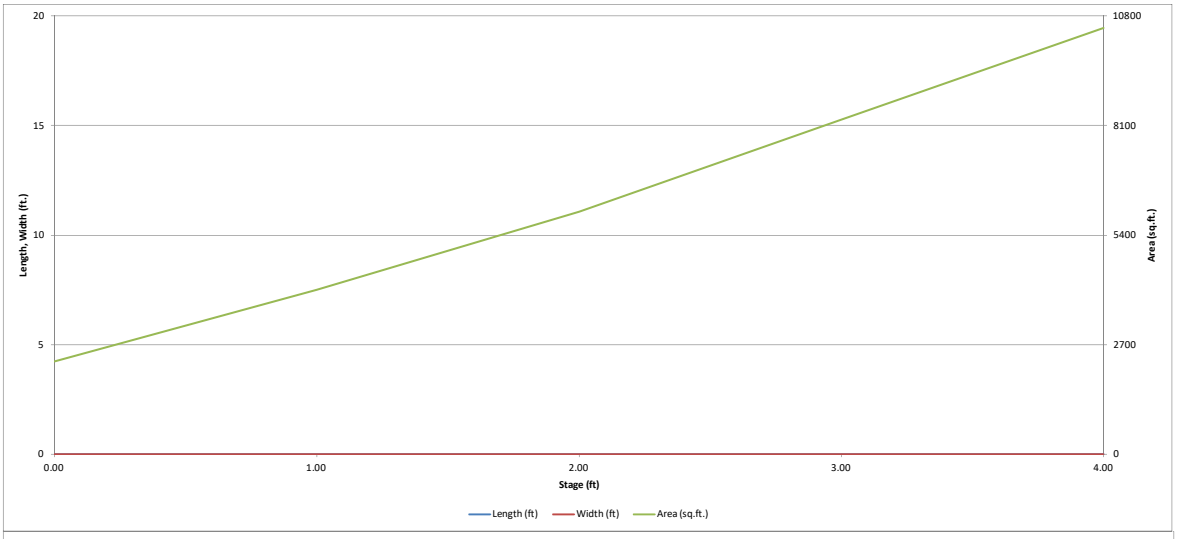
Zone 1 Volume (WQCV) =	0.025	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.085	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.042	acre-feet
Total Detention Basin Volume =	0.152	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	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

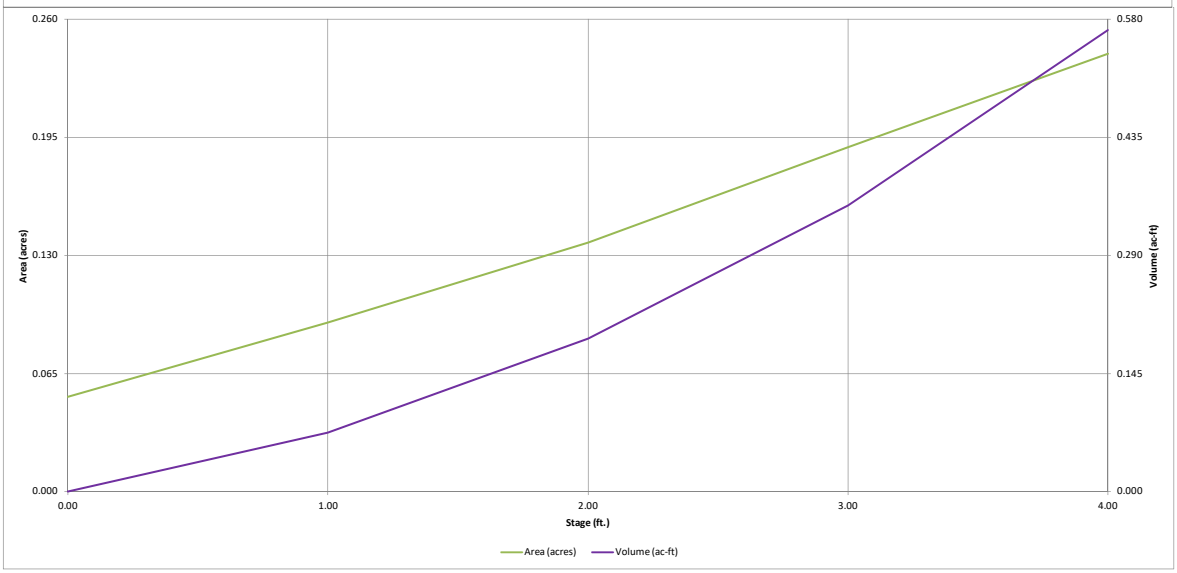
Depth Increment = ft

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)
Media Surface	--	0.00	--	--	--	2,281	0.052		
	--	1.00	--	--	--	4,053	0.093	3,167	0.073
	--	2.00	--	--	--	5,975	0.137	8,181	0.188
	--	3.00	--	--	--	8,256	0.190	15,296	0.351
	--	4.00	--	--	--	10,500	0.241	24,674	0.566

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



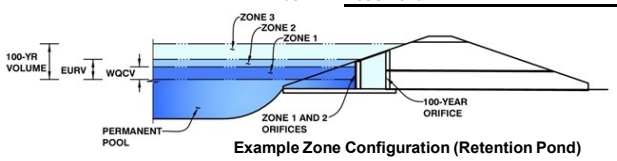


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Willowind Commercial

Basin ID: Lot 5 Pond 4A



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.42	0.025	Filtration Media
Zone 2 (EURV)	1.37	0.085	Filtration Media
Zone 3 (100-year)	1.73	0.042	Weir&Pipe (Restrict)
Total (all zones)		0.152	

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

Underdrain Orifice Invert Depth =	2.30	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.78	inches	Underdrain Orifice Centroid =	0.03	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	N/A	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 =	N/A	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

Calculated Parameters for Plate

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

	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			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
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
Vertical Orifice Diameter =	N/A	N/A	inches			

Calculated Parameters for Vertical Orif

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			Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	1.37	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	1.37	N/A
Overflow Weir Front Edge Length =	2.91	N/A	feet	Overflow Weir Slope Length =	2.91	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	212.53	N/A
Horiz. Length of Weir Sides =	2.91	N/A	feet	Overflow Grate Open Area w/o Debris =	5.89	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	2.95	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow W

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected
Depth to Invert of Outlet Pipe =	2.75	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.03	N/A
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.04	N/A
Restrictor Plate Height Above Pipe Invert =	0.80		inches	Half-Central Angle of Restrictor Plate on Pipe =	0.42	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	1.60	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.36	feet
Spillway Crest Length =	4.00	feet	Stage at Top of Freeboard =	2.96	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.19	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.34	acre-ft

Calculated Parameters for Spillway

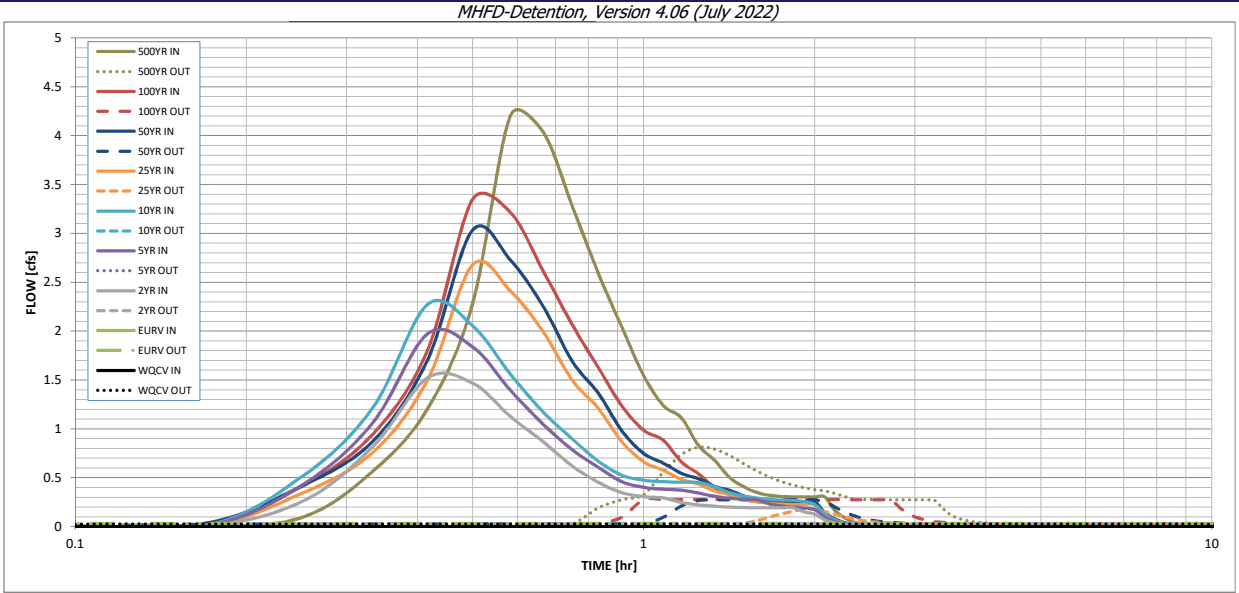
Routed Hydrograph Results

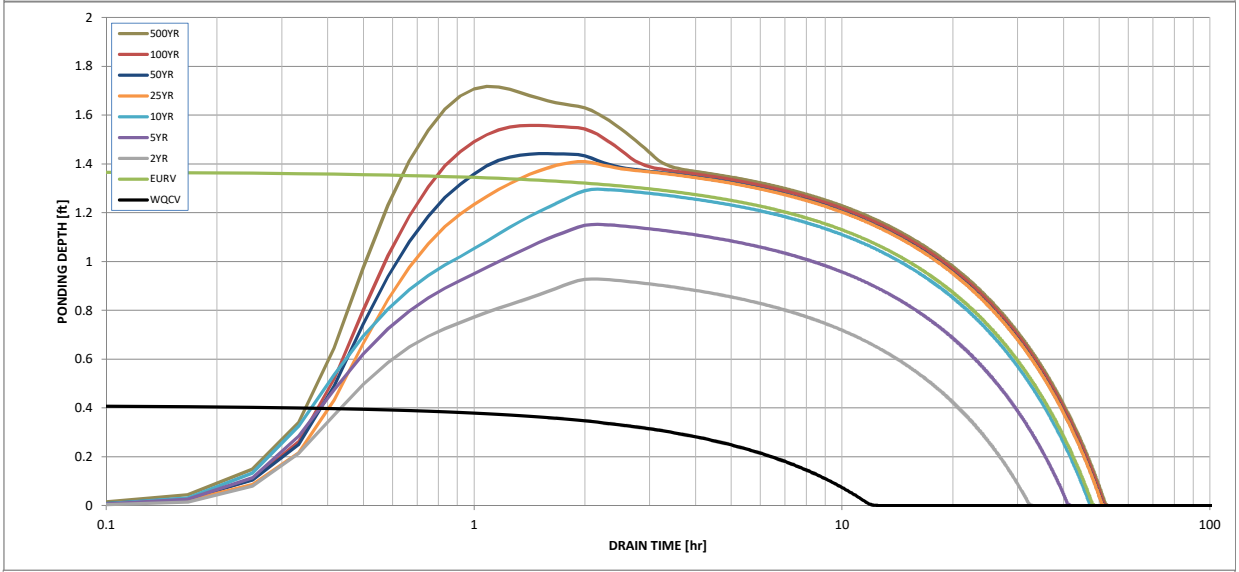
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AI

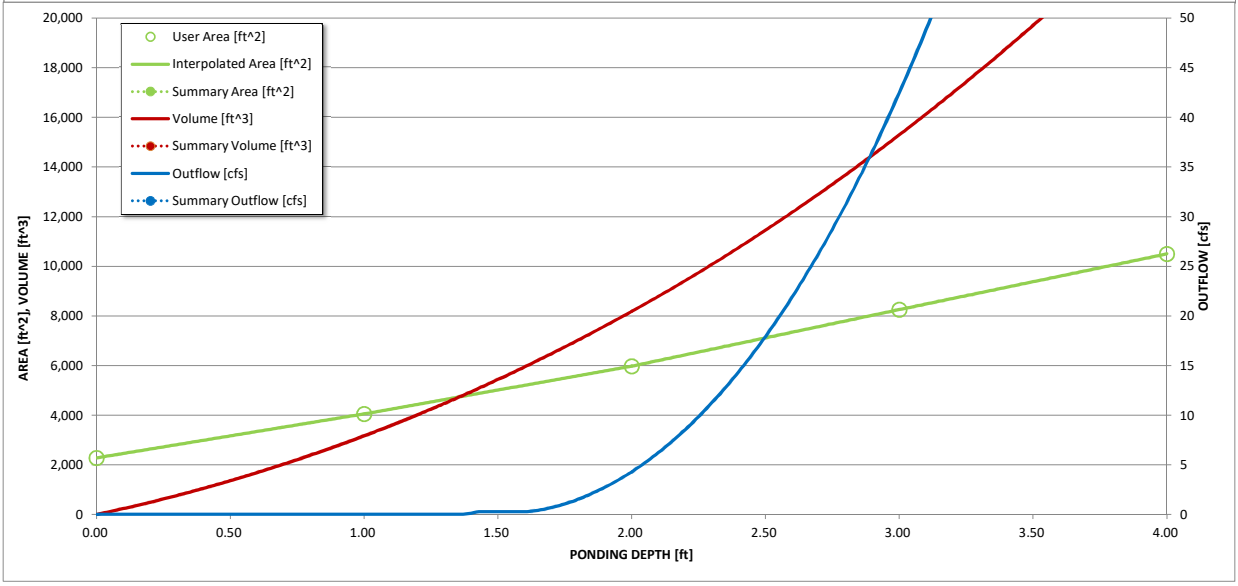
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.52	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.025	0.110	0.071	0.092	0.107	0.124	0.141	0.159
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.071	0.092	0.107	0.124	0.141	0.159
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.2	0.4	0.6
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	0.03	0.23	0.45	0.73
Peak Inflow Q (cfs) =	N/A	N/A	1.5	2.0	2.3	2.7	3.0	3.3
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.8	1.4	0.9	0.7	0.5
Structure Controlling Flow =	Filtration Media	Overflow Weir 1	Filtration Media	Filtration Media	Filtration Media	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.0	0.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	12	47	31	40	46	49	49	49
Time to Drain 99% of Inflow Volume (hours) =	**12**	48	32	41	47	51	51	51
Maximum Ponding Depth (ft) =	0.42	1.37	0.93	1.15	1.30	1.41	1.44	1.56
Area at Maximum Ponding Depth (acres) =	0.07	0.11	0.09	0.10	0.11	0.11	0.11	0.12
Maximum Volume Stored (acre-ft) =	0.026	0.110	0.065	0.087	0.102	0.113	0.118	0.131

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.

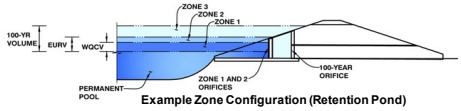
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.09
	0:15:00	0.00	0.00	0.25	0.42	0.51	0.34	0.41	0.41	0.56
	0:20:00	0.00	0.00	0.81	1.05	1.21	0.75	0.87	0.94	1.20
	0:25:00	0.00	0.00	1.52	1.97	2.27	1.50	1.70	1.80	2.28
	0:30:00	0.00	0.00	1.47	1.84	2.06	2.67	3.03	3.34	4.21
	0:35:00	0.00	0.00	1.13	1.39	1.56	2.41	2.73	3.21	4.03
	0:40:00	0.00	0.00	0.87	1.04	1.17	1.99	2.25	2.61	3.27
	0:45:00	0.00	0.00	0.62	0.78	0.89	1.49	1.69	2.06	2.59
	0:50:00	0.00	0.00	0.45	0.60	0.67	1.21	1.36	1.62	2.04
	0:55:00	0.00	0.00	0.35	0.46	0.52	0.87	0.98	1.23	1.55
	1:00:00	0.00	0.00	0.30	0.40	0.47	0.66	0.75	0.99	1.24
	1:05:00	0.00	0.00	0.29	0.38	0.46	0.58	0.65	0.88	1.11
	1:10:00	0.00	0.00	0.24	0.37	0.45	0.48	0.54	0.66	0.83
	1:15:00	0.00	0.00	0.22	0.34	0.45	0.43	0.49	0.54	0.68
	1:20:00	0.00	0.00	0.21	0.31	0.41	0.36	0.41	0.40	0.50
	1:25:00	0.00	0.00	0.20	0.29	0.35	0.33	0.37	0.33	0.41
	1:30:00	0.00	0.00	0.19	0.28	0.31	0.28	0.31	0.28	0.35
	1:35:00	0.00	0.00	0.19	0.27	0.29	0.25	0.28	0.26	0.32
	1:40:00	0.00	0.00	0.19	0.23	0.28	0.24	0.27	0.25	0.31
	1:45:00	0.00	0.00	0.19	0.21	0.27	0.23	0.26	0.24	0.30
	1:50:00	0.00	0.00	0.19	0.20	0.27	0.23	0.25	0.24	0.30
	1:55:00	0.00	0.00	0.15	0.19	0.25	0.22	0.25	0.24	0.30
	2:00:00	0.00	0.00	0.13	0.17	0.22	0.22	0.25	0.24	0.30
	2:05:00	0.00	0.00	0.07	0.10	0.12	0.13	0.14	0.14	0.17
	2:10:00	0.00	0.00	0.04	0.05	0.07	0.07	0.08	0.08	0.10
	2:15:00	0.00	0.00	0.02	0.03	0.03	0.04	0.04	0.04	0.05
	2:20:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.02
	2:25:00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Willowind Commercial

Basin ID: Lot 3 Pond 5



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	SF	
Watershed Area =	0.87	acres
Watershed Length =	225	ft
Watershed Length to Centroid =	112	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	95.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	12.0	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) =	0.026	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.114	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.074	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.52 in.) =	0.096	acre-feet	1.52	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.111	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.129	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.146	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.166	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.209	acre-feet		inches
Approximate 2-yr Detention Volume =	0.075	acre-feet		
Approximate 5-yr Detention Volume =	0.099	acre-feet		
Approximate 10-yr Detention Volume =	0.116	acre-feet		
Approximate 25-yr Detention Volume =	0.136	acre-feet		
Approximate 50-yr Detention Volume =	0.148	acre-feet		
Approximate 100-yr Detention Volume =	0.157	acre-feet		

Define Zones and Basin Geometry

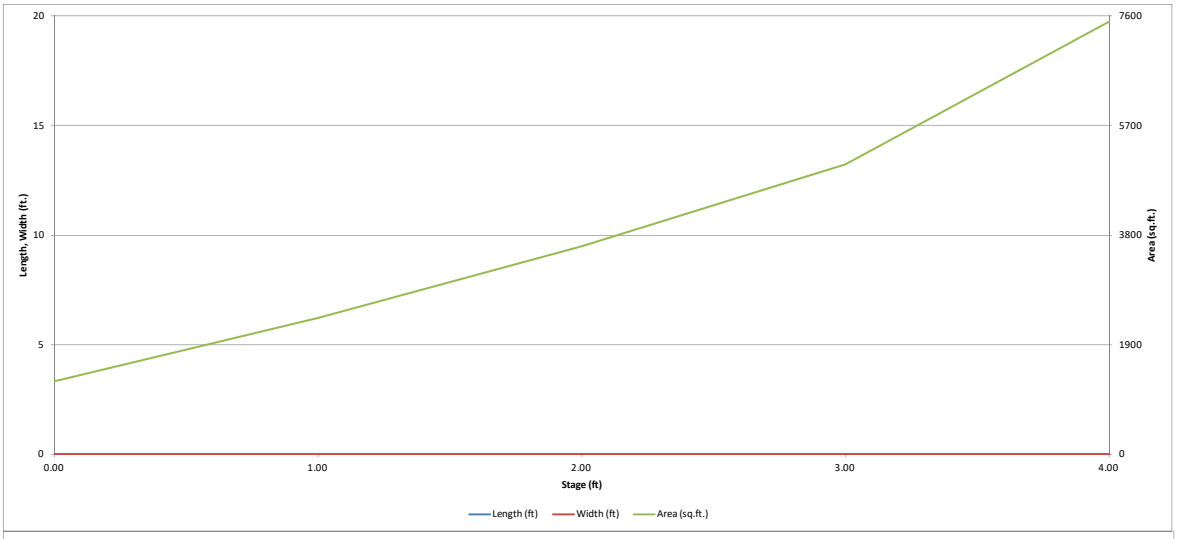
Zone 1 Volume (WQCV) =	0.026	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.088	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.043	acre-feet
Total Detention Basin Volume =	0.157	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	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

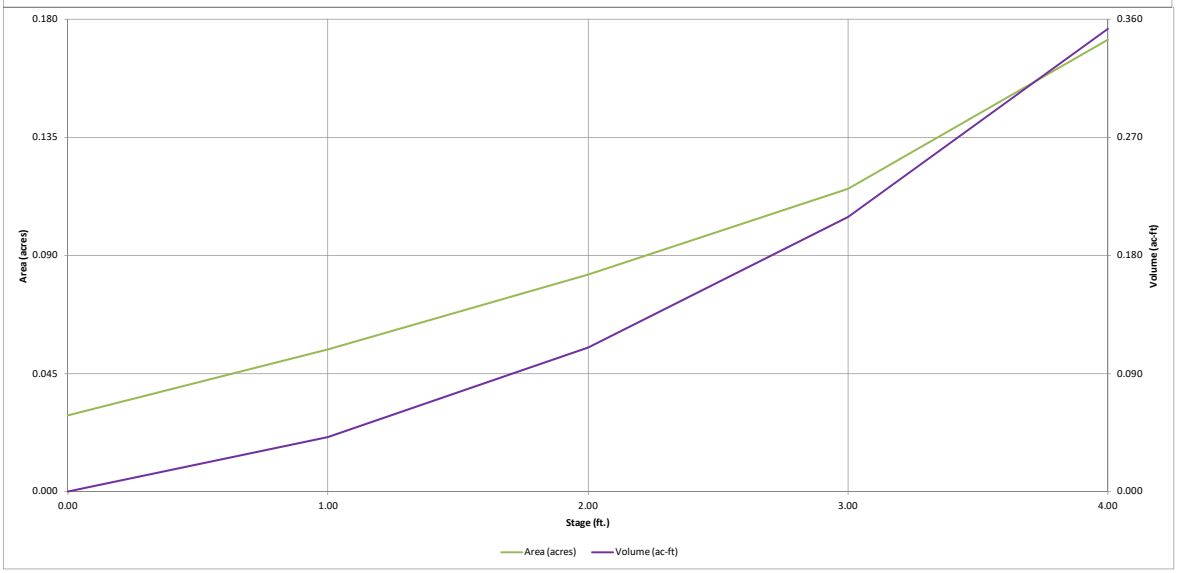
Depth Increment = ft

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)
Media Surface	--	0.00	--	--	--	1,266	0.029		
	--	1.00	--	--	--	2,361	0.054	1,813	0.042
	--	2.00	--	--	--	3,606	0.083	4,797	0.110
	--	3.00	--	--	--	5,028	0.115	9,114	0.209
	--	4.00	--	--	--	7,500	0.172	15,378	0.353

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



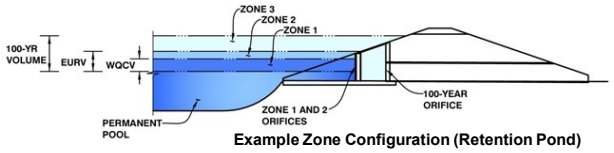


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Willowind Commercial

Basin ID: Lot 3 Pond 5



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.69	0.026	Filtration Media
Zone 2 (EURV)	2.05	0.088	Filtration Media
Zone 3 (100-year)	2.52	0.043	Weir&Pipe (Restrict)
Total (all zones)		0.157	

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

Underdrain Orifice Invert Depth =	2.50	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.77	inches	Underdrain Orifice Centroid =	0.03	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	N/A	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 =	N/A	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

Calculated Parameters for Plate

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

	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			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
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
Vertical Orifice Diameter =	N/A	N/A	inches			

Calculated Parameters for Vertical Orif

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			Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	2.05	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	2.05	N/A
Overflow Weir Front Edge Length =	2.91	N/A	feet	Overflow Weir Slope Length =	2.91	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	96.99	N/A
Horiz. Length of Weir Sides =	2.91	N/A	feet	Overflow Grate Open Area w/o Debris =	5.89	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	2.95	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow W

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected
Depth to Invert of Outlet Pipe =	2.75	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.06	N/A
Outlet Pipe Diameter =	15.00	N/A	inches	Outlet Orifice Centroid =	0.07	N/A
Restrictor Plate Height Above Pipe Invert =	1.45		inches	Half-Central Angle of Restrictor Plate on Pipe =	0.63	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.35	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.19	feet
Spillway Crest Length =	11.50	feet	Stage at Top of Freeboard =	3.54	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.15	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.28	acre-ft

Calculated Parameters for Spillway

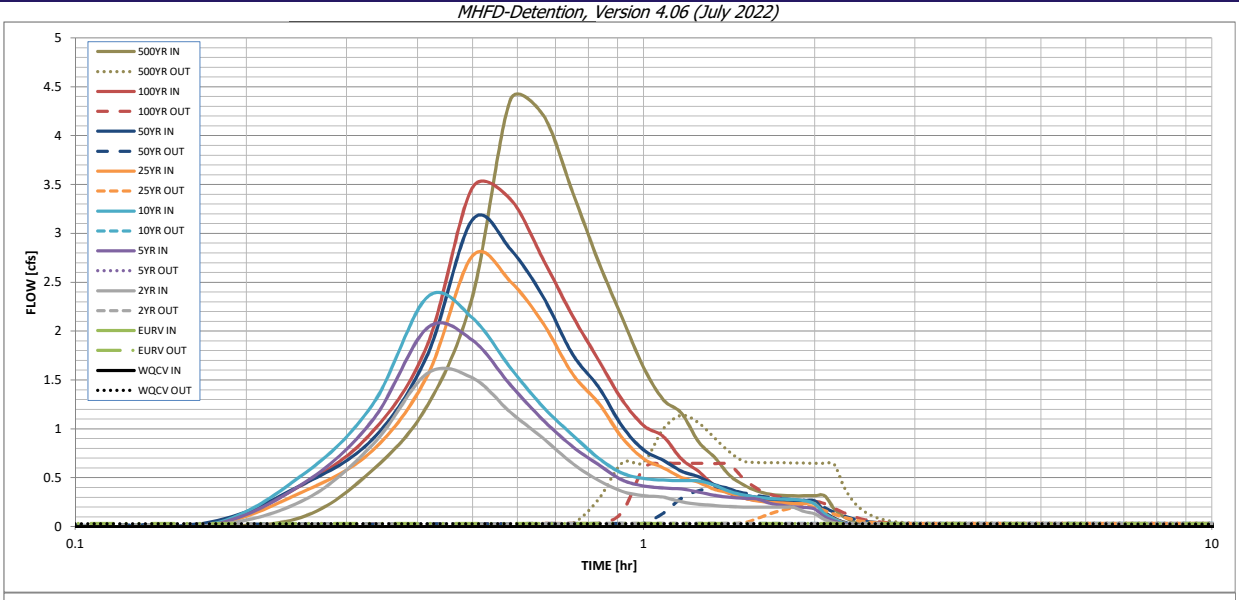
Routed Hydrograph Results

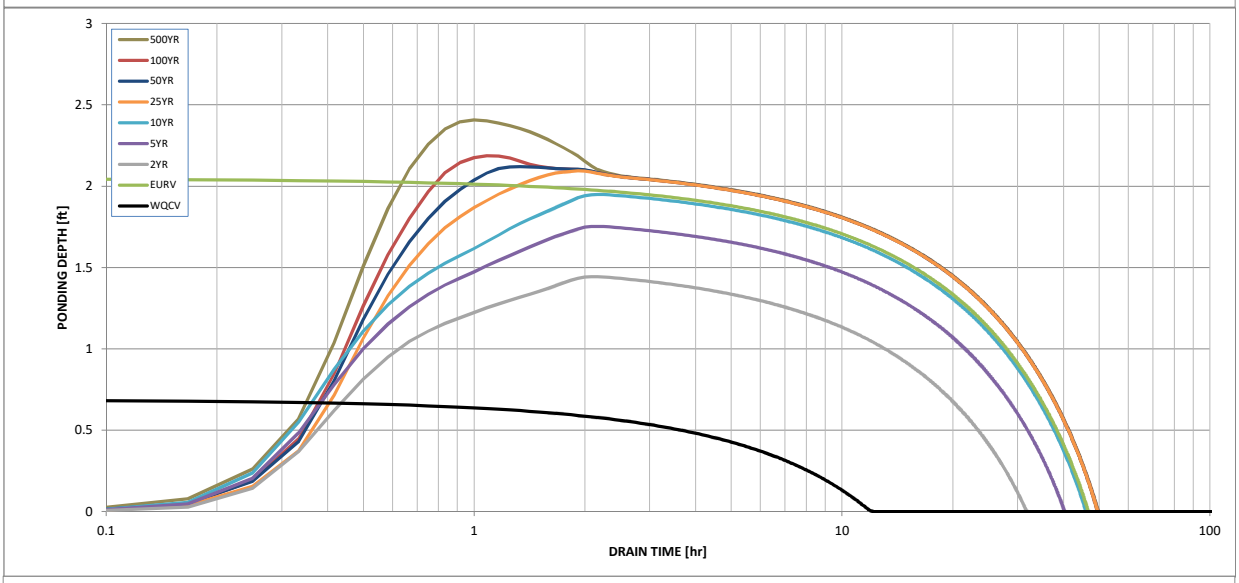
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AI

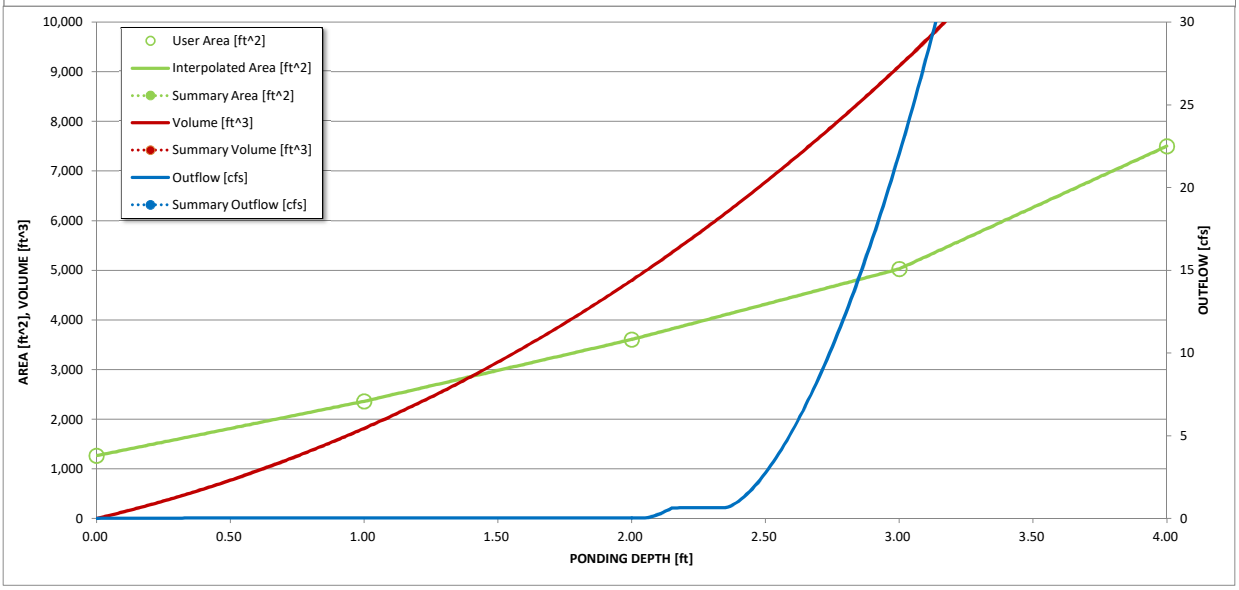
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.52	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.026	0.114	0.074	0.096	0.111	0.129	0.146	0.166
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.074	0.096	0.111	0.129	0.146	0.166
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.2	0.4	0.6
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	0.03	0.23	0.44	0.73
Peak Inflow Q (cfs) =	N/A	N/A	1.6	2.0	2.3	2.8	3.1	3.5
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.9	1.5	1.0	1.0	1.0
Structure Controlling Flow =	Filtration Media	Overflow Weir 1	Filtration Media	Filtration Media	Filtration Media	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.1	0.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	12	45	31	39	45	48	48	47
Time to Drain 99% of Inflow Volume (hours) =	**12**	46	31	40	46	49	49	49
Maximum Ponding Depth (ft) =	0.69	2.05	1.44	1.75	1.95	2.09	2.12	2.19
Area at Maximum Ponding Depth (acres) =	0.05	0.08	0.07	0.08	0.08	0.09	0.09	0.09
Maximum Volume Stored (acre-ft) =	0.026	0.114	0.068	0.090	0.105	0.118	0.120	0.126

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.

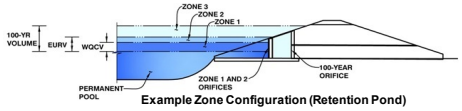
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.09
	0:15:00	0.00	0.00	0.26	0.43	0.52	0.35	0.42	0.42	0.58
	0:20:00	0.00	0.00	0.84	1.08	1.24	0.78	0.89	0.97	1.24
	0:25:00	0.00	0.00	1.57	2.03	2.35	1.54	1.76	1.86	2.35
	0:30:00	0.00	0.00	1.52	1.91	2.13	2.77	3.14	3.47	4.37
	0:35:00	0.00	0.00	1.17	1.45	1.62	2.51	2.84	3.35	4.21
	0:40:00	0.00	0.00	0.90	1.09	1.22	2.07	2.35	2.73	3.43
	0:45:00	0.00	0.00	0.65	0.82	0.94	1.56	1.76	2.16	2.71
	0:50:00	0.00	0.00	0.47	0.63	0.70	1.26	1.43	1.70	2.14
	0:55:00	0.00	0.00	0.36	0.48	0.55	0.91	1.03	1.30	1.63
	1:00:00	0.00	0.00	0.32	0.42	0.49	0.69	0.78	1.03	1.30
	1:05:00	0.00	0.00	0.30	0.40	0.48	0.60	0.68	0.92	1.16
	1:10:00	0.00	0.00	0.25	0.39	0.47	0.50	0.57	0.69	0.87
	1:15:00	0.00	0.00	0.23	0.35	0.47	0.45	0.51	0.56	0.71
	1:20:00	0.00	0.00	0.21	0.32	0.42	0.38	0.43	0.42	0.52
	1:25:00	0.00	0.00	0.21	0.30	0.36	0.34	0.39	0.34	0.43
	1:30:00	0.00	0.00	0.20	0.29	0.32	0.29	0.33	0.29	0.36
	1:35:00	0.00	0.00	0.20	0.28	0.30	0.26	0.30	0.27	0.33
	1:40:00	0.00	0.00	0.20	0.24	0.29	0.25	0.28	0.26	0.32
	1:45:00	0.00	0.00	0.20	0.22	0.28	0.24	0.27	0.25	0.31
	1:50:00	0.00	0.00	0.20	0.20	0.28	0.23	0.26	0.25	0.31
	1:55:00	0.00	0.00	0.16	0.20	0.26	0.23	0.26	0.25	0.31
	2:00:00	0.00	0.00	0.13	0.18	0.23	0.23	0.26	0.25	0.31
	2:05:00	0.00	0.00	0.07	0.10	0.13	0.13	0.15	0.14	0.18
	2:10:00	0.00	0.00	0.04	0.06	0.07	0.07	0.08	0.08	0.10
	2:15:00	0.00	0.00	0.02	0.03	0.04	0.04	0.04	0.04	0.05
	2:20:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.03
	2:25:00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Willowind Commercial

Basin ID: Lot 4 Pond 6



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	SF	
Watershed Area =	0.82	acres
Watershed Length =	245	ft
Watershed Length to Centroid =	155	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	95.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	12.0	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) =	0.024	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.108	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.072	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.52 in.) =	0.093	acre-feet	1.52	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.108	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.125	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.142	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.161	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.203	acre-feet		inches
Approximate 2-yr Detention Volume =	0.071	acre-feet		
Approximate 5-yr Detention Volume =	0.093	acre-feet		
Approximate 10-yr Detention Volume =	0.109	acre-feet		
Approximate 25-yr Detention Volume =	0.128	acre-feet		
Approximate 50-yr Detention Volume =	0.139	acre-feet		
Approximate 100-yr Detention Volume =	0.148	acre-feet		

Define Zones and Basin Geometry

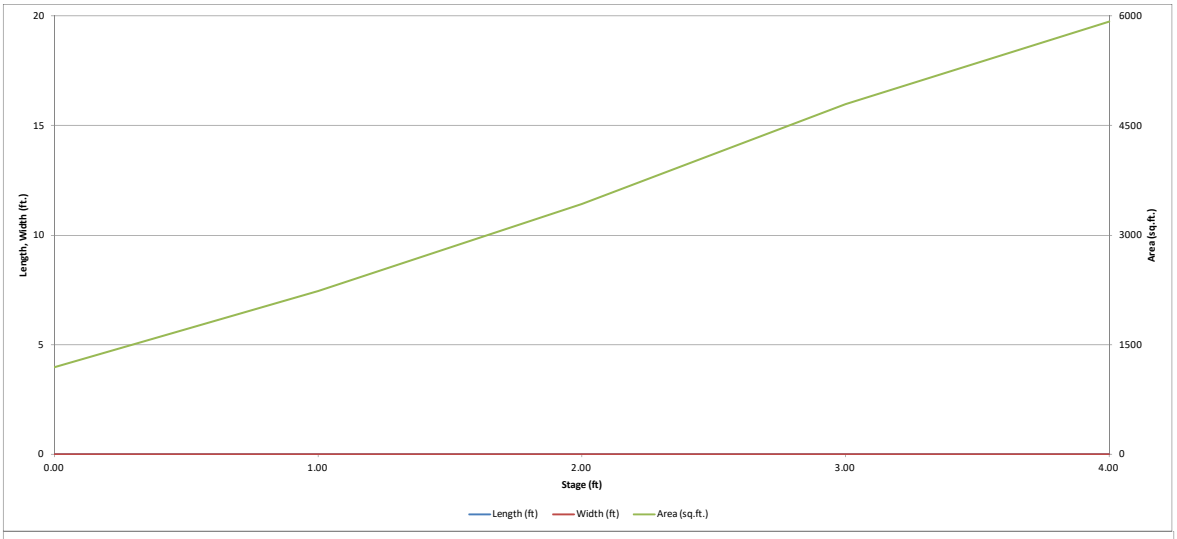
Zone 1 Volume (WQCV) =	0.024	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.083	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.041	acre-feet
Total Detention Basin Volume =	0.148	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	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

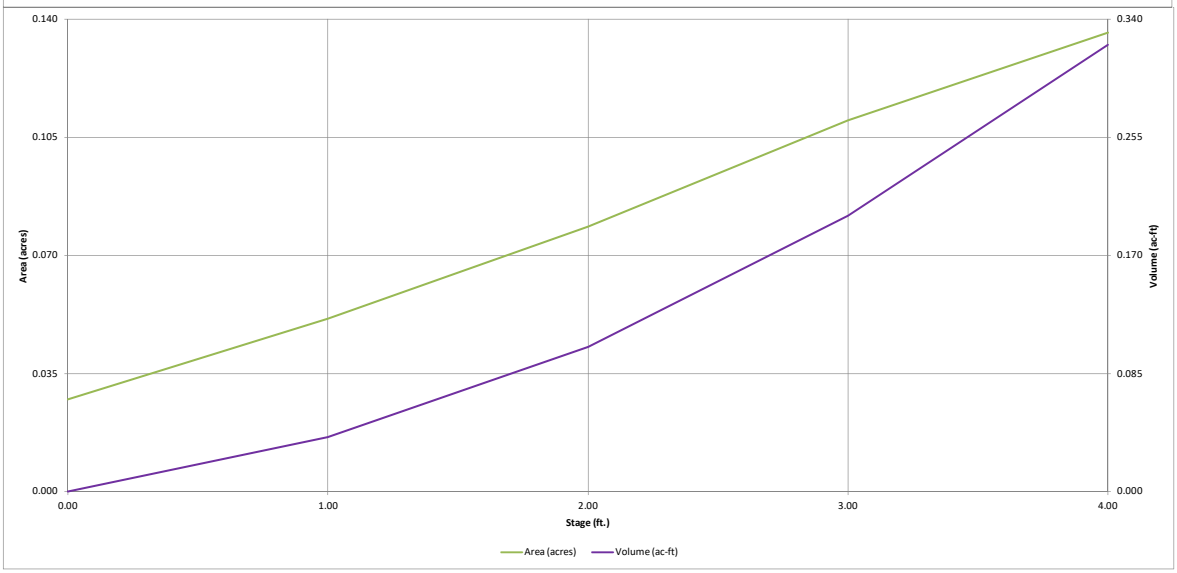
Depth Increment = ft

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)
Media Surface	--	0.00	--	--	--	1,190	0.027		
	--	1.00	--	--	--	2,234	0.051	1,712	0.039
	--	2.00	--	--	--	3,427	0.079	4,542	0.104
	--	3.00	--	--	--	4,795	0.110	8,653	0.199
	--	4.00	--	--	--	5,925	0.136	14,013	0.322

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



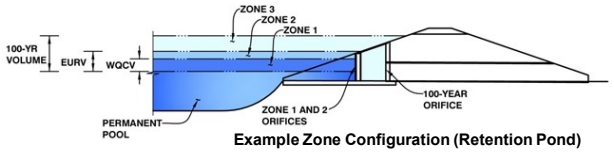


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Willowind Commercial

Basin ID: Lot 4 Pond 6



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.69	0.024	Filtration Media
Zone 2 (EURV)	2.05	0.083	Filtration Media
Zone 3 (100-year)	2.51	0.041	Weir&Pipe (Restrict)
Total (all zones)		0.148	

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

Underdrain Orifice Invert Depth =	2.50	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.73	inches	Underdrain Orifice Centroid =	0.03	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	N/A	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 =	N/A	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

Calculated Parameters for Plate

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

	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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)	Vertical Orifice Area =	N/A	N/A
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
Vertical Orifice Diameter =	N/A	N/A	inches			

Calculated Parameters for Vertical Orif

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 =	2.25	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	2.25	N/A
Overflow Weir Front Edge Length =	2.91	N/A	feet	Overflow Weir Slope Length =	2.91	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	83.79	N/A
Horiz. Length of Weir Sides =	2.91	N/A	feet	Overflow Grate Open Area w/o Debris =	5.89	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	2.95	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow W

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 =	2.75	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.07	N/A
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.07	N/A
Restrictor Plate Height Above Pipe Invert =	1.50		inches	Half-Central Angle of Restrictor Plate on Pipe =	0.59	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.45	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.30	feet
Spillway Crest Length =	5.00	feet	Stage at Top of Freeboard =	3.75	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.13	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.29	acre-ft

Calculated Parameters for Spillway

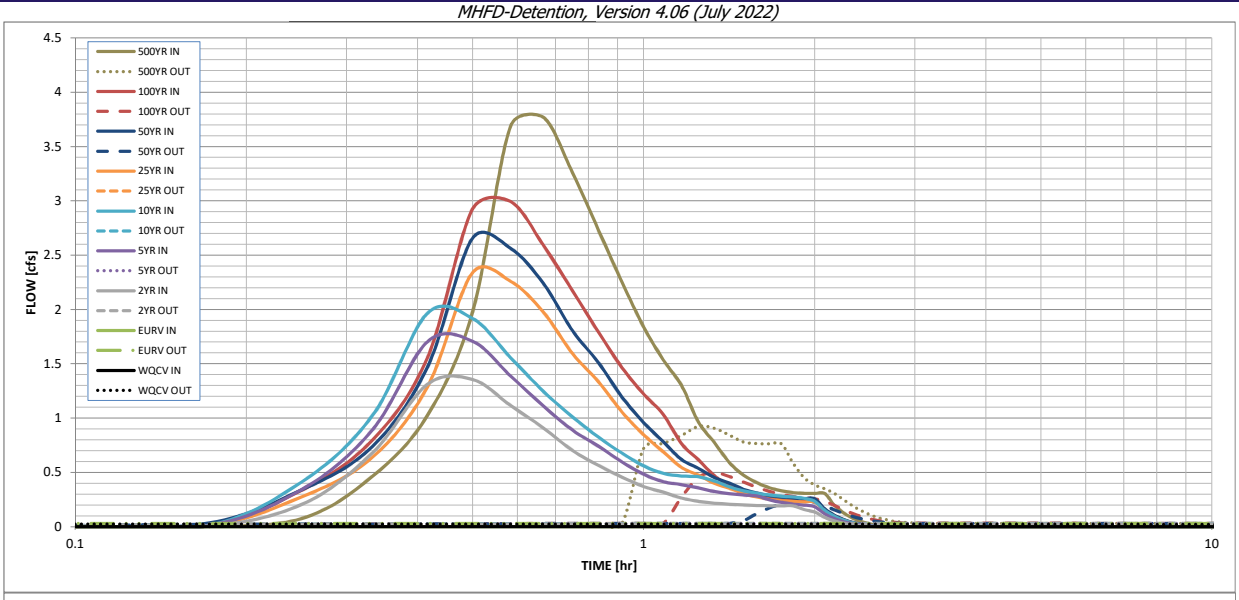
Routed Hydrograph Results

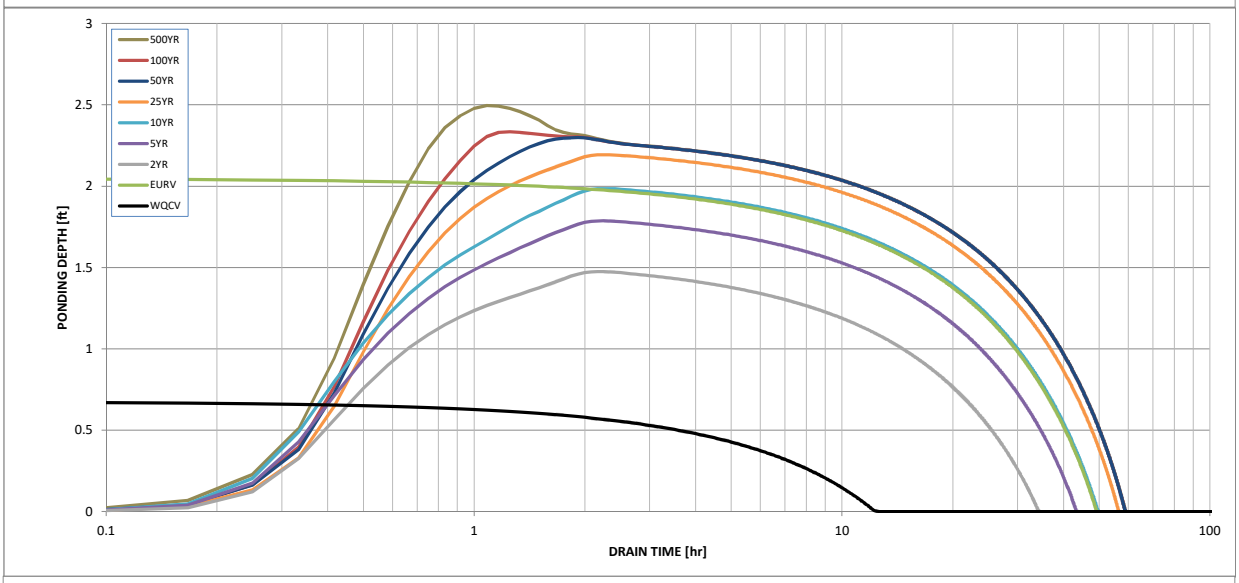
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AI

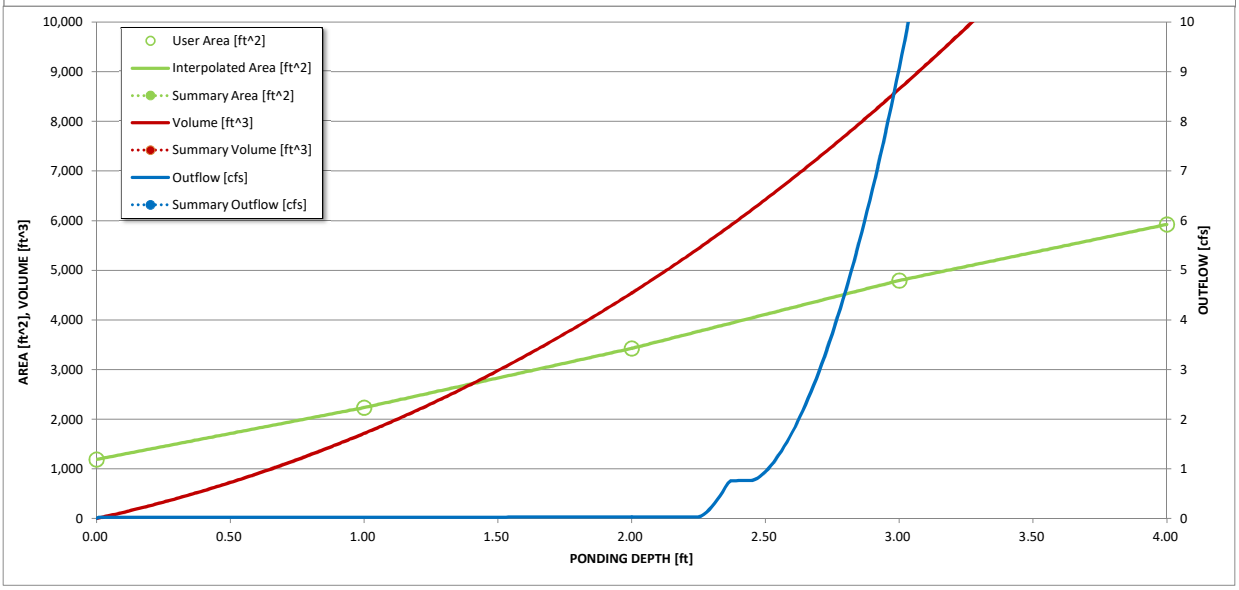
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.52	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.024	0.108	0.072	0.093	0.108	0.125	0.142	0.161
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.072	0.093	0.108	0.125	0.142	0.161
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.2	0.3	0.5
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	0.02	0.19	0.38	0.62
Peak Inflow Q (cfs) =	N/A	N/A	1.4	1.7	2.0	2.3	2.7	3.0
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.2	1.7	0.2	0.8	1.0
Structure Controlling Flow =	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Overflow Weir 1	Overflow Weir 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	0.0	0.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	12	48	33	42	48	55	57	56
Time to Drain 99% of Inflow Volume (hours) =	**12**	49	34	43	49	56	58	58
Maximum Ponding Depth (ft) =	0.68	2.05	1.47	1.79	1.99	2.19	2.30	2.34
Area at Maximum Ponding Depth (acres) =	0.04	0.08	0.06	0.07	0.08	0.08	0.09	0.09
Maximum Volume Stored (acre-ft) =	0.024	0.108	0.066	0.088	0.103	0.120	0.128	0.132

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			

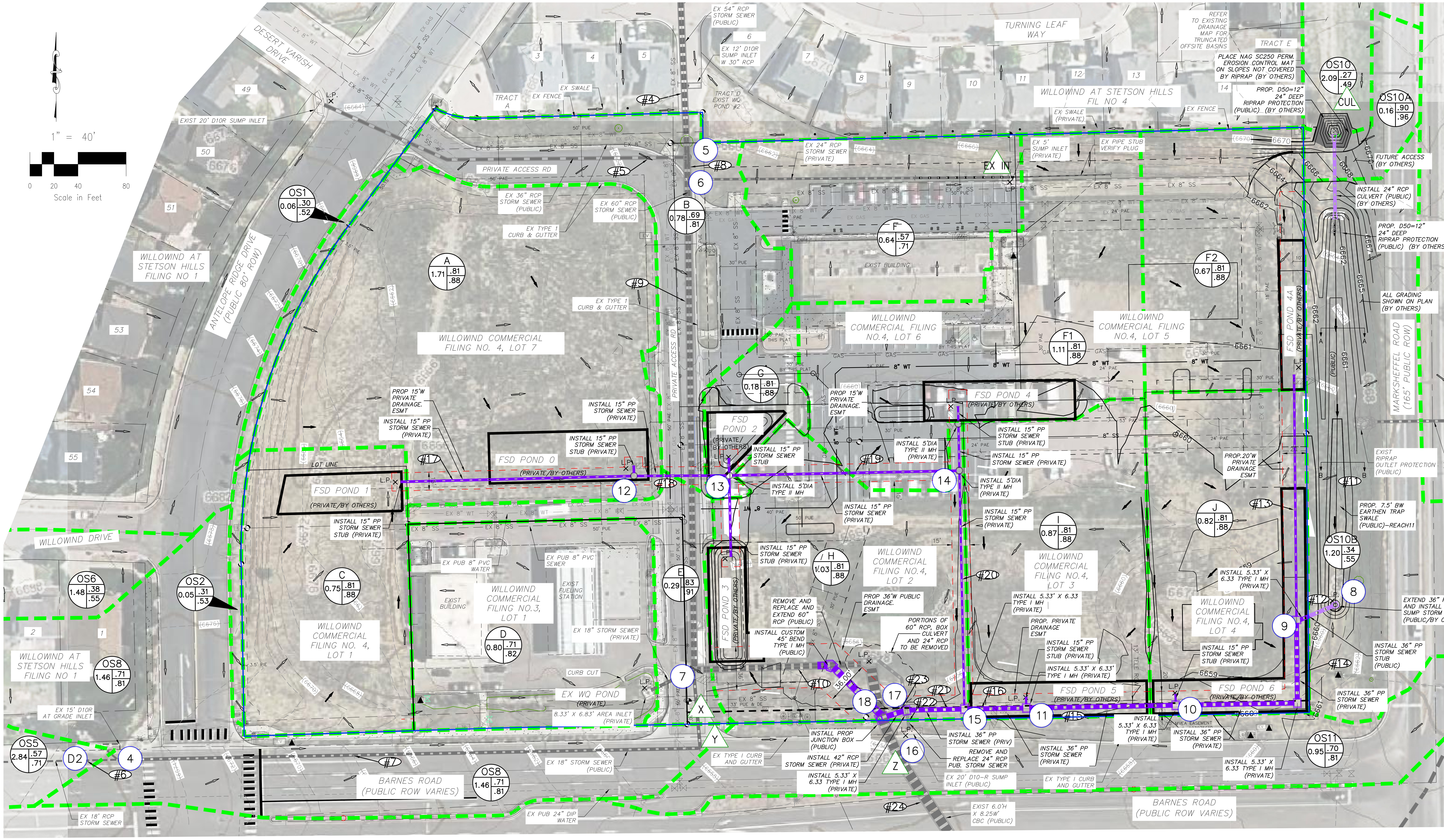
DETENTION BASIN OUTLET STRUCTURE DESIGN

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	0.02	0.00	0.07
	0:15:00	0.00	0.00	0.20	0.34	0.41	0.27	0.34	0.33	0.46
	0:20:00	0.00	0.00	0.68	0.89	1.02	0.64	0.74	0.80	1.02
	0:25:00	0.00	0.00	1.31	1.70	1.96	1.29	1.47	1.56	1.97
	0:30:00	0.00	0.00	1.35	1.71	1.92	2.34	2.65	2.92	3.68
	0:35:00	0.00	0.00	1.12	1.39	1.56	2.26	2.56	3.00	3.77
	0:40:00	0.00	0.00	0.91	1.11	1.25	1.98	2.24	2.59	3.26
	0:45:00	0.00	0.00	0.70	0.89	1.01	1.59	1.80	2.17	2.73
	0:50:00	0.00	0.00	0.56	0.74	0.82	1.34	1.51	1.79	2.25
	0:55:00	0.00	0.00	0.46	0.60	0.68	1.06	1.19	1.47	1.84
	1:00:00	0.00	0.00	0.37	0.48	0.56	0.85	0.96	1.22	1.54
	1:05:00	0.00	0.00	0.32	0.41	0.49	0.69	0.78	1.03	1.30
	1:10:00	0.00	0.00	0.26	0.39	0.47	0.55	0.62	0.77	0.96
	1:15:00	0.00	0.00	0.23	0.35	0.46	0.47	0.54	0.62	0.77
	1:20:00	0.00	0.00	0.22	0.32	0.42	0.40	0.45	0.47	0.59
	1:25:00	0.00	0.00	0.21	0.30	0.37	0.35	0.40	0.38	0.47
	1:30:00	0.00	0.00	0.20	0.29	0.33	0.30	0.34	0.32	0.40
	1:35:00	0.00	0.00	0.20	0.28	0.31	0.27	0.31	0.29	0.36
	1:40:00	0.00	0.00	0.19	0.25	0.29	0.25	0.28	0.26	0.33
	1:45:00	0.00	0.00	0.19	0.22	0.28	0.24	0.27	0.25	0.31
	1:50:00	0.00	0.00	0.19	0.21	0.27	0.23	0.26	0.25	0.31
	1:55:00	0.00	0.00	0.16	0.20	0.26	0.23	0.26	0.24	0.31
	2:00:00	0.00	0.00	0.14	0.18	0.23	0.23	0.26	0.24	0.31
	2:05:00	0.00	0.00	0.09	0.12	0.15	0.15	0.16	0.16	0.20
	2:10:00	0.00	0.00	0.05	0.07	0.10	0.09	0.11	0.10	0.13
	2:15:00	0.00	0.00	0.03	0.04	0.06	0.06	0.07	0.06	0.08
	2:20:00	0.00	0.00	0.02	0.03	0.03	0.03	0.04	0.04	0.05
	2:25:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.03
	2:30:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



LEGEND

- BASIN DESIGNATION (G1; 2.35 ACRES; .53 C5; .66 C100)
- PIPE RUN/REACH REFERENCE LABEL
- JUNCTION (HMS MODEL)
- DESIGN POINT
- BASIN BOUNDARY
- (6920) EXISTING CONTOUR (1')
- 6920 PROP CONTOUR (1')
- SUBDIVISION BOUNDARY
- PROPOSED STORM SEWER PIPE
- FUTURE STORM SEWER PIPE (BY OTHERS)
- EXISTING STORM SEWER PIPES
- INLET (BY OTHERS)
- EXISTING INLET
- MANHOLE
- EXISTING FLOW DIRECTION ARROW
- PROPOSED FLOW DIRECTION ARROW
- FLARED END SECTION (BY OTHERS)
- EXISTING FLARED END SECTION
- H.P. HIGH POINT
- L.P. LOW POINT
- EMERGENCY OVERFLOW DIRECTION

BASIN SUMMARY

BASIN	AREA (ACRES)	Q_5	Q_{100}
A	1.71	7.1	12.9
B	0.76	2.4	4.6
C	0.75	3.2	5.7
D	0.80	2.9	5.6
E	0.29	1.2	2.3
F	0.64	1.8	3.8
F1	1.11	4.7	8.5
F2	0.67	2.8	5.1
G	0.18	0.7	1.4
H	1.03	4.3	6.1
I	0.87	3.7	6.7

BASIN SUMMARY

BASIN	AREA (ACRES)	Q_5	Q_{100}
J	0.82	3.4	6.2
OS1	0.06	0.1	0.3
OS2	0.05	0.1	0.2
OS3	3.75	7.3	15.0
OS4	4.96	8.9	20.1
OS5	2.84	5.9	12.3
OS6	1.48	2.1	5.1
OS7	NOT	USED	
OS8	1.46	4.6	8.9
OS9	15.45	7.0	36.1
OS10	2.09	2.3	6.9
OS10A	0.16	0.7	1.3
OS10B	1.20	1.8	3.3
OS11	0.95	3.2	6.3

BASIN SUMMARY VALUES SHOWN PER RATIONAL CALCULATION ANALYSIS

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FOR BURIED UTILITY INFORMATION
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CALL 1-800-922-1987

JUNCTION SUMMARY

JUNCT	Q_5	Q_{100}	CONTRIB. BASIN/DP/ REACH
1	106.7	233.3	A, R1
2	143.0	299.1	SHOWN
3	159.6	330.7	SHOWN
4	19.5	19.5	INLET 1/R5
5	187.2	387.5	R4, R5
6	188.0	387.5	R8, L
7	206.7	402.6	R7, R9, K
8	19.6	51.2	R11, P, Q, Q2
9	19.5	51.3	R12, R13
10	19.2	51.1	R14, POND 6
11	18.9	51.2	R15, POND 5
12	0.1	1.7	R17, POND 0
13	0.1	2.6	R18, PONDS 2&3
14	0.1	3.5	R18, POND 4
15	18.9	54.5	R16, R20
16	12.7	41.0	DIV2, H, M
17	31.5	95.2	R21, R22
18	236.8	495.5	R10, R23
19	10.6	23.1	DIV1, T
20	246.1	516.7	R24, J19

DESIGN POINT SUMMARY

DESIGN POINT	Q_5	Q_{100}	RATIONAL BASIN	STRUCTURE
POND 0	7.2	13.2	OS1, A	SF POND 0
POND 1	3.2	6.0	OS2, C	SF POND 1
EX POND	2.9	5.6	D	EX AREA DRAIN/WQ POND
X	3.3	6.3	B, E	EX BARNES ROAD C&G
I1	7.3	15.0	OS3	EX 10' D10R AT-GRADE INLET
I2	14.2	31.0	OS4, OS5	EX 15' D10R AT-GRADE INLET
Y	10.2	28.8	OS2, OS6, OS8, DPX, FB DPI2	EX BARNES ROAD C&G
EX IN	1.8	3.8	F	EXISTING TYPE R 5' SUMP INLET
POND 4	4.7	8.5	F1	SF POND 4
POND 4A	3.5	6.4	10A, F2	SF POND 4A
POND 2	0.7	1.4	G	SF POND 2
POND 3	4.3	7.9	H	SF POND 3
CUL	2.3	6.9	OS10	PROP. 24" CULVERT
EX CUL	7.0	36.1	OS9	EX FES
POND 6	3.4	6.2	J	SF POND 6
POND 5	3.7	6.9	I	SF POND 5
Z	12.1	32.1	OS11, DPY	EX 20' D10R SUMP INLET

THE ABOVE DP VALUES WERE USED TO EVALUATE THE HEC-HMS MODEL AND ARE FOR INFORMATION PURPOSES ONLY.

STORM SEWER SUMMARY

PIPE RUN/ REACH	Q_5	Q_{100}	PIPE SIZE
#1	NOT	SHOWN	ON MAP
#2	NOT	SHOWN	ON MAP
#3	NOT	SHOWN	ON MAP
#4	158.8	329.2	EX 54" RCP
#5	28.4	56.6	EX 36" RCP
#6	6.6	9.1	EX 18" RCP
#7	19.5	19.5	EX 18" RCP
#8	186.6	384.7	EX 60" RCP
#9	185.5	383.1	EX 60" RCP
#10	205.5	400.6	EX 60" RCP
#11	3.4	7.5	7.5' BW TRAP
#12	19.5	51.0	PROP 36" PP
#13	0.0	0.3	PROP 15" PP
#14	19.2	50.6	PROP 36" PP

STORM SEWER SUMMARY

PIPE RUN/ REACH	Q_5	Q_{100}	PIPE SIZE
#15	18.9	50.6	PROP 36" PP
#16	18.8	51.0	PROP 36" PP
#17	0.0	0.6	PROP 15" PP
#18	0.1	1.7	PROP 15" PP
#19	0.1	2.6	PROP 15" PP
#20	0.1	3.5	PROP 15" PP
#21	18.8	54.3	PROP 36" PP
#22	12.6	40.9	EX 24" RCP
#23	31.3	95.0	PROP 36" PP
#24	235.5	493.6	EX 6'X8.25'CBC

#X VALUES PROVIDED PER HEC-HMS MODEL OUTPUT
THESE VALUES WERE USED IN HYDRAULIC GRADE LINE MODELS

REFER TO WWCF4 HEC-HMS DEVELOPED CONDITION DRAINAGE MAP FOR REACHES AND JUNCTIONS NOT SHOWN ON MAP

SAND FILTER FSD POND SUMMARY

POND	CONTRIB. ACREAGE	CONTRIB. BASINS	IMPERVIOUS	EPC/URBAN DRAINAGE SAND FILTER BASIN-SEE STD. DET.		WQCV**	EURV**	100 YR**	TOTAL**	ASSUMED DISCHARGE***	
ID	(ACRES)	ID	%	SAND FILTER AREA	SQ FT*	(AC-FT)	(AC-FT)	(AC-FT)	(AC-FT)	Q5 (CFS)	Q100 (CFS)
0	1.77	OS1,A	93.1	REQUIRED	895	0.051	0227	0.184	0.267	0.1	1.1
1	0.81	OS2, C	91.7	(AT RIGHT)	400	0.022	0.079	0.040	0.141	0.0	0.6
2	0.18	G	95.0		92	0.005	0.018	0.009	0.033	0.0	0.1
3	1.03	H	95.0		576	0.031	0.104	0.051	0.186	0.0	0.8
4	1.11	F1	95.0		312	0.033	0.112	0.055	0.201	0.0	0.9
4A	0.67	F2	95.0		348	0.020	0.068	0.033	0.121	0.0	0.3
5	0.87	I	95.0		452	0.026	0.088	0.043	0.157	0.0	0.6
6	0.82	J	95.0		423	0.024	0.083	0.041	0.148	0.0	0.5

* BASED UPON MIN. FILTER AREA PER UD-BMP_V3.07, SUBJECT TO PONDING DEPTH OF WATER QUALITY EVENT, WQCV DEPTH OF AVG PRODUCING STORM
** BASED UPON DATA PROVIDED BY MHFD-DETENTION VERSION 4.06 WORKSHEET, BASIN TAB
*** BASED UPON DATA PROVIDED BY MHFD-DETENTION, VERSION 4.06 WORKSHEET, OUTLET STRUCTURE TAB

POTENTIAL POND LOCATION (SYMBOL SHOWN DOES NOT REFLECT REQUIRED SIZE, DEPENDENT UPON ACTUAL DEVELOPMENT)

NOTES:
1) ITEMS REFERENCED AS "BY OTHERS" IS NOT A PART OF 'INITIAL INFRASTRUCTURE'

NOTES:

1. ALL PROPOSED STORM SEWER WILL BE PRIVATELY OWNED AND MAINTAINED BY THE DISTRICT, EXCEPT FOR THE PROP. 60" RCP (INCL 45° BOX), THE PROP. JUNCTION BOX, AND THE PROP. STORM SEWER WITHIN THE BARNES AND MARKSHEFFEL RIGHTS OF WAY WHICH SHALL BE PUBLICLY OWNED AND MAINTAINED.

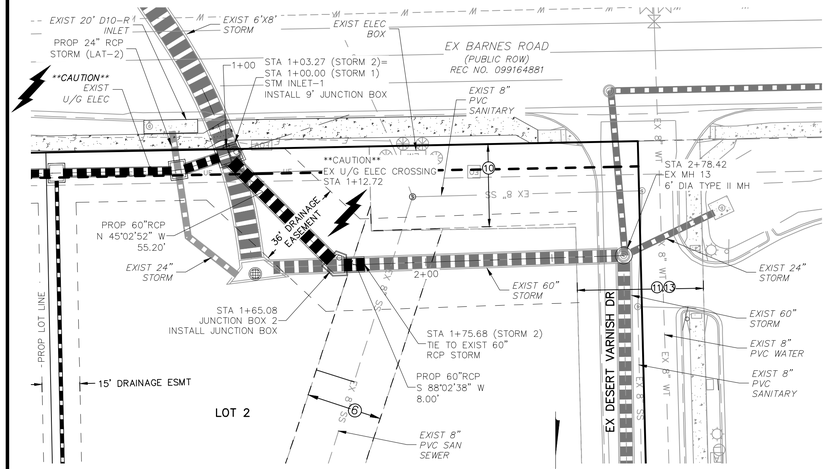
CIVIL CONSULTANTS, INC.
212 N. WAHSATCH AVE., STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

WILLOWIND COMMERICAL FILING NO.4

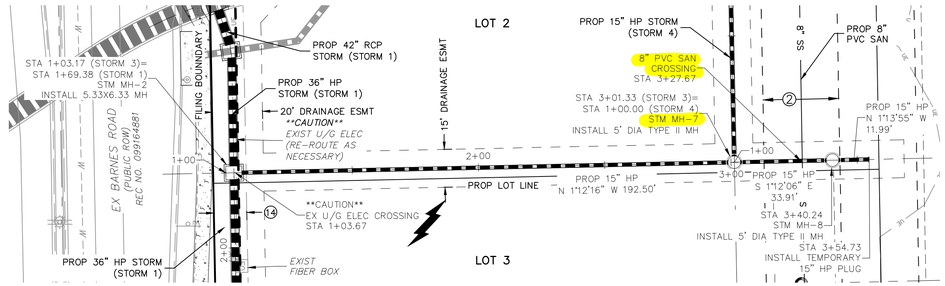
PROPOSED CONDITIONS DRAINAGE MAP

PROJECT NO. 10-021
DESIGNED BY: DLM
DRAWN BY: DLM
CHECKED BY: VAS
SCALE: HORIZONTAL: 1"=40' VERTICAL: N/A
DATE: 08-21-23
SHEET 1 OF 2
PDM1

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STORM 2 (PRIVATE)
STA 1+03.23 - STA 2+78.42



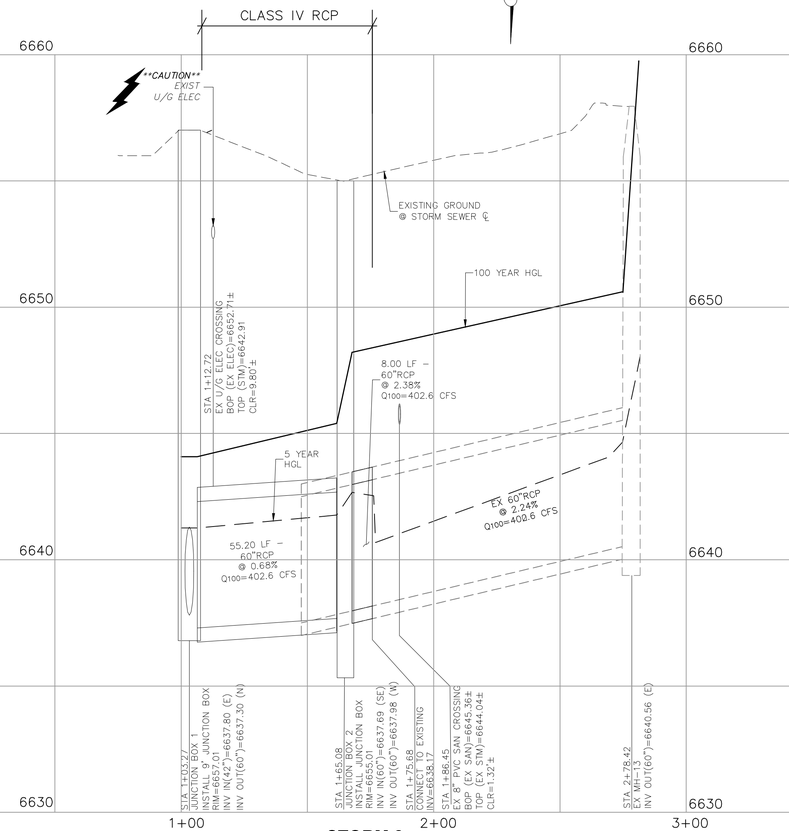
STORM 3 (PRIVATE)
STA 1+00.00 - STA 3+54.73

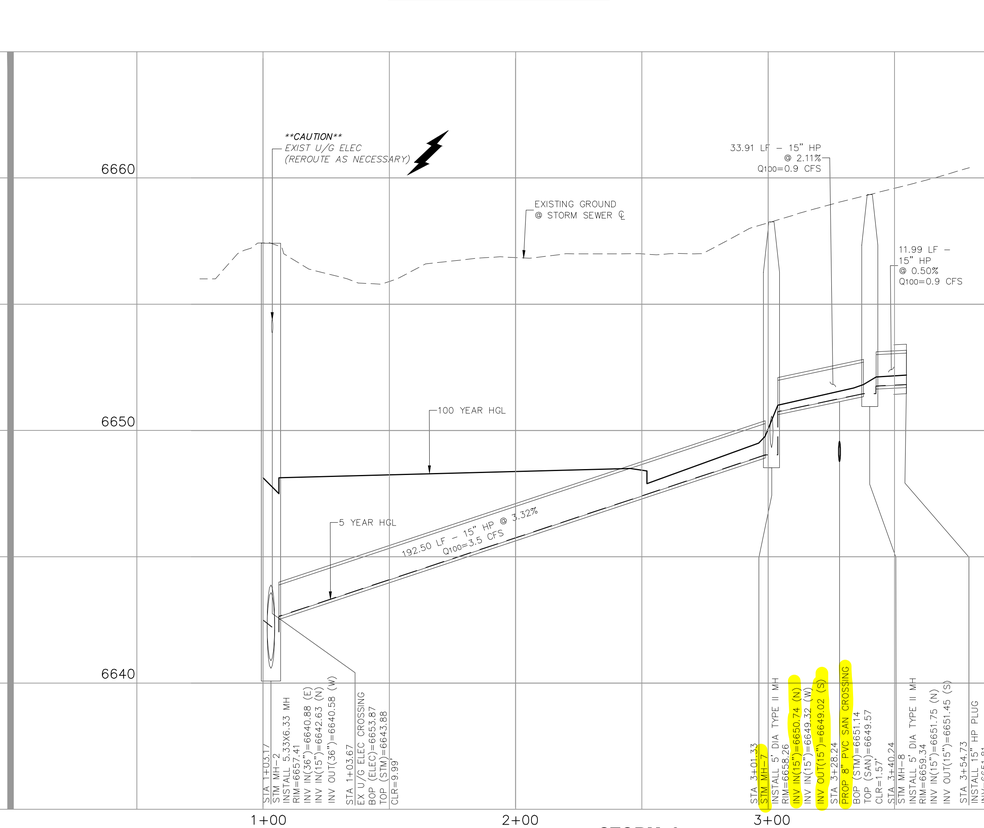
ABBREVIATIONS

CL	CENTERLINE
LT	LEFT
RT	RIGHT
C&G	CURB AND GUTTER
EL	ELEVATION
W	WEST
CONST	CONSTRUCTION
N	NORTH
WTR	WATER
S	SOUTH
STM	STORM SEWER
PUB	PUBLIC
EX	EXISTING
STA	STATION
NTS	NOT TO SCALE
PROP	PROPOSED
SAN	SANITARY SEWER

KEY NOTES:

1. 50' PUBLIC UTILITY EASEMENT
2. 30' PUBLIC UTILITY EASEMENT
3. 24' PUBLIC ACCESS EASEMENT
4. 30' PUBLIC ACCESS EASEMENT
5. 40' PUBLIC ACCESS EASEMENT
6. 18' PUBLIC ACCESS EASEMENT
7. 45' PUBLIC ACCESS EASEMENT
7a. 50' PUBLIC ACCESS EASEMENT
8. 53' PUBLIC ACCESS EASEMENT
9. EX 30' PUBLIC UTILITY EASEMENT REC NO. 204048326
10. EX 33' PUBLIC UTILITY AND DRAINAGE EASEMENT REC NO 201007064
11. EX 50' PUBLIC ACCESS EASEMENT REC NO. 204048326
12. EX 50' PUBLIC UTILITY EASEMENT REC NO 212713209
13. EX 50' PUBLIC UTILITY EASEMENT REC NO 201007064
14. EX 13' PRIVATE TELEPHONE EASEMENT BOOK 5300, PAGE 1479
15. EX 0.5' PUBLIC IMPROVEMENT EASEMENT REC NO 2121713209
16. EX PUBLIC UTILITY EASEMENT REC NO 218023280
17. EX 10' COMMUNICATIONS EASEMENT REC NO 208034930





DRAINAGE DESIGN:

DRAINAGE DESIGN:_____ DATE: _____

THIS IS FILED IN ACCORDANCE WITH SECTION 7-7-906 (DRAINAGE ORDINANCE) OF THE CODE OF THE CITY OF COLORADO SPRINGS 2001, AS AMENDED.

STATEMENT:

THE CITY OF COLORADO SPRINGS RECOGNIZES THE DESIGN ENGINEER AS HAVING RESPONSIBILITY FOR THE DESIGN; THE CITY HAS LIMITED ITS SCOPE OF REVIEW ACCORDINGLY. RESUBMITTAL REQUIRED IF CONSTRUCTION HAS NOT COMMENCED WITHIN 180 DAYS AFTER APPROVAL DATE.

FOR LOCATING & MARKING GAS, ELECTRIC, WATER & TELEPHONE LINES

FOR BURIED UTILITY INFORMATION
48 HRS BEFORE YOU DIG
CALL 1-800-922-1987

REVISIONS:

NO.	DATE:	BY:	DESCRIPTION:	APPVD. BY:	DATE:

THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE, OR LIABLE FOR, UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES TO THE PLANS MUST BE IN WRITING AND MUST BE APPROVED BY THE PREPARER OF THESE PLANS.

CAUTION

WILLOWIND COMMERCIAL FILING NO. 4

STORM SEWER PLANS

PROJECT NO. 10-021 | SCALE: HORIZONTAL: 1"=30' VERTICAL: 1"=3' | DATE: 08/20/23 | SHEET 4 OF 12 | ST04

DESIGNED BY: DM
DRAWN BY: CLP
CHECKED BY: VAS

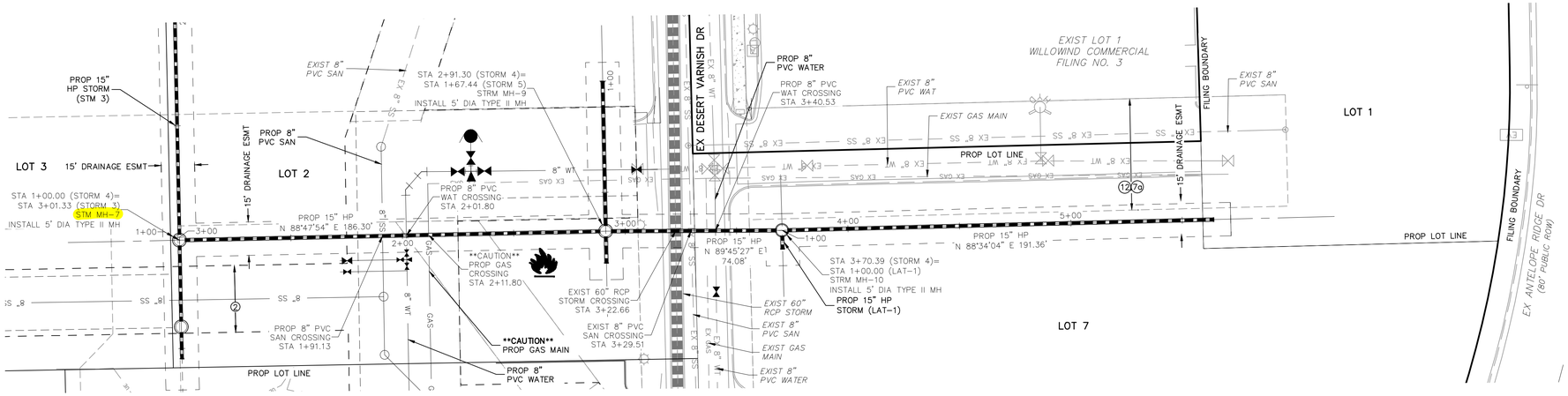
212 N. WAHSATCH AVE., STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

CIVIL CONSULTANTS, INC.

FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.

VIRGIL A. SANCHEZ, COLORADO P.E. NO. 37160

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STORM 4 (PRIVATE)
STA 1+00.00- STA 5+76.25

ABBREVIATIONS

CL	CENTERLINE
LT	LEFT
RT	RIGHT
C&G	CURB AND GUTTER
EL	ELEVATION
W	WEST
CONST	CONSTRUCTION
N	NORTH
WTR	WATER
S	SOUTH
STM	STORM SEWER
PUB	PUBLIC
EX	EXISTING
STA	STATION
NTS	NOT TO SCALE
PROP	PROPOSED
SAN	SANITARY SEWER

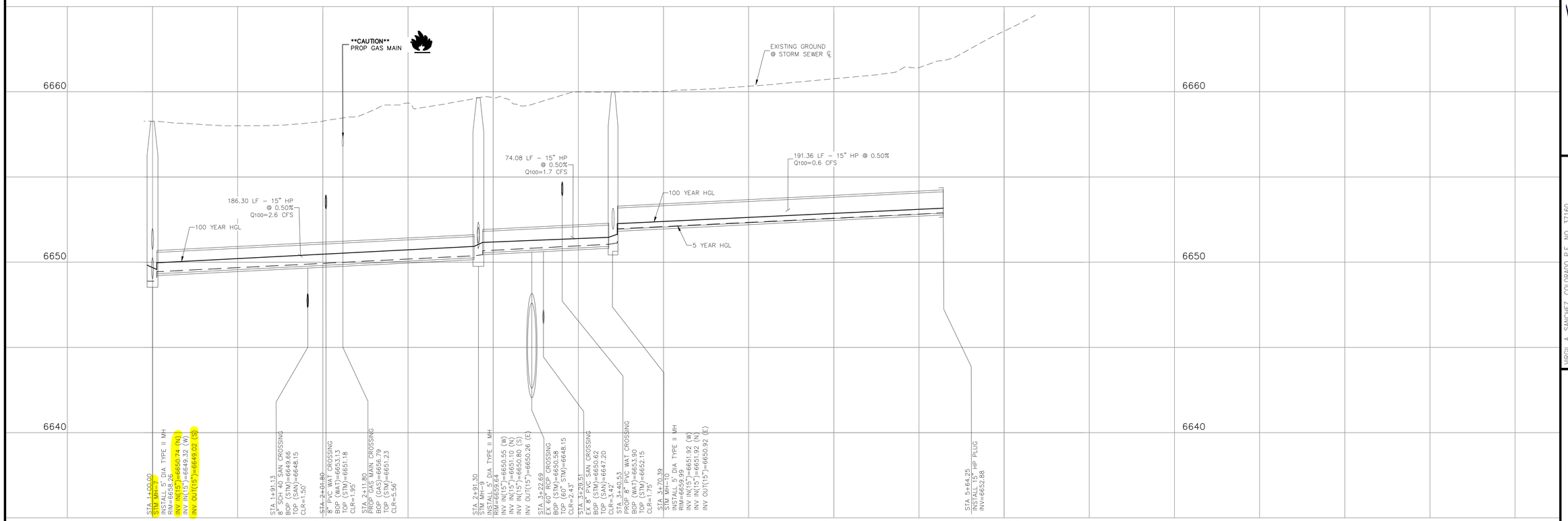
1" = 30'

0 15 30 60

Scale in Feet

KEY NOTES:

1. 50' PUBLIC UTILITY EASEMENT
2. 30' PUBLIC UTILITY EASEMENT
3. 24' PUBLIC ACCESS EASEMENT
4. 30' PUBLIC ACCESS EASEMENT
5. 40' PUBLIC ACCESS EASEMENT
6. 18' PUBLIC ACCESS EASEMENT
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STORM 4

DRAINAGE DESIGN:

DRAINAGE DESIGN:_____ DATE: _____

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WILLOWIND COMMERCIAL FILING NO. 4

STORM SEWER PLANS

PROJECT NO. 10-021 | DATE: 08/20/23 | SHEET 5 OF 12 | ST05

SCALE: HORIZONTAL: 1"=30' VERTICAL: 1"=3'

DESIGNED BY: DM
DRAWN BY: CLP
CHECKED BY: VAS

212 N. WAHSATCH AVE., STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

CIVIL CONSULTANTS, INC.

FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.

VIRGIL A. SANCHEZ, COLORADO P.E. NO. 37160

REVISIONS:

NO.	DATE:	BY:	DESCRIPTION:	APPVD. BY:	DATE:

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CAUTION

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