PRELIMINARY DRAINAGE REPORT
FOR
ESTEBAN RODRIGUEZ SUBDIVISION
EL PASO COUNTY, COLORADO

October 2024

Prepared For:

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Prepared By:

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Job No. 25277.00

PCD File No.: SF-24XX

ENGINEER'S STATEMENT:
The attached drainage report and plan was prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by El Paso County for drainage reports and said report 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.

Bryan T. Law, Colorado P.E. # 25043 Date
For and On Behalf of JR Engineering, LLC

DEVELOPER'S STATEMENT:
I, the developer, have read and will comply with all of the requirements specified in this drainage report and plan.

Business Name: Brent Houser Enterprises, LLC

By:
Esteban Rodriguez
Title:
Address: 11890 Garrett Road
Peyton, CO 80831-7685

El Paso County:
Filed in accordance with the requirements of the El Paso County Land Development Code, Drainage Criteria Manual, Volumes 1 and 2 and Engineering Criteria Manual, as amended.

Joshua Palmer, P.E. Date
County Engineer/ ECM Administrator

Conditions:

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PURPOSE

This document is the Preliminary Drainage Report for Esteban Rodriguez Subdivision. The purpose of this report is to identify on-site and off-site drainage patterns, culverts, areas tributary to the site, and to safely route developed storm water to adequate outfall facilities.

GENERAL LOCATION AND DESCRIPTION

General Location

The proposed Esteban Rodriguez Subdivision development (hereby referred to as the "site") is located within the west half of Section 2, the southwest quarter of the southeast quarter of the east half of Section 2, and the north half of the north half of Section 11, Township 13 South, Range 64 West of the Sixth Principal Meridian, El Paso County, Colorado. The site is bound by existing large acre Cowboy Ranch VW developments to the east, existing Judge Orr Road to the north, the future Saddlehorn Ranch to the west, and by the existing Sagecreek North development and 7360 Falcon Grassy Hts. to the south. A vicinity map is presented in Appendix A.

Description of Property

The proposed Esteban Rodriguez Subdivision development contains approximately 496 acres and will be comprised of 2.5-acre single-family lots, 5-acre single-family lots, commercial areas and detention pond areas. The site is currently unoccupied and undeveloped. The existing ground cover is sparse short and mixed grass prairie vegetation. Currently there is one major drainageway located on-site, which is titled Geick Ranch WF-R8a per the "Gieck Ranch Drainage Basin Planning Study" by Drexel, Barrel dated October, 2007 and updated in February 2010. This drainageway was analyzed hydrologically and hydraulically later in this report.

Per a NRCS web soil survey of the area, the site is made up of Hydrologic Group A and D soils. Type A soils are typically deep well-drained to excessively drained sands that have a high infiltration rate when thoroughly wet. Type D soils are typically clays and soils with a high water table that have a very slow infiltration rate. Most of the developable area of the site has Type A soils. The Type D soils are located mostly within the undevelopable floodplain area. A NRCS soil survey map is presented in Appendix A.

Floodplain Statement

Based on the FEMA FIRM numbers 08041C0558G, 08041C0559G, 08041C0566G, and 08041C0567G dated December 7, 2018, the site lies within Zone A and Zone X. Zone A is defined as area within the Special Flood Hazard Area (SFHA) with no base flood elevations determined. Zone X is defined as area outside the SFHA and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood. The floodplains throughout the site shall be considered no-build areas and all proposed development within the site will occur in Zone X. Draft model backed BFEs for this area have been developed as part of Phase 1 for the ongoing El Paso County, CO, Risk MAP project.

FEMA approved floodplain elevations will be required on the final plat. The FIRM panels are presented in Appendix A.

Environmental Statement

The "Wetland, Wildlife and Natural Features Report for Esteban Rodriguez Subdivision in El Paso County, Colorado" by ECOS dated June 19, 2023 describes the existing environmental features of the site. No critical habitat, wildlife refuges, or hatcheries are found in the vicinity of the site. The site does have existing wetland and riparian habitats located within the drainageway. In compliance with the environmental report, these areas will not be impacted by development except for around the two proposed roadway crossings, as well as required channel improvements. As mentioned in the environmental report, a portion of the creek below the existing stock pond is head-cutting severely. If not addressed, the headcut will completely degrade the abutting wetland and therefore should be stabilized immediately. The proposed development will also remove the existing stock pond and improve the channel against possible erosion. See Appendix D for excerpts of the afore mentioned environmental report.

MAJOR DRAINAGE BASINS AND SUB-BASINS

Major Basin Descriptions

Gieck Ranch

A portion of the site lies within the Gieck Ranch Drainage Basin. The "Gieck Ranch Drainage Basin Planning Study" by Drexel, Barrel dated October, 2007 and updated in February 2010 has not been approved by El Paso County as of the date of this report. The Gieck Ranch Drainage Basin covers approximately 22 square miles beginning approximately 5 miles northeast of the Town of Falcon and extends approximately 15 miles to the southeast. The Gieck Ranch Drainage Bain is tributary to Black Squirrel Creek, which drains south to its confluence with the Arkansas River near Pueblo, Colorado. In general, the Gieck Ranch Drainage Basin flows from west to east across the proposed site.

As described in the report, a portion of the west fork of the Gieck Ranch drainageway flows from west to east across the proposed site. The specific channel reaches are WF-R7a, WF-R7b, and WF-R8a. The proposed improvements described within that report are described as vegetation augmentation and selective stabilization along these reaches. The report proposes several grade control structures as well as the removal of the existing stock pond located within the channel near the east site boundary to avoid further headcutting. Excerpts of the Gieck Ranch DBPS are shown in Appendix D for information only. The proposed development does not intend to change peak flows in the existing drainageways. Due to proposed rural local roadways crossing the existing Gieck Ranch West Tributary drainageway in two locations, a No Rise Letter shall be provided with the future Final Draiange Report. The No Rise Letter shall show that the proposed channel improvements will not adversely affect the floodplain width and water surface elevation. See the

Channel Analysis and Design portion of the report for proposed improvements and drainage infrastructure.

Haegler Ranch

A portion of the site also lies within the Haegler Ranch Drainage Basin. The "Haegler Ranch Basin Drainage Basin Planning Study" by URS Corporation dated May, 2009 describes the characteristics of the Haegler Ranch basin. The Haegler Ranch Drainage Basin covers approximately 17 square miles located in the central portion of El Paso County. The Haegler Ranch Drainage Bain is tributary to Ellicott Consolidated Drainage Basin unnamed tributary, which is tributary to Black Squirrel Creek. In general, the Haegler Ranch Drainage Basin flows from north to south to the west of the proposed site.

As described in the report, a portion of the main stem flows north to south to the west of the proposed site. The specific channel reaches adjacent to the proposed site are MS-5 and MS-6. The proposed improvements described within the Haegler Ranch DPBS suggest sub-regional detention facilities as the selected design alternative. None of the Haegler Ranch drainageway floodplains are located on-site, and there will therefore be no impacts due to the proposed development. The proposed development does not intend to change peak flows in the existing drainageways. Excerpts of the Haegler Ranch DBPS are shown in Appendix D.

EXISTING DRAINAGE CONDITIONS

Existing Sub-basin Drainage

The existing basin delineation for Esteban Rodriguez Subdivision as shown on the map within Appendix E is as follows:

Basin OS1 is approximately 1.56 acres with a 2% impervious and is comprised of undeveloped areas to the west of the project site, a future tract within the Saddlehorn Ranch Filing No. 4 development. Flow will follow the historic path overland from the northwest to the southeast where it will enter Basin EXA and follow the drainage patterns of that basin. The basin flows will combine at DP1.

Basin OS2 is approximately 17.5 acres with a 10% impervious and is comprised of future portions of Saddlehorn Ranch Filing No. 4 and 5 to the west of the project site. Flow will follow the historic path overland from the southwest to the northeast where it will enter Basin EXA and follow the drainage patterns of that basin. The basin flows will combine at DP1.

Existing Basin EXA is approximately 179.6 acres with a 2% impervious and in the existing condition is comprised of undeveloped land and part of the FEMA floodplain for Gieck Ranch West Tributary. Historically runoff from this basin flows from northwest and southwest to the drainageway in the middle where the flows enter the existing drainageway. Flows from the off-site basins OS1 and OS2 will combine with Basin EXA at DP1 (Q_5=86 cfs, Q_{100}=753 cfs). These flows are from the reach

WF-R8a within the "Gieck Ranch Drainage Basin Planning Study" by Drexel, Barrell & Co. dated October 2007. Flows then continue flowing east off-site within the existing Gieck Ranch drainageway.

Existing Basin EXB is approximately 32.2 acres with a 2% impervious and in the existing condition is comprised of undeveloped land. Historically runoff from this basin flows from northwest to the southeast where the flows follow the existing path flowing to the southeast off-site at DP2 (Q_5=7 cfs, Q_{100}=44 cfs). Flows then continue flowing southeast onto the 16365 Judge Orr Road property before entering the existing Gieck Ranch drainageway.

Existing Basin EXC is approximately 29.0 acres with a 2% impervious and in the existing condition is comprised of undeveloped land. Historically runoff from this basin flows from south to the north where the flows follow the existing path flowing to the northeast off-site at DP3 (Q_5=6 cfs, Q_{100}=40 cfs). Flows then continue flowing northeast onto the Cowboy Ranch VW property before entering the existing Gieck Ranch drainageway.

Existing Basin EXD is approximately 48.2 acres with a 2% impervious and in the existing condition is comprised of undeveloped land. Historically runoff from this basin flows from north to the south where the flows follow the existing path flowing to the southwest off-site at DP4 (Q_5=7 cfs, Q_{100}=48 cfs). Flows then continue flowing south onto the 7120 Falcon Grassy Hts. property before entering the existing Haegler Ranch drainageway.

Existing Basin EXE is approximately 152.2 acres with a 2% impervious and in the existing condition is comprised of undeveloped land. Historically runoff from this basin flows from north to the south where the flows follow the existing path flowing to the southwest off-site at DP5 (Q_5=22 cfs, Q_{100}=145 cfs). Flows then continue flowing south onto the Sagecreek North Development property. Runoff then continues following the historic path within the Haegler Ranch drainage basin.

Existing Basin EXF is approximately 50.2 acres with a 2% impervious and in the existing condition is comprised of undeveloped land. Historically runoff from this basin flows from north to the south where the flows follow the existing path flowing to the southwest off-site at DP6 (Q_5=8 cfs, Q_{100}=55 cfs). Flows then continue flowing south within an existing natural ditch onto the 7360 Falcon Grassy Hts and Sagecreek North Development properties. Runoff then continues following the historic path within the Haegler Ranch drainage basin.

A summary of existing basin parameters is presented in Appendix B.

PROPOSED DRAINAGE CONDITIONS

Proposed Drainage Conveyance

In general, developed flows are collected in proposed roadside swales, which convey water to the proposed detention areas. Proposed rural minor collector roadways with 80' right-of-ways as well as rural local roadways with 60' right-of-ways are used throughout the site and are per the typical El Paso County section. Proposed swales will be designed per the typical county rural roadside ditch section and designed to ensure they are stable and have required capacity to satisfy criteria. A swale is considered stable with a velocity of 5 ft/s or less. If velocities exceed 5 ft/s, swales shall be protected by buried soil riprap to limit potential erosion. To ensure capacity, swales will have a minimum of 1 ft. of freeboard over the water surface for flows anticipated in a 100-year storm event. The roadside swales shall comply with Table 6-1 of the EPC DCM Volume 1. In addition to the swales, a few proposed culverts also convey flows under proposed roadways. Culverts under paved roads will be sized to not overtop the roadways with flows from a 100-year storm event. The inlets and outlets of the proposed culverts will be protected with riprap to limit potential erosion. More detailed analysis shall be provided in the future Final Drainage Report.

Proposed Sub-basin Drainage

The proposed basin delineation for Esteban Rodriguez Subdivision as shown on the map within Appendix E is as follows:

Basin A1 is approximately 12.1 acres with an 85% impervious and is comprised of proposed commercial areas, the north half of Glorietta Street and west half of Cabarillo Circle East. Runoff from this basin will be collected in a proposed roadside swale. Flows will be piped across Cabarillo Circle East via a culvert at DP1 (Q_5=33 cfs, Q_{100}=62 cfs). Flows continue within a proposed swale to the combination at DP2.1.

Basin A2 is approximately 4.18 acres with a 72% impervious and is comprised of proposed commercial areas, the east half of Cabarillo Circle East and a proposed swale. Runoff from this basin will be collected in a proposed swale along the southern basin line at DP2 (Q_5=12 cfs, Q_{100}=23 cfs). Flows combine with DP1 at the proposed culvert at DP2.1 (Q_5=44 cfs, Q_{100}=84 cfs). Flows continue within a proposed swale to the combination at DP3.1.

Basin A3 is approximately 3.84 acres with an 88% impervious and is comprised of proposed commercial areas and a proposed swale. Runoff from this basin will be collected in a proposed swale along the southern basin line to the proposed swale at DP3 (Q_5=12 cfs, Q_{100}=23 cfs). DP3 flows combine with DP2.1 within the proposed swale at DP3.1 (Q_5=54 cfs, Q_{100}=102 cfs). Flows continue within a proposed swale to the combination at DP4.1

Basin A4 is approximately 4.15 acres with a 26% impervious and is comprised of a large single-family lot and the east half of Cabrillo Circle East. Runoff from this basin will be collected in

proposed roadside swales at DP4 (Q_5=3 cfs, Q_{100}=10 cfs). DP4 flows combine with DP3.1 flows at the culvert at DP4.1 (Q_5=56 cfs, Q_{100}=102 cfs). Flows enter into Pond 1 via a forebay and combine with other inflows at DP8.1.

Basin OS1 is approximately 1.56 acres with a 10% impervious and is comprised of undeveloped areas to the west of the project site (a future tract within the Saddlehorn Ranch Filing No. 4 development) as well as the west half of proposed Elbert Road. This basin is off-site and only a proposed Elbert Road connection is proposed. Runoff from this basin will follow the historic path overland from the northwest to the southeast and flow to the proposed roadside swale at DP5 (Q_5=1 cfs, Q_{100}=3 cfs). Flows continue along the roadside swale to the combination at DP6.1.

Basin A5 is approximately 5.99 acres with a 26% impervious and is comprised of large single-family lots, the south half of Elbert Road and the west half of Cabrillo Circle West. Runoff from this basin will be collected in proposed roadside swales to DP6 (Q_5=4 cfs, Q_{100}=13 cfs). Flows combine with DP5 at the proposed culvert at DP6.1 (Q_5=5 cfs, Q_{100}=16 cfs). Runoff is then directed to Pond 1 along a proposed swale. DP6.1 flows enter Pond 1 via a forebay and combine with other inflows at DP8.1.

Basin A6 is approximately 38.2 acres with a 15% impervious and is comprised of large single-family lots, the south half of Glorietta Street, the north half of Elbert Road and the east half of Cabrillo Circle East. Runoff from this basin will be collected in proposed roadside swales DP7 (Q_5=19 cfs, Q_{100}=70 cfs). DP7 flows enter Pond 1 via a forebay and combine with other inflows at DP8.1.

Basin A7 is approximately 7.57 acres with a 21% impervious and is comprised of is comprised of large single-family lots, the south half of Elbert Road, the east half of Cabrillo Circle West, the west half of Cabrillo Circle East and proposed Pond 1. Runoff from this basin will be collected in proposed roadside swales and sheet flow towards Pond 1 at DP8 (Q_5=7 cfs, Q_{100}=22 cfs). The inflows combine within Pond 1 at DP8.1 (Q_5=68 cfs, Q_{100}=178 cfs). Runoff is treated within Pond 1 and then released through the outlet structure at DP8.2 (Q_5=1 cfs, Q_{100}=32 cfs). DP8.2 flows then are directed to the proposed channel within the existing drainageway. Flows will ultimately follow the historic conveyance to the existing Gieck Ranch West Tributary drainageway then continue flowing east.

Basin B is approximately 0.74 acres with a 2% impervious and is comprised of an existing electric transmission easement. Runoff from this basin (Q_5=0 cfs, Q_{100}=2 cfs) will flow southeast overland towards the eastern site boundary. The existing utility easement does not allow for any proposed development in this area. Flows will therefore follow the historic path to the existing Gieck Ranch West Tributary drainageway without a permanent stormwater quality measure and are excluded from water quality treatment. This in accordance with Section I.7.1.B.5 of the ECM Stormwater Quality Policy and Procedure. Basin B and C flows combine at DP9.

Basin C is approximately 15.8 acres with a 10% impervious and is comprised of large single-family lots. Runoff from this basin (Q_5=8 cfs, Q_{100}=34 cfs) will flow southeast overland towards the eastern site boundary. Runoff from this basin is comprised of only large single-family lots and does not include any proposed roadway flows. Flows will therefore follow the historic path to the existing Gieck Ranch West Tributary drainageway without a permanent stormwater quality measure and are excluded from water quality treatment. This in accordance with Section I.7.1.B.5 of the ECM Stormwater Quality Policy and Procedure. Basin B and C flows combine at DP9 (Q_5=8 cfs, Q_{100}=36 cfs) representing the flow leaving the site to the east.

Basin D1 is approximately 4.49 acres with a 10% impervious and is comprised of large single-family lots. Runoff from this basin will flow southeast overland towards the existing drainageway. Runoff from this basin is comprised of only large single-family lots and does not include any proposed roadway flows. Flows will therefore follow the historic path to the existing Gieck Ranch West Tributary drainageway without a permanent stormwater quality measure and are excluded from water quality treatment. This in accordance with Section I.7.1.B.5 of the ECM Stormwater Quality Policy and Procedure. Runoff will follow the historic drainage pattern from west to east to the site boundary at DP10.

Basin OS2a is approximately 14.5 acres with a 2% impervious and is comprised of portions of future Saddlehorn Ranch Filing No. 4 and 5 to the west of the project site. Flow will follow the historic path overland from the southwest to the northeast where it will enter Basin D2 and follow the drainage patterns of that basin.

Basin D2 is approximately 11.0 acres with a 10% impervious and is comprised of large single-family lots. Runoff from this basin will flow northeast overland towards the existing drainageway. Runoff from this basin is comprised of only large single-family lots and does not include any proposed roadway flows. Flows will therefore follow the historic path to the existing Gieck Ranch West Tributary drainageway without a permanent stormwater quality measure and are excluded from water quality treatment. This in accordance with Section I.7.1.B.5 of the ECM Stormwater Quality Policy and Procedure. Runoff will follow the historic drainage pattern from west to east to the site boundary at DP10.

Basin D3 is approximately 29.6 acres with a 2% impervious and is the boundary of the existing Gieck Ranch West Tributary floodplain that crosses the site. Proposed Cabrillo Circle West crosses the floodplain and is also the boundary of the basin. The only proposed disturbances within this basin are channel improvements and a dual 12’ x 5’ RCBC to cross the roadway. The basin does not have a permanent stormwater quality measure and is excluded from water quality treatment in accordance with Section I.7.1.B.8 of the ECM Stormwater Quality Policy and Procedure. Flows will follow the historic drainage pattern from west to east to the site boundary at DP10.

Basin D4 is approximately 5.75 acres with a 2% impervious and is the boundary of the existing Gieck Ranch West Tributary floodplain that crosses the site. Proposed Cabrillo Circle West and

Cabrillo Circle East cross the floodplain and are also the boundary of the basin. The only proposed disturbances within this basin are channel improvements and the two sets of dual 12' x 5' RCBC to cross the two roadways. The basin does not have a permanent stormwater quality measure and is excluded from water quality treatment in accordance with Section I.7.1.B.8 of the ECM Stormwater Quality Policy and Procedure. Flows will follow the historic drainage pattern from west to east to the site boundary at DP10.

Basin D5 is approximately 4.53 acres with a 2% impervious and is the boundary of the existing Gieck Ranch West Tributary floodplain that crosses the site. Proposed Cabrillo Circle East crosses the floodplain and is also the boundary of the basin. The only proposed disturbances within this basin are channel improvements and the dual 12' x 5' RCBC to cross the roadway. The basin does not have a permanent stormwater quality measure and is excluded from water quality treatment in accordance with Section I.7.1.B.8 of the ECM Stormwater Quality Policy and Procedure. Flows will follow the historic drainage pattern from west to east to the site boundary at DP10 (Q_5=86 cfs, Q_{100}=753 cfs). These flows are from reach WF-R8a within the "Gieck Ranch Drainage Basin Planning Study" by Drexel, Barrell & Co. dated October 2007. Flows then continue flowing east off-site within the existing drainageway.

Basin OS2b is approximately 3.06 acres with a 2% impervious and is comprised of portions of future Saddlehorn Ranch Filing No. 5 to the west of the project site. Flow will follow the historic path overland from the southwest to the northeast where it will enter Basin E1 at DP11 (Q_5=1 cfs, Q_{100}=5 cfs). DP11 runoff combines at DP12.1.

Basin E1 is approximately 28.7 acres with a 16% impervious and is comprised of large single-family lots, La Noria Way, Adella Place and the west half of Cabrillo Circle West. Runoff from this basin will be collected in proposed roadside swales to DP12 (Q_5=19 cfs, Q_{100}=69 cfs). Flows combine with DP11 at the proposed culvert at DP12.1 (Q_5=20 cfs, Q_{100}=75 cfs). Runoff is then directed to Pond 2 along a proposed swale. DP12.1 flows enter Pond 2 via a forebay and combine with other inflows at DP14.1.

Basin E2 is approximately 1.63 acres with a 55% impervious and is comprised of the east half of Cabrillo Circle East. Runoff from this basin will be collected in proposed roadside swales towards the culvert at DP13 (Q_5=3 cfs, Q_{100}=6 cfs). Flows enter into Pond 2 via a forebay and combine with other inflows at DP14.1.

Basin E3 is approximately 43.5 acres with a 16% impervious and is comprised of is comprised of large single-family lots, La Noria Way, the east half of Cabrillo Circle West, west half of Cabrillo Circle East and proposed Pond 2. Runoff from this basin will be collected in proposed roadside swales towards Pond 2 at DP14 (Q_5=26 cfs, Q_{100}=93 cfs). DP14 flows enter Pond 2 via a forebay and combine with other inflows at DP14.1 (Q_5=46 cfs, Q_{100}=165 cfs). Runoff is treated within Pond 2 and then released through the outlet structure at DP14.2 (Q_5=0 cfs, Q_{100}=45 cfs). DP14.2 flows then are directed to the proposed channel within the existing drainageway. Flows will ultimately follow the

historic conveyance to the existing Gieck Ranch West Tributary drainageway then continue flowing east.

Basin F is approximately 22.0 acres with a 10% impervious and is comprised of large single-family lots. Runoff from this basin will flow northeast overland towards the existing drainageway at DP15 (Q_5=9 cfs, Q_{100}=40 cfs). Runoff from this basin is comprised of only large single-family lots and does not include any proposed roadway flows. Flows will therefore follow the historic path to the existing Gieck Ranch West Tributary drainageway without a permanent stormwater quality measure and are excluded from water quality treatment. This in accordance with Section I.7.1.B.5 of the ECM Stormwater Quality Policy and Procedure.

Basin G1 is approximately 17.6 acres with a 13% impervious and is comprised of large single-family lots, north half of Visalia Court and the east half of Cabrillo Circle West. Runoff from this basin will be collected in proposed roadside swales to DP16 (Q_5=9 cfs, Q_{100}=35 cfs). DP16 flows combine at the DP17.1 roadside swale.

Basin G2 is approximately 17.6 acres with a 15% impervious and is comprised of large single-family lots, south half of Visalia Court, north half of Tulago Place and the east half of Cabrillo Circle West. Runoff from this basin will be collected in proposed roadside swales to DP17 (Q_5=9 cfs, Q_{100}=33 cfs). DP17 flows combine at DP17.1 (Q_5=16 cfs, Q_{100}=63 cfs). DP17.1 flows combine at the DP18.1 culvert.

Basin G3 is approximately 5.70 acres with a 22% impervious and is comprised of large single-family lots, south half of Tulago Place and the east half of Cabrillo Circle West. Runoff from this basin will be collected in proposed roadside swales to DP18 (Q_5=5 cfs, Q_{100}=15 cfs). DP18 flows combine at DP18.1 (Q_5=19 cfs, Q_{100}=72 cfs). DP18.1 flows combine at the DP19.1 swale.

Basin G4 is approximately 20.4 acres with a 14% impervious and is comprised of large single-family lots and the west half of Cabrillo Circle West. Runoff from this basin will be collected in proposed roadside swales to DP19 (Q_5=10 cfs, Q_{100}=39 cfs). DP19 flows combine at DP19.1 (Q_5=27 cfs, Q_{100}=108 cfs). DP19.1 flows enter into Pond 3 via a forebay and combine at DP20.1.

Basin G5 is approximately 10.4 acres with a 12% impervious and is comprised of is comprised of large single-family lots and proposed Pond 3. Runoff from this basin will be collected in a proposed swale along the western basin boundary and sheet flow towards Pond 3 at DP20 (Q_5=6 cfs, Q_{100}=23 cfs). The inflows combine within Pond 3 at DP20.1 (Q_5=29 cfs, Q_{100}=120 cfs). Runoff is treated within Pond 3 and then released through the outlet structure at DP20.2 (Q_5=0 cfs, Q_{100}=32 cfs). DP20.2 flows then are directed to a proposed flow spreader before flowing offsite towards the 7120 Falcon Grassy Hts property and then enter the existing Haegler Ranch drainageway. Flows will ultimately follow the historic flowing west.

Basin H1 is approximately 24.0 acres with a 12% impervious and is comprised of large single-family lots, the west half of Cabrillo Circle East and Tarawa Place. Runoff from this basin will be collected in proposed roadside swales to DP21 (Q_5=12 cfs, Q_{100}=47 cfs). DP21 flows around Tarawa Place via a roadside swale and continue within a proposed swale to combine at DP22.1.

Basin H2 is approximately 41.8 acres with a 12% impervious and is comprised of large single-family lots and north half of Cabrillo Circle West. Runoff from this basin will sheet flow to the proposed swale to DP22 (Q_5=17 cfs, Q_{100}=67 cfs). DP21 and DP22 flows combine at DP22.1 (Q_5=26 cfs, Q_{100}=106 cfs). DP23.1 flows continue within a roadside swale to the combination at DP23.1 culvert.

Basin H3 is approximately 21.3 acres with a 15% impervious and is comprised of large single-family lots and west/north half of Cabrillo Circle East. Runoff from this basin will sheet flow to the proposed swale to DP23 (Q_5=11 cfs, Q_{100}=41 cfs). DP23 and DP22.1 flows combine at DP23.1 (Q_5=34 cfs, Q_{100}=139 cfs). DP23.1 flows enter the proposed culvert under Cabrillo Circle East to the proposed swale at DP24.1.

Basin H4 is approximately 1.96 acres with a 54% impervious and is comprised of the south half of Cabrillo Circle West/ Cabrillo Circle East. Runoff from this basin will be collected in proposed roadside swale at DP24 (Q_5=3 cfs, Q_{100}=6 cfs). DP24 and DP23.1 flows combine at DP24.1 (Q_5=37 cfs, Q_{100}=144 cfs). DP24.1 flows enter into the proposed swale and combine at DP25.1.

Basin H5 is approximately 3.18 acres with a 50% impervious and is comprised of large single-family lots and Cabrillo Circle East. Runoff from this basin will be collected in proposed channel to DP25 (Q_5=4 cfs, Q_{100}=9 cfs). DP25 flows around Tarawa Place via a proposed channel to the combination at DP25.1 (Q_5=37 cfs, Q_{100}=145 cfs).

Basin H6 is approximately 36.6 acres with a 11% impervious and is comprised of large single-family lots, the east half of Cabrillo Circle East and proposed Pond 4. Runoff from this basin will be collected in proposed channel to DP26 (Q_5=13 cfs, Q_{100}=54 cfs). DP26 flows via a proposed channel to the combination at DP26.1 (Q_5=47 cfs, Q_{100}=196 cfs). DP26.1 flows to Pond 4 via a forebay. Runoff is treated within Pond 4 and then released through the outlet structure at DP26.2 (Q_5=0 cfs, Q_{100}=42 cfs). DP14.2 flows then are directed to a proposed flow spreader before flowing offsite existing natural dich adjacent to the existing platted right-of-way and Sagecreek North development. The existing natural ditch will convey the flows as it does in the existing condition.

Basin I is approximately 46.8 acres with a 10% impervious and is comprised of large single-family lots. Runoff from this basin will flow south overland towards the site boundary at DP27 (Q_5=24 cfs, Q_{100}=103 cfs). Runoff from this basin is comprised of only large single-family lots and does not include any proposed roadway flows. Flows will therefore follow the historic path to the 7360 Falcon Grassy Hts property without a permanent stormwater quality measure and are excluded from water quality treatment. This in accordance with Section I.7.1.B.5 of the ECM Stormwater Quality Policy and Procedure.

A summary of proposed basin parameters is presented in Appendix B.

Comparison of Flows

There are several locations where the existing and proposed flows leave the site:

- Flows leave the mid-eastern part of the site at existing DP1 and proposed DP10. Existing DP1 flows (Q_5=86 cfs, Q_{100}=753 cfs) are the same as the proposed DP10 flows (Q_5=86 cfs, Q_{100}=753 cfs). These values are from the Gieck Ranch DBPS. The proposed Pond 1 and Pond 2 will release flows into the existing drainageway at the rate required to ensure proposed values are less than or equal to existing flows.
- Flows leave the northeastern part of the site at existing DP2 and proposed DP9. Existing DP2 flows (Q_5=7 cfs, Q_{100}=44 cfs) are greater in the major storm than the proposed DP9 (Q_5=8 cfs, Q_{100}=36 cfs).
- Flows also leave the mid-eastern part of the site at existing DP3 and proposed DP15. Existing DP3 flows (Q_5=7 cfs, Q_{100}=48 cfs) are the more than the proposed DP15 flows (Q_5=9 cfs, Q_{100}=40 cfs).
- Flows leave the southwestern part of the site at existing DP4 and proposed Pond 3 discharge at DP20.2. Existing DP4 flows (Q_5=7 cfs, Q_{100}=48 cfs) are the less than the proposed Pond 3 discharge at DP20.2 (Q_5=0 cfs, Q_{100}=32 cfs). The proposed Pond 4 will release flows at the rate required to ensure proposed values are less than or equal to existing flows.
- Flows also leave the southern part of the site at existing DP5 and proposed DP27. Existing DP5 flows (Q_5=22 cfs, Q_{100}=145 cfs) are greater in the major storm than the proposed DP27 flows (Q_5=24 cfs, Q_{100}=103 cfs).
- Flows leave the southeastern part of the site at existing DP6 and proposed Pond 4 discharge at DP26.2. Existing DP6 flows (Q_5=8 cfs, Q_{100}=55 cfs) are the greater than the proposed Pond 4 discharge at DP26.2 (Q_5=0 cfs, Q_{100}=42 cfs). The proposed Pond 4 will release flows at the rate required to ensure proposed values are less than or equal to existing flows.

All proposed flows in the major storm leave the site at less than or equal to the historic flow rates. Therefore, there is no negative impact anticipated to downstream properties. All pond outfalls shall be designed with level flow spreaders to ensure that outflows from the pond are not concentrated and remain in sheet flow conditions to prevent erosive potential.

Channel Analysis and Design

Drainageway WF-R8a was evaluated in its existing condition to analyze the existing floodplain and channel stability. In its current condition, WF-R8a is a heavily vegetated channel with weeds as tall as the typical flow depth meaning this would classify that channel as a natural minor stream with sluggish reaches, weedy and deep pools, per the El Paso County Drainage Criteria Manual Table 10-2. Given this classification, a Manning's roughness coefficient of 0.060 was used when analyzing the channel bottom and 0.045 on the sides which have less vegetation cover. The GeoHECRAS model determined that the existing channel has stable average velocities, with isolated instances of high

velocities, ranging from 0.3 fps to 11.6 fps. Velocities are allowable based on the max stable velocity of 7 fps for erosion resistant channels, per Table 8-1 from MHFCD. There are only three instances where the velocities exceed that maximum value of 7 fps. Those are located in the middle of the drainageway crossing the site and shall be stabilized in the proposed condition. In the evaluated channel model, there is one instance where the Froude number exceeds the El Paso County maximum of 0.90. This are located at the middle of the drainageway. This part of the existing channel shall be revised in the proposed condition and stabilization measures shall be taken.

In the proposed section of the channel, there are several boulder drop structures proposed. Due to this, some velocities in the channel reach 19.2 fps and a Froude max of 2.8. These sections will be lined with riprap along bottom of the proposed channel and lined with erosion control blankets; this will mitigate the erosion risk associated with these higher velocities and Froude's. In addition to the protection discussed above, cutoff walls and reinforced rock berms will also be installed at all location where the Froude numbers exceed 0.90 to stabilize the channel against erosion.

Shear stresses present in the channel in its existing condition are approximately 1.50 lbs/sf on average, above the MHFCD Maximum Shear Stress of 1.2 lbs/sf per Table 8-3. In the proposed condition, the average shear stresses shall be improved using erosion prevention designs. The proposed dual 12'x5' RCBC culverts shall be designed with riprap, which will prevent soil erosion. The area just upstream of the proposed channel improvements will be lined in a TRM that will mitigate the potential for erosion due to the excess shear. The modeled results of the existing and proposed channel can be found in Appendix C.

Table 1: Channel Design Parameters

Design Parameter	Erosive Soils or Poor Vegetation	Erosive Resistant Soils and Vegetation
Max Low-flow Velocity (ft/s)	3.5	5.0
Max 100-year Velocity (ft/s)	5.0	7.0
Froude Number Low Flow	0.5	0.7
Froude Number 100-year Flow	0.6	0.9

In the Final Drainage Report, a No Rise Letter shall be provided evaluating how the proposed channel improvements will not adversely affect the floodplain width and water surface elevation.

DRAINAGE DESIGN CRITERIA

Development Criteria Reference

Storm drainage analysis and design criteria for the project were taken from the "City of Colorado Spring/El Paso County Drainage Criteria Manual" Volumes 1 and 2 (EPCDCM), dated October 12, 1994, the "Urban Storm Drainage Criteria Manual" Volumes 1 - 3 (USDCM) and Chapter 6 and Section 3.2.1 of Chapter 13 of the "Colorado Springs Drainage Criteria Manual (CCSDCM)", dated

May 2014, as adopted by El Paso County, as well as the El Paso County "Engineering Criteria Manual" (ECM), dated October 14, 2020.

Hydrologic Criteria

All hydrologic data was obtained from the "El Paso Drainage Criteria Manual" Volumes 1 and 2, and the "Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual" Volumes 1, 2, and 3. On-site flows were determined based on the 5-year (minor) storm event and the 100-year (major) storm event. Runoff was calculated using the Rational Method, and rainfall intensities for the 5-year and the 100-year storm return frequencies were obtained from Figure 6-5 Intensity Duration Frequency Curve of the Colorado Springs DCM. Runoff coefficients were determined based on proposed land use and from data in Table 6-6 from the DCM. One-hour point rainfall data for the storm events are 1.50 inches for the 5-year and 2.52 inches for the 100-year storm.

Hydraulic Criteria

The Rational Method and USDCM's SF-2 and SF-3 forms were used to determine the runoff from the minor and major storms on the site. Autodesk Inc.'s Hydraflow Express Extension (Volume 10.5) was used to size the roadside ditches and drainage swales per criteria. Per Section 6.4.1 of the EPCDCM, culverts were sized as to not overtop the road in the 100-year storm. The MHFD-Detention_v4.06 spreadsheet was utilized for evaluating proposed detention and water quality for the five ponds. Required detention volumes and allowable release rates were designed per USDCM and CCS/EPCDCM. CivilGEO Inc.'s GeoHECRAS was used to analyze the existing drainageway and the two proposed roadway crossings. See Appendix C for calculations. The hydraulic design will be finalized with the Final Drainage Report.

DRAINAGE FACILITY DESIGN

General Concept

The proposed stormwater conveyance system was designed to convey the developed Esteban Rodriguez Subdivision flows to one of four full-spectrum EDBs via roadside ditches and roadway culverts. All proposed full-spectrum EDBs will be designed to release flows at less than historic to minimize adverse impacts downstream. Due to this, there are no drainage problems anticipated downstream of the Esteban Rodriguez Subdivision development. The EDBs will outfall at two points of the existing drainageway and all proposed development shall stay out of the floodplain besides specific channel improvements and outfall stabilization.

The "Soil and Geology Study: Esteban Subdivision" prepared by Rocky Mountain Group showed some bore test results with groundwater located within 10 feet of the surface. The test borings taken were not located in the immediate vicinity of the proposed full-spectrum EDBs, but Ponds 1 and 2 may have some risk for shallow groundwater. When the final pond locations are determined with future analysis within the drainage reports submitted for development plans, additional test bore holes may be required. If shallow groundwater is an issue for any of the full-spectrum EDBs,

mitigation options such as clay or geomembrane layers shall be defined in the future drainage reports.

In accordance with Section I.7.1.B.5 of the ECM Stormwater Quality Policy and Procedure, developed basins with large lot single-family sites with a maximum of 10% impervious area shall be allowed to release runoff without a downstream permanent stormwater quality measure. In accordance with Section I.7.1.B.8, sites with constructing activity that is for the purpose of stream stabilization are also excluded from having a downstream permanent stormwater quality measure. See highlighted areas in the drainage map presented in Appendix E, as well as Table 2 in the Water Quality section.

Specific Details

All full-spectrum EDBs will have proposed forebays at inflow points, concrete trickle channels, and outlet structures. The proposed pond forebays and weir contain the required percentage of the Water Quality Capture Volume (WQCV). The forebays weir will release 2% or 3% of the undetained peak 100-year inflow (depending on impervious acres per EDB-4) into the full-spectrum EDB to the proposed concrete trickle channel. The trickle channel will direct flows into the proposed full-spectrum EDB outlet structure, which will detain water per times specified by criteria. The WQCV will be released within 40 hours and the EURV will be released within 72 hours.

Four Step Process to Minimize Adverse Impacts of Urbanization

In accordance with the El Paso County Drainage Criteria Manual Volume 2, this site has implemented the four step process to minimize adverse impacts of urbanization. The four step process includes reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways and implementing source controls.

Step 1: Reducing Runoff Volumes - The development of the project site is proposed as single-family residential (2.5-acre min.) with lawn areas interspersed within the development which helps disconnect impervious areas and reduce runoff volumes. Roadways will utilize roadside ditches to further disconnect impervious areas. Proposed flow in general follows the historic path over pervious surfaces into existing drainage paths. These practices will also allow for increased infiltration and reduce runoff volume.

Step 2: Provide WQCV - Runoff from this development is treated through capture and slow release of the WQCV in one of several on-site permanent full-spectrum EDBs that are be designed per current El Paso County drainage criteria. The 2.5-acre (minimum) residential lots will be limited to a maximum of 10% imperviousness to meet the requirements of Section I.7.1.B.5 of the ECM Stormwater Quality Policy and Procedure for water quality through a plat note. Should any lot exceed 10% imperviousness, a lot specific drainage report addressing the increased imperviousness must be submitted.

Step 3: Stabilize Drainageways - This site utilizes roadside ditches with culvert crossings throughout the site. Roadside ditches will be stabilized by keeping velocities below 5 ft/s, or providing additional erosion protection. These roadside ditches will then direct the applicable on-site and off-site development flows to one of several proposed full-spectrum EDBs within the project. Developed flows leaving the site are limited to below existing rates, and therefore no impact to downstream drainageways is anticipated. As part of the development the existing WF-R8a channel shall be improved for stability using boulder drop structures, riprap along bottom of the proposed channel lined with erosion control blankets, cutoff walls and reinforced rock berms. The existing stock pond shall be removed as well, which will prevent continued erosion.

Step 4: Implement Source Controls - A site specific stormwater quality and erosion control plan and narrative shall be prepared in conjunction with the final drainage report. Site specific temporary source control BMPs as well as permanent BMP's will be detailed in this plan and narrative to protect receiving waters.

Water Quality

In accordance with Section 13.3.2.1 of the CCS/EPCDCM, full-spectrum water quality and detention will be provided for all of the development site not meeting exclusions present in the ECM - Stormwater Quality Policy and Procedures Section I.7.1.B. As previously stated, the applicable exclusions for Basins B, C, D1-D2, F and I fall under Section I.7.1.B.5 of the ECM Stormwater Quality Policy and Procedure for areas with large single-family lots (2.5-acre min.). In addition, Basins D3-D5 fall under the Section I.7.1.B.8 of the ECM Stormwater Quality Policy and Procedure for stream stabilization sites. The proposed roadway will be treated within the proposed full-spectrum EDBs. Outlet structure release rates will be limited to less than historic rates to minimize adverse impacts to downstream stormwater facilities.

See Table 2 below for the water quality treatment summary table indicating which basins are treated and which are excluded.

Table 2 - Water quality treatment summary table.

PBMP Summary Table		
Basins	Tributary Area (acres)	PBMP
A1-A7	76.0	POND 1
B	0.74	EXCLUDED**
C	15.8	EXCLUDED*
D1-D2	15.5	EXCLUDED*
D3-D5	39.9	EXCLUDED***
E1-E3	73.8	POND 2
F	22.0	EXCLUDED*
G1-G5	71.7	POND 3
H1-H6	128.8	POND 4
I	46.8	EXCLUDED*
*EXCLUDED BASED ON LARGE-LOT SINGLE FAMILY SITE PER ECM APP. I.7.B.5 **EXCLUDED BASED ON LAND DIST. TO UNDEVELOPED LAND TO REMAIN UNDEVELOPED PER ECM APP. I.7.B.7 *** EXCLUDED BASED ON STREAM STABILIZATION SITE PER ECM APP. I.7.B.8		

Proposed Full-Spectrum EDBs

Water quality is provided for the site by four private full-spectrum detention and water quality EDBs. Table 3 below shows the basin parameters for all four ponds. Refer to Appendix C for the MHFD-Detention design sheets that include the tributary basin parameters as well as the stage-storage table and outlet structure design. The outlet structure includes an orifice plate, overflow grate, and restrictor plate to release stormwater at the appropriate rates. The WQCV will be released within 40 hours, the EURV will be released within 72 hours, and the minor and major flows will be released at or below the pre-development flow rate. Table 4 below gives the designed results for Pond 1-4.

Table 3 - Watershed design parameters for both EDBs.

Name	Watershed Area	Percent Impervious	Watershed Slope
Pond 1	78.0 ac	34.5%	0.035 ft/ft
Pond 2	77.0 ac	16.0%	0.040 ft/ft
Pond 3	72.0 ac	14.5%	0.040 ft/ft
Pond 4	129.0 ac	14.0%	0.045 ft/ft

Table 4- Full-spectrum EDB design for both EDBs.

Name	Required Volume (ac-ft)	Provided Volume (ac-ft)	WQCV (ac-ft)	EURV (ac-ft)	5-year Release (cfs)	100-year Release (cfs)
Pond 1	5.0	5.7	1.1	2.8	0.8	32.0
Pond 2	2.5	2.9	0.6	1.0	0.3	45.0
Pond 3	2.2	2.5	0.5	0.9	0.2	32.0
Pond 4	3.8	4.5	1.0	1.5	0.3	41.5

Calculations and pond design parameters are presented in Appendix C.

- For Pond 1, a broad-crested weir lined with buried soil riprap is provided as an emergency spillway along the southern embankment of the pond. Pond 1 emergency flows are conveyed via a proposed drainage swale to the proposed channel within the existing drainageway.
- For Pond 2, a broad-crested weir lined with buried soil riprap is provided as an emergency spillway along the northern embankment of the pond. Pond 2 emergency flows are conveyed via a proposed drainage swale to the proposed channel within the existing drainageway.
- For Pond 3, a broad-crested weir lined with buried soil riprap is provided as an emergency spillway along the southern embankment of the pond. Pond 3 emergency flows are conveyed via a proposed drainage swale to the proposed flow spreader before going off-site to the west, following the historic drainage patterns.
- For Pond 4, a broad-crested weir lined with buried soil riprap is provided as an emergency spillway along the southern embankment of the pond. Pond 4 emergency flows are conveyed via a proposed drainage swale to the proposed flow spreader before going off-site to the east, following the historic drainage patterns.

Erosion Control Plan

We respectfully request that the Final Erosion Control Plan and associated Cost Estimate to be submitted in conjunction with the construction drawings and plat prior to obtaining a grading permit.

Operation & Maintenance

In order to ensure the function and effectiveness of the stormwater infrastructure, maintenance activities such as inspection, routine maintenance, restorative maintenance, rehabilitation and repair, are required. All proposed drainage structures within any platted County R.O.W. (roadside ditches and local road culverts) will be owned and maintained by El Paso County. All proposed drainage structures within easements or tracts (full-spectrum water quality ponds, drainageway culverts and drainageway improvements) will be owned and maintained by the property owner unless another party accepts such responsibility in writing and responsibility is properly assigned through legal documentation. Inspection access for El Paso County will be provided through maintenance easements.

Drainage and Bridge Fees

The proposed site lies within both the Gieck Ranch and Haegler Ranch Drainage Basins. The drainage and basin fees will be assessed in conjunction with the construction drawings and plat prior to obtaining a grading permit.

Construction Cost Opinion

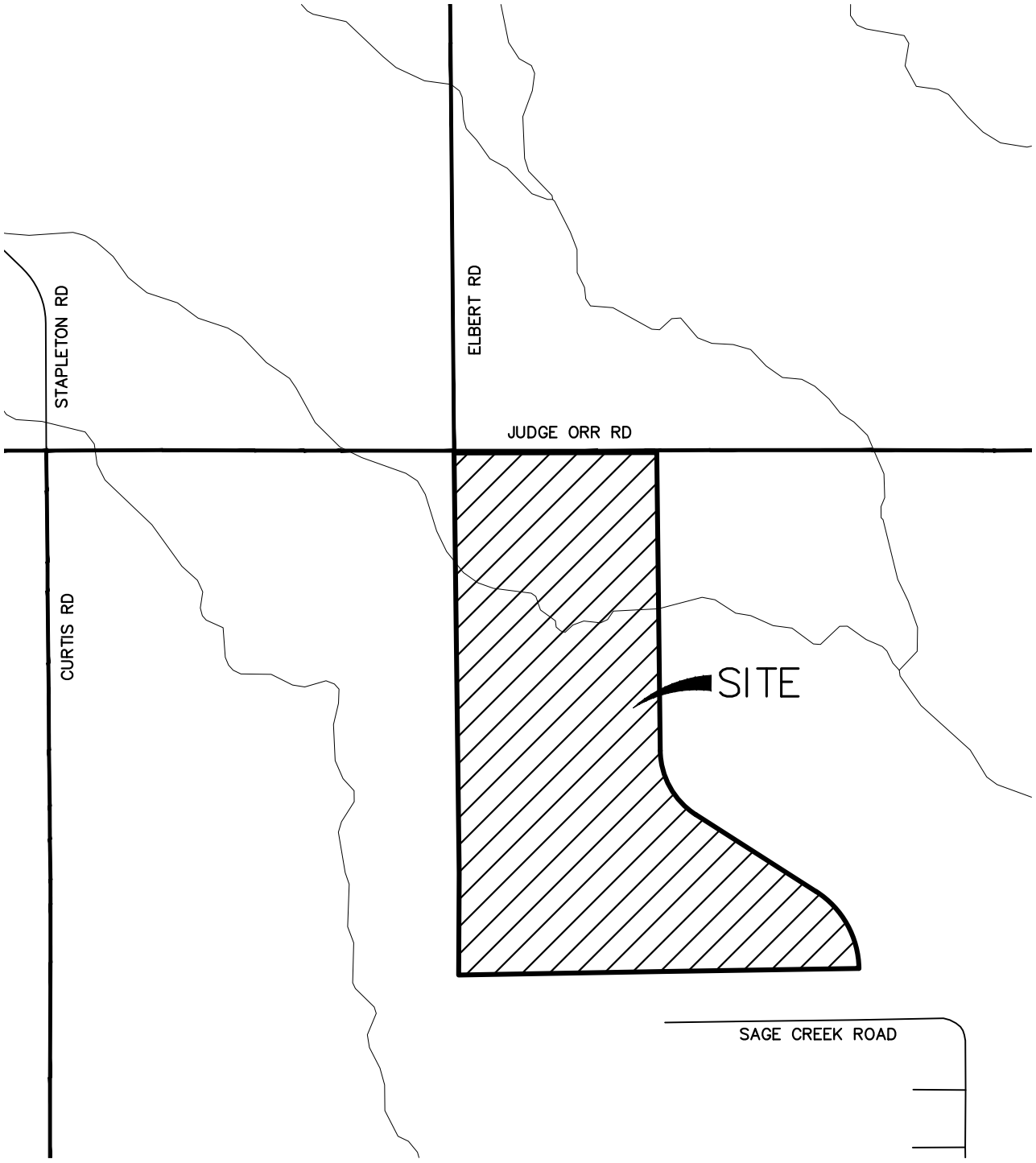
A construction cost opinion for the drainage infrastructure will be provided in conjunction with the construction drawings and plat prior to obtaining a grading permit.

SUMMARY

The Preliminary Drainage Report for Esteban Rodriguez Subdivision identifies on-site and off-site drainage patterns, storm sewer, culvert locations, areas tributary to the site, and safely routes developed storm water to adequate outfall facilities. The proposed Esteban Rodriguez Subdivision development will not adversely affect the off-site major drainageways or surrounding development. This report meets the latest El Paso County Drainage Criteria requirements for this site.

APPENDIX A

FIGURES AND EXHIBITS



VICINITY MAP
ESTEBAN RODRIGUEZ SUBDIVISION–
SKETCH PLAN
JOB NO. 25277.00
07/11/2023
SHEET 1 OF 1

N

2000 1000 0 2000

ORIGINAL SCALE: 1" = 2000'

J·R ENGINEERING
A Westrian Company
Centennial 303-740-9393 • Colorado Springs 719-593-2593
Fort Collins 970-491-9888 • www.jrengineering.com

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at http://www.ngs.noaa.gov/.

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, and Anderson Consulting Engineers, Inc. These data are current as of 2008.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

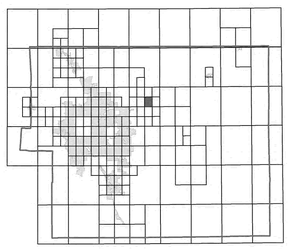
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

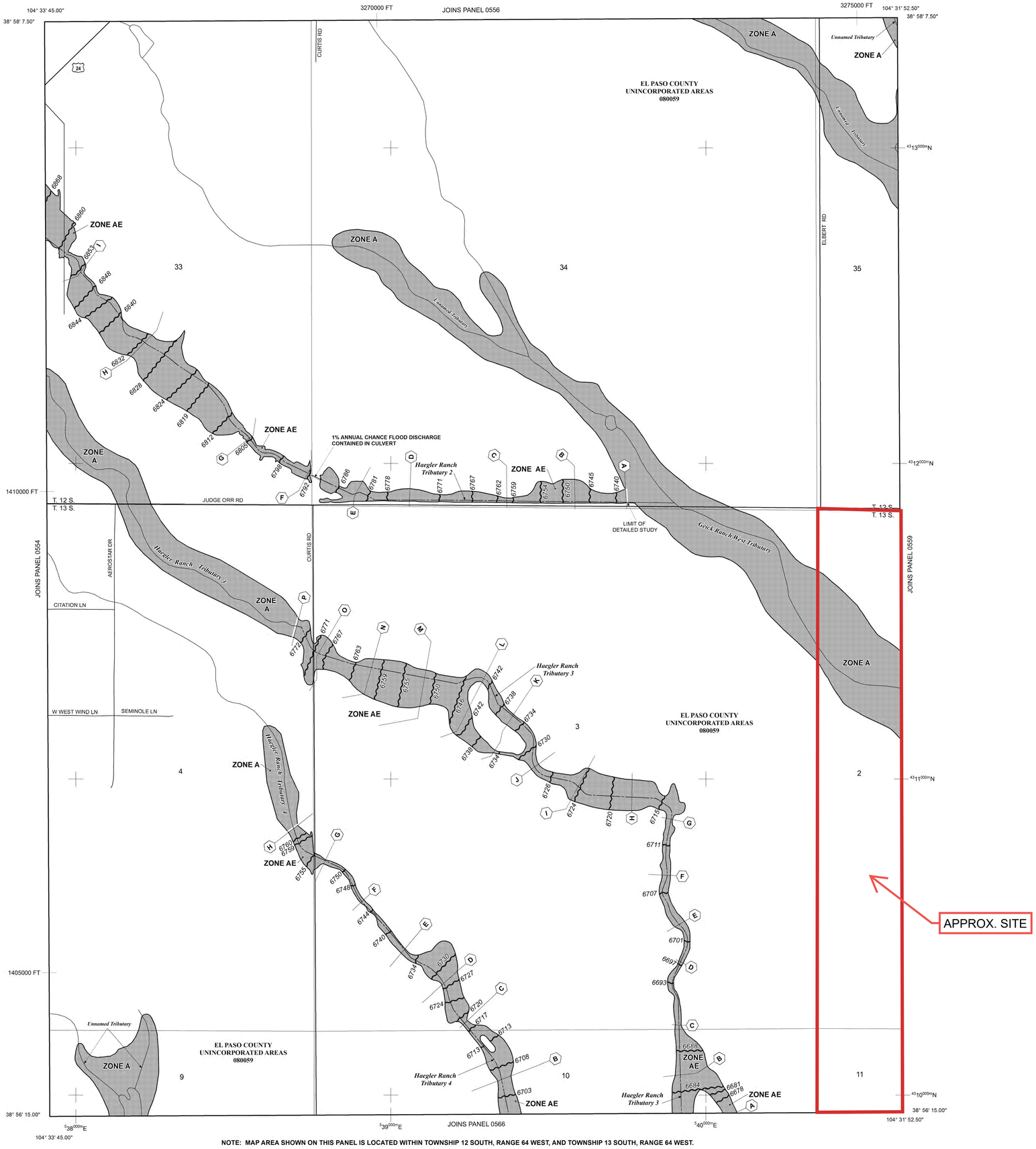
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 64 WEST, AND TOWNSHIP 13 SOUTH, RANGE 64 WEST.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	Floodplain boundary
	Floodway boundary
	Zone D Boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 — 23	Transect line
97° 07' 30.00" / 32° 22' 30.00"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN	1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT	5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510	Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

PANEL 0558G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 558 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0558	G

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
08041C0558G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

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Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
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SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at http://www.ngs.noaa.gov/.

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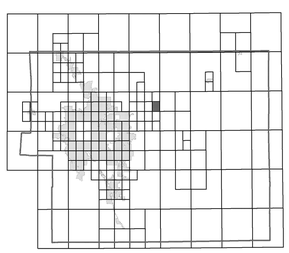
El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

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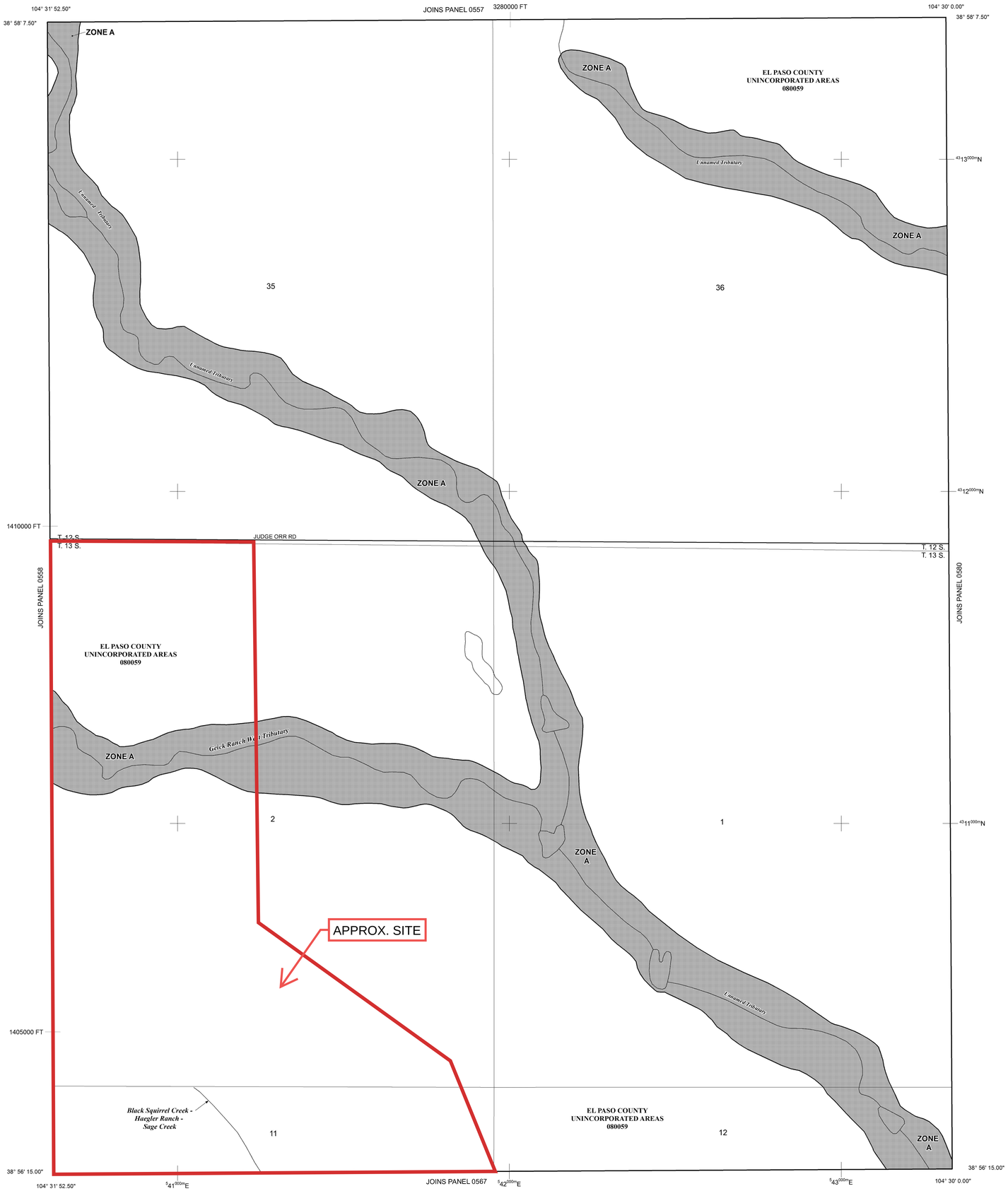

NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 64 WEST, AND TOWNSHIP 13 SOUTH, RANGE 64 WEST.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
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ZONE AR	Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
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ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	Floodplain boundary
	Floodway boundary
	Zone D Boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 — 23	Transect line
97° 07' 30.00" 32° 22' 30.00"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275 000mN	1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT	5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

PANEL 0559G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 559 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0559	G

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
08041C0559G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

NOTES TO USERS

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Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

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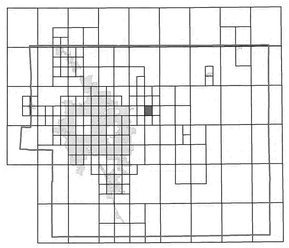
El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

Panel Location Map



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NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 13 SOUTH, RANGE 64 WEST.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

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ZONE A	No Base Flood Elevations determined.
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ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

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OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
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COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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	Floodway boundary
	Zone D Boundary
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	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

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DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
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MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

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MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

PANEL 0566G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 566 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0566	G

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
08041C0566G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

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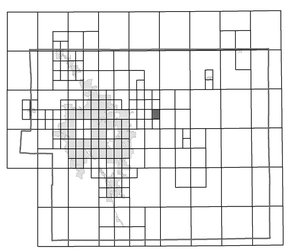
Panel Location Map



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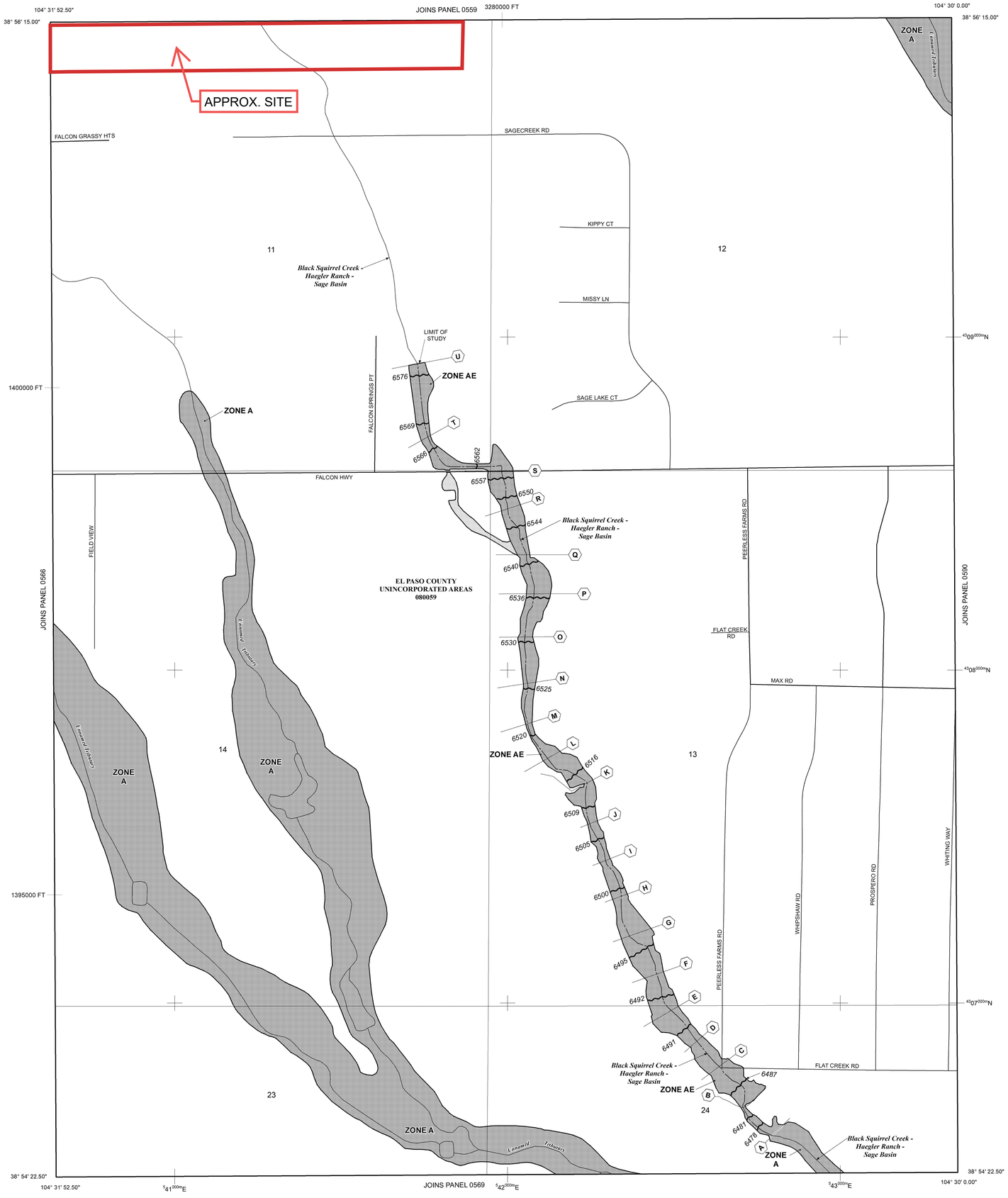

NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 13 SOUTH, RANGE 64 WEST.

LEGEND

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FLOODWAY AREAS IN ZONE AE

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OTHER FLOOD AREAS

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FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

PANEL 0567G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 567 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0567	G

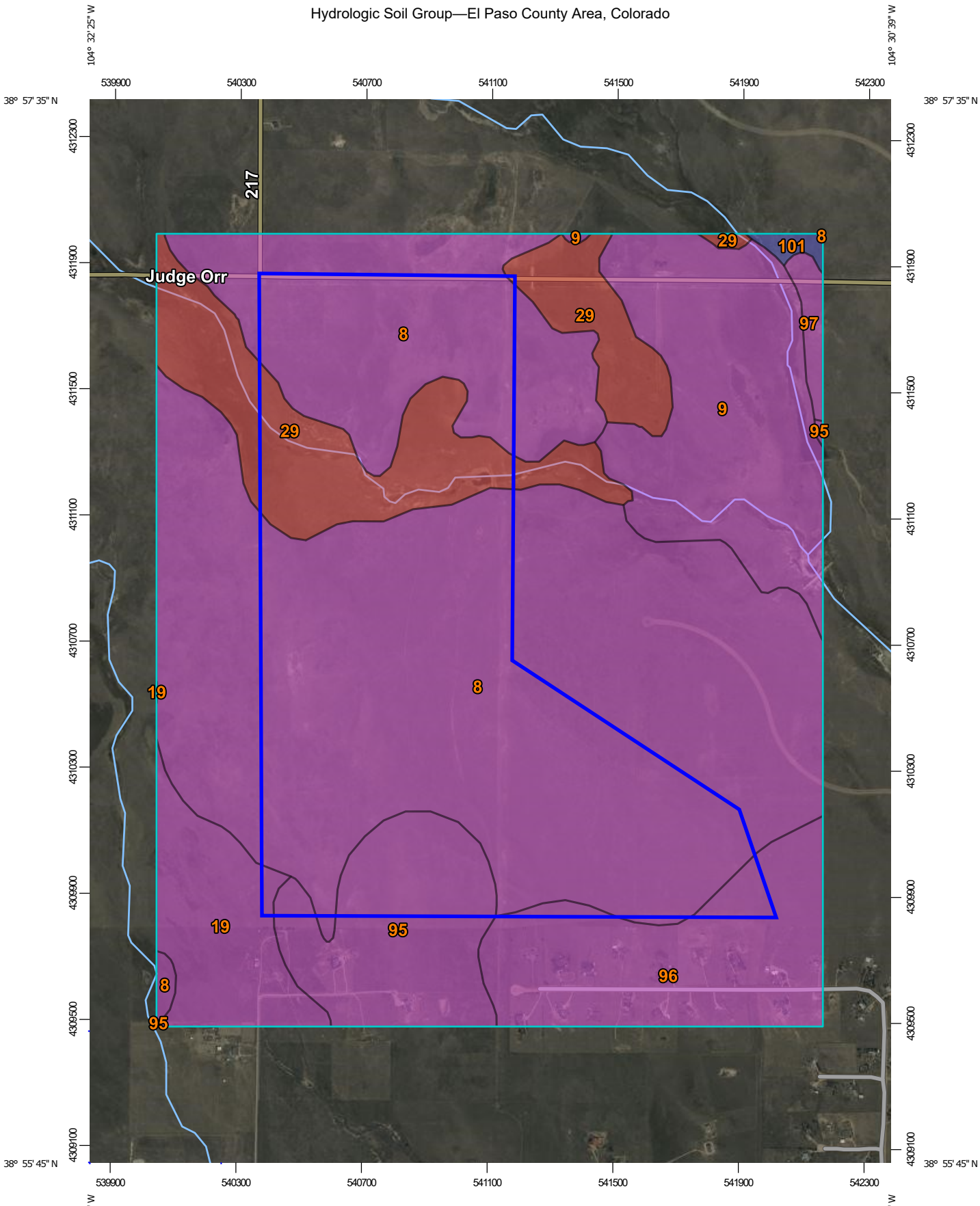
Notice: This map was reissued on 05/15/2020 to make a correction.This version replaces any previous versions. See the Notice-to-User Letter that accompanied this correction for details.

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
08041C0567G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency



Map Scale: 1:16,400 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 200 400 800 1200

Feet: 0 500 1000 2000 3000

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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: Sep 11, 2018—Oct 20, 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
8	Blakeland loamy sand, 1 to 9 percent slopes	A	759.5	57.4%
9	Blakeland-Fluvaquentic Haplaquolls	A	145.9	11.0%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	63.8	4.8%
29	Fluvaquentic Haplaquolls, nearly level	D	139.2	10.5%
95	Truckton loamy sand, 1 to 9 percent slopes	A	89.4	6.8%
96	Truckton sandy loam, 0 to 3 percent slopes	A	113.3	8.6%
97	Truckton sandy loam, 3 to 9 percent slopes	A	8.3	0.6%
101	Ustic Torrifluvents, loamy	B	3.8	0.3%
Totals for Area of Interest			**1,323.3**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX B

HYDROLOGIC CALCULATIONS

EXISTING COMPOSITE % IMPERVIOUS/C VALUE CALCULATIONS

Subdivision: Esteban Rodriguez Subdivision
Location: El Paso County

Project Name: Esteban Rodriguez Subdivision-PDR
Project No.: 25277.00
Calculated By: GAG
Checked By:
Date: 8/6/24

Basin ID	Total Area (ac)	Hardscape (100% Impervious)				Single-Family (2.5-5 acre) (10% Impervious)				Undeveloped (2% Impervious)				Basin Total Weighted C		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
EXA	179.6	0.90	0.96	0.00	0.0%	0.16	0.4	0.00	0.0%	0.09	0.4	179.6	2.0%	0.09	0.36	2.0%
EXB	32.2	0.90	0.96	0.00	0.0%	0.16	0.4	0.00	0.0%	0.09	0.4	32.2	2.0%	0.09	0.36	2.0%
EXC	29.0	0.90	0.96	0.00	0.0%	0.16	0.4	0.00	0.0%	0.09	0.4	29.0	2.0%	0.09	0.36	2.0%
EXD	48.2	0.90	0.96	0.00	0.0%	0.16	0.4	0.00	0.0%	0.09	0.4	48.2	2.0%	0.09	0.36	2.0%
EXE	152.2	0.90	0.96	0.00	0.0%	0.16	0.4	0.00	0.0%	0.09	0.4	152.2	2.0%	0.09	0.36	2.0%
EXF	50.2	0.90	0.96	0.00	0.0%	0.16	0.4	0.00	0.0%	0.09	0.4	50.2	2.0%	0.09	0.36	2.0%
OS1	1.56	0.90	0.96	0.00	0.0%	0.16	0.4	0.00	0.0%	0.09	0.4	1.6	2.0%	0.09	0.36	2.0%
OS2	17.5	0.90	0.96	0.00	0.0%	0.16	0.4	17.5	10.0%	0.09	0.4	0.0	0.0%	0.16	0.41	10.0%
Total On-Site	491.40															2.0%

EXISTING STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Esteban Rodriguez Subdivision
Location: El Paso County

Project Name: Esteban Rodriguez Subdivision-PDR
Project No.: 25277.00
Calculated By: GAG
Checked By:
Date: 8/6/24

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
EXA	179.6	A	2%	0.09	0.36	-	-	-	-	-	-	-	-	-	-	-	-
EXB	32.2	A	2%	0.09	0.36	300	3.0%	22.0	800	2.2%	7.0	1.0	12.8	34.8	1100.0	35.3	34.8
EXC	29.0	A	2%	0.09	0.36	300	2.7%	22.8	800	2.7%	7.0	1.2	11.6	34.3	1100.0	34.4	34.3
EXD	48.2	A	2%	0.09	0.36	300	3.1%	21.7	2635	3.1%	7.0	1.2	35.6	57.4	2935.0	52.5	52.5
EXE	152.2	A	2%	0.09	0.36	300	3.5%	20.9	3035	3.5%	7.0	1.3	38.6	59.5	3335.0	54.8	54.8
EXF	50.2	A	2%	0.09	0.36	300	3.8%	20.3	2330	3.8%	7.0	1.4	28.5	48.8	2630.0	47.1	47.1
OS1	1.56	A	2%	0.09	0.36	300	3.0%	22.0	30	1.0%	7.0	0.7	0.7	22.7	330.0	26.2	22.7
OS2	17.5	A	10%	0.16	0.41	300	3.5%	19.4	510	3.7%	7.0	1.3	6.3	25.8	810.0	28.5	25.8

NOTES:

$$t_c = t_i + t_t$$

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

Equation 6-2

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}}$$

Where:

t_i = overland (initial) flow time (minutes)
C_5 = runoff coefficient for 5-year frequency (from Table 6-4)
L_i = length of overland flow (ft)
S_o = average slope along the overland flow path (ft/ft).

Equation 6-3

Table 6-2. NRCS Conveyance factors, K

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

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$

Equation 6-4

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_o = waterway slope (ft/ft)
V_t = travel time velocity (ft/sec) = $K\sqrt{S_o}$
K = NRCS conveyance factor (see Table 6-2).

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

Equation 6-5

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)
i = imperviousness (expressed as a decimal)
S_t = slope of the channelized flow path (ft/ft).

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

EXISTING STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Esteban Rodriguez Subdivision
Location: El Paso County
Design Storm: 5-Year

Project Name: Esteban Rodriguez Subdivision-PDR
Project No.: 25277.00
Calculated By: GAG
Checked By:
Date: 8/6/24

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
		OS1	1.56	0.09	22.7	0.14	2.90	0.4															Off-site flows onto the site on the west side Combines flow in Gieck Ranch West Tributary at DP1
		OS2	17.5	0.16	25.8	2.80	2.71	7.6															Off-site flows onto the site on the west side Combines flow in Gieck Ranch West Tributary at DP1
		EXA	179.6	0.09	-	16.16	-	-															On-site flows sheet flow to Gieck Ranch West Tributary at DP1. Flows not anlyzed since studied
	1								-	-	-	86											Combined flows of OS1, OS2, and EXA Used Gieck Ranch DBPS reach flows from reference
	2	EXB	32.2	0.09	34.8	2.90	2.26	6.5															On-site flows sheet flow to east boudary at DP2 Historic path off-site to 16365 Judge Orr Road property
	3	EXC	29.0	0.09	34.3	2.61	2.28	5.9															On-site flows sheet flow to east boudary at DP3 Historic path off-site to Cowboy Ranch VW
	4	EXD	48.2	0.09	52.5	4.34	1.64	7.1															On-site flows sheet flow to southwest boundary at DP4 Historic path off-site to 7120 Falcon Grassy Hts
	5	EXE	152.2	0.09	54.8	13.70	1.58	21.6															On-site flows sheet flow to south boundary at DP5 Historic path off-site to 7360 Falcon Grassy Hts
	6	EXF	50.2	0.09	47.1	4.52	1.80	8.2															On-site flows sheet flow to southeast boundary at DP6 Historic path off-site to Sagecreek North Development

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
*Basin specific flows not analyzed since tributatry to Gieck Ranch West Tributary. Used reach flow from Gieck Ranch DBPS by Drexel, Barrel & Co. dated October 2007

EXISTING STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Esteban Rodriguez Subdivision
Location: El Paso County
Design Storm: 100-Year

Project Name: Esteban Rodriguez Subdivision-PDR
Project No.: 25277.00
Calculated By: GAG
Checked By:
Date: 8/6/24

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
		OS1	1.56	0.36	22.7	0.56	4.87	2.7															Off-site flows onto the site on the west side Combines flow in Gieck Ranch West Tributary at DP1
		OS2	17.5	0.41	25.8	7.18	4.55	32.7															Off-site flows onto the site on the west side Combines flow in Gieck Ranch West Tributary at DP1
		EXA	179.6	0.36	-	64.66	-	-															On-site flows sheet flow to Gieck Ranch West Tributary at DP1. Flows not anlyzed since studied
	1								-	-	-	753											Combined flows of OS1, OS2, and EXA Used Gieck Ranch DBPS reach flows from reference
	2	EXB	32.2	0.36	34.8	11.59	3.79	43.9															On-site flows sheet flow to east boudary at DP2 Historic path off-site to 16365 Judge Orr Road property
	3	EXC	29.0	0.36	34.3	10.44	3.82	39.9															On-site flows sheet flow to east boudary at DP3 Historic path off-site to Cowboy Ranch VW
	4	EXD	48.2	0.36	52.5	17.35	2.75	47.7															On-site flows sheet flow to southwest boundary at DP4 Historic path off-site to 7120 Falcon Grassy Hts
	5	EXE	152.2	0.36	54.8	54.79	2.65	145.0															On-site flows sheet flow to south boundary at DP5 Historic path off-site to 7360 Falcon Grassy Hts
	6	EXF	50.2	0.36	47.1	18.07	3.03	54.7															On-site flows sheet flow to southeast boundary at DP6 Historic path off-site to Sagecreek North Development

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
*Basin specific flows not analyzed since tributatry to Gieck Ranch West Tributary. Used reach flow from Gieck Ranch DBPS by Drexel, Barrel & Co. dated October 2007

PROPOSED COMPOSITE % IMPERVIOUS/C VALUE CALCULATIONS

Subdivision: Esteban Rodriguez Subdivision
Location: El Paso County

Project Name: Esteban Rodriguez Subdivision-PDR
Project No.: 25277.00
Calculated By: GAG
Checked By:
Date: 10/21/24

Basin ID	Total Area (ac)	Hardscape (100% Impervious)				Gravel (80% Impervious)				Commercial (95% Impervious)				Single-Family (2.5-5 acre) (10% Impervious)				Undeveloped (2% Impervious)				Basin Total Weighted C		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
A1	12.1	0.90	0.96	1.28	10.6%	0.59	0.70	0.00	0.0%	0.81	0.88	9.44	74.1%	0.16	0.41	0.00	0.0%	0.09	0.36	1.38	0.2%	0.74	0.83	84.9%
A2	4.18	0.90	0.96	0.88	21.2%	0.59	0.70	0.00	0.0%	0.81	0.88	2.21	50.3%	0.16	0.41	0.00	0.0%	0.09	0.36	1.08	0.5%	0.64	0.76	72.0%
A3	3.84	0.90	0.96	0.36	9.3%	0.59	0.70	0.00	0.0%	0.81	0.88	3.17	78.4%	0.16	0.41	0.00	0.0%	0.09	0.36	0.31	0.2%	0.76	0.85	87.9%
A4	4.15	0.90	0.96	0.78	18.7%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	2.69	6.5%	0.09	0.36	0.68	0.3%	0.29	0.50	25.5%
A5	5.99	0.90	0.96	1.18	19.6%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	3.48	5.8%	0.09	0.36	1.33	0.4%	0.29	0.51	25.9%
A6	38.2	0.90	0.96	2.23	5.8%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	33.6	8.8%	0.09	0.36	2.35	0.1%	0.20	0.44	14.8%
A7	7.57	0.90	0.96	0.89	11.7%	0.59	0.70	0.14	1.5%	0.81	0.88	0.00	0.0%	0.16	0.41	5.8	7.6%	0.09	0.36	0.78	0.2%	0.25	0.47	21.0%
B	0.74	0.90	0.96	0.00	0.0%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	0.00	0.0%	0.09	0.36	0.74	2.0%	0.09	0.36	2.0%
C	15.8	0.90	0.96	0.00	0.0%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	15.8	10.0%	0.09	0.36	0.00	0.0%	0.16	0.41	10.0%
D1	4.49	0.90	0.96	0.00	0.0%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	4.49	10.0%	0.09	0.36	0.00	0.0%	0.16	0.41	10.0%
D2	11.0	0.90	0.96	0.00	0.0%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	11.0	10.0%	0.09	0.36	0.00	0.0%	0.16	0.41	10.0%
D3	29.6	0.90	0.96	0.00	0.0%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	0.00	0.0%	0.09	0.36	29.6	2.0%	0.09	0.36	2.0%
D4	5.75	0.90	0.96	0.00	0.0%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	0.00	0.0%	0.09	0.36	5.8	2.0%	0.09	0.36	2.0%
D5	4.53	0.90	0.96	0.00	0.0%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	0.00	0.0%	0.09	0.36	4.5	2.0%	0.09	0.36	2.0%
E1	28.7	0.90	0.96	1.94	6.8%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	25.1	8.7%	0.09	0.36	1.70	0.1%	0.21	0.44	15.6%
E2	1.63	0.90	0.96	0.88	53.7%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	0.0	0.0%	0.09	0.36	0.76	0.9%	0.53	0.68	54.6%
E3	43.5	0.90	0.96	2.82	6.5%	0.59	0.70	0.14	0.3%	0.81	0.88	0.00	0.0%	0.16	0.41	38.1	8.8%	0.09	0.36	2.42	0.1%	0.21	0.44	15.6%
F	22.0	0.90	0.96	0.00	0.0%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	22.0	10.0%	0.09	0.36	0.00	0.0%	0.16	0.41	10.0%
G1	17.6	0.90	0.96	0.72	4.1%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	16.3	9.2%	0.09	0.36	0.63	0.1%	0.19	0.43	13.4%
G2	17.6	0.90	0.96	1.09	6.2%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	15.6	8.8%	0.09	0.36	0.95	0.1%	0.20	0.44	15.1%
G3	5.70	0.90	0.96	0.85	15.0%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	4.10	7.2%	0.09	0.36	0.75	0.3%	0.26	0.49	22.4%
G4	20.4	0.90	0.96	0.82	4.0%	0.59	0.70	0.05	0.2%	0.81	0.88	0.00	0.0%	0.16	0.41	18.8	9.2%	0.09	0.36	0.72	0.1%	0.19	0.43	13.5%
G5	10.4	0.90	0.96	0.03	0.3%	0.59	0.70	0.27	2.1%	0.81	0.88	0.00	0.0%	0.16	0.41	10.1	9.7%	0.09	0.36	0.00	0.0%	0.17	0.42	12.1%
H1	24.0	0.90	0.96	0.51	2.1%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	23.1	9.6%	0.09	0.36	0.44	0.0%	0.17	0.42	11.7%
H2	41.8	0.90	0.96	0.87	2.1%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	40.2	9.6%	0.09	0.36	0.76	0.0%	0.17	0.42	11.7%
H3	21.3	0.90	0.96	1.17	5.5%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	19.1	9.0%	0.09	0.36	1.03	0.1%	0.20	0.44	14.6%
H4	1.96	0.90	0.96	1.04	53.2%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	0.00	0.0%	0.09	0.36	0.91	0.9%	0.52	0.68	54.2%
H5	3.18	0.90	0.96	1.54	48.3%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	0.30	0.9%	0.09	0.36	1.34	0.8%	0.49	0.65	50.1%
H6	36.6	0.90	0.96	0.08	0.2%	0.59	0.70	0.33	0.7%	0.81	0.88	0.00	0.0%	0.16	0.41	36.2	9.9%	0.09	0.36	0.00	0.0%	0.17	0.41	10.8%
I	46.8	0.90	0.96	0.00	0.0%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	46.8	10.0%	0.09	0.36	0.00	0.0%	0.16	0.41	10.0%

Basin ID	Total Area (ac)	Hardscape (100% Impervious)				Gravel (80% Impervious)				Commercial (95% Impervious)				Single-Family (2.5-5 acre) (10% Impervious)				Undeveloped (2% Impervious)				Basin Total Weighted C		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
OS1	1.56	0.90	0.96	0.13	8.1%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	0.00	0.0%	0.09	0.36	1.43	1.8%	0.16	0.41	9.9%
OS2a	14.5	0.90	0.96	0.00	0.0%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	0.00	0.0%	0.09	0.36	14.5	2.0%	0.09	0.36	2.0%
OS2b	3.06	0.90	0.96	0.00	0.0%	0.59	0.70	0.00	0.0%	0.81	0.88	0.00	0.0%	0.16	0.41	0.00	0.0%	0.09	0.36	3.06	2.0%	0.09	0.36	2.0%
Total On-Site	491.1																							15.7%
Total Pond 1 (Basin OS1, A1-A7)	77.6																							34.4%
Total Pond 2 (Basin OS2b, E1-E3)	76.9																							15.9%
Total Pond 3 (Basin G1, G5)	71.7																							14.4%
Total Pond 4 (Basin H1 - H6)	128.8																							13.5%

PROPOSED STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Esteban Rodriguez Subdivision
Location: El Paso County

Project Name: Esteban Rodriguez Subdivision-PDR
Project No.: 25277.00
Calculated By: GAG
Checked By:
Date: ########

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
A1	12.1	A	85%	0.74	0.83	100	2.0%	5.2	1390	2.0%	20.0	2.8	8.2	13.4	1490.0	19.4	13.4
A2	4.18	A	72%	0.64	0.76	31	2.0%	3.7	850	2.0%	20.0	2.8	5.0	8.7	881.0	19.0	8.7
A3	3.84	A	88%	0.76	0.85	31	2.0%	2.7	1150	2.0%	20.0	2.8	6.8	9.5	1181.0	17.4	9.5
A4	4.2	A	26%	0.29	0.50	100	3.0%	10.2	1935	2.0%	15.0	2.1	15.2	25.4	2035.0	39.8	25.4
A5	6.0	A	26%	0.29	0.51	26	2.0%	5.9	2905	2.0%	15.0	2.1	22.8	28.8	2931.0	48.7	28.8
A6	38.2	A	15%	0.20	0.44	26	2.0%	6.6	2945	2.0%	15.0	2.1	23.1	29.7	2971.0	54.8	29.7
A7	7.6	A	21%	0.25	0.47	26	2.0%	6.2	880	2.0%	15.0	2.1	6.9	13.2	906.0	31.1	13.2
B	0.74	A	2%	0.09	0.36	160	2.5%	17.0	0	0.0%	7.0	0.0	0.0	17.0	160.0	25.7	17.0
C	15.8	A	10%	0.16	0.41	100	2.5%	12.5	970	2.7%	15.0	2.5	6.6	19.1	1070.0	33.8	19.1
D1	4.49	D	10%	0.16	0.41	100	2.0%	13.5	175	3.0%	15.0	2.6	1.1	14.6	275.0	25.9	14.6
D2	11.0	D	10%	0.16	0.41	100	2.0%	13.5	580	3.0%	15.0	2.6	3.7	17.2	680.0	29.7	17.2
D3	29.6	D	2%	0.09	0.36	-	-	-	-	-	-	-	-	-	-	-	-
D4	5.75	D	2%	0.09	0.36	-	-	-	-	-	-	-	-	-	-	-	-
D5	4.53	D	2%	0.09	0.36	-	-	-	-	-	-	-	-	-	-	-	-
E1	28.7	A	16%	0.21	0.44	20	2.0%	5.7	2215	4.0%	15.0	3.0	12.3	18.0	2235.0	39.8	18.0
E2	1.6	A	55%	0.53	0.68	20	2.0%	3.7	2135	4.0%	15.0	3.0	11.9	15.6	2155.0	27.4	15.6
E3	43.5	A	16%	0.21	0.44	20	2.0%	5.7	3140	4.0%	15.0	3.0	17.4	23.2	3160.0	46.7	23.2
F	22.0	A	10%	0.16	0.41	100	2.3%	12.9	1800	2.0%	15.0	2.1	14.1	27.0	1900.0	44.7	27.0
G1	17.6	A	13%	0.19	0.43	100	3.0%	11.5	1675	2.0%	15.0	2.1	13.2	24.6	1775.0	41.9	24.6
G2	17.6	A	15%	0.20	0.44	100	3.0%	11.3	2175	2.0%	15.0	2.1	17.1	28.4	2275.0	46.5	28.4
G3	5.7	A	22%	0.26	0.49	31	2.0%	6.7	1415	2.0%	15.0	2.1	11.1	17.8	1446.0	35.9	17.8
G4	20.4	A	14%	0.19	0.43	100	4.0%	10.4	2655	3.0%	15.0	2.6	17.0	27.4	2755.0	47.2	27.4
G5	10.4	A	12%	0.17	0.42	100	3.0%	11.6	1065	2.0%	15.0	2.1	8.4	20.0	1165.0	35.7	20.0

PROPOSED STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Esteban Rodriguez Subdivision
Location: El Paso County

Project Name: Esteban Rodriguez Subdivision-PDR
Project No.: 25277.00
Calculated By: GAG
Checked By:
Date: ########

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
H1	24.0	A	12%	0.17	0.42	100	3.0%	11.6	1620	2.0%	15.0	2.1	12.7	24.4	1720.0	41.9	24.4
H2	41.8	A	12%	0.17	0.42	100	3.0%	11.6	2870	2.0%	15.0	2.1	22.5	34.2	2970.0	55.8	34.2
H3	21.3	A	15%	0.20	0.44	31	2.0%	7.2	2615	2.0%	15.0	2.1	20.5	27.8	2646.0	51.4	27.8
H4	1.96	A	54%	0.52	0.68	20	2.0%	3.7	3240	2.0%	15.0	2.1	25.5	29.2	3260.0	39.8	29.2
H5	3.2	A	50%	0.49	0.65	20	2.0%	3.9	3095	2.0%	15.0	2.1	24.3	28.2	3115.0	40.3	28.2
H6	36.6	A	11%	0.17	0.41	100	2.0%	13.4	3115	2.0%	15.0	2.1	24.5	37.9	3215.0	59.1	37.9
I	46.8	A	10%	0.16	0.41	100	7.0%	8.9	1500	3.0%	15.0	2.6	9.6	18.6	1600.0	38.2	18.6
OS1	1.56	A	10%	0.16	0.41	300	3.0%	20.6	30	1.0%	7.0	0.7	0.7	21.3	330.0	24.8	21.3
OS2a	14.5	A	2%	0.09	0.36	300	3.5%	20.9	515	3.7%	7.0	1.3	6.4	27.3	815.0	30.5	27.3
OS2b	3.06	A	2%	0.09	0.36	300	3.5%	20.9	190	3.0%	7.0	1.2	2.6	23.5	490.0	27.6	23.5

NOTES:

$$t_c = t_i + t_t$$ Equation 6-2

Where:

t_c = computed time of concentration (minutes)
t_i = overland (initial) flow time (minutes)
t_t = channelized flow time (minutes).

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$ Equation 6-4

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_o = waterway slope (ft/ft)
V_t = travel time velocity (ft/sec) = $K\sqrt{S_o}$
K = NRCS conveyance factor (see Table 6-2).

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}}$$ Equation 6-3

Where:

t_i = overland (initial) flow time (minutes)
C_5 = runoff coefficient for 5-year frequency (from Table 6-4)
L_i = length of overland flow (ft)
S_o = average slope along the overland flow path (ft/ft).

$$t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$ Equation 6-5

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)
i = imperviousness (expressed as a decimal)
S_t = slope of the channelized flow path (ft/ft).

Table 6-2. NRCS Conveyance factors, K

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

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

PROPOSED STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Esteban Rodriguez Subdivision
Location: El Paso County
Design Storm: 5-Year

Project Name: Esteban Rodriguez Subdivision-PDR
Project No.: 25277.00
Calculated By: GAG
Checked By:
Date: 10/21/24

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	1	A1	12.10	0.74	13.4	8.92	3.69	32.9															Flows along roadside swales to the culvert at DP1 Combines flow at swale at DP2.1
	2	A2	4.18	0.64	8.7	2.69	4.34	11.7															Flows to the roadside swale at DP2 Combines flow at roadside swale at DP2.1
	2.1								13.4	11.61	3.69	42.8											Combines flow of DP1 and DP2 in roadside swale Flow combines at proposed swale at DP3.1
	3	A3	3.84	0.76	9.5	2.92	4.21	12.3															Flows to the proposed swale at DP3 Flow combines at proposed swale at DP3.1
	3.1								13.4	14.53	3.69	53.6								320	3.6	1.5	Combines flow of DP2.1 and DP3 at proposed swale Flow combines at roadside swale at DP4.1
	4	A4	4.15	0.29	25.4	1.19	2.73	3.2															Flows to the roadside swale at DP4 Flow combines at roadside swale at DP4.1
	4.1								14.9	15.72	3.53	55.5											Combines flow of DP3.1 and DP4 at culvert Combines flow within Pond 1 at DP8.1
	5	OS1	1.56	0.16	21.3	0.24	3.00	0.7															Off-site flows onto the site at DP5 Enters Basin B2 and combines at DP6.1
	6	A5	5.99	0.29	28.8	1.74	2.54	4.4															Flows along roadside swale to DP6 Combines flow at DP6.1
	6.1								28.8	1.98	2.54	5.0											Combines flow of DP5 and DP6 at swale and culvert Flow continues within a swale and combines at DP8.1
	7	A6	38.20	0.20	29.7	7.60	2.49	19.0															Flows to roadside swales to culvert at DP7 Combines flow within Pond 1 at DP8.1
	8	A7	7.57	0.25	13.2	1.87	3.72	7.0															Sheet flows to swales and enter Pond 1 at DP8 Combines flow within Pond 1 at DP8.1
	8.1								29.7	27.17	2.49	67.8											Combines flow of DP4, DP6.1, DP7 and DP8 in Pond 1 Flows released through Pond 1 EDB outlet DP8.2
	8.2								-	-	-	0.8											Controlled release from Pond 1 outlet at DP8.2 Released into drainageway, follows historic path east
		B	0.74	0.09	17.0	0.07	3.33	0.2															Sheet flows overland to east boundary Combines flow along eastern boundary at DP9
		C	15.80	0.16	19.1	2.53	3.16	8.0															Sheet flows overland to east boundary Combines flow along eastern boundary at DP9
	9								19.1	2.60	3.16	8.2											Combines flow of Basins B and C at east boundary Historic path off-site to 16365 Judge Orr Road property

PROPOSED STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Esteban Rodriguez Subdivision
Location: El Paso County
Design Storm: 5-Year

Project Name: Esteban Rodriguez Subdivision-PDR
Project No.: 25277.00
Calculated By: GAG
Checked By:
Date: 10/21/24

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
		OS2a	14.50	0.09	27.3	1.31	2.62	3.4															Off-site flows from Saddlehorn Ranch F4 & F5 Flows through Basin D2 to drainageway then DP4
		D1	4.49	0.16	14.6	0.72	3.56	2.6															On-site flows follow historic path to drainageway Flows east and to east site boundary at DP4
		D2	11.00	0.16	17.2	1.76	3.31	5.8															On-site flows follow historic path to drainageway Flows east and to east site boundary at DP4
		D3	29.60	0.09	-	2.66	-	-															On-site flows within Gieck Ranch West Tributary Flows east and to east site boundary at DP4
		D4	5.75	0.09	-	0.52	-	-															On-site flows within Gieck Ranch West Tributary Flows east and to east site boundary at DP4
		D5	4.53	0.09	-	0.41	-	-															On-site flows within Gieck Ranch West Tributary Flows east and to east site boundary at DP4
	10								-	-	-	86											Combination of Basins OS2a and D1-D5 Used Gieck Ranch DBPS reach flow from reference
	11	OS2b	3.06	0.09	23.5	0.28	2.85	0.8															Off-site flows from Saddlehorn Ranch F5 to DP11 Flows through Basin E1 to DP12.1
	12	E1	28.70	0.21	18.0	5.91	3.24	19.2															Flows along roadside swale to DP12 Combines at culvert at DP12.1
	12.1								18.0	6.19	3.24	20.1											Combines flow of DP11 and DP12 Flows along swale and combines at DP14.1
	13	E2	1.63	0.53	15.6	0.86	3.47	3.0															Flows along roadside swale to DP13 Combines flow within Pond 2 at DP14.1
	14	E3	43.50	0.21	23.2	8.93	2.87	25.6															Flows along roadside swales to DP14 Combines flow within Pond 2 at DP14.1
	14.1								23.2	15.98	2.87	45.8											Combines flow of DP4, DP6.1, DP7 and DP8 in Pond 2 Flows released through Pond 2 EDB outlet DP8.2
	14.2								-	-	-	0.3											Controlled release from Pond 2 outlet at DP8.2 Released into drainageway, follows historic path east
	15	F	22.00	0.16	27.0	3.52	2.64	9.3															Sheet flows overland to east boundary at DP6 Historic path off-site to Cowboy Ranch VW property

PROPOSED STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Esteban Rodriguez Subdivision
Location: El Paso County
Design Storm: 5-Year

Project Name: Esteban Rodriguez Subdivision-PDR
Project No.: 25277.00
Calculated By: GAG
Checked By:
Date: 10/21/24

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	16	G1	17.60	0.19	24.6	3.30	2.78	9.2												1760	3.5	8.4	Flows along roadside swale to DP16 Combines flow at DP17.1 culvert
	17	G2	17.60	0.20	28.4	3.55	2.56	9.1															Flows along roadside swale to DP17 Combines flow at DP17.1 culvert
	17.1								33.0	6.85	2.34	16.0								475	3.5	2.3	Combines flow of DP16 and DP17 at culvert Combines flow at DP18.1 culvert
	18	G3	5.70	0.26	17.8	1.49	3.26	4.9															Flows along roadside swales to DP18 Combines flow at DP18.1 culvert
	18.1								35.3	8.34	2.24	18.7											Combines flow of DP17.1 and DP18 at culvert Combines flow at DP19.1 swale
	19	G4	20.40	0.19	27.4	3.84	2.61	10.0															Flows along roadside swale to DP19 Combines flow at DP19.1 swale
	19.1								35.3	12.18	2.24	27.3								685	3.5	3.3	Combines flow of DP18.1 and DP19 at swale Flows along proposed swale to Pond 3 at DP20.1
	20	G5	10.40	0.17	20.0	1.80	3.09	5.6															Flows along proposed swale to DP20 Flows along proposed swale to Pond 3 at DP20.1
	20.1								38.5	13.98	2.11	29.4											Combines flow of DP19.1 and DP20 into Pond 3 Flows released through Pond 3 EDB outlet DP20.2
	20.2								-	-	-	0.2											Controlled release from Pond 3 outlet at DP20.2 Flow spreader and then follows historic path west
	21	H1	24.00	0.17	24.4	4.18	2.79	11.7												1435	3.6	6.6	Flows along roadside swales to DP21 Combines flow at DP22.1
	22	H2	41.80	0.17	34.2	7.28	2.29	16.6															Flows along roadside swales to DP22 Combines flow at DP22.1
	22.1								34.2	11.46	2.29	26.2								430	3.6	2.0	Combines flow of DP21 and DP22 Flows along roadside swale to DP23.1
	23	H3	21.30	0.20	27.8	4.20	2.60	10.9															Flows along roadside swale to DP23.1 Combines flow at DP23.1 culvert
	23.1								36.2	15.66	2.20	34.5											Combines flow of DP22.1 and DP23 Flow continues to DP25.1
	24	H4	1.96	0.52	29.2	1.02	2.52	2.6															Flows along roadside swale to DP24 Combines flow at DP24.1 swale

PROPOSED STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Esteban Rodriguez Subdivision
Location: El Paso County
Design Storm: 5-Year

Project Name: Esteban Rodriguez Subdivision-PDR
Project No.: 25277.00
Calculated By: GAG
Checked By:
Date: 10/21/24

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	24.1								36.2	16.68	2.20	36.7								1040	3.6	4.8	Combines flow of DP23.1 and DP24 Flow continues to DP25.1 swale
	25	H5	3.18	0.49	28.2	1.55	2.57	4.0															Flows within swale to DP25 Combines flow within Pond 4 at DP24.1
	25.1								41.0	18.23	2.01	36.7								435	3.6	2.0	Combines flow of DP24.1 and DP25 Combines flow within Pond 4 at DP26.1
	26	H6	36.60	0.17	37.9	6.06	2.13	12.9															Flows along roadside swales to DP26 Combines flow at DP26.1
	26.1								43.0	24.29	1.94	47.1											Combines flow of DP25.1 and DP26 into Pond 4 Flows released through Pond 4 EDB outlet DP26.2
	26.2								-	-	-	0.3											Controlled release from Pond 4 outlet at DP26.2 Flow spreader and then follows historic path south
	27	I	46.80	0.16	18.6	7.49	3.20	24.0															Sheet flows overland to southern boundary at DP27 Historic path off-site to 7360 Falcon Grassy Hts

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
*Basin specific flows not analyzed since tributary to Gieck Ranch West Tributary. Used reach flow from Gieck Ranch DBPS by Drexel, Barrel & Co. dated October 2007

PROPOSED STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Esteban Rodriguez Subdivision
Location: El Paso County
Design Storm: 100-Year

Project Name: Esteban Rodriguez Subdivision-PDR
Project No.: 25277.00
Calculated By: GAG
Checked By:
Date: 10/21/24

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	t_C (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	1	A1	12.10	0.83	13.4	10.03	6.20	62.1															Flows along roadside swales to the culvert at DP1 Combines flow at swale at DP2.1
	2	A2	4.18	0.76	8.7	3.19	7.29	23.3															Flows to the roadside swale at DP2 Combines flow at roadside swale at DP2.1
	2.1								13.4	13.22	6.20	81.9											Combines flow of DP1 and DP2 in roadside swale Flow combines at proposed swale at DP3.1
	3	A3	3.84	0.85	9.5	3.24	7.06	22.9															Flows to the proposed swale at DP3 Flow combines at proposed swale at DP3.1
	3.1								13.4	16.46	6.20	102.0								320	5.0	1.1	Combines flow of DP2.1 and DP3 at proposed swale Flow combines at roadside swale at DP4.1
	4	A4	4.15	0.50	25.4	2.09	4.58	9.6															Flows to the roadside swale at DP4 Flow combines at roadside swale at DP4.1
	4.1								14.5	18.55	6.00	111.3											Combines flow of DP3.1 and DP4 at culvert Combines flow within Pond 1 at DP8.1
	5	OS1	1.56	0.41	21.3	0.64	5.03	3.2															Off-site flows onto the site at DP5 Enters Basin B2 and combines at DP6.1
	6	A5	5.99	0.51	28.8	3.04	4.27	13.0															Flows along roadside swale to DP6 Combines flow at DP6.1
	6.1								28.8	3.68	4.27	15.7											Combines flow of DP5 and DP6 at swale and culvert Flow continues within a swale and combines at DP8.1
	7	A6	38.20	0.44	29.7	16.77	4.19	70.2															Flows to roadside swales to culvert at DP7 Combines flow within Pond 1 at DP8.1
	8	A7	7.57	0.47	13.2	3.59	6.24	22.4															Sheet flows to swales and enter Pond 1 at DP8 Combines flow within Pond 1 at DP8.1
	8.1								29.7	42.59	4.19	178.3											Combines flow of DP4, DP6.1, DP7 and DP8 in Pond 1 Flows released through Pond 1 EDB outlet DP8.2
	8.2								-	-	-	32.0											Controlled release from Pond 1 outlet at DP8.2 Released into drainageway, follows historic path east
		B	0.74	0.36	17.0	0.27	5.59	1.5															Sheet flows overland to east boundary Combines flow along eastern boundary at DP9
		C	15.80	0.41	19.1	6.48	5.30	34.4															Sheet flows overland to east boundary Combines flow along eastern boundary at DP9
	9								19.1	6.75	5.30	35.8											Combines flow of Basins B and C at east boundary Historic path off-site to 16365 Judge Orr Road property

PROPOSED STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Esteban Rodriguez Subdivision
Location: El Paso County
Design Storm: 100-Year

Project Name: Esteban Rodriguez Subdivision-PDR
Project No.: 25277.00
Calculated By: GAG
Checked By:
Date: 10/21/24

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	t_C (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
		OS2a	14.50	0.36	27.3	5.22	4.40	23.0															Off-site flows from Saddlehorn Ranch F4 & F5 Flows through Basin D2 to drainageway then DP4
		D1	4.49	0.41	14.6	1.84	5.97	11.0															On-site flows follow historic path to drainageway Flows east and to east site boundary at DP4
		D2	11.00	0.41	17.2	4.51	5.56	25.1															On-site flows follow historic path to drainageway Flows east and to east site boundary at DP4
		D3	29.60	0.36	-	10.66	-	-															On-site flows within Gieck Ranch West Tributary Flows east and to east site boundary at DP4
		D4	5.75	0.36	-	2.07	-	-															On-site flows within Gieck Ranch West Tributary Flows east and to east site boundary at DP4
		D5	4.53	0.36	-	1.63	-	-															On-site flows within Gieck Ranch West Tributary Flows east and to east site boundary at DP4
	10								-	-	-	753											Combination of Basins OS2a and D1-D5 Used Gieck Ranch DBPS reach flow from reference
	11	OS2b	3.06	0.36	23.5	1.10	4.78	5.3															Off-site flows from Saddlehorn Ranch F5 to DP11 Flows through Basin E1 to DP12.1
	12	E1	28.70	0.44	18.0	12.75	5.44	69.4															Flows along roadside swale to DP12 Combines at culvert at DP12.1
	12.1								18.0	13.85	5.44	75.4											Combines flow of DP11 and DP12 Flows along swale and combines at DP14.1
	13	E2	1.63	0.68	15.6	1.11	5.82	6.5															Flows along roadside swale to DP13 Combines flow within Pond 2 at DP14.1
	14	E3	43.50	0.44	23.2	19.30	4.81	92.9															Flows along roadside swales to DP14 Combines flow within Pond 2 at DP14.1
	14.1								23.2	34.26	4.81	164.9											Combines flow of DP4, DP6.1, DP7 and DP8 in Pond 2 Flows released through Pond 2 EDB outlet DP8.2
	14.2								-	-	-	45.0											Controlled release from Pond 2 outlet at DP8.2 Released into drainageway, follows historic path east
	15	F	22.00	0.41	27.0	9.02	4.43	39.9															Sheet flows overland to east boundary at DP6 Historic path off-site to Cowboy Ranch VW property

PROPOSED STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Esteban Rodriguez Subdivision
Location: El Paso County
Design Storm: 100-Year

Project Name: Esteban Rodriguez Subdivision-PDR
Project No.: 25277.00
Calculated By: GAG
Checked By:
Date: 10/21/24

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	t_C (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	16	G1	17.60	0.43	24.6	7.58	4.66	35.3												1760	5.0	5.9	Flows along roadside swale to DP16 Combines flow at DP17.1 culvert
	17	G2	17.60	0.44	28.4	7.77	4.30	33.4															Flows along roadside swale to DP17 Combines flow at DP17.1 culvert
	17.1								30.5	15.35	4.12	63.3								475	5.0	1.6	Combines flow of DP16 and DP17 at culvert Combines flow at DP18.1 culvert
	18	G3	5.70	0.49	17.8	2.77	5.48	15.2															Flows along roadside swales to DP18 Combines flow at DP18.1 culvert
	18.1								32.1	18.12	4.00	72.4											Combines flow of DP17.1 and DP18 at culvert Combines flow at DP19.1 swale
	19	G4	20.40	0.43	27.4	8.79	4.39	38.6															Flows along roadside swale to DP19 Combines flow at DP19.1 swale
	19.1								32.1	26.91	4.00	107.5								685	5.0	2.3	Combines flow of DP18.1 and DP19 at swale Flows along proposed swale to Pond 3 at DP20.1
	20	G5	10.40	0.42	20.0	4.36	5.18	22.6															Flows along proposed swale to DP20 Flows along proposed swale to Pond 3 at DP20.1
	20.1								34.4	31.27	3.82	119.5											Combines flow of DP19.1 and DP20 into Pond 3 Flows released through Pond 3 EDB outlet DP20.2
	20.2								-	-	-	32.0											Controlled release from Pond 3 outlet at DP20.2 Flow spreader and then follows historic path west
	21	H1	24.00	0.42	24.4	10.10	4.69	47.4												1435	5.0	4.8	Flows along roadside swales to DP21 Combines flow at DP22.1
	22	H2	41.80	0.42	34.2	17.58	3.84	67.4															Flows along roadside swales to DP22 Combines flow at DP22.1
	22.1								34.2	27.68	3.84	106.2								430	6.0	1.2	Combines flow of DP21 and DP22 Flows along roadside swale to DP23.1
	23	H3	21.30	0.44	27.8	9.33	4.36	40.7															Flows along roadside swale to DP23.1 Combines flow at DP23.1 culvert
	23.1								35.4	37.01	3.75	138.7											Combines flow of DP22.1 and DP23 Flow continues to DP25.1
	24	H4	1.96	0.68	29.2	1.33	4.23	5.6															Flows along roadside swale to DP24 Combines flow at DP24.1 swale

PROPOSED STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Esteban Rodriguez Subdivision
Location: El Paso County
Design Storm: 100-Year

Project Name: Esteban Rodriguez Subdivision-PDR
Project No.: 25277.00
Calculated By: GAG
Checked By:
Date: 10/21/24

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	t_C (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	24.1								35.4	38.34	3.75	143.7								1040	7.5	2.3	Combines flow of DP23.1 and DP24 Flow continues to DP25.1 swale
	25	H5	3.18	0.65	28.2	2.08	4.32	9.0															Flows within swale to DP25 Combines flow within Pond 4 at DP24.1
	25.1								37.7	40.42	3.59	145.1								435	7.5	1.0	Combines flow of DP24.1 and DP25 Combines flow within Pond 4 at DP26.1
	26	H6	36.60	0.41	37.9	15.15	3.58	54.2															Flows along roadside swales to DP26 Combines flow at DP26.1
	26.1								38.7	55.57	3.53	195.9											Combines flow of DP25.1 and DP26 into Pond 4 Flows released through Pond 4 EDB outlet DP26.2
	26.2								-	-	-	41.5											Controlled release from Pond 4 outlet at DP26.2 Flow spreader and then follows historic path south
	27	I	46.80	0.41	18.6	19.19	5.38	103.1															Sheet flows overland to southern boundary at DP27 Historic path off-site to 7360 Falcon Grassy Hts

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
*Basin specific flows not analyzed since tributary to Gieck Ranch West Tributary. Used reach flow from Gieck Ranch DBPS by Drexel, Barrel & Co. dated October 2007

APPENDIX C

HYDRAULIC CALCULATIONS

Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 13 2024

DP1-Culvert

Invert Elev Dn (ft)	=	100.00
Pipe Length (ft)	=	51.00
Slope (%)	=	0.51
Invert Elev Up (ft)	=	100.26
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

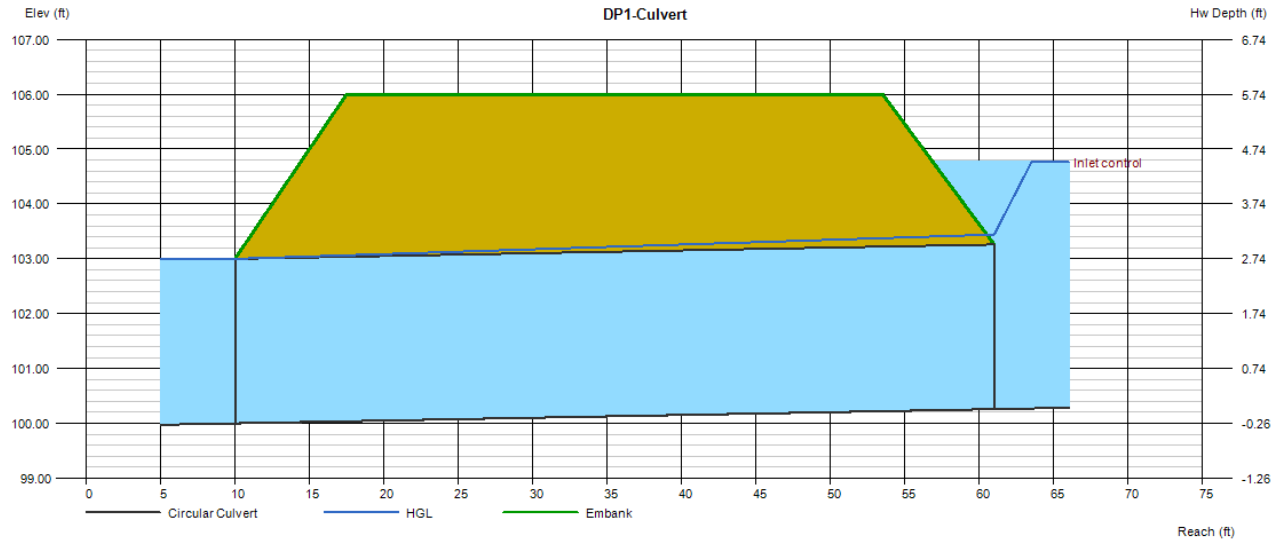
Top Elevation (ft)	=	106.00
Top Width (ft)	=	36.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	62.00
Qmax (cfs)	=	62.00
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	62.00
Qpipe (cfs)	=	62.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.77
Veloc Up (ft/s)	=	8.77
HGL Dn (ft)	=	103.00
HGL Up (ft)	=	103.44
Hw Elev (ft)	=	104.76
Hw/D (ft)	=	1.50
Flow Regime	=	Inlet Control



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 13 2024

DP2.1-Swale

Triangular

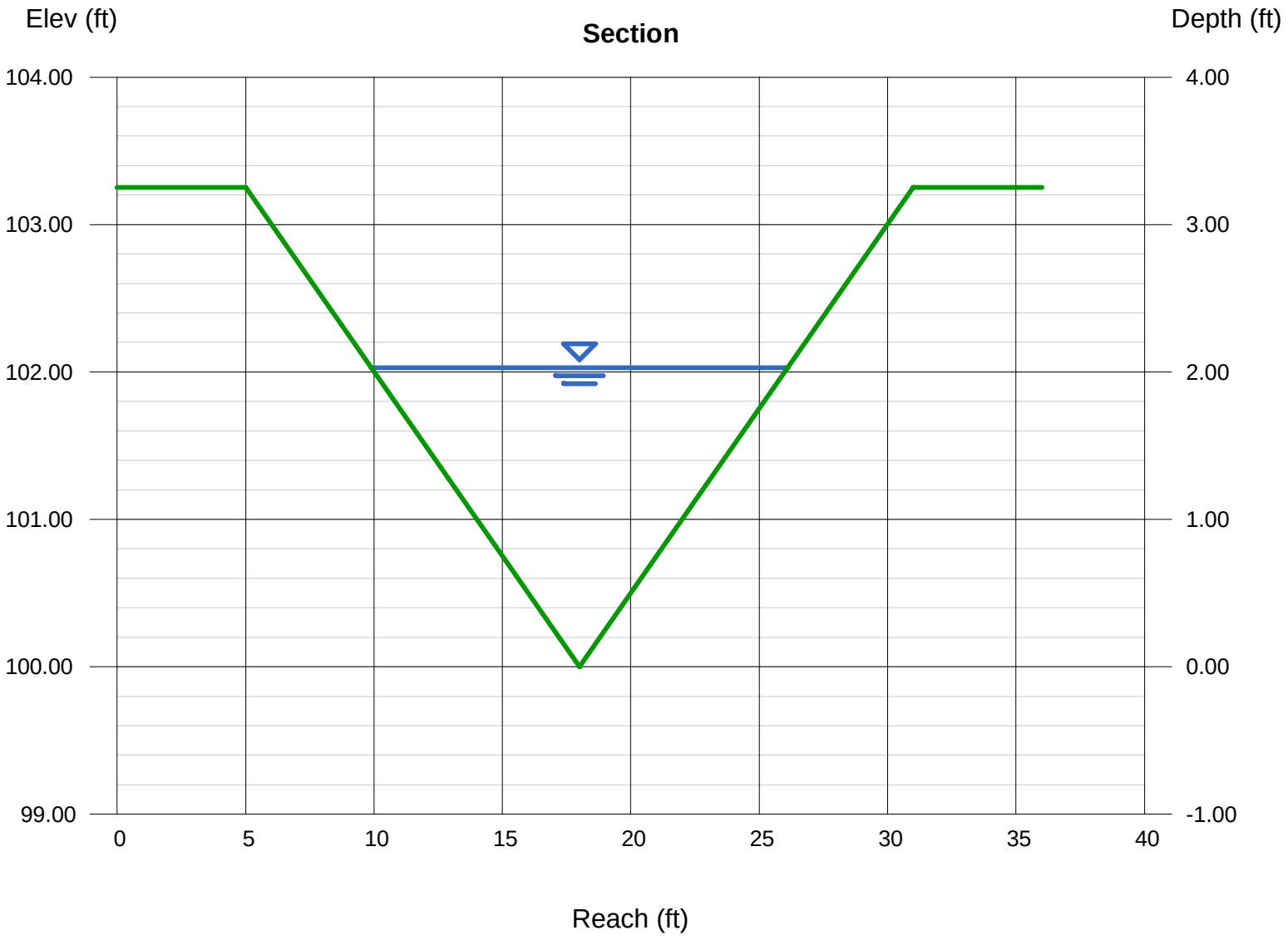
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 3.25
Invert Elev (ft)	= 100.00
Slope (%)	= 1.05
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 82.00

Highlighted

Depth (ft)	= 2.03
Q (cfs)	= 82.00
Area (sqft)	= 16.48
Velocity (ft/s)	= 4.97
Wetted Perim (ft)	= 16.74
Crit Depth, Yc (ft)	= 1.93
Top Width (ft)	= 16.24
EGL (ft)	= 2.41



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Oct 21 2024

DP3-Swale

Triangular

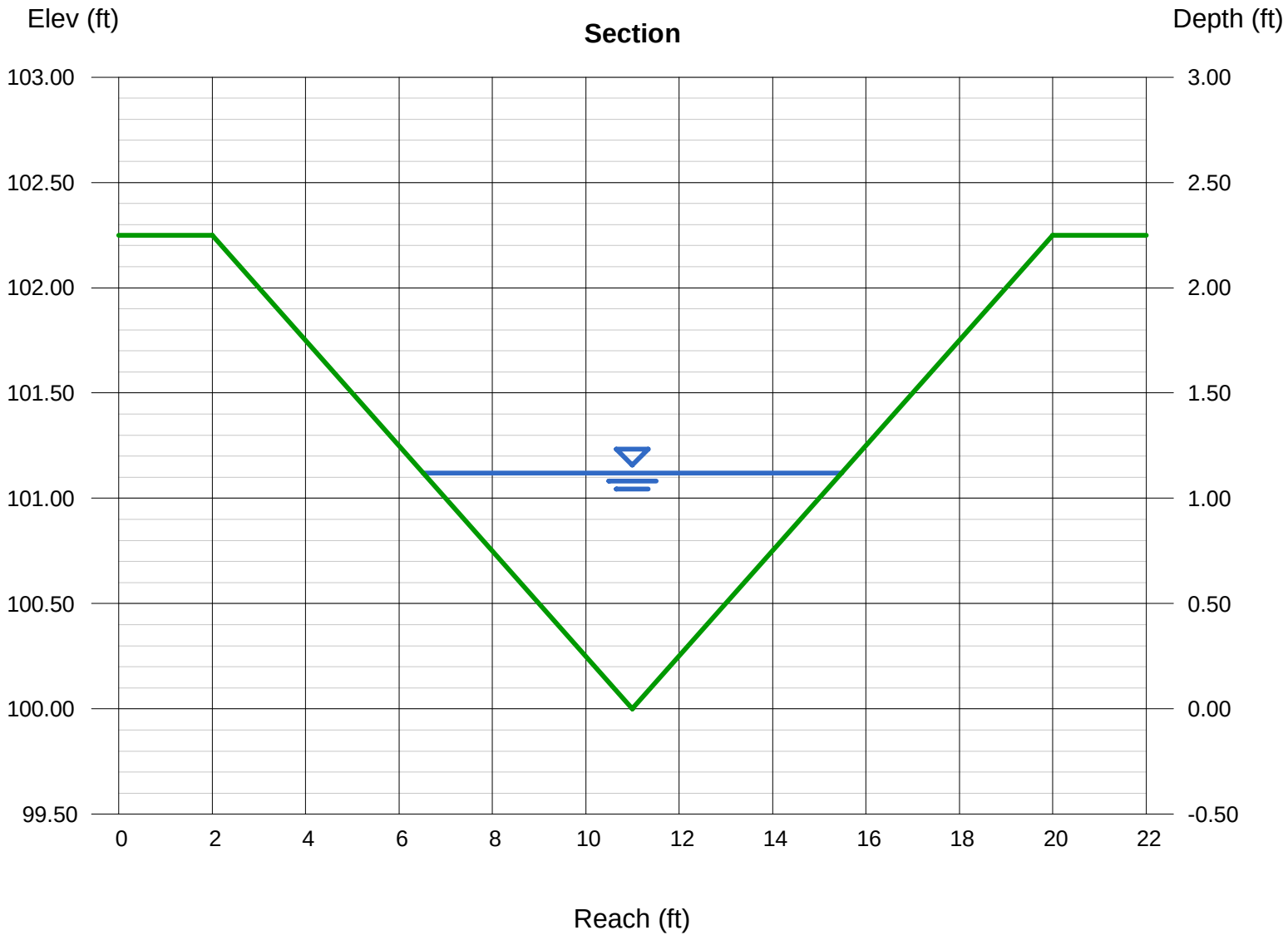
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.25
Invert Elev (ft)	= 100.00
Slope (%)	= 2.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 23.00

Highlighted

Depth (ft)	= 1.12
Q (cfs)	= 23.00
Area (sqft)	= 5.02
Velocity (ft/s)	= 4.58
Wetted Perim (ft)	= 9.24
Crit Depth, Yc (ft)	= 1.16
Top Width (ft)	= 8.96
EGL (ft)	= 1.45



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Oct 21 2024

DP3.1-Swale

Triangular

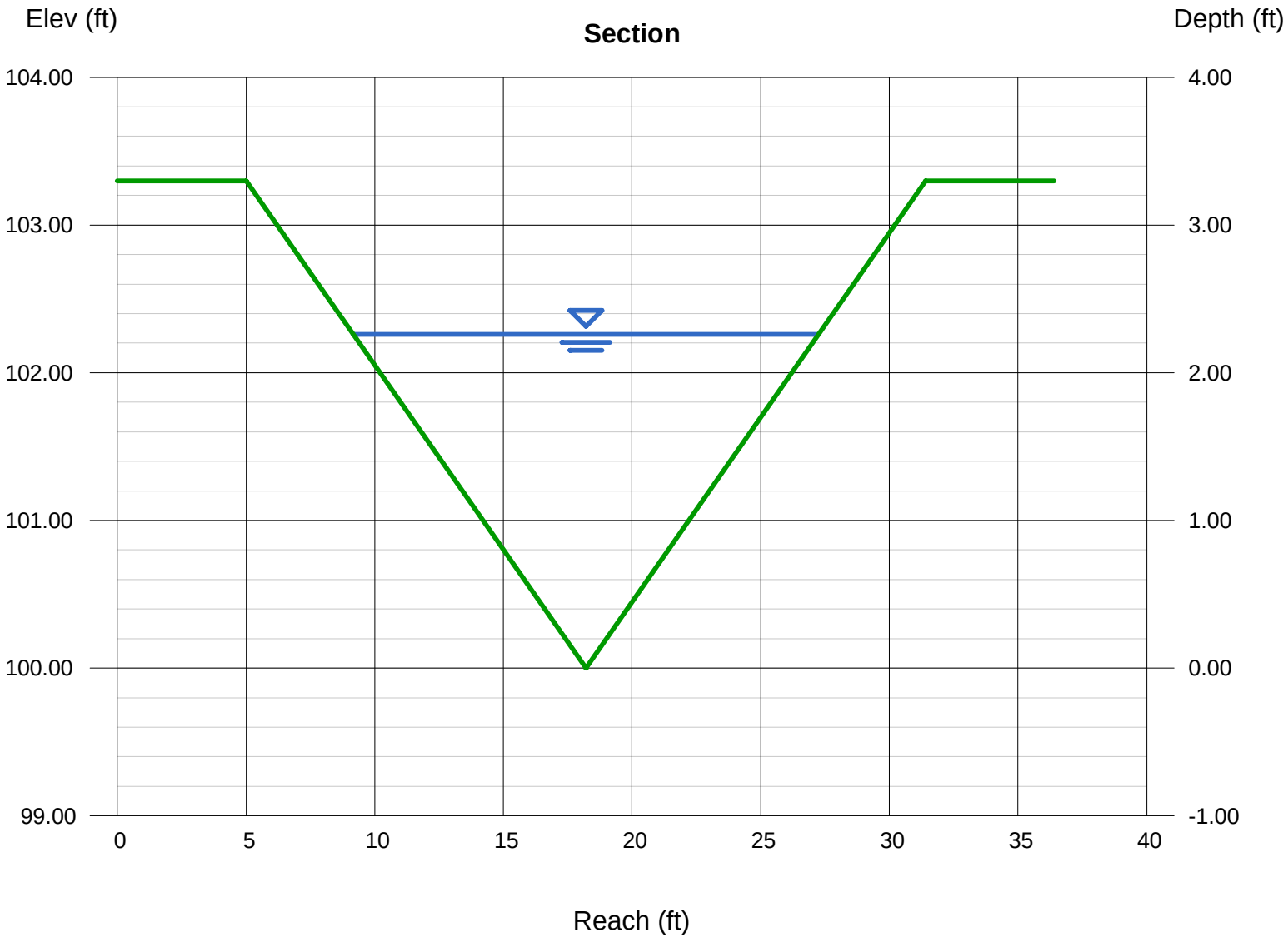
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 3.30
Invert Elev (ft)	= 100.00
Slope (%)	= 0.90
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 102.00

Highlighted

Depth (ft)	= 2.26
Q (cfs)	= 102.00
Area (sqft)	= 20.43
Velocity (ft/s)	= 4.99
Wetted Perim (ft)	= 18.64
Crit Depth, Yc (ft)	= 2.10
Top Width (ft)	= 18.08
EGL (ft)	= 2.65



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Oct 21 2024

DP4.1-Pond 1 Inflow

Invert Elev Dn (ft)	=	100.00
Pipe Length (ft)	=	61.00
Slope (%)	=	0.51
Invert Elev Up (ft)	=	100.31
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

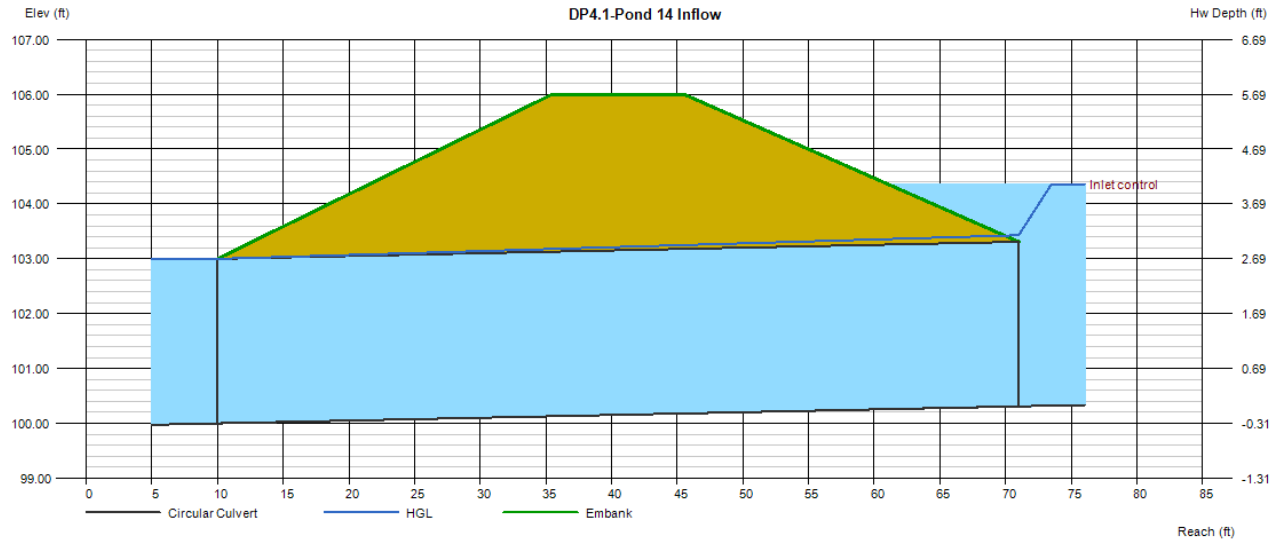
Top Elevation (ft)	=	106.00
Top Width (ft)	=	10.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	112.00
Qmax (cfs)	=	112.00
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	112.00
Qpipe (cfs)	=	112.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	7.92
Veloc Up (ft/s)	=	7.92
HGL Dn (ft)	=	103.00
HGL Up (ft)	=	103.43
Hw Elev (ft)	=	104.36
Hw/D (ft)	=	1.35
Flow Regime	=	Inlet Control



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 13 2024

DP6.1-Swale

Triangular

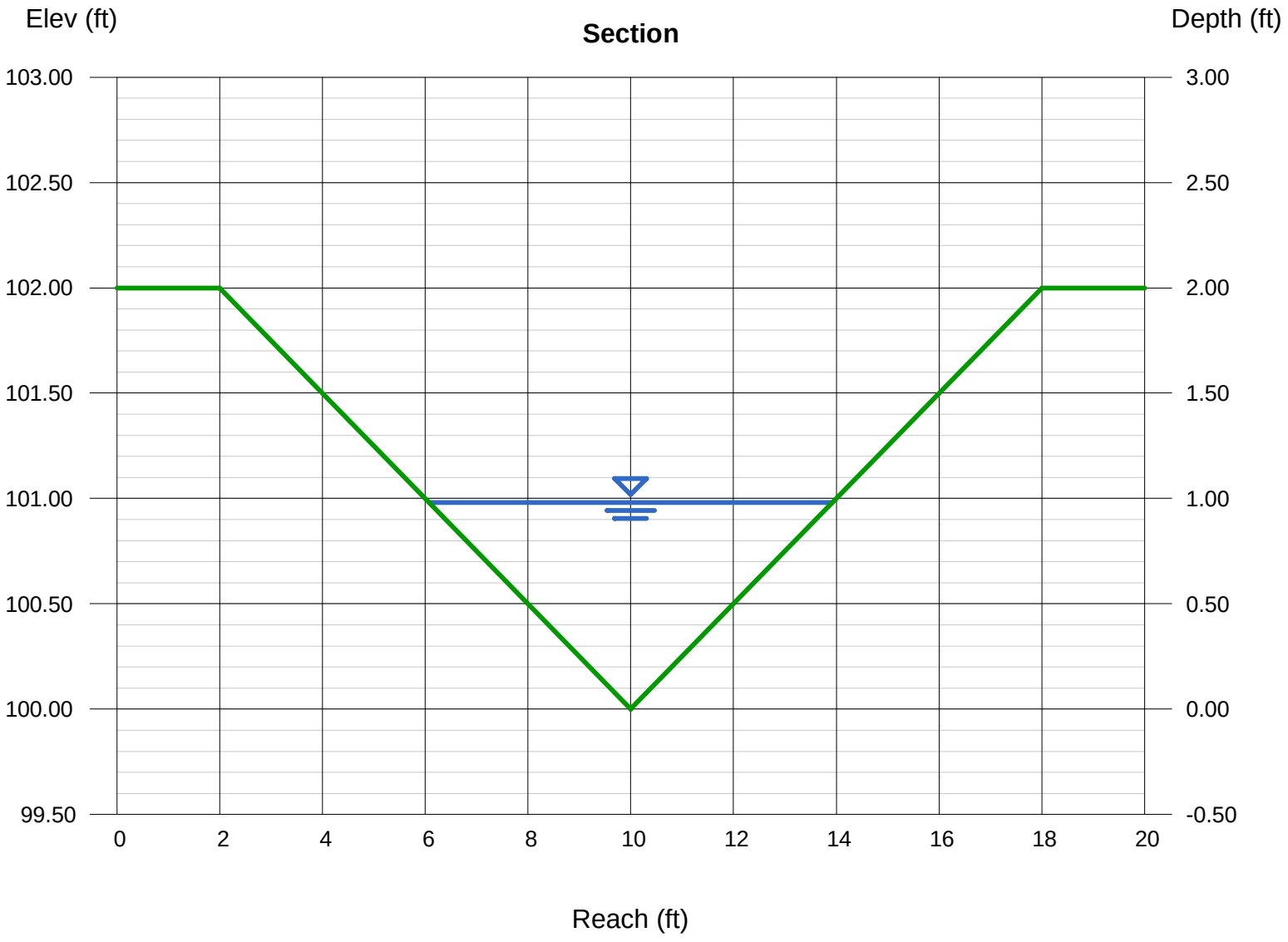
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 2.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 16.00

Highlighted

Depth (ft)	= 0.98
Q (cfs)	= 16.00
Area (sqft)	= 3.84
Velocity (ft/s)	= 4.16
Wetted Perim (ft)	= 8.08
Crit Depth, Yc (ft)	= 1.00
Top Width (ft)	= 7.84
EGL (ft)	= 1.25



Culvert Report

DP6.1-Culvert/ Pond 1 Inflow

Invert Elev Dn (ft)	=	100.00
Pipe Length (ft)	=	52.00
Slope (%)	=	0.50
Invert Elev Up (ft)	=	100.26
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

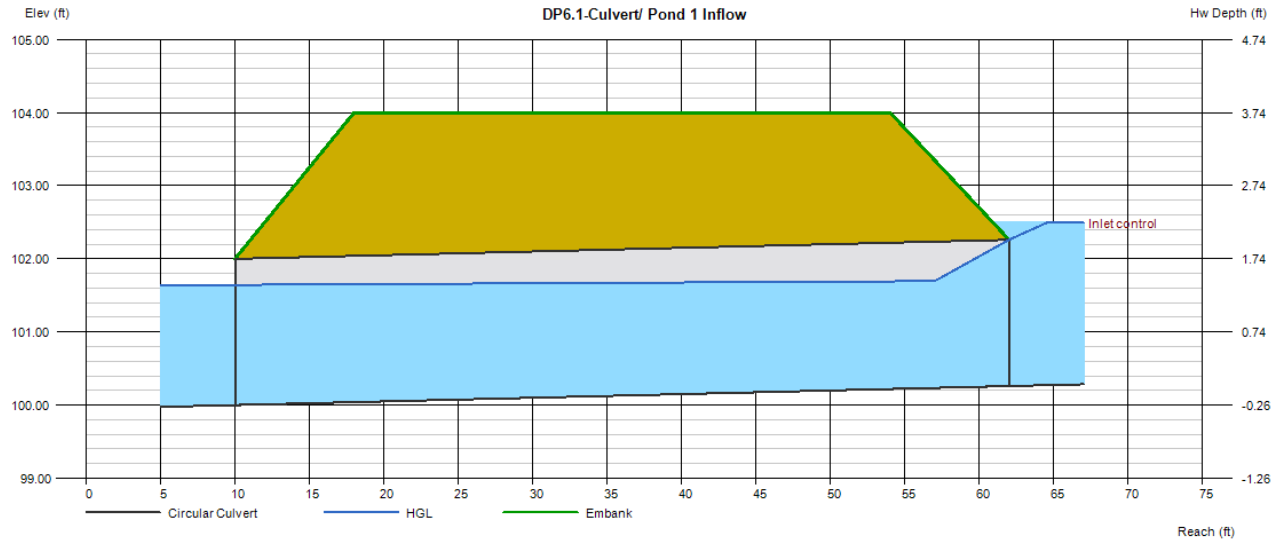
Top Elevation (ft)	=	104.00
Top Width (ft)	=	36.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	16.00
Qmax (cfs)	=	16.00
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	16.00
Qpipe (cfs)	=	16.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.79
Veloc Up (ft/s)	=	6.60
HGL Dn (ft)	=	101.64
HGL Up (ft)	=	101.70
Hw Elev (ft)	=	102.49
Hw/D (ft)	=	1.12
Flow Regime	=	Inlet Control



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 13 2024

DP7-Swale

Triangular

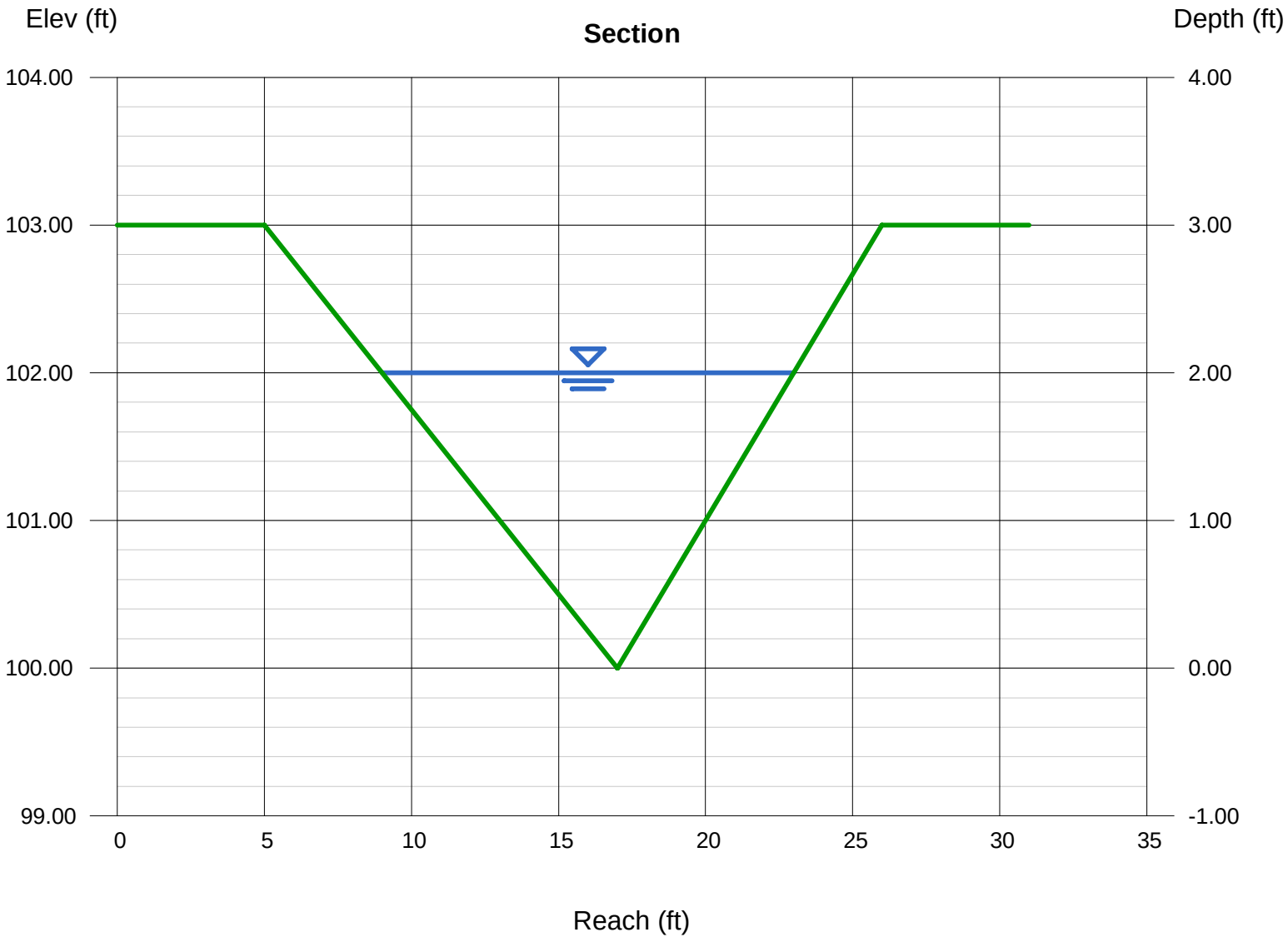
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 100.00
Slope (%)	= 1.10
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 70.00

Highlighted

Depth (ft)	= 2.00
Q (cfs)	= 70.00
Area (sqft)	= 14.00
Velocity (ft/s)	= 5.00
Wetted Perim (ft)	= 14.57
Crit Depth, Yc (ft)	= 1.91
Top Width (ft)	= 14.00
EGL (ft)	= 2.39



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Oct 21 2024

DP7-Pond 1 Inflow

Invert Elev Dn (ft)	=	100.00
Pipe Length (ft)	=	61.00
Slope (%)	=	0.51
Invert Elev Up (ft)	=	100.31
Rise (in)	=	42.0
Shape	=	Circular
Span (in)	=	42.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

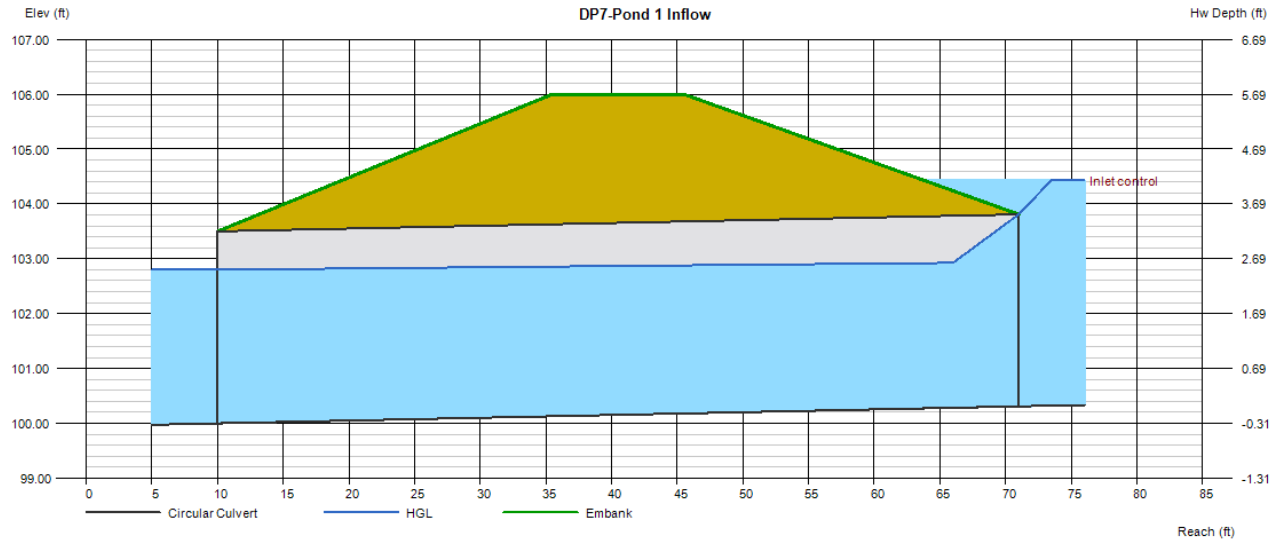
Top Elevation (ft)	=	106.00
Top Width (ft)	=	10.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	70.00
Qmax (cfs)	=	70.00
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	70.00
Qpipe (cfs)	=	70.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.48
Veloc Up (ft/s)	=	9.04
HGL Dn (ft)	=	102.80
HGL Up (ft)	=	102.94
Hw Elev (ft)	=	104.44
Hw/D (ft)	=	1.18
Flow Regime	=	Inlet Control



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 13 2024

DP12.1-Swale

Triangular

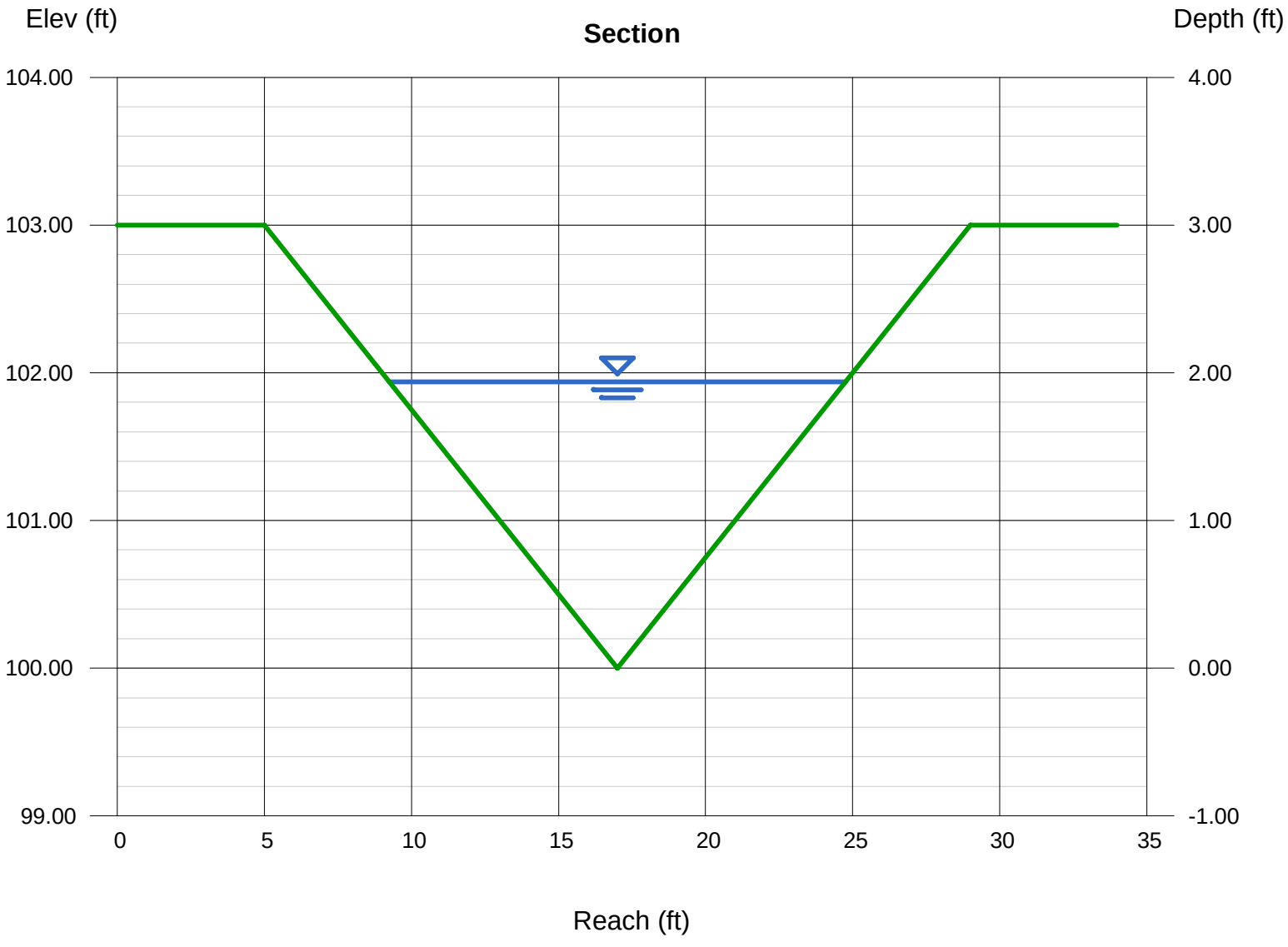
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 100.00
Slope (%)	= 1.10
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 75.00

Highlighted

Depth (ft)	= 1.94
Q (cfs)	= 75.00
Area (sqft)	= 15.05
Velocity (ft/s)	= 4.98
Wetted Perim (ft)	= 16.00
Crit Depth, Yc (ft)	= 1.86
Top Width (ft)	= 15.52
EGL (ft)	= 2.33



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 13 2024

DP12.1-Culvert

Invert Elev Dn (ft)	=	100.00
Pipe Length (ft)	=	51.00
Slope (%)	=	0.51
Invert Elev Up (ft)	=	100.26
Rise (in)	=	42.0
Shape	=	Circular
Span (in)	=	42.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

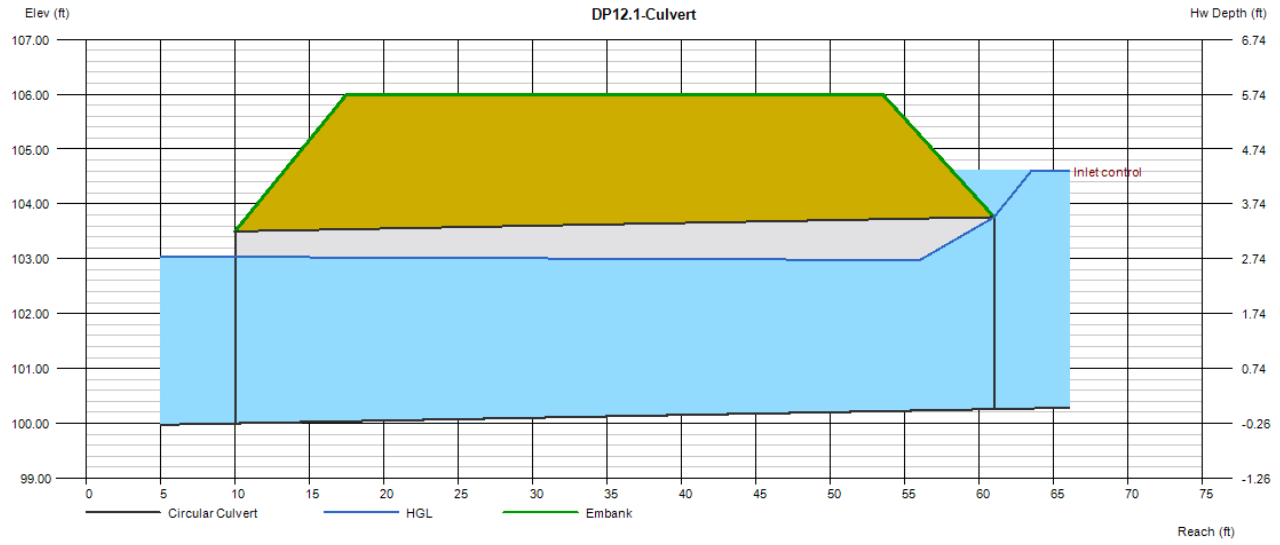
Top Elevation (ft)	=	106.00
Top Width (ft)	=	36.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	75.00
Qmax (cfs)	=	75.00
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	75.00
Qpipe (cfs)	=	75.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.46
Veloc Up (ft/s)	=	9.39
HGL Dn (ft)	=	103.03
HGL Up (ft)	=	102.97
Hw Elev (ft)	=	104.60
Hw/D (ft)	=	1.24
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Oct 21 2024

DP12.1-Pond 2 Inflow

Invert Elev Dn (ft)	=	100.00
Pipe Length (ft)	=	51.00
Slope (%)	=	0.51
Invert Elev Up (ft)	=	100.26
Rise (in)	=	42.0
Shape	=	Circular
Span (in)	=	42.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

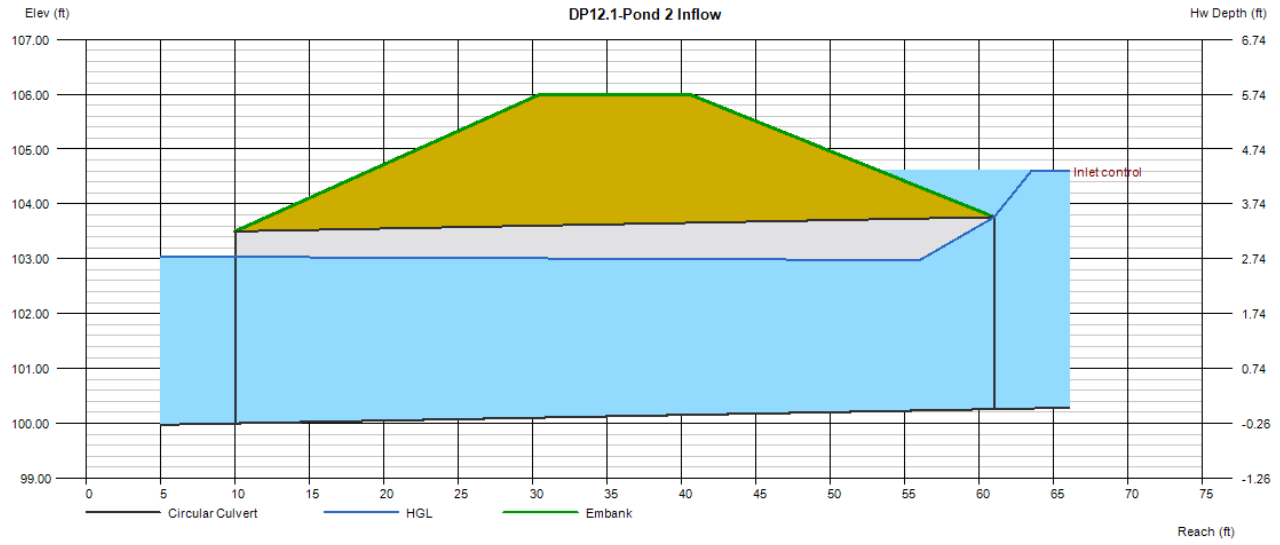
Top Elevation (ft)	=	106.00
Top Width (ft)	=	10.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	75.00
Qmax (cfs)	=	75.00
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	75.00
Qpipe (cfs)	=	75.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.46
Veloc Up (ft/s)	=	9.39
HGL Dn (ft)	=	103.03
HGL Up (ft)	=	102.97
Hw Elev (ft)	=	104.60
Hw/D (ft)	=	1.24
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 13 2024

DP13-Culvert

Invert Elev Dn (ft)	=	100.00
Pipe Length (ft)	=	51.00
Slope (%)	=	0.51
Invert Elev Up (ft)	=	100.26
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

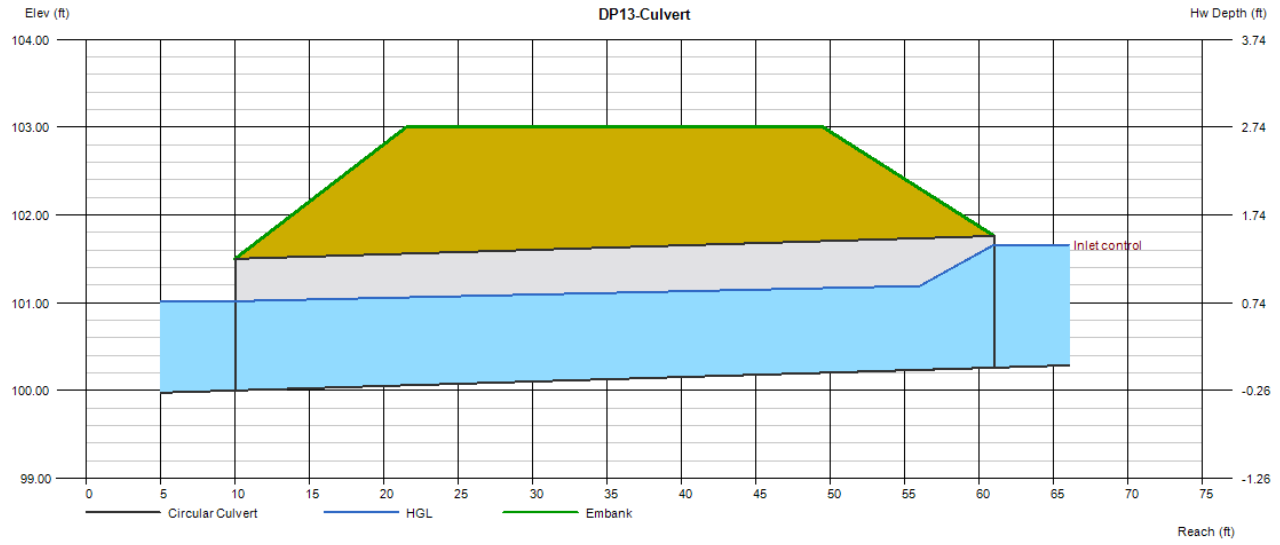
Top Elevation (ft)	=	103.00
Top Width (ft)	=	28.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	6.00
Qmax (cfs)	=	6.00
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	6.00
Qpipe (cfs)	=	6.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.70
Veloc Up (ft/s)	=	5.09
HGL Dn (ft)	=	101.02
HGL Up (ft)	=	101.21
Hw Elev (ft)	=	101.66
Hw/D (ft)	=	0.93
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Oct 21 2024

DP14-Pond 2 Inflow

Invert Elev Dn (ft)	=	100.00
Pipe Length (ft)	=	51.00
Slope (%)	=	0.51
Invert Elev Up (ft)	=	100.26
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

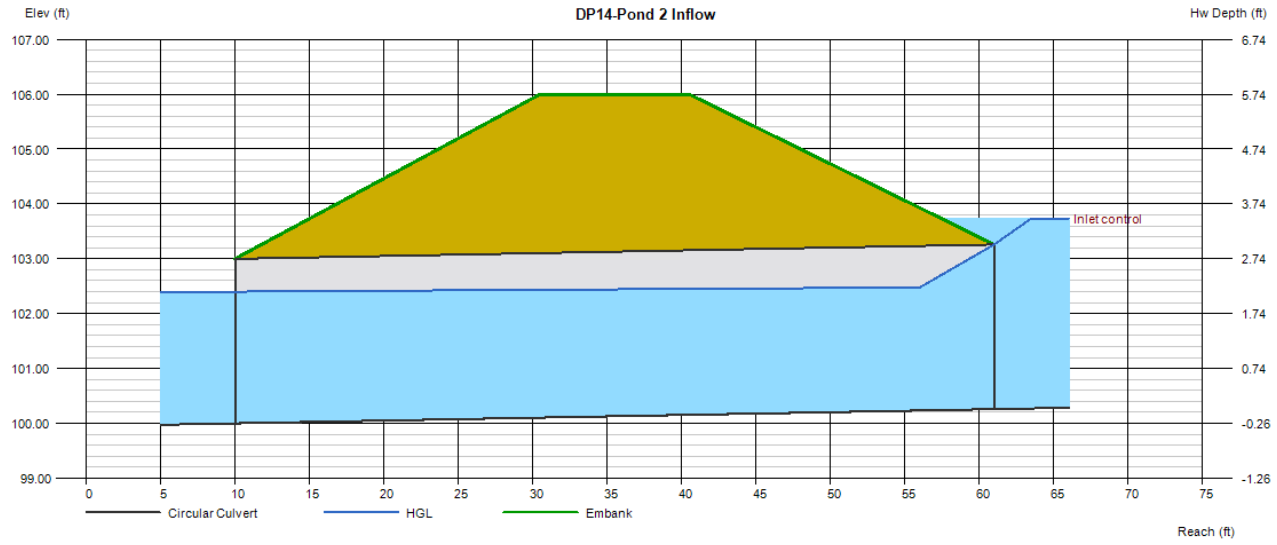
Top Elevation (ft)	=	106.00
Top Width (ft)	=	10.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	93.00
Qmax (cfs)	=	93.00
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	93.00
Qpipe (cfs)	=	93.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	7.67
Veloc Up (ft/s)	=	8.27
HGL Dn (ft)	=	102.40
HGL Up (ft)	=	102.49
Hw Elev (ft)	=	103.74
Hw/D (ft)	=	1.16
Flow Regime	=	Inlet Control



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 13 2024

DP16-Roadside Swale

Triangular

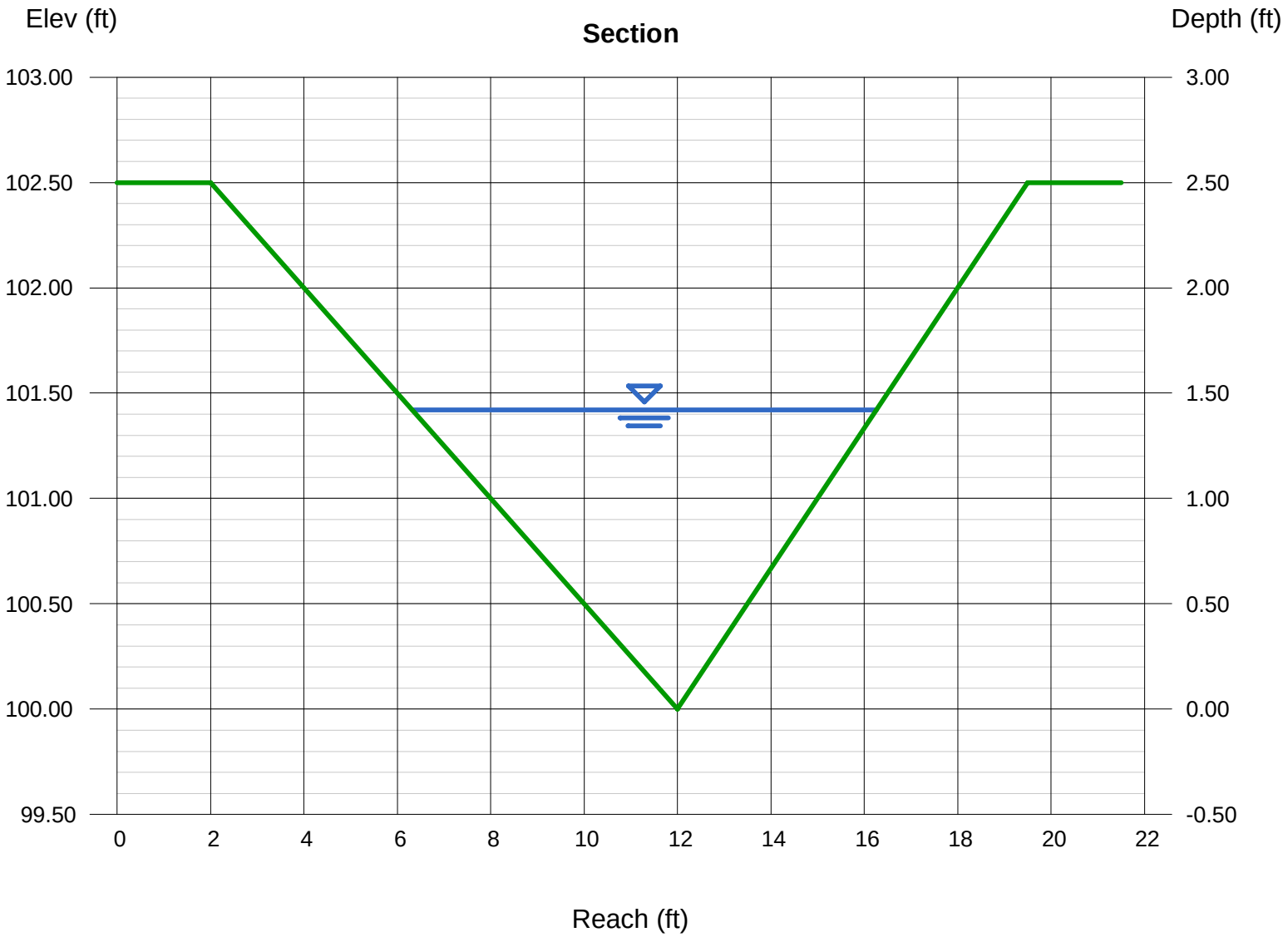
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 100.00
Slope (%)	= 1.70
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 35.00

Highlighted

Depth (ft)	= 1.42
Q (cfs)	= 35.00
Area (sqft)	= 7.06
Velocity (ft/s)	= 4.96
Wetted Perim (ft)	= 10.35
Crit Depth, Yc (ft)	= 1.45
Top Width (ft)	= 9.94
EGL (ft)	= 1.80



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 13 2024

DP16-Swale

Triangular

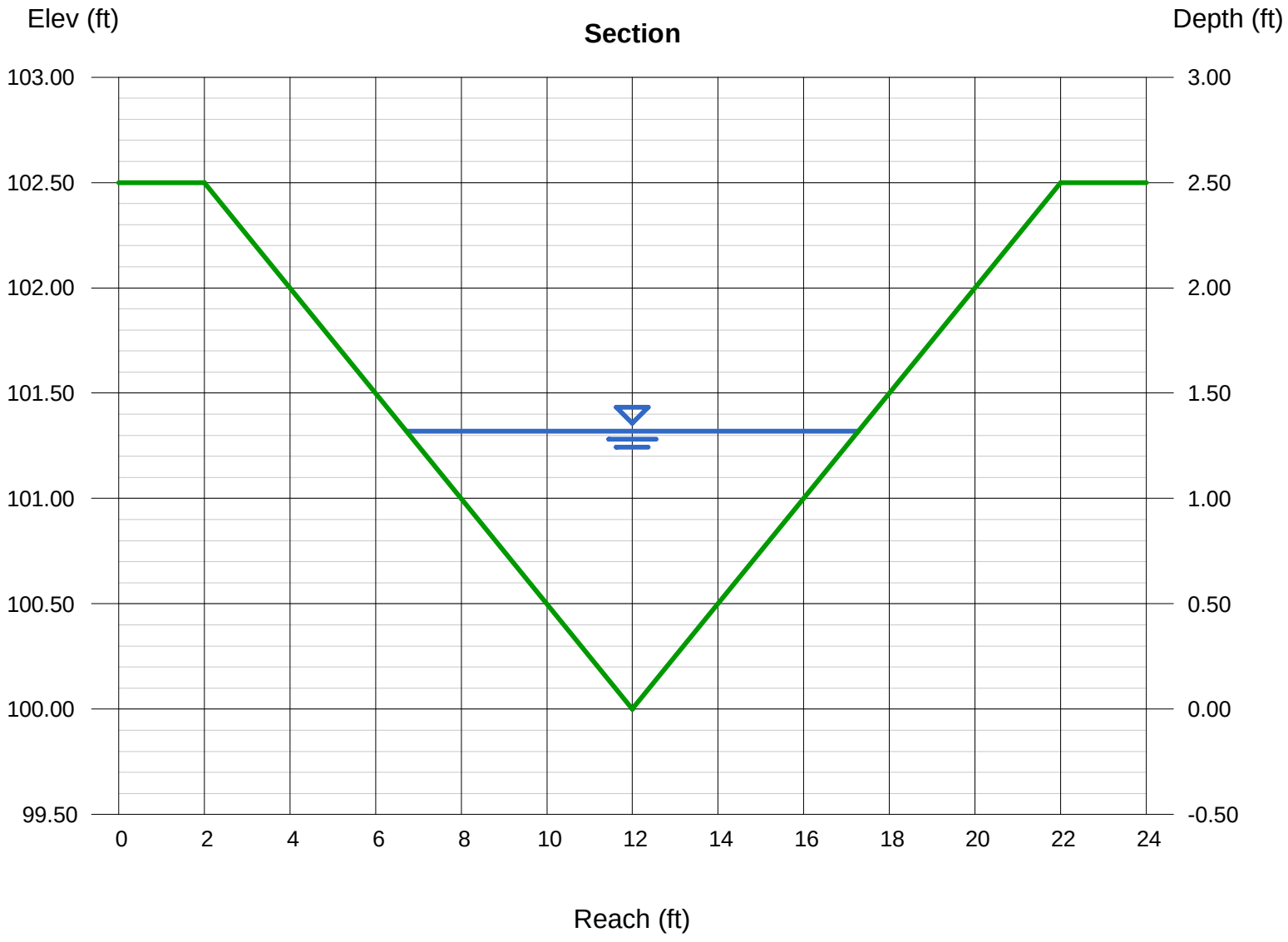
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 100.00
Slope (%)	= 1.90
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 35.00

Highlighted

Depth (ft)	= 1.32
Q (cfs)	= 35.00
Area (sqft)	= 6.97
Velocity (ft/s)	= 5.02
Wetted Perim (ft)	= 10.88
Crit Depth, Yc (ft)	= 1.37
Top Width (ft)	= 10.56
EGL (ft)	= 1.71



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 13 2024

DP17.1-Roadside Swale

Triangular

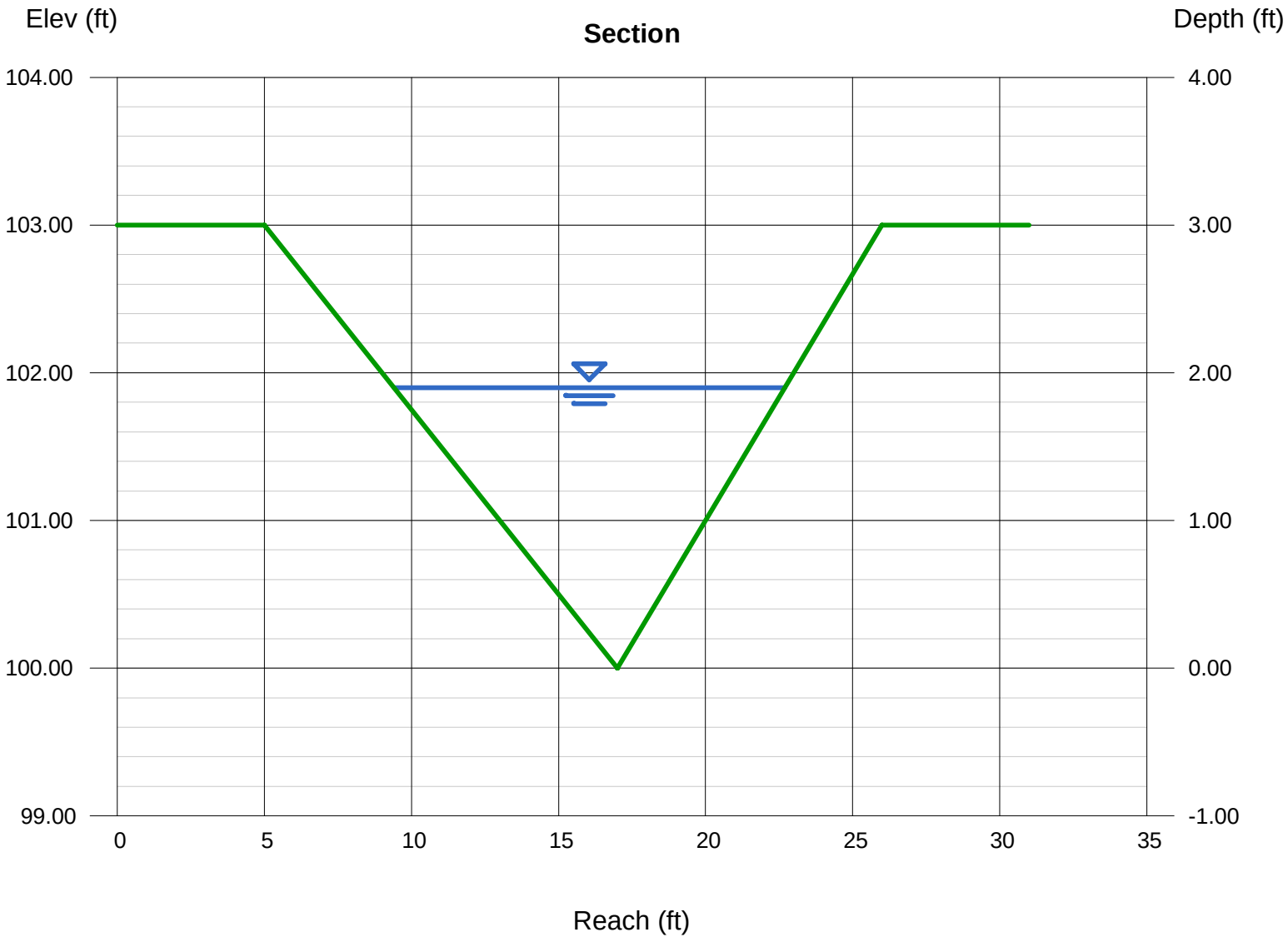
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 100.00
Slope (%)	= 1.15
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 63.00

Highlighted

Depth (ft)	= 1.90
Q (cfs)	= 63.00
Area (sqft)	= 12.63
Velocity (ft/s)	= 4.99
Wetted Perim (ft)	= 13.84
Crit Depth, Yc (ft)	= 1.83
Top Width (ft)	= 13.30
EGL (ft)	= 2.29



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 13 2024

DP17.1-Culvert

Invert Elev Dn (ft)	=	100.00
Pipe Length (ft)	=	60.00
Slope (%)	=	0.50
Invert Elev Up (ft)	=	100.30
Rise (in)	=	42.0
Shape	=	Circular
Span (in)	=	42.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

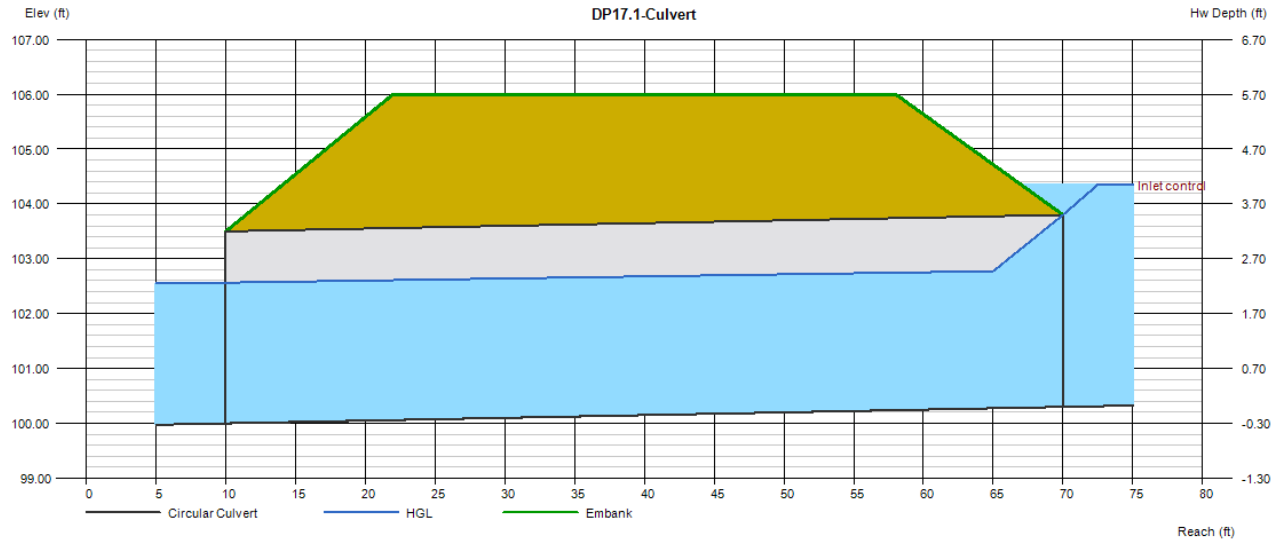
Top Elevation (ft)	=	106.00
Top Width (ft)	=	36.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	63.00
Qmax (cfs)	=	63.00
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	63.00
Qpipe (cfs)	=	63.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.34
Veloc Up (ft/s)	=	8.59
HGL Dn (ft)	=	102.56
HGL Up (ft)	=	102.79
Hw Elev (ft)	=	104.35
Hw/D (ft)	=	1.16
Flow Regime	=	Inlet Control



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 13 2024

DP18.1-Roadside Swale

Triangular

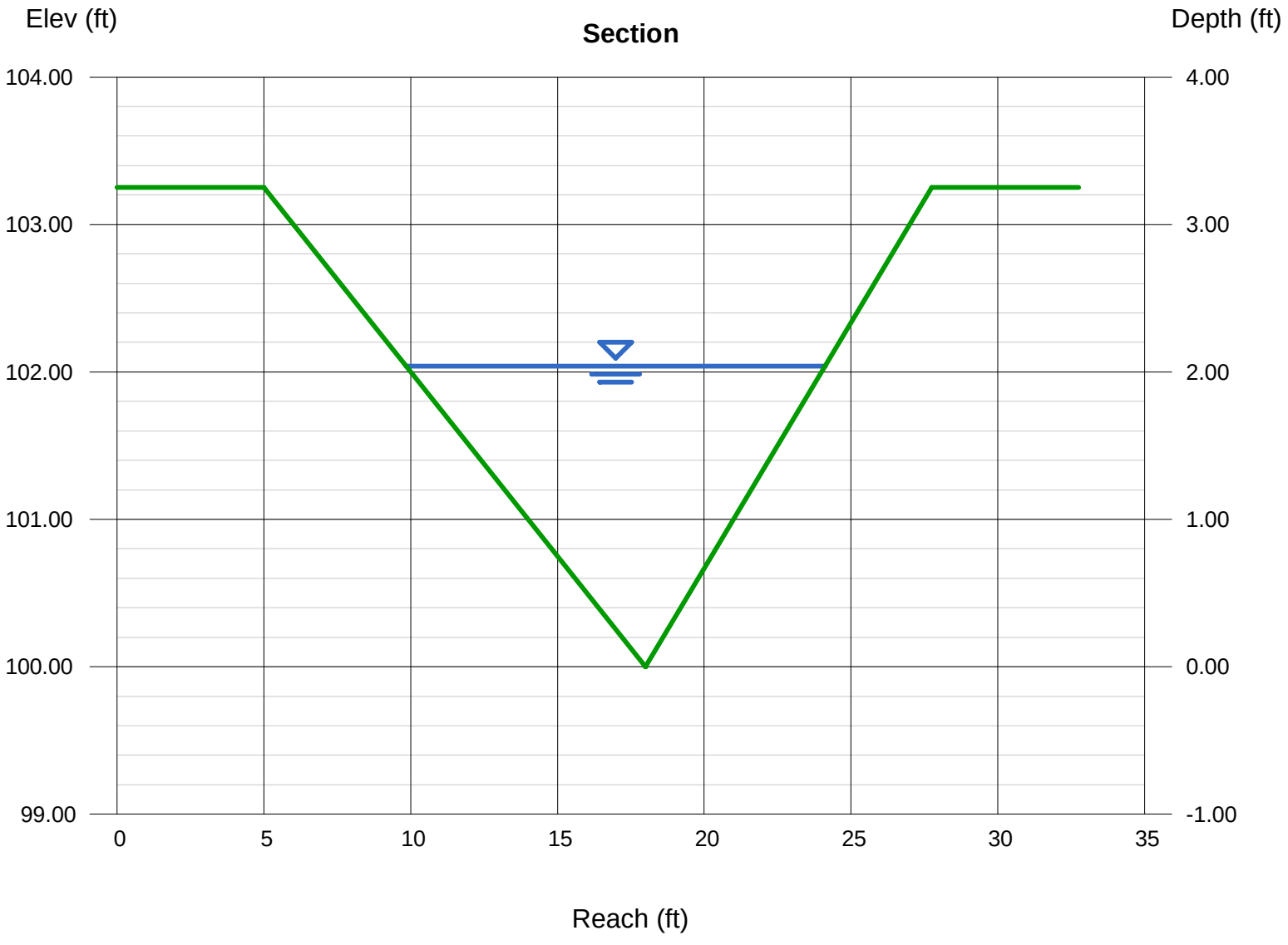
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.25
Invert Elev (ft)	= 100.00
Slope (%)	= 1.05
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 72.00

Highlighted

Depth (ft)	= 2.04
Q (cfs)	= 72.00
Area (sqft)	= 14.57
Velocity (ft/s)	= 4.94
Wetted Perim (ft)	= 14.86
Crit Depth, Yc (ft)	= 1.93
Top Width (ft)	= 14.28
EGL (ft)	= 2.42



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 13 2024

DP18.1-Culvert

Invert Elev Dn (ft)	=	100.00
Pipe Length (ft)	=	60.00
Slope (%)	=	0.50
Invert Elev Up (ft)	=	100.30
Rise (in)	=	42.0
Shape	=	Circular
Span (in)	=	42.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

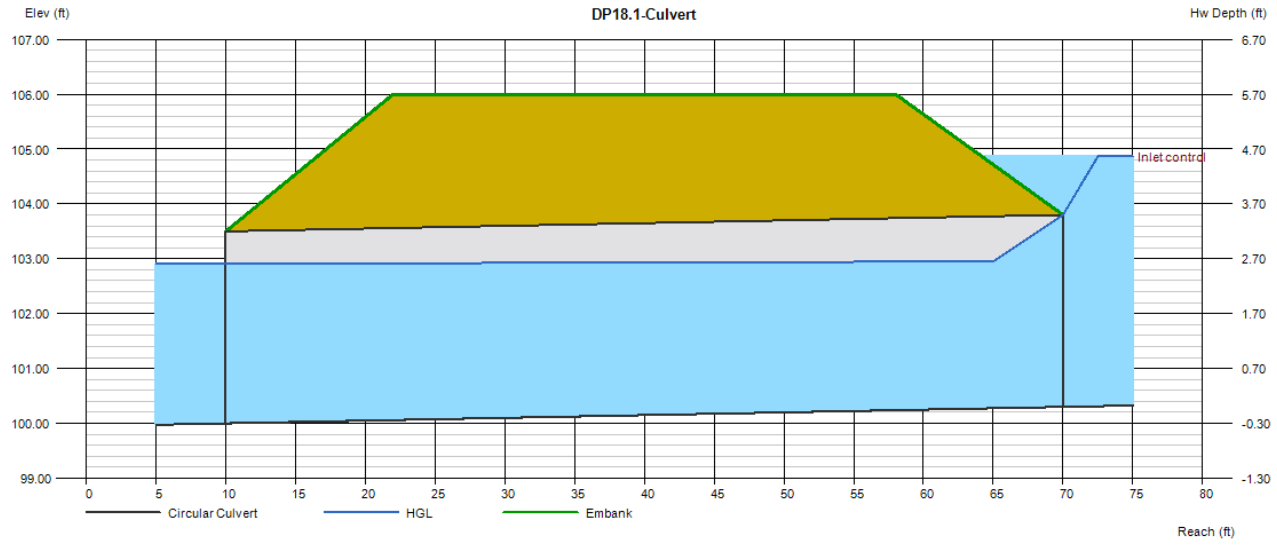
Top Elevation (ft)	=	106.00
Top Width (ft)	=	36.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	72.00
Qmax (cfs)	=	72.00
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	72.00
Qpipe (cfs)	=	72.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.42
Veloc Up (ft/s)	=	9.19
HGL Dn (ft)	=	102.91
HGL Up (ft)	=	102.96
Hw Elev (ft)	=	104.87
Hw/D (ft)	=	1.30
Flow Regime	=	Inlet Control



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 13 2024

DP19.1-Swale

Triangular

Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 3.25
Invert Elev (ft)	= 100.00
Slope (%)	= 2.00
N-Value	= 0.030

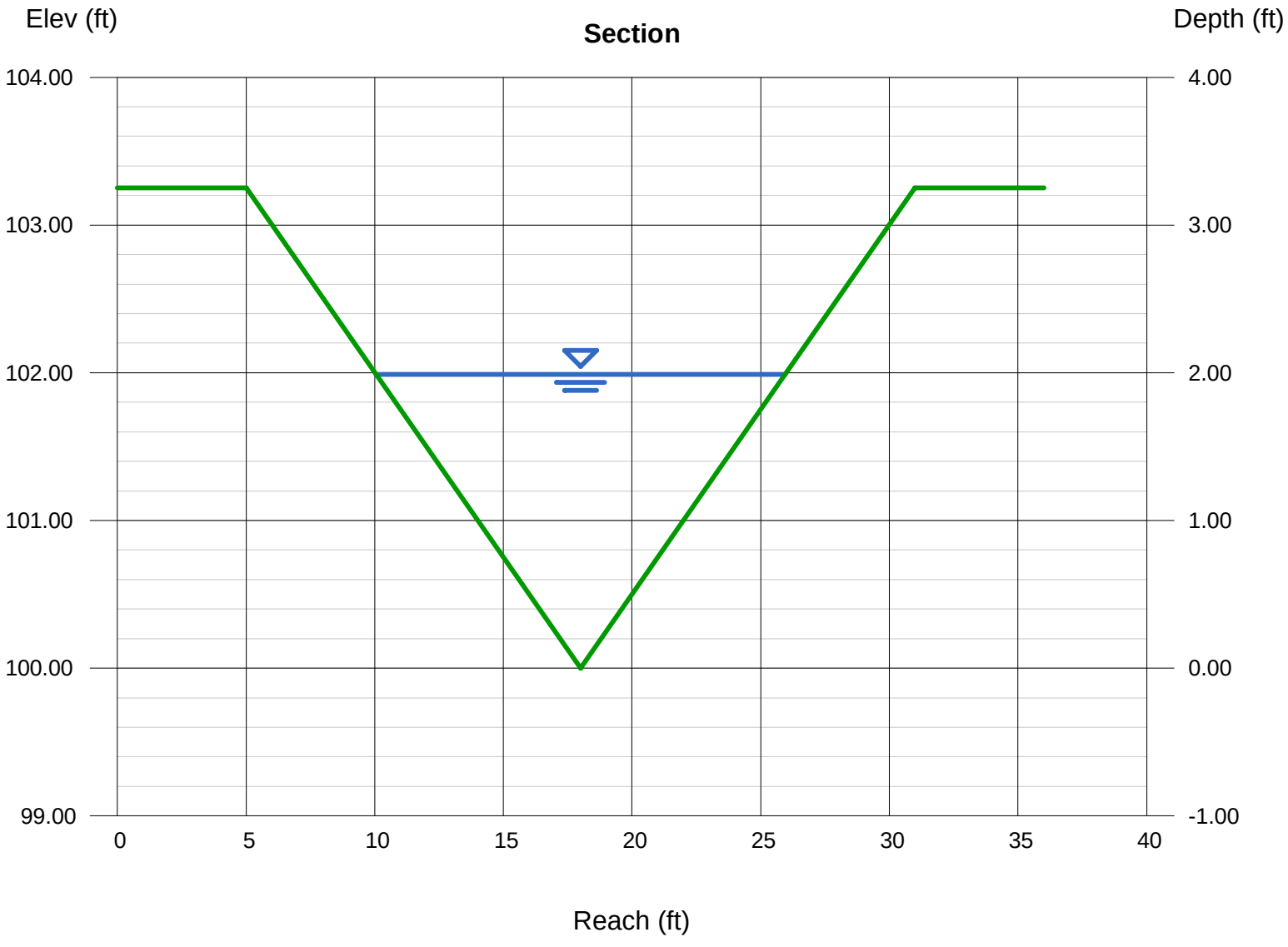
Calculations

Compute by:	Known Q
Known Q (cfs)	= 108.00

Highlighted

Depth (ft)	= 1.99
Q (cfs)	= 108.00
Area (sqft)	= 15.84
Velocity (ft/s)	= 6.82
Wetted Perim (ft)	= 16.41
Crit Depth, Yc (ft)	= 2.15
Top Width (ft)	= 15.92
EGL (ft)	= 2.71

Swale to be protected w/ soil riprap where above 5 ft/s



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Oct 21 2024

DP19.1-Pond 3 Inflow

Invert Elev Dn (ft)	=	100.00
Pipe Length (ft)	=	61.00
Slope (%)	=	0.51
Invert Elev Up (ft)	=	100.31
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

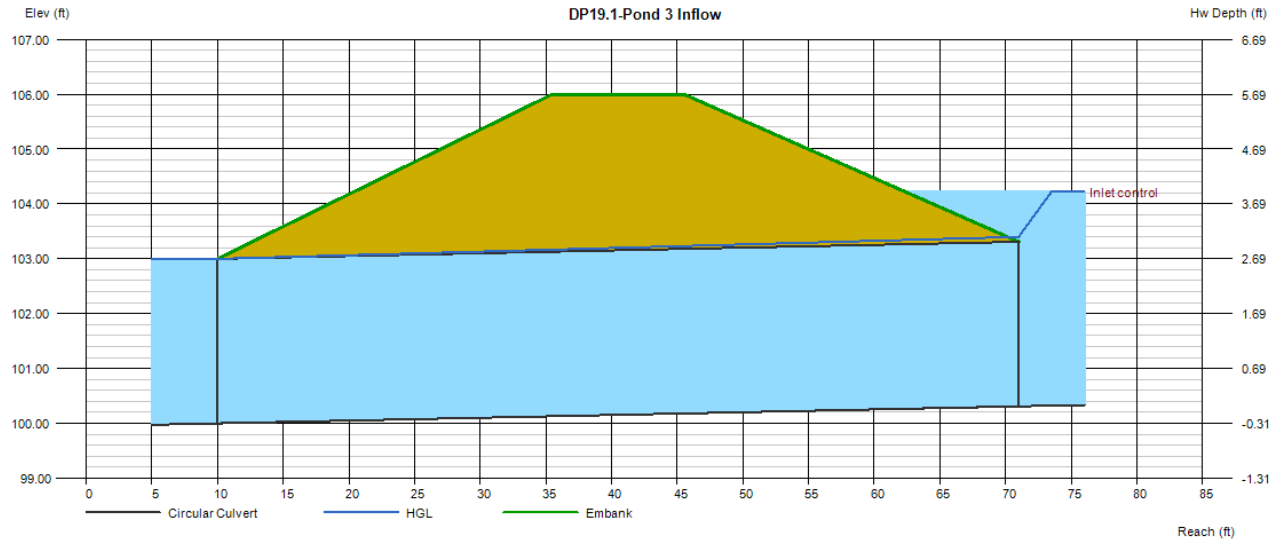
Top Elevation (ft)	=	106.00
Top Width (ft)	=	10.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	108.00
Qmax (cfs)	=	108.00
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	108.00
Qpipe (cfs)	=	108.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	7.64
Veloc Up (ft/s)	=	7.64
HGL Dn (ft)	=	103.00
HGL Up (ft)	=	103.40
Hw Elev (ft)	=	104.22
Hw/D (ft)	=	1.30
Flow Regime	=	Inlet Control



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 13 2024

DP20-Swale

Triangular

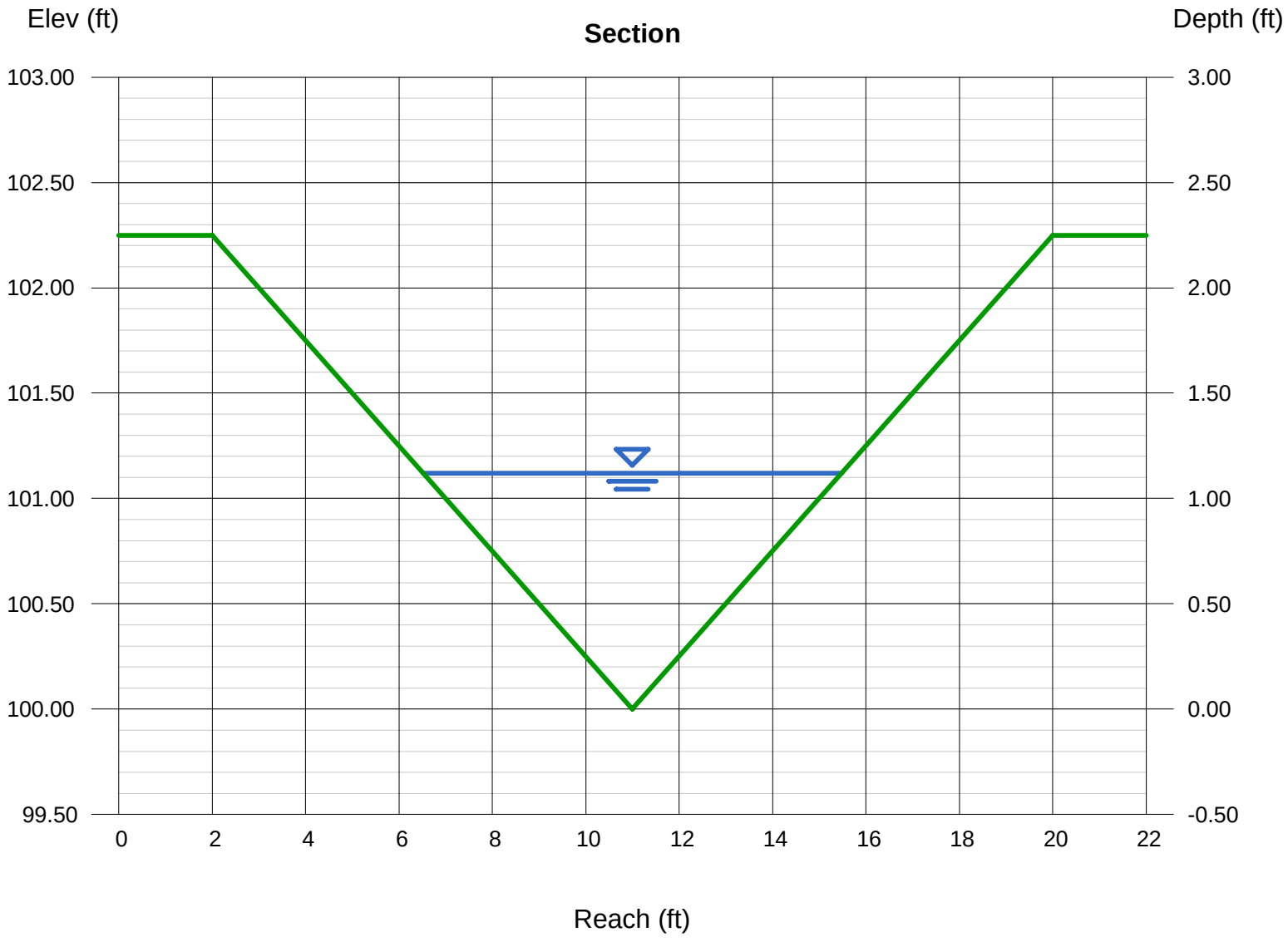
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.25
Invert Elev (ft)	= 100.00
Slope (%)	= 2.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 23.00

Highlighted

Depth (ft)	= 1.12
Q (cfs)	= 23.00
Area (sqft)	= 5.02
Velocity (ft/s)	= 4.58
Wetted Perim (ft)	= 9.24
Crit Depth, Yc (ft)	= 1.16
Top Width (ft)	= 8.96
EGL (ft)	= 1.45



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Oct 21 2024

DP20-Pond 3 Inflow

Invert Elev Dn (ft)	=	100.00
Pipe Length (ft)	=	61.00
Slope (%)	=	0.51
Invert Elev Up (ft)	=	100.31
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

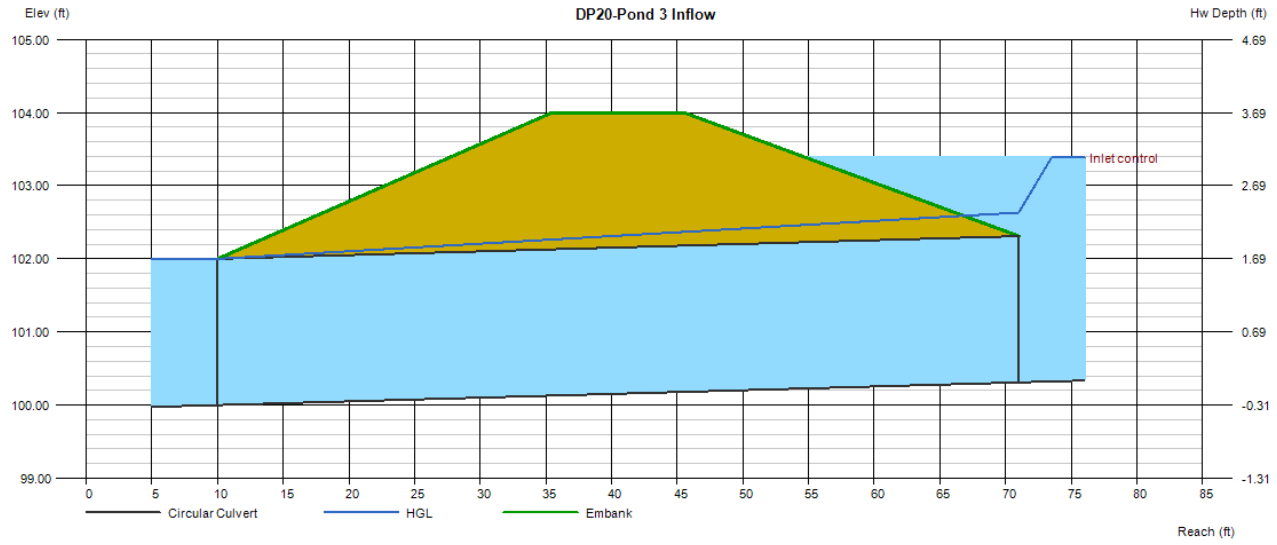
Top Elevation (ft)	=	104.00
Top Width (ft)	=	10.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	23.00
Qmax (cfs)	=	23.00
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	23.00
Qpipe (cfs)	=	23.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	7.32
Veloc Up (ft/s)	=	7.32
HGL Dn (ft)	=	102.00
HGL Up (ft)	=	102.63
Hw Elev (ft)	=	103.38
Hw/D (ft)	=	1.54
Flow Regime	=	Inlet Control



Channel Report

DP22.1-Swale

Triangular

Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 3.25
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.030

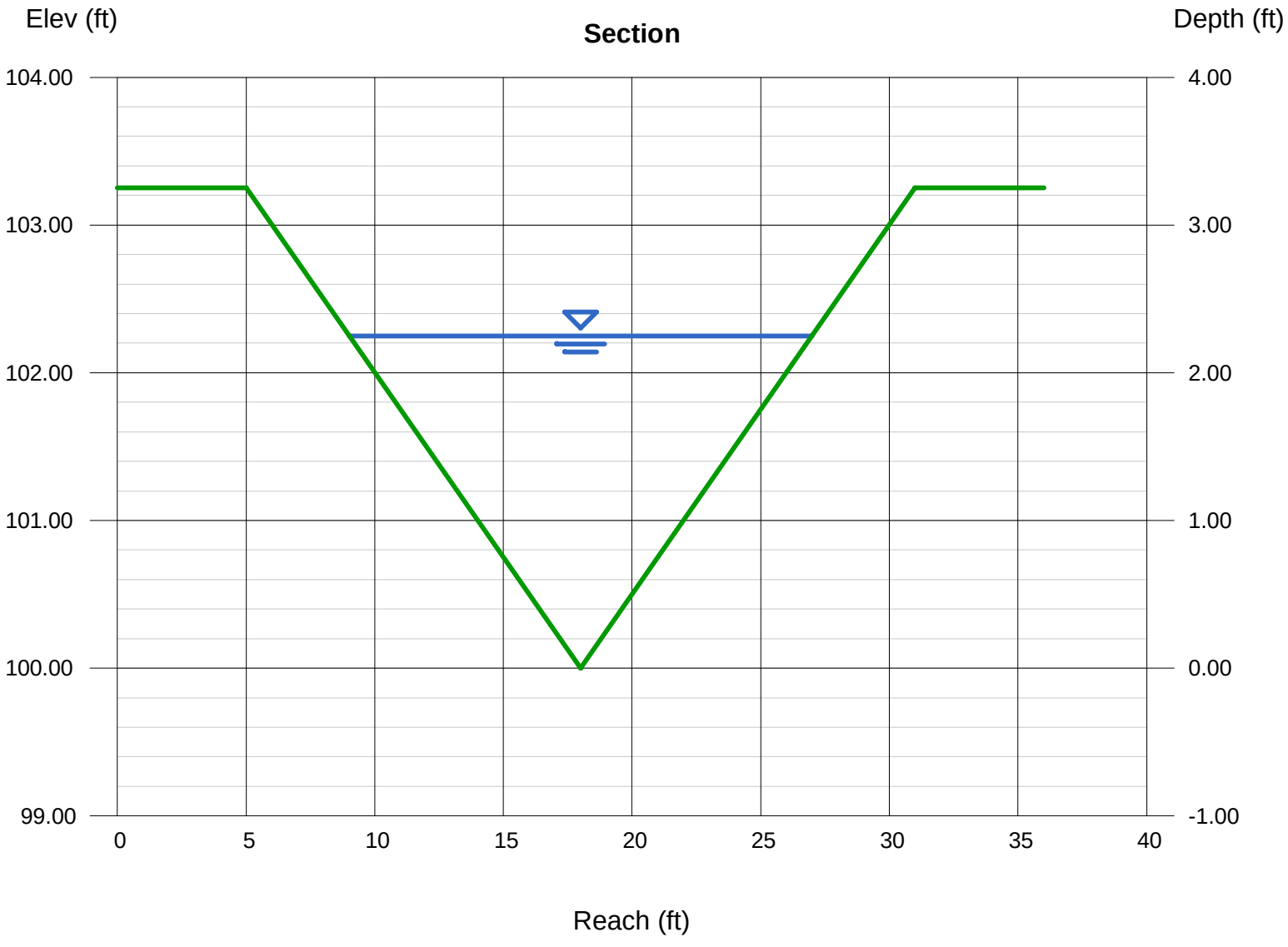
Calculations

Compute by:	Known Q
Known Q (cfs)	= 106.00

Highlighted

Depth (ft)	= 2.25
Q (cfs)	= 106.00
Area (sqft)	= 20.25
Velocity (ft/s)	= 5.23
Wetted Perim (ft)	= 18.55
Crit Depth, Yc (ft)	= 2.13
Top Width (ft)	= 18.00
EGL (ft)	= 2.68

Swale to be protected w/ soil riprap where above 5 ft/s



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 13 2024

DP23.1-Culvert

Invert Elev Dn (ft)	=	100.00
Pipe Length (ft)	=	60.00
Slope (%)	=	0.50
Invert Elev Up (ft)	=	100.30
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	3
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

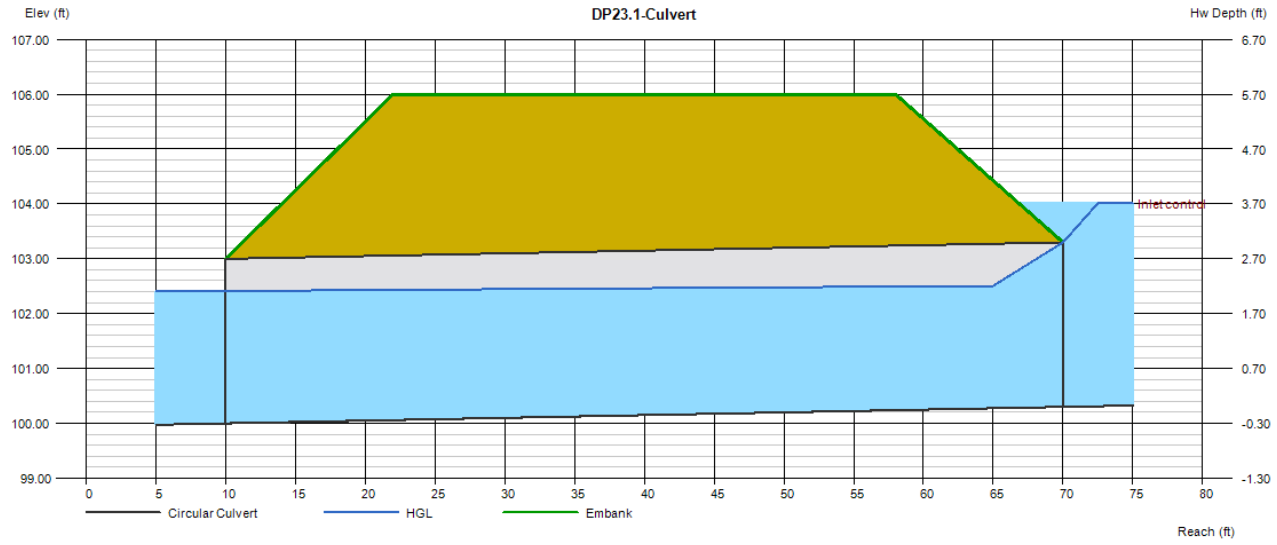
Top Elevation (ft)	=	106.00
Top Width (ft)	=	36.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	139.00
Qmax (cfs)	=	139.00
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	139.00
Qpipe (cfs)	=	139.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	7.60
Veloc Up (ft/s)	=	8.28
HGL Dn (ft)	=	102.41
HGL Up (ft)	=	102.52
Hw Elev (ft)	=	104.01
Hw/D (ft)	=	1.24
Flow Regime	=	Inlet Control



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 13 2024

DP23.1-Roadside Swale

Triangular

Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.50
Invert Elev (ft)	= 100.00
Slope (%)	= 1.50
N-Value	= 0.030

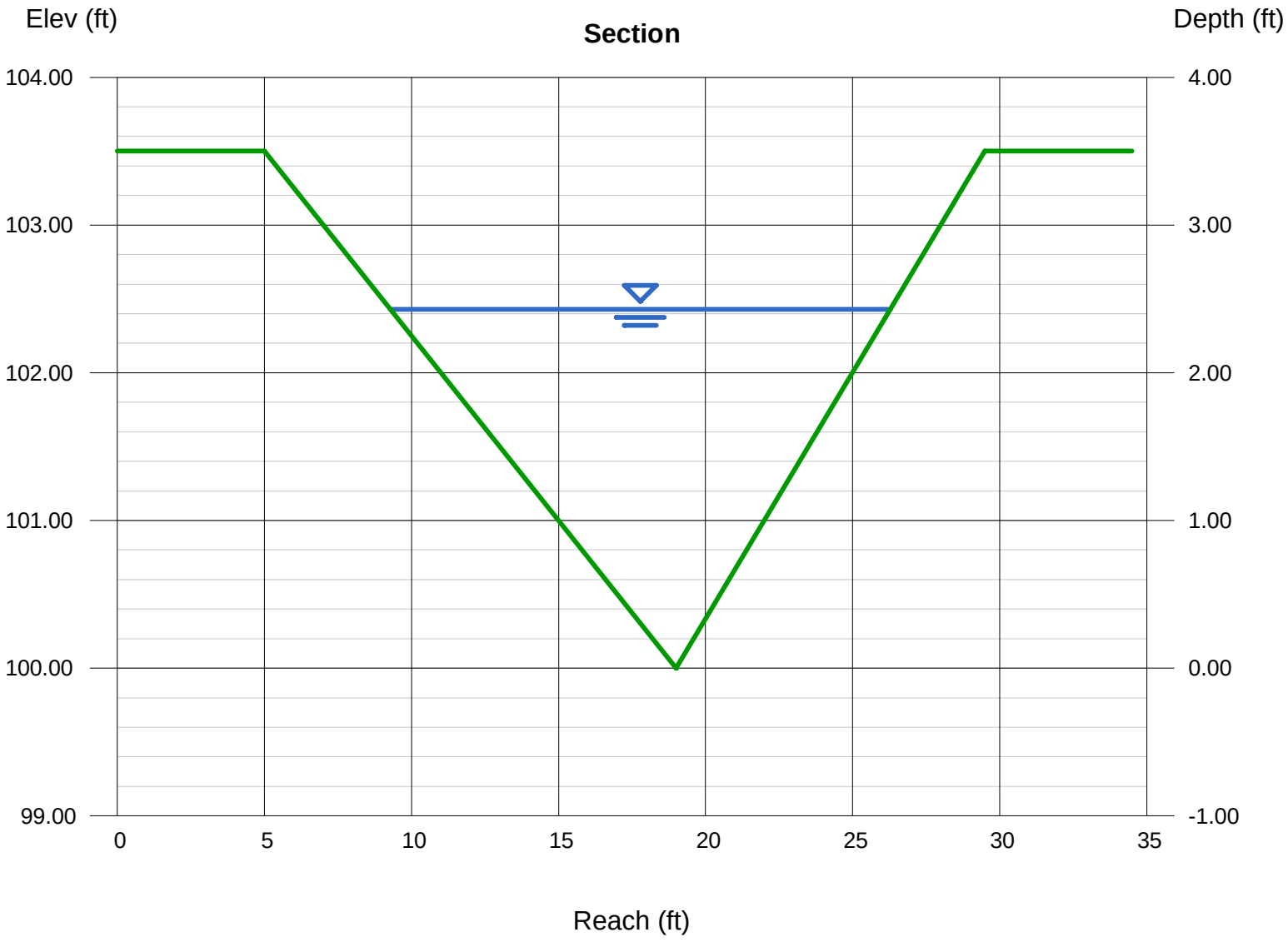
Calculations

Compute by:	Known Q
Known Q (cfs)	= 139.00

Highlighted

Depth (ft)	= 2.43
Q (cfs)	= 139.00
Area (sqft)	= 20.67
Velocity (ft/s)	= 6.73
Wetted Perim (ft)	= 17.70
Crit Depth, Yc (ft)	= 2.51
Top Width (ft)	= 17.01
EGL (ft)	= 3.13

Swale to be protected w/ soil riprap where above 5 ft/s



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 13 2024

DP24.1-Roadside Swale

Triangular

Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.50
Invert Elev (ft)	= 100.00
Slope (%)	= 2.00
N-Value	= 0.030

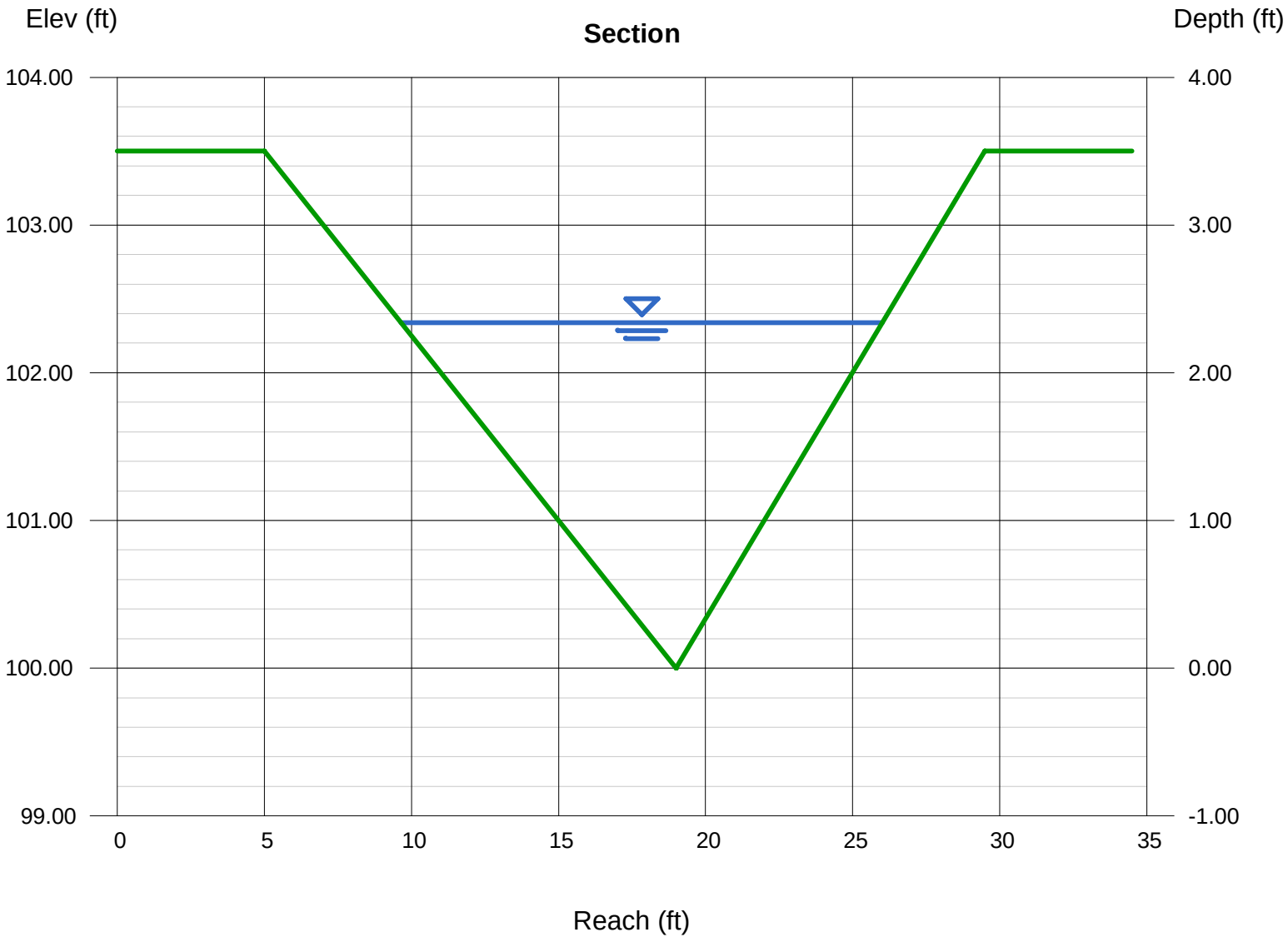
Calculations

Compute by:	Known Q
Known Q (cfs)	= 144.00

Highlighted

Depth (ft)	= 2.34
Q (cfs)	= 144.00
Area (sqft)	= 19.16
Velocity (ft/s)	= 7.51
Wetted Perim (ft)	= 17.05
Crit Depth, Yc (ft)	= 2.54
Top Width (ft)	= 16.38
EGL (ft)	= 3.22

Swale to be protected w/ soil riprap where above 5 ft/s



Channel Report

DP25.1-Swale

Triangular

Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 3.50
Invert Elev (ft)	= 100.00
Slope (%)	= 2.00
N-Value	= 0.030

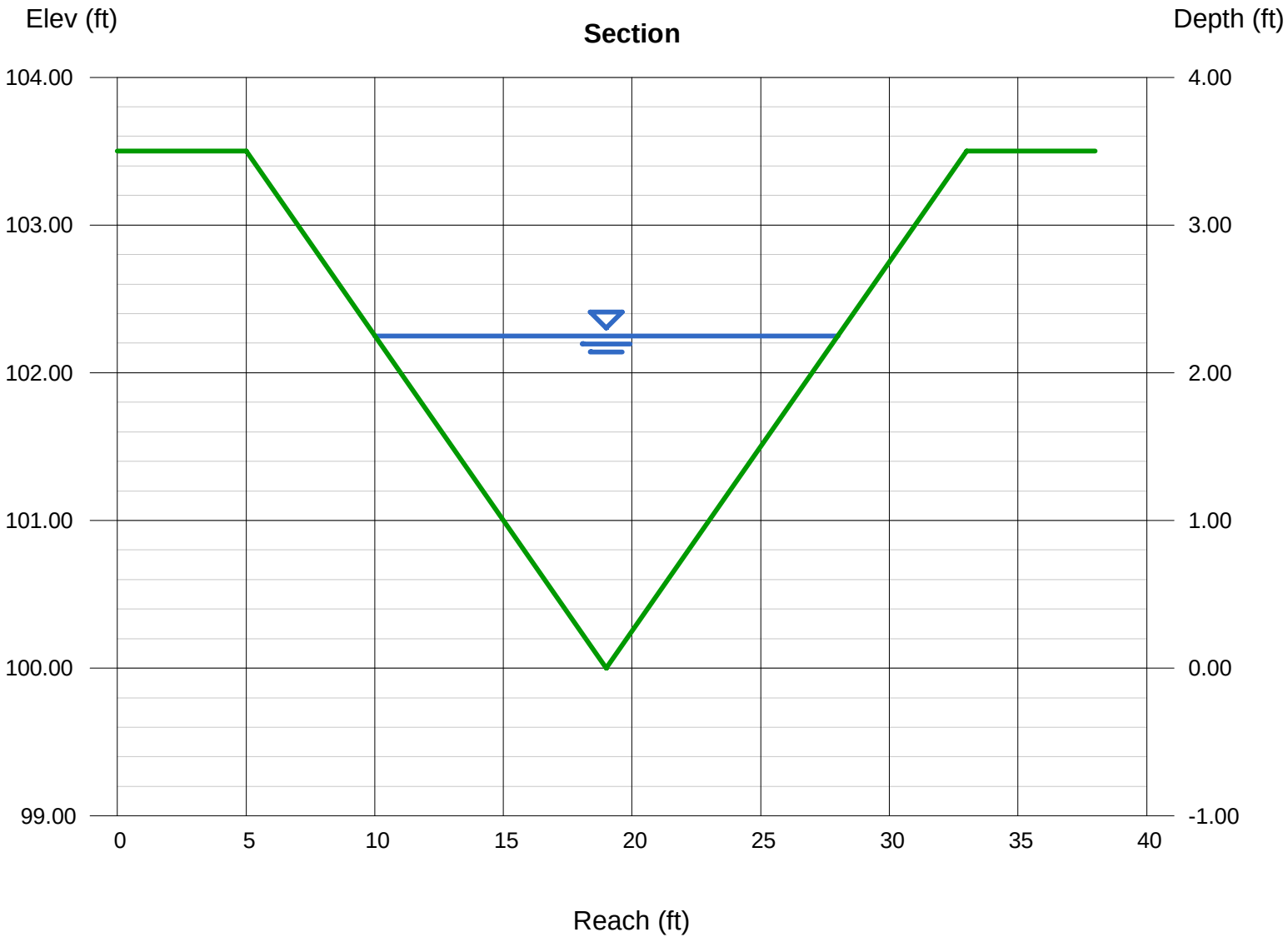
Calculations

Compute by:	Known Q
Known Q (cfs)	= 150.00

Highlighted

Depth (ft)	= 2.25
Q (cfs)	= 150.00
Area (sqft)	= 20.25
Velocity (ft/s)	= 7.41
Wetted Perim (ft)	= 18.55
Crit Depth, Yc (ft)	= 2.45
Top Width (ft)	= 18.00
EGL (ft)	= 3.10

Swale to be protected w/ soil riprap where above 5 ft/s



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Oct 21 2024

DP26.1-Pond 4 Inflow

Invert Elev Dn (ft)	=	100.00
Pipe Length (ft)	=	60.00
Slope (%)	=	0.50
Invert Elev Up (ft)	=	100.30
Rise (in)	=	35.0
Shape	=	Elliptical
Span (in)	=	53.0
No. Barrels	=	3
n-Value	=	0.013
Culvert Type	=	Horizontal Ellipse Concrete
Culvert Entrance	=	Square edge w/headwall (H)
Coeff. K,M,c,Y,k	=	0.01, 2, 0.0398, 0.67, 0.5

Embankment

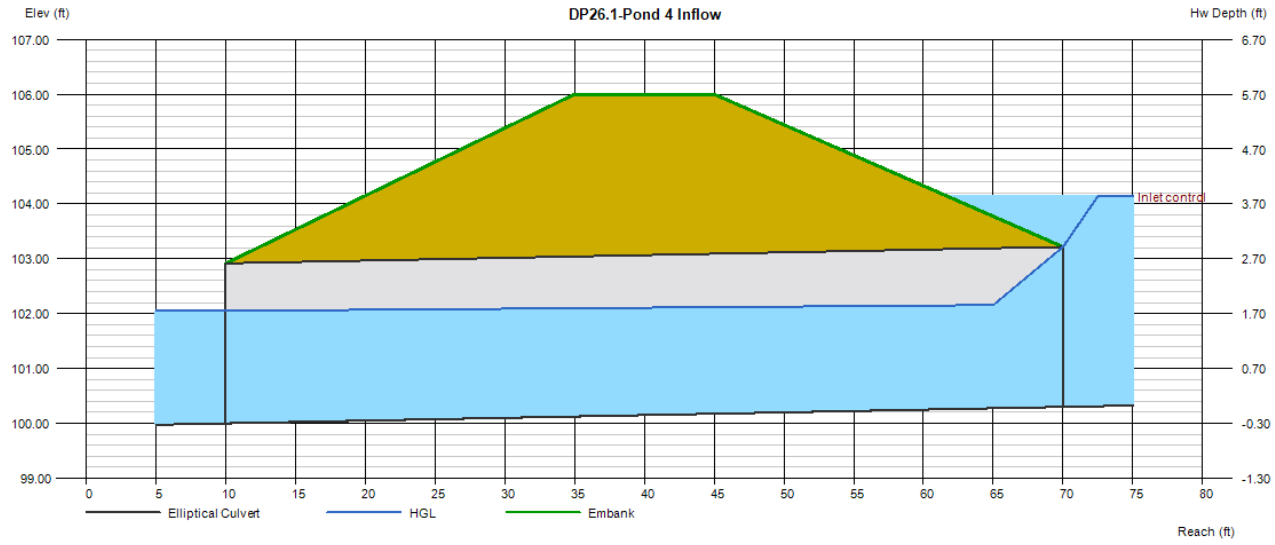
Top Elevation (ft)	=	106.00
Top Width (ft)	=	10.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	202.00
Qmax (cfs)	=	202.00
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	202.00
Qpipe (cfs)	=	202.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.37
Veloc Up (ft/s)	=	9.51
HGL Dn (ft)	=	102.05
HGL Up (ft)	=	102.17
Hw Elev (ft)	=	104.14
Hw/D (ft)	=	1.32
Flow Regime	=	Inlet Control

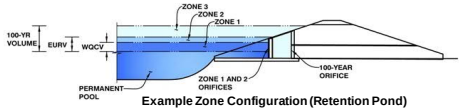


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Esteban Rodriguez Subdivision-PDR

Basin ID: Pond 1



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	78.00	acres
Watershed Length =	4,400	ft
Watershed Length to Centroid =	2,200	ft
Watershed Slope =	0.035	ft/ft
Watershed Imperviousness =	34.50%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	1.071	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	2.797	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	2.042	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.779	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	3.377	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	4.712	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	5.971	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	7.646	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	11.235	acre-feet	inches
Approximate 2-yr Detention Volume =	1.769	acre-feet	
Approximate 5-yr Detention Volume =	2.352	acre-feet	
Approximate 10-yr Detention Volume =	2.920	acre-feet	
Approximate 25-yr Detention Volume =	3.657	acre-feet	
Approximate 50-yr Detention Volume =	4.180	acre-feet	
Approximate 100-yr Detention Volume =	4.968	acre-feet	

Define Zones and Basin Geometry

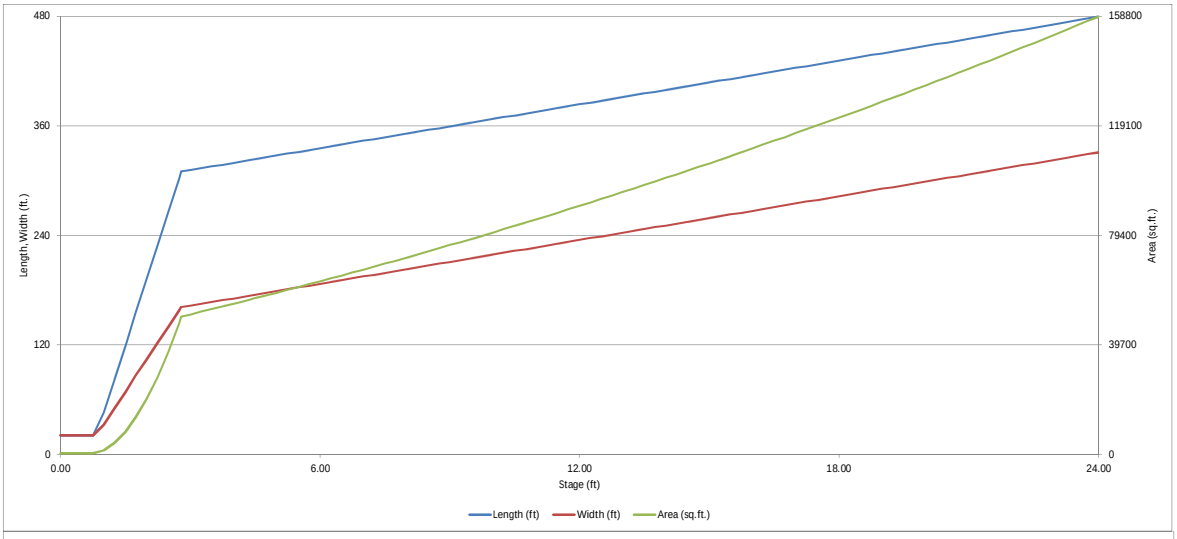
Zone 1 Volume (WQCV) =	1.071	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.725	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	2.172	acre-feet
Total Detention Basin Volume =	4.968	acre-feet
Initial Surcharge Volume (ISV) =	140	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	6.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.007	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio (R_{LW}) =	2	
Initial Surcharge Area (A_{ISV}) =	424	ft^2
Surcharge Volume Length (L_{ISV}) =	20.6	ft
Surcharge Volume Width (W_{ISV}) =	20.6	ft
Depth of Basin Floor (H_{FLOOR}) =	1.97	ft
Length of Basin Floor (L_{FLOOR}) =	309.9	ft
Width of Basin Floor (W_{FLOOR}) =	161.3	ft
Area of Basin Floor (A_{FLOOR}) =	49,992	ft^2
Volume of Basin Floor (V_{FLOOR}) =	36,131	ft^3
Depth of Main Basin (H_{MAIN}) =	3.20	ft
Length of Main Basin (L_{MAIN}) =	335.5	ft
Width of Main Basin (W_{MAIN}) =	186.9	ft
Area of Main Basin (A_{MAIN}) =	62,710	ft^2
Volume of Main Basin (V_{MAIN}) =	179,939	ft^3
Calculated Total Basin Volume (V_{total}) =	4.968	acre-feet

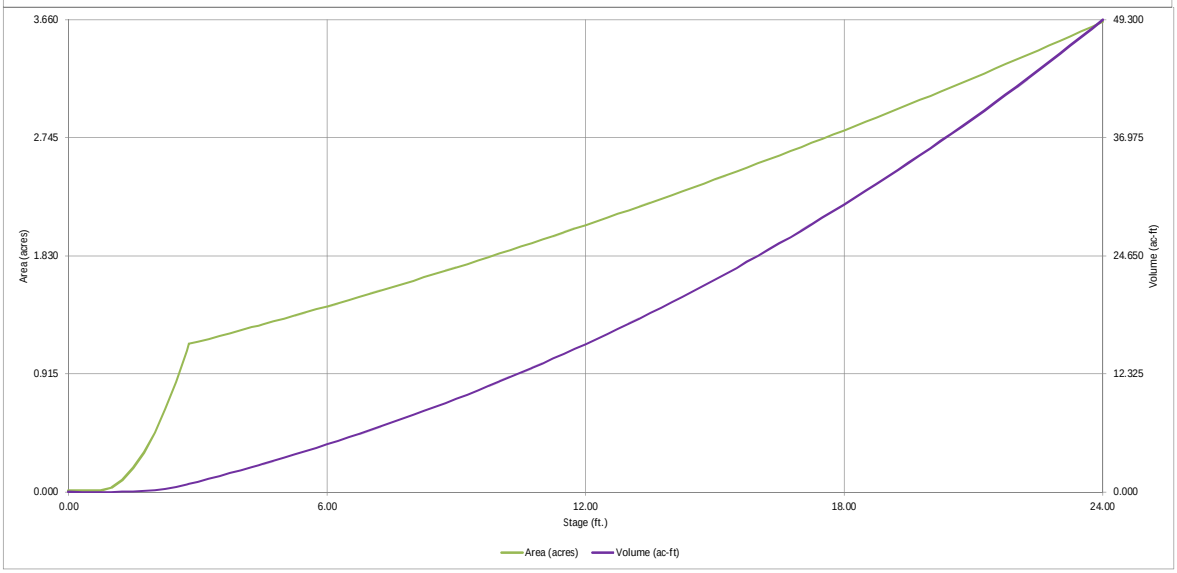
Depth Increment = 0.25 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		20.6	20.6	424		0.010		
ISV	0.33		20.6	20.6	424		0.010	140	0.003
	0.50		20.6	20.6	424		0.010	212	0.005
	0.75		20.6	20.6	424		0.010	318	0.007
	1.00		45.6	32.7	1,492		0.034	506	0.012
	1.25		82.3	50.6	4,163		0.096	1,186	0.027
	1.50		119.0	68.5	8,146		0.187	2,697	0.062
	1.75		155.7	86.3	13,439		0.309	5,368	0.123
	2.00		192.4	104.2	20,044		0.460	9,526	0.219
	2.25		229.1	122.0	27,960		0.642	15,499	0.356
	2.50		265.8	139.9	37,188		0.854	23,616	0.542
	2.75		302.6	157.7	47,727		1.096	34,203	0.785
Floor	2.80		309.9	161.3	49,992		1.148	36,645	0.841
Zone 1 (WQCV)	3.00		311.5	162.9	50,748		1.165	46,719	1.073
	3.25		313.5	164.9	51,701		1.187	59,525	1.367
	3.50		315.5	166.9	52,662		1.209	72,570	1.666
	3.75		317.5	168.9	53,631		1.231	85,857	1.971
	4.00		319.5	170.9	54,607		1.254	99,386	2.282
	4.25		321.5	172.9	55,592		1.276	113,161	2.598
Zone 2 (EURV)	4.41		322.8	174.2	56,227		1.291	122,107	2.803
	4.50		323.5	174.9	56,585		1.299	127,183	2.920
	4.75		325.5	176.9	57,586		1.322	141,454	3.247
	5.00		327.5	178.9	58,595		1.345	155,977	3.581
	5.25		329.5	180.9	59,612		1.368	170,753	3.920
	5.50		331.5	182.9	60,637		1.392	185,783	4.265
	5.75		333.5	184.9	61,669		1.416	201,071	4.616
Zone 3 (100-year)	6.00		335.5	186.9	62,710		1.440	216,619	4.973
	6.25		337.5	188.9	63,759		1.464	232,427	5.336
	6.50		339.5	190.9	64,816		1.488	248,499	5.705
	6.75		341.5	192.9	65,881		1.512	264,836	6.080
	7.00		343.5	194.9	66,954		1.537	281,440	6.461
	7.25		345.5	196.9	68,034		1.562	298,313	6.848
	7.50		347.5	198.9	69,123		1.587	315,458	7.242
	7.75		349.5	200.9	70,220		1.612	332,876	7.642
	8.00		351.5	202.9	71,325		1.637	350,568	8.048

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



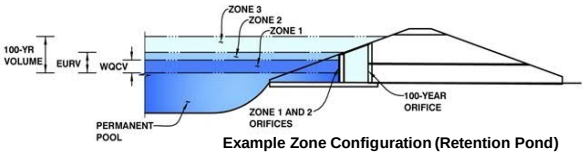


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Esteban Rodriguez Subdivision-PDR

Basin ID: Pond 1



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.00	1.071	Orifice Plate
Zone 2 (EURV)	4.41	1.725	Orifice Plate
Zone 3 (100-year)	6.00	2.172	Weir&Pipe (Restrict)
Total (all zones)		4.968	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	2.840E-02	ft^2
Depth at top of Zone using Orifice Plate =	4.41	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 =	4.09	sq. inches (use rectangular openings)	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 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.47	2.94	3.40				
Orifice Area (sq. inches)	4.09	4.09	4.09	4.09				

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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 =	5.00	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.00	N/A	feet
Overflow Weir Front Edge Length =	5.00	N/A	feet	Overflow Weir Slope Length =	5.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	6.43	N/A	
Horiz. Length of Weir Sides =	5.00	N/A	feet	Overflow Grate Open Area w/o Debris =	19.78	N/A	ft^2
Overflow Grate Type =	Close Mesh Grate	N/A		Overflow Grate Open Area w/ Debris =	9.89	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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 =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	3.08	N/A	ft^2
Outlet Pipe Diameter =	30.00	N/A	inches	Outlet Orifice Centroid =	0.85	N/A	feet
Restrictor Plate Height Above Pipe Invert =	18.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.77	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.44	feet
Spillway Crest Length =	90.00	feet	Stage at Top of Freeboard =	7.94	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.63	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	7.95	acre-ft

Calculated Parameters for Spillway

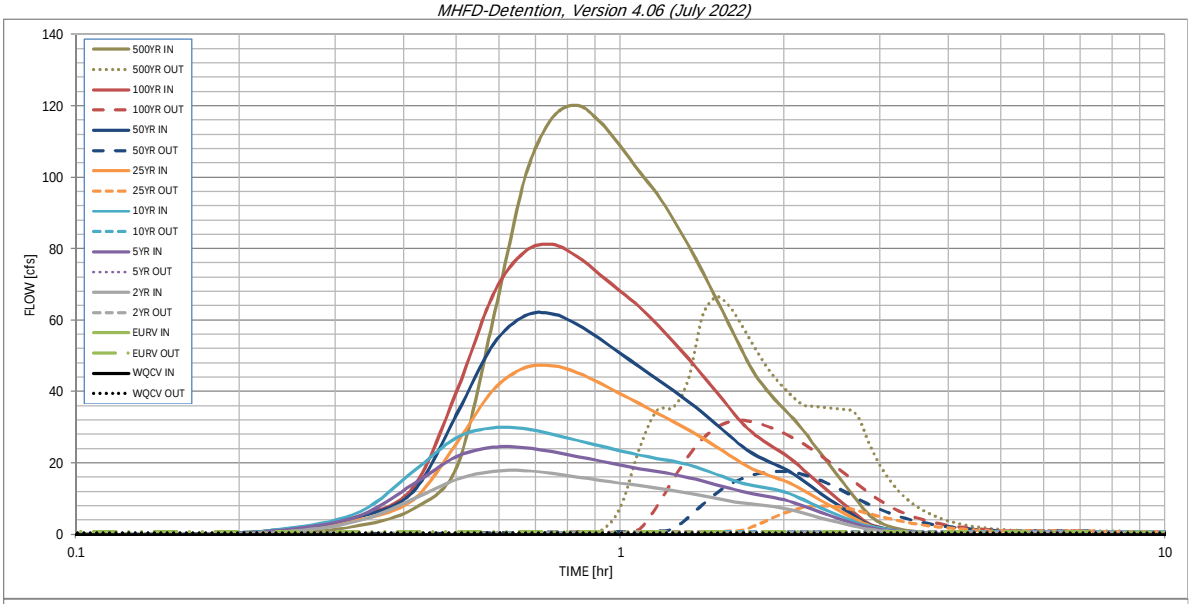
Routed Hydrograph Results

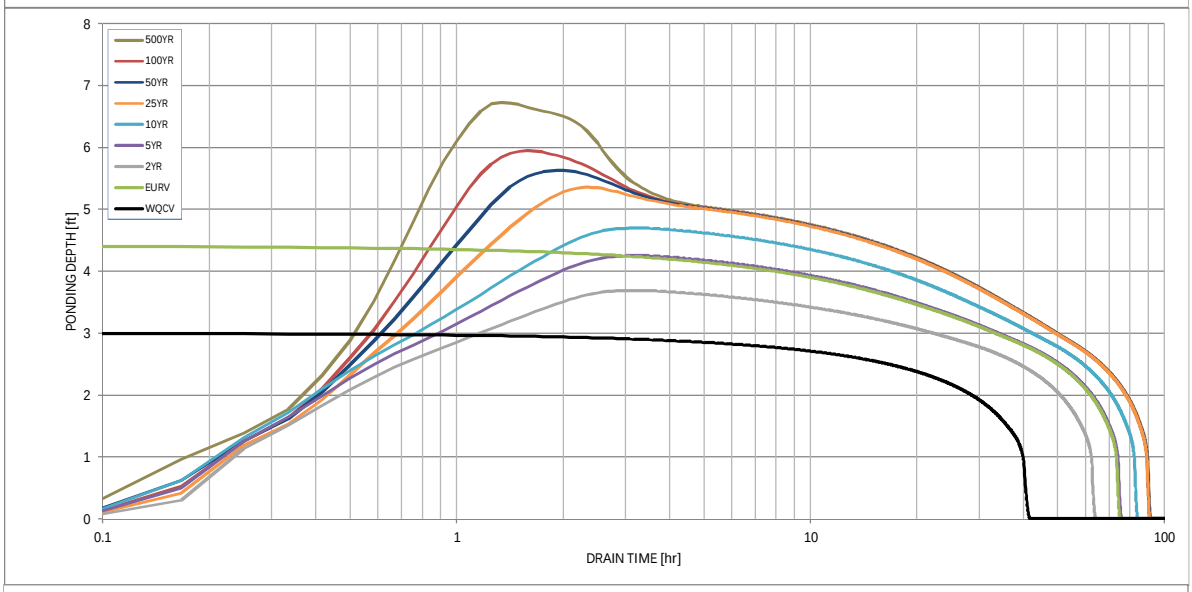
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

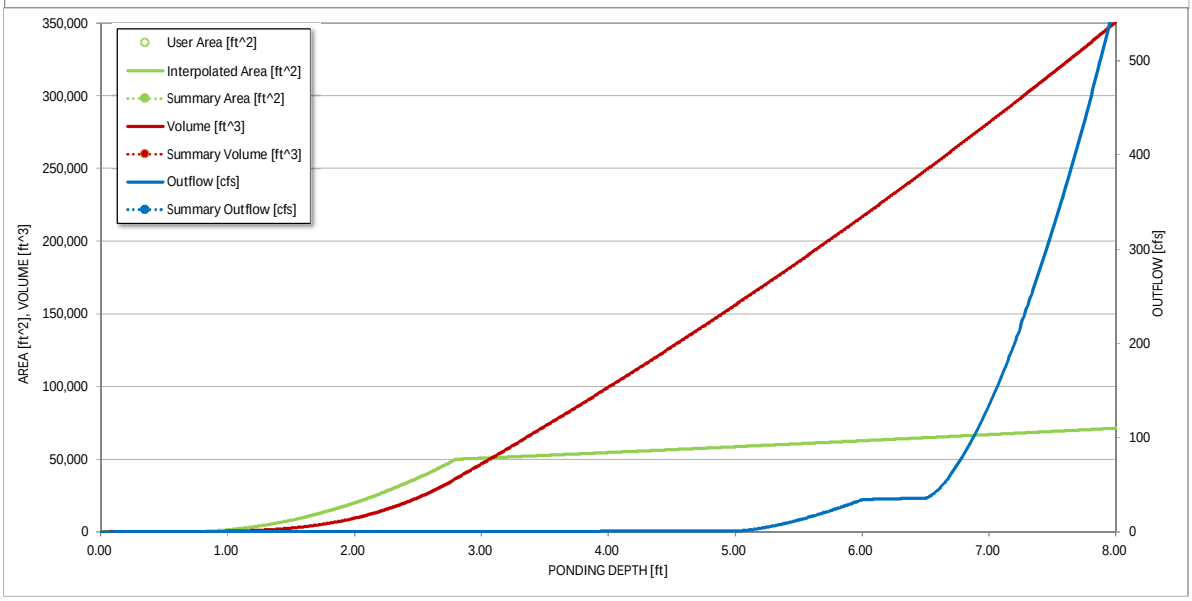
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	1.071	2.797	2.042	2.779	3.377	4.712	5.971	7.646	11.235
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.042	2.779	3.377	4.712	5.971	7.646	11.235
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.4	0.8	1.1	9.8	19.6	32.8	60.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.01	0.13	0.25	0.42	0.78
Peak Inflow Q (cfs) =	N/A	N/A	17.9	24.4	29.9	47.3	61.8	81.2	120.1
Peak Outflow Q (cfs) =	0.4	0.8	0.7	0.8	0.9	8.1	17.6	32.0	66.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.0	0.8	0.8	0.9	1.0	1.1
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.4	0.8	1.6	1.8
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	68	58	69	76	81	80	78	74
Time to Drain 99% of Inflow Volume (hours) =	40	72	62	73	81	87	86	85	83
Maximum Ponding Depth (ft) =	3.00	4.41	3.69	4.25	4.70	5.36	5.63	5.95	6.73
Area at Maximum Ponding Depth (acres) =	1.17	1.29	1.23	1.28	1.32	1.38	1.40	1.43	1.51
Maximum Volume Stored (acre-ft) =	1.073	2.803	1.897	2.598	3.168	4.057	4.433	4.901	6.034

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.

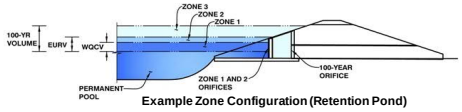
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.01	0.36
	0:15:00	0.00	0.00	0.92	1.50	1.89	1.29	1.70	1.60	2.57
	0:20:00	0.00	0.00	3.95	5.38	6.49	4.20	5.04	5.30	7.23
	0:25:00	0.00	0.00	9.91	14.12	17.69	9.76	12.07	13.28	18.74
	0:30:00	0.00	0.00	15.45	21.82	27.06	25.55	33.61	39.94	59.89
	0:35:00	0.00	0.00	17.67	24.42	29.93	40.37	53.07	67.05	99.52
	0:40:00	0.00	0.00	17.87	24.32	29.66	46.68	61.22	79.13	116.66
	0:45:00	0.00	0.00	17.12	23.17	28.11	47.26	61.80	81.23	120.14
	0:50:00	0.00	0.00	16.09	21.85	26.37	45.32	58.80	77.80	115.60
	0:55:00	0.00	0.00	15.17	20.62	24.82	42.42	54.84	72.82	108.65
	1:00:00	0.00	0.00	14.36	19.46	23.42	39.38	50.75	68.09	101.70
	1:05:00	0.00	0.00	13.66	18.43	22.23	36.63	47.05	63.74	95.44
	1:10:00	0.00	0.00	12.97	17.65	21.33	33.97	43.49	58.90	88.33
	1:15:00	0.00	0.00	12.26	16.85	20.53	31.64	40.32	54.09	80.98
	1:20:00	0.00	0.00	11.54	15.93	19.54	29.34	37.20	49.28	73.47
	1:25:00	0.00	0.00	10.82	14.95	18.25	27.00	34.05	44.47	65.94
	1:30:00	0.00	0.00	10.10	13.96	16.86	24.62	30.88	39.90	58.84
	1:35:00	0.00	0.00	9.43	13.03	15.56	22.27	27.76	35.53	52.05
	1:40:00	0.00	0.00	8.87	12.12	14.51	20.08	24.87	31.50	45.84
	1:45:00	0.00	0.00	8.49	11.40	13.80	18.34	22.68	28.47	41.45
	1:50:00	0.00	0.00	8.22	10.81	13.22	17.07	21.06	26.21	38.02
	1:55:00	0.00	0.00	7.81	10.26	12.64	16.03	19.70	24.27	35.01
	2:00:00	0.00	0.00	7.32	9.71	11.96	15.08	18.46	22.51	32.25
	2:05:00	0.00	0.00	6.69	8.91	10.94	13.81	16.86	20.44	29.14
	2:10:00	0.00	0.00	5.97	7.98	9.75	12.36	15.04	18.18	25.82
	2:15:00	0.00	0.00	5.29	7.07	8.60	10.93	13.26	16.00	22.62
	2:20:00	0.00	0.00	4.65	6.20	7.50	9.56	11.55	13.93	19.60
	2:25:00	0.00	0.00	4.05	5.39	6.49	8.27	9.94	11.96	16.70
	2:30:00	0.00	0.00	3.49	4.64	5.54	7.05	8.40	10.05	13.89
	2:35:00	0.00	0.00	2.96	3.92	4.65	5.87	6.91	8.19	11.17
	2:40:00	0.00	0.00	2.45	3.23	3.81	4.75	5.50	6.42	8.56
	2:45:00	0.00	0.00	1.98	2.61	3.07	3.71	4.19	4.77	6.17
	2:50:00	0.00	0.00	1.58	2.07	2.48	2.77	3.05	3.40	4.43
	2:55:00	0.00	0.00	1.29	1.71	2.07	2.12	2.34	2.53	3.32
	3:00:00	0.00	0.00	1.09	1.44	1.75	1.69	1.87	1.97	2.55
	3:05:00	0.00	0.00	0.92	1.22	1.48	1.38	1.52	1.55	1.97
	3:10:00	0.00	0.00	0.78	1.03	1.25	1.13	1.24	1.23	1.54
	3:15:00	0.00	0.00	0.67	0.87	1.05	0.94	1.03	0.98	1.20
	3:20:00	0.00	0.00	0.56	0.73	0.89	0.78	0.85	0.78	0.94
	3:25:00	0.00	0.00	0.47	0.61	0.73	0.64	0.69	0.63	0.75
	3:30:00	0.00	0.00	0.39	0.50	0.60	0.52	0.57	0.51	0.61
	3:35:00	0.00	0.00	0.32	0.41	0.48	0.42	0.45	0.41	0.49
	3:40:00	0.00	0.00	0.26	0.32	0.38	0.33	0.36	0.33	0.38
	3:45:00	0.00	0.00	0.20	0.25	0.30	0.26	0.28	0.25	0.29
	3:50:00	0.00	0.00	0.15	0.19	0.23	0.20	0.21	0.19	0.21
	3:55:00	0.00	0.00	0.11	0.14	0.16	0.14	0.15	0.13	0.15
	4:00:00	0.00	0.00	0.07	0.10	0.11	0.10	0.10	0.09	0.09
	4:05:00	0.00	0.00	0.05	0.06	0.07	0.06	0.06	0.05	0.05
	4:10:00	0.00	0.00	0.03	0.04	0.04	0.03	0.03	0.02	0.02
	4:15:00	0.00	0.00	0.01	0.02	0.02	0.01	0.01	0.01	0.00
	4:20:00	0.00	0.00	0.00	0.01	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: Esteban Rodriguez Subdivision-PDR

Basin ID: Pond 2



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	77.00	acres
Watershed Length =	2,900	ft
Watershed Length to Centroid =	1,300	ft
Watershed Slope =	0.040	ft/ft
Watershed Imperviousness =	16.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.629	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	1.033	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.614	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.919	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.196	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	2.333	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	3.430	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	4.942	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	8.258	acre-feet	inches
Approximate 2-yr Detention Volume =	0.632	acre-feet	
Approximate 5-yr Detention Volume =	0.856	acre-feet	
Approximate 10-yr Detention Volume =	1.102	acre-feet	
Approximate 25-yr Detention Volume =	1.449	acre-feet	
Approximate 50-yr Detention Volume =	1.797	acre-feet	
Approximate 100-yr Detention Volume =	2.534	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.629	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.403	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.501	acre-feet
Total Detention Basin Volume =	2.534	acre-feet
Initial Surcharge Volume (ISV) =	82	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	6.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.010	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio (R_{LW}) =	2	

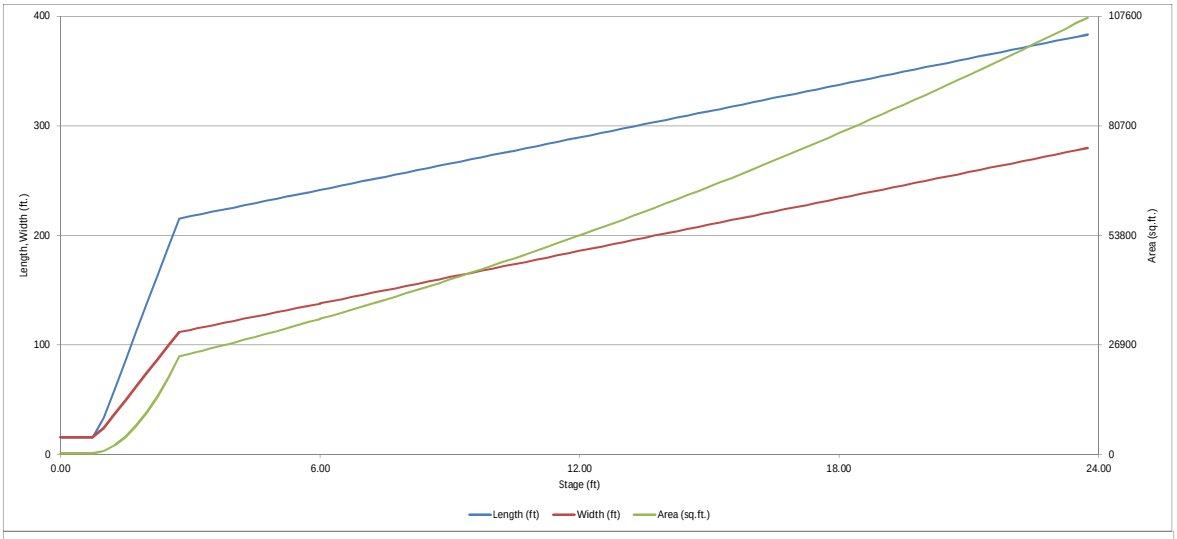
Initial Surcharge Area (A_{ISV}) =	249	ft^2
Surcharge Volume Length (L_{ISV}) =	15.8	ft
Surcharge Volume Width (W_{ISV}) =	15.8	ft
Depth of Basin Floor (H_{FLOOR}) =	1.92	ft
Length of Basin Floor (L_{FLOOR}) =	215.5	ft
Width of Basin Floor (W_{FLOOR}) =	111.8	ft
Area of Basin Floor (A_{FLOOR}) =	24,086	ft^2
Volume of Basin Floor (V_{FLOOR}) =	17,142	ft^3
Depth of Main Basin (H_{MAIN}) =	3.25	ft
Length of Main Basin (L_{MAIN}) =	241.5	ft
Width of Main Basin (W_{MAIN}) =	137.8	ft
Area of Main Basin (A_{MAIN}) =	33,270	ft^2
Volume of Main Basin (V_{MAIN}) =	92,803	ft^3
Calculated Total Basin Volume (V_{total}) =	2.529	acre-feet

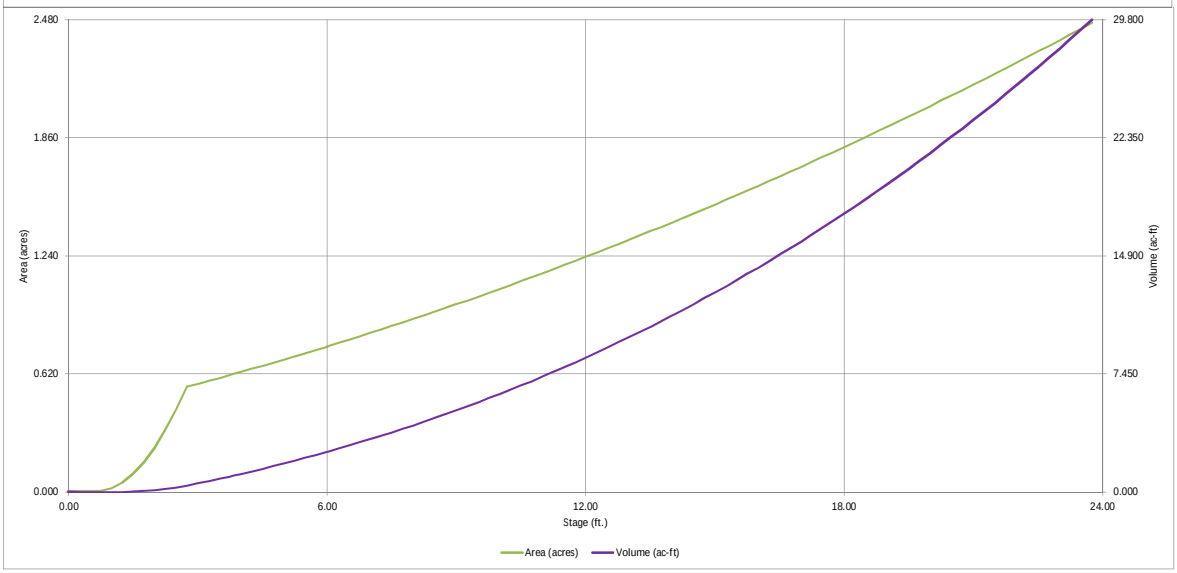
Depth Increment = 0.25 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		15.8	15.8	249		0.006		
ISV	0.33		15.8	15.8	249		0.006	82	0.002
	0.50		15.8	15.8	249		0.006	125	0.003
	0.75		15.8	15.8	249		0.006	187	0.004
	1.00		33.5	24.3	813		0.019	293	0.007
	1.25		59.5	36.8	2,187		0.050	654	0.015
	1.50		85.5	49.3	4,212		0.097	1,441	0.033
	1.75		111.5	61.8	6,887		0.158	2,815	0.065
	2.00		137.5	74.3	10,212		0.234	4,938	0.113
	2.25		163.5	86.8	14,186		0.326	7,975	0.183
	2.50		189.5	99.3	18,811		0.432	12,086	0.277
Floor	2.75		215.5	111.8	24,086		0.553	17,434	0.400
	3.00		217.5	113.8	24,744		0.568	23,538	0.540
Zone 1 (WQCV)	3.16		218.7	115.1	25,170		0.578	27,531	0.632
	3.25		219.5	115.8	25,411		0.583	29,807	0.684
	3.50		221.5	117.8	26,085		0.599	36,244	0.832
	3.75		223.5	119.8	26,768		0.615	42,851	0.984
Zone 2 (EURV)	3.83		224.1	120.4	26,988		0.620	45,001	1.033
	4.00		225.5	121.8	27,458		0.630	49,629	1.139
	4.25		227.5	123.8	28,157		0.646	56,580	1.299
	4.50		229.5	125.8	28,863		0.663	63,708	1.463
	4.75		231.5	127.8	29,578		0.679	71,013	1.630
	5.00		233.5	129.8	30,300		0.696	78,497	1.802
	5.25		235.5	131.8	31,031		0.712	86,164	1.978
	5.50		237.5	133.8	31,769		0.729	94,014	2.158
	5.75		239.5	135.8	32,516		0.746	102,049	2.343
	6.00		241.5	137.8	33,270		0.764	110,272	2.531
Zone 3 (100-year)	6.01		241.5	137.9	33,301		0.764	110,605	2.539
	6.25		243.5	139.8	34,033		0.781	118,685	2.725
	6.50		245.5	141.8	34,803		0.799	127,289	2.922
	6.75		247.5	143.8	35,582		0.817	136,087	3.124
	7.00		249.5	145.8	36,368		0.835	145,081	3.331
	7.25		251.5	147.8	37,163		0.853	154,272	3.542
	7.50		253.5	149.8	37,965		0.872	163,663	3.757
	7.75		255.5	151.8	38,776		0.890	173,255	3.977
	8.00		257.5	153.8	39,594		0.909	183,052	4.202

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



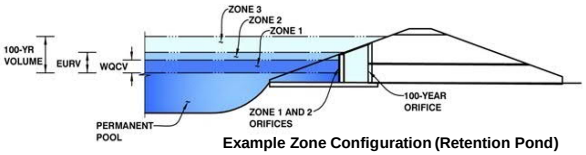


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Esteban Rodriguez Subdivision-PDR

Basin ID: Pond 2



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.16	0.629	Orifice Plate
Zone 2 (EURV)	3.83	0.403	Orifice Plate
Zone 3 (100-year)	6.01	1.501	Weir&Pipe (Restrict)
Total (all zones)		2.534	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	3.83	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 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.20	2.40	3.00				
Orifice Area (sq. inches)	2.70	0.90	0.70	0.50				

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

User Input: Vertical Orifice (Circular or Rectangular)

	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	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

Calculated Parameters for Vertical Orifice

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 =	4.50	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.50	N/A	feet
Overflow Weir Front Edge Length =	8.00	N/A	feet	Overflow Weir Slope Length =	8.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	11.43	N/A	
Horiz. Length of Weir Sides =	8.00	N/A	feet	Overflow Grate Open Area w/o Debris =	50.62	N/A	ft^2
Overflow Grate Type =	Close Mesh Grate	N/A		Overflow Grate Open Area w/ Debris =	25.31	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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 =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	4.43	N/A	ft^2
Outlet Pipe Diameter =	36.00	N/A	inches	Outlet Orifice Centroid =	1.02	N/A	feet
Restrictor Plate Height Above Pipe Invert =	21.60		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.77	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.46	feet
Spillway Crest Length =	70.00	feet	Stage at Top of Freeboard =	7.96	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.91	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	4.17	acre-ft

Calculated Parameters for Spillway

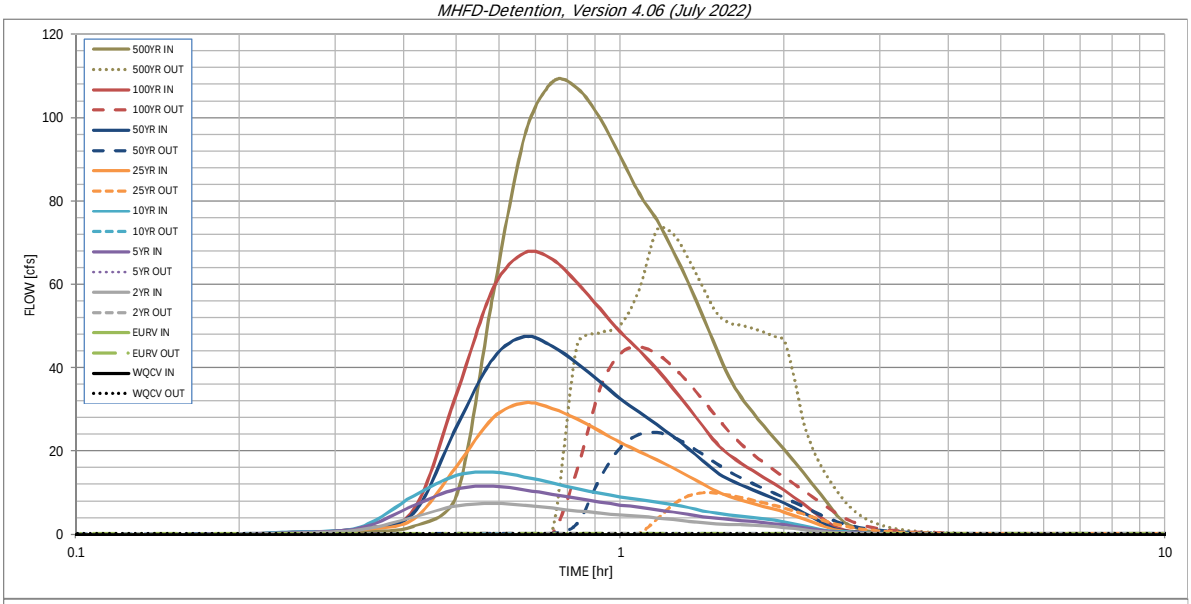
Routed Hydrograph Results

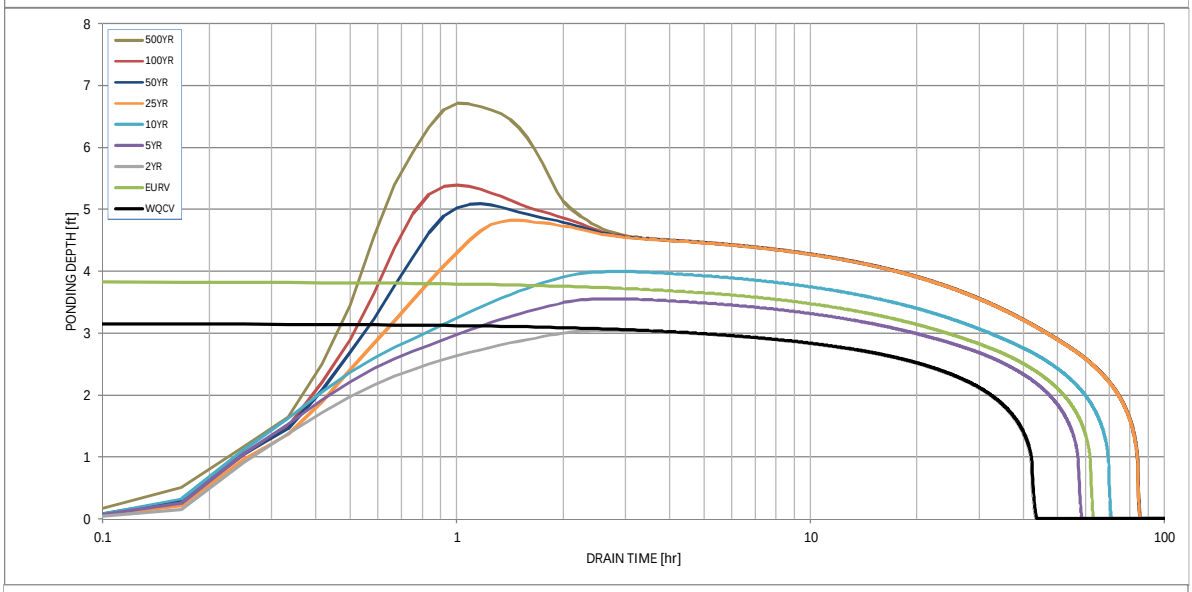
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

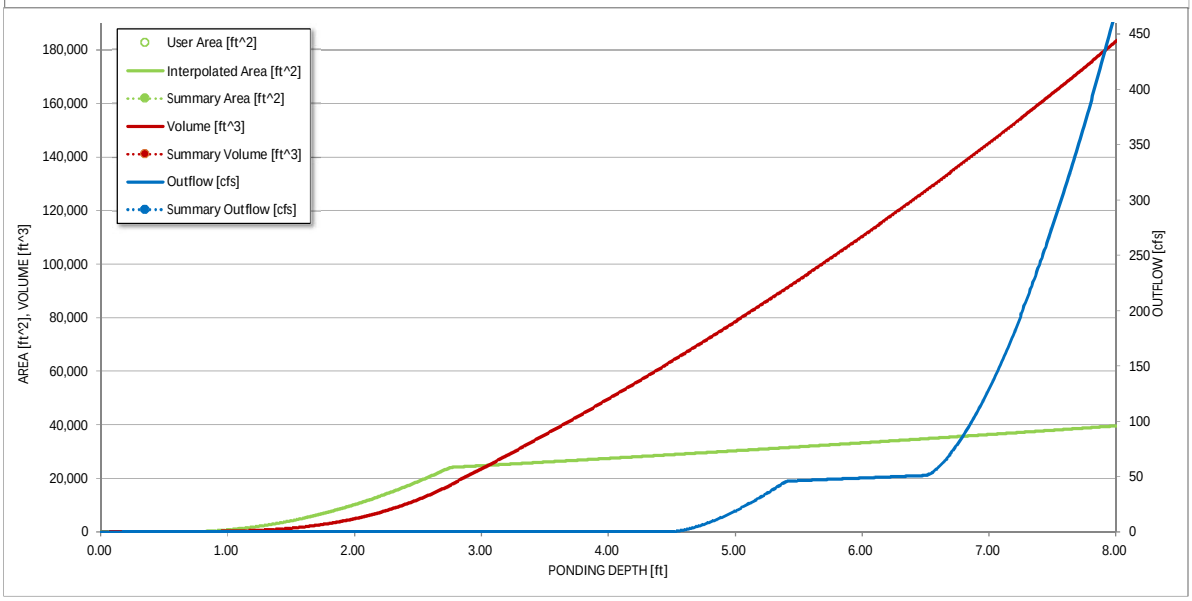
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.629	1.033	0.614	0.919	1.196	2.333	3.430	4.942	8.258
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.614	0.919	1.196	2.333	3.430	4.942	8.258
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.6	1.2	1.7	15.2	30.2	49.1	89.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.02	0.20	0.39	0.64	1.16
Peak Inflow Q (cfs) =	N/A	N/A	7.4	11.6	14.9	31.6	47.5	67.6	108.6
Peak Outflow Q (cfs) =	0.2	0.3	0.2	0.3	0.3	10.0	24.5	45.0	73.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.2	0.7	0.8	0.9	0.8
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.2	0.5	0.9	1.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	41	59	41	55	66	78	75	72	65
Time to Drain 99% of Inflow Volume (hours) =	42	61	42	57	69	82	81	80	77
Maximum Ponding Depth (ft) =	3.16	3.83	3.05	3.55	3.99	4.82	5.09	5.39	6.71
Area at Maximum Ponding Depth (acres) =	0.58	0.62	0.57	0.60	0.63	0.68	0.70	0.72	0.81
Maximum Volume Stored (acre-ft) =	0.632	1.033	0.563	0.862	1.133	1.678	1.865	2.071	3.092

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.

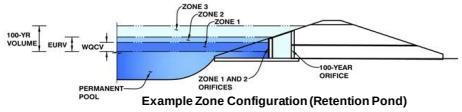
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.11
	0:15:00	0.00	0.00	0.29	0.47	0.59	0.40	0.51	0.49	0.75
	0:20:00	0.00	0.00	1.16	1.56	1.85	1.18	1.40	1.48	1.97
	0:25:00	0.00	0.00	4.18	6.91	9.26	3.71	5.11	5.93	9.36
	0:30:00	0.00	0.00	6.90	10.93	14.18	16.41	25.86	33.69	57.39
	0:35:00	0.00	0.00	7.44	11.56	14.94	27.96	42.19	59.03	95.64
	0:40:00	0.00	0.00	7.02	10.72	13.82	31.62	47.50	67.64	108.61
	0:45:00	0.00	0.00	6.32	9.59	12.34	30.23	45.17	66.03	107.12
	0:50:00	0.00	0.00	5.69	8.64	11.06	27.72	41.09	60.37	99.94
	0:55:00	0.00	0.00	5.15	7.77	9.89	24.83	36.70	54.25	90.66
	1:00:00	0.00	0.00	4.72	7.07	9.02	22.09	32.55	48.57	81.78
	1:05:00	0.00	0.00	4.37	6.51	8.35	19.92	29.34	44.18	75.49
	1:10:00	0.00	0.00	3.99	5.97	7.76	17.92	26.37	39.63	68.11
	1:15:00	0.00	0.00	3.59	5.39	7.20	15.98	23.52	35.04	60.34
	1:20:00	0.00	0.00	3.20	4.79	6.47	14.03	20.59	30.47	52.39
	1:25:00	0.00	0.00	2.84	4.22	5.67	12.14	17.71	26.03	44.71
	1:30:00	0.00	0.00	2.61	3.87	5.16	10.36	15.02	21.98	37.78
	1:35:00	0.00	0.00	2.46	3.64	4.77	9.12	13.21	19.14	32.92
	1:40:00	0.00	0.00	2.32	3.38	4.42	8.24	11.87	17.10	29.24
	1:45:00	0.00	0.00	2.18	3.11	4.08	7.47	10.72	15.33	26.02
	1:50:00	0.00	0.00	2.05	2.85	3.76	6.74	9.63	13.69	23.09
	1:55:00	0.00	0.00	1.86	2.59	3.43	6.05	8.58	12.11	20.33
	2:00:00	0.00	0.00	1.67	2.33	3.07	5.38	7.56	10.57	17.64
	2:05:00	0.00	0.00	1.42	1.98	2.60	4.59	6.42	8.96	14.91
	2:10:00	0.00	0.00	1.17	1.62	2.12	3.79	5.26	7.35	12.23
	2:15:00	0.00	0.00	0.93	1.27	1.66	3.00	4.12	5.76	9.59
	2:20:00	0.00	0.00	0.71	0.96	1.25	2.24	3.02	4.21	7.01
	2:25:00	0.00	0.00	0.54	0.71	0.94	1.53	1.99	2.73	4.56
	2:30:00	0.00	0.00	0.43	0.56	0.76	0.99	1.26	1.66	2.86
	2:35:00	0.00	0.00	0.36	0.47	0.64	0.70	0.87	1.09	1.92
	2:40:00	0.00	0.00	0.30	0.39	0.53	0.54	0.66	0.77	1.33
	2:45:00	0.00	0.00	0.25	0.33	0.44	0.42	0.51	0.57	0.94
	2:50:00	0.00	0.00	0.20	0.27	0.36	0.33	0.39	0.42	0.66
	2:55:00	0.00	0.00	0.17	0.22	0.29	0.26	0.31	0.30	0.45
	3:00:00	0.00	0.00	0.14	0.18	0.24	0.21	0.24	0.22	0.30
	3:05:00	0.00	0.00	0.11	0.15	0.19	0.17	0.19	0.17	0.22
	3:10:00	0.00	0.00	0.09	0.12	0.15	0.14	0.15	0.14	0.18
	3:15:00	0.00	0.00	0.07	0.09	0.12	0.11	0.12	0.11	0.14
	3:20:00	0.00	0.00	0.06	0.07	0.09	0.08	0.09	0.09	0.11
	3:25:00	0.00	0.00	0.04	0.05	0.07	0.06	0.07	0.07	0.08
	3:30:00	0.00	0.00	0.03	0.04	0.05	0.05	0.05	0.05	0.06
	3:35:00	0.00	0.00	0.02	0.03	0.03	0.03	0.04	0.03	0.04
	3:40:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	3:45:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
	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: Esteban Rodriguez Subdivision-PDR

Basin ID: Pond 3



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	72.00	acres
Watershed Length =	3,160	ft
Watershed Length to Centroid =	1,500	ft
Watershed Slope =	0.040	ft/ft
Watershed Imperviousness =	14.50%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.545	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.851	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.490	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.748	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.979	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	2.024	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	3.038	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	4.442	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	7.526	acre-feet		inches
Approximate 2-yr Detention Volume =	0.518	acre-feet		
Approximate 5-yr Detention Volume =	0.705	acre-feet		
Approximate 10-yr Detention Volume =	0.911	acre-feet		
Approximate 25-yr Detention Volume =	1.205	acre-feet		
Approximate 50-yr Detention Volume =	1.517	acre-feet		
Approximate 100-yr Detention Volume =	2.199	acre-feet		

Define Zones and Basin Geometry

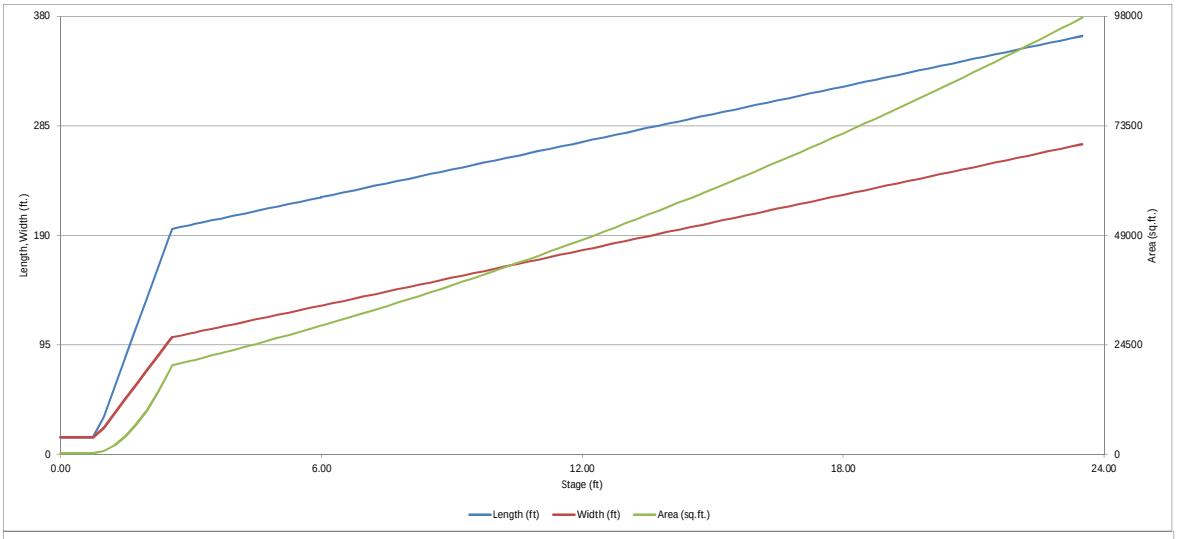
Zone 1 Volume (WQCV) =	0.545	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.306	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.348	acre-feet
Total Detention Basin Volume =	2.199	acre-feet
Initial Surcharge Volume (ISV) =	71	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	6.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.010	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio (R_{LW}) =	2	
Initial Surcharge Area (A_{ISV}) =	216	ft^2
Surcharge Volume Length (L_{ISV}) =	14.7	ft
Surcharge Volume Width (W_{ISV}) =	14.7	ft
Depth of Basin Floor (H_{FLOOR}) =	1.74	ft
Length of Basin Floor (L_{FLOOR}) =	195.7	ft
Width of Basin Floor (W_{FLOOR}) =	101.7	ft
Area of Basin Floor (A_{FLOOR}) =	19,896	ft^2
Volume of Basin Floor (V_{FLOOR}) =	12,867	ft^3
Depth of Main Basin (H_{MAIN}) =	3.43	ft
Length of Main Basin (L_{MAIN}) =	223.1	ft
Width of Main Basin (W_{MAIN}) =	129.1	ft
Area of Main Basin (A_{MAIN}) =	28,809	ft^2
Volume of Main Basin (V_{MAIN}) =	83,059	ft^3
Calculated Total Basin Volume (V_{total}) =	2.206	acre-feet

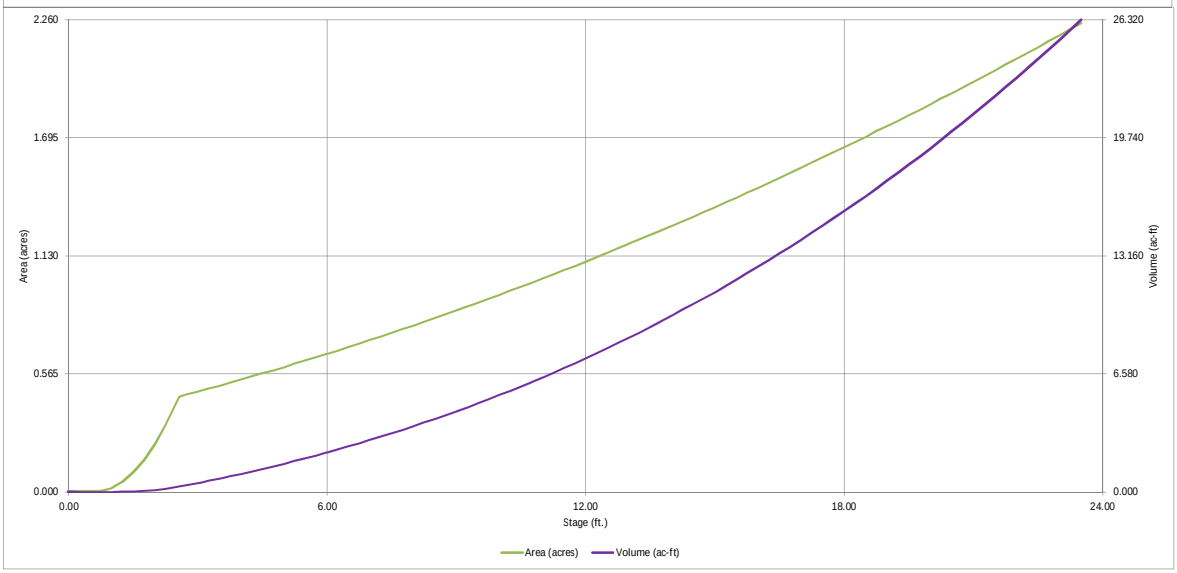
Depth Increment = 0.25 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		14.7	14.7	216		0.005		
ISV	0.33		14.7	14.7	216		0.005	71	0.002
	0.50		14.7	14.7	216		0.005	108	0.002
	0.75		14.7	14.7	216		0.005	162	0.004
	1.00		32.4	23.2	751		0.017	257	0.006
	1.25		58.4	35.7	2,083		0.048	598	0.014
	1.50		84.4	48.2	4,066		0.093	1,353	0.031
	1.75		110.4	60.7	6,699		0.154	2,685	0.062
	2.00		136.4	73.2	9,981		0.229	4,757	0.109
	2.25		162.4	85.7	13,914		0.319	7,730	0.177
	2.50		188.4	98.2	18,497		0.425	11,768	0.270
Floor	2.57		195.7	101.7	19,896		0.457	13,111	0.301
	2.75		197.1	103.1	20,327		0.467	16,731	0.384
	3.00		199.1	105.1	20,931		0.481	21,888	0.502
Zone 1 (WQCV)	3.09		199.8	105.9	21,151		0.486	23,782	0.546
	3.25		201.1	107.1	21,544		0.495	27,197	0.624
	3.50		203.1	109.1	22,164		0.509	32,661	0.750
Zone 2 (EURV)	3.70		204.7	110.7	22,666		0.520	37,144	0.853
	3.75		205.1	111.1	22,792		0.523	38,280	0.879
	4.00		207.1	113.1	23,429		0.538	44,058	1.011
	4.25		209.1	115.1	24,073		0.553	49,995	1.148
	4.50		211.1	117.1	24,726		0.568	56,095	1.288
	4.75		213.1	119.1	25,386		0.583	62,359	1.432
	5.00		215.1	121.1	26,055		0.598	68,789	1.579
	5.25		217.1	123.1	26,731		0.614	75,387	1.731
	5.50		219.1	125.1	27,416		0.629	82,155	1.886
	5.75		221.1	127.1	28,108		0.645	89,095	2.045
Zone 3 (100-year)	5.99		223.0	129.1	28,780		0.661	95,922	2.202
	6.00		223.1	129.1	28,809		0.661	96,210	2.209
	6.25		225.1	131.1	29,517		0.678	103,500	2.376
	6.50		227.1	133.1	30,233		0.694	110,969	2.547
	6.75		229.1	135.1	30,958		0.711	118,618	2.723
	7.00		231.1	137.1	31,690		0.728	126,448	2.903
	7.25		233.1	139.1	32,431		0.745	134,463	3.087
	7.50		235.1	141.1	33,179		0.762	142,664	3.275
	7.75		237.1	143.1	33,936		0.779	151,054	3.468
	8.00		239.1	145.1	34,700		0.797	159,633	3.665

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



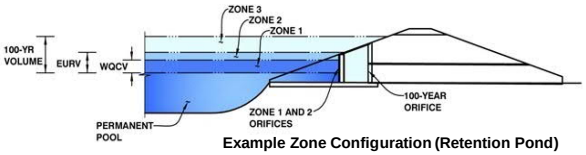


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Esteban Rodriguez Subdivision-PDR

Basin ID: Pond 3



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.09	0.545	Orifice Plate
Zone 2 (EURV)	3.70	0.306	Orifice Plate
Zone 3 (100-year)	5.99	1.348	Weir&Pipe (Restrict)
Total (all zones)		2.199	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	4.39	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 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	2.00	3.25	3.75				
Orifice Area (sq. inches)	2.65	1.10	0.30	0.30				

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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 =	4.50	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.50	N/A	feet
Overflow Weir Front Edge Length =	5.00	N/A	feet	Overflow Weir Slope Length =	5.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	6.56	N/A	
Horiz. Length of Weir Sides =	5.00	N/A	feet	Overflow Grate Open Area w/o Debris =	19.78	N/A	ft^2
Overflow Grate Type =	Close Mesh Grate	N/A		Overflow Grate Open Area w/ Debris =	9.89	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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 =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	3.02	N/A	ft^2
Outlet Pipe Diameter =	24.00	N/A	inches	Outlet Orifice Centroid =	0.96	N/A	feet
Restrictor Plate Height Above Pipe Invert =	22.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.56	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.49	feet
Spillway Crest Length =	50.00	feet	Stage at Top of Freeboard =	7.99	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.80	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	3.66	acre-ft

Calculated Parameters for Spillway

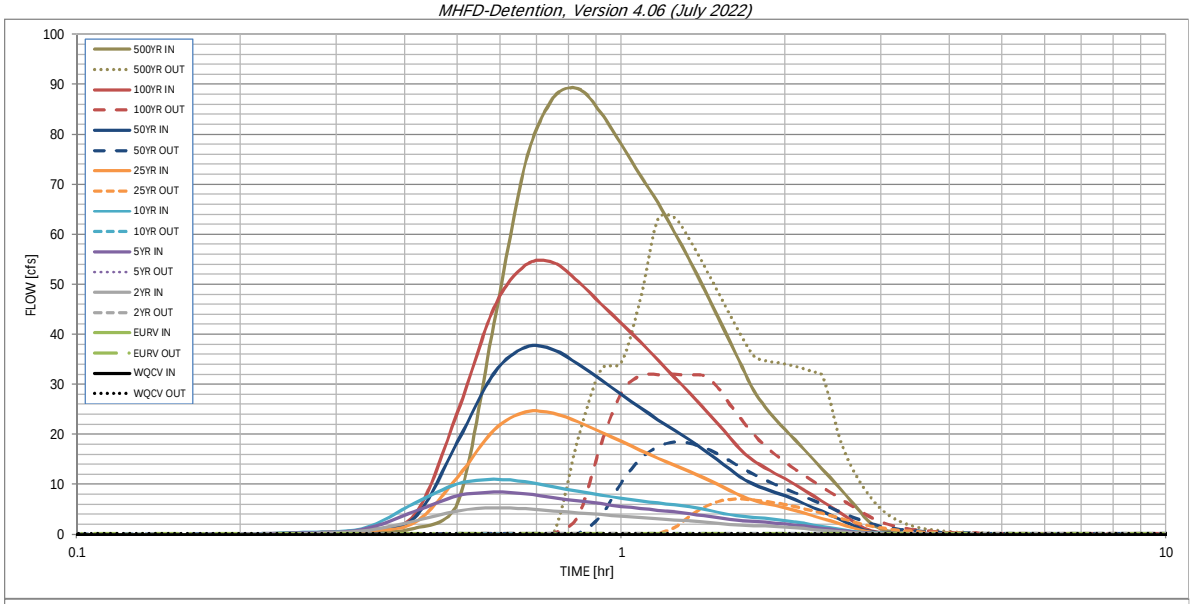
Routed Hydrograph Results

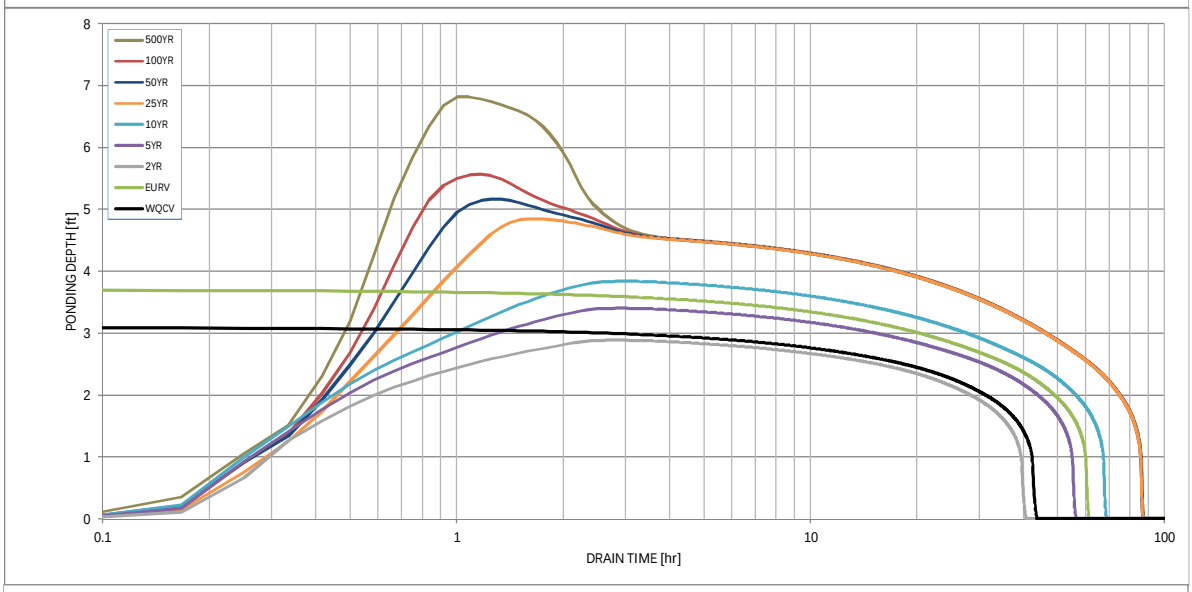
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

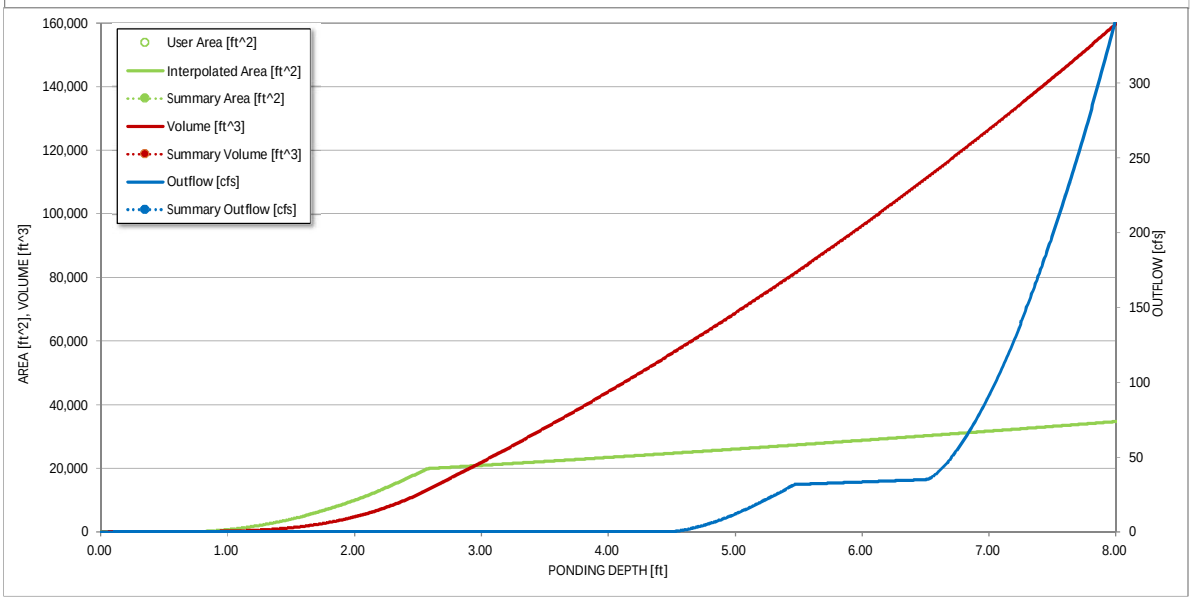
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.545	0.851	0.490	0.748	0.979	2.024	3.038	4.442	7.526
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.490	0.748	0.979	2.024	3.038	4.442	7.526
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.5	1.0	1.4	12.3	24.7	41.2	74.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.02	0.17	0.34	0.57	1.04
Peak Inflow Q (cfs) =	N/A	N/A	5.3	8.5	11.0	24.5	37.5	54.4	89.2
Peak Outflow Q (cfs) =	0.2	0.2	0.2	0.2	0.2	7.1	18.5	32.0	63.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.2	0.6	0.7	0.8	0.8
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.3	0.9	1.6	1.8
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	41	58	38	53	65	80	77	73	66
Time to Drain 99% of Inflow Volume (hours) =	42	60	40	55	67	84	83	82	78
Maximum Ponding Depth (ft) =	3.09	3.70	2.89	3.40	3.84	4.85	5.17	5.57	6.82
Area at Maximum Ponding Depth (acres) =	0.49	0.52	0.47	0.50	0.53	0.59	0.61	0.63	0.71
Maximum Volume Stored (acre-ft) =	0.546	0.853	0.445	0.699	0.921	1.484	1.676	1.930	2.766

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.

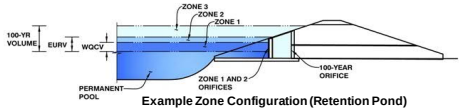
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	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	0.18	0.29	0.36	0.24	0.31	0.30	0.46
	0:20:00	0.00	0.00	0.73	0.99	1.17	0.75	0.89	0.93	1.26
	0:25:00	0.00	0.00	2.71	4.62	6.22	2.38	3.35	3.92	6.29
	0:30:00	0.00	0.00	4.74	7.75	10.14	11.49	18.57	24.42	42.15
	0:35:00	0.00	0.00	5.32	8.47	11.03	20.87	32.21	45.35	74.42
	0:40:00	0.00	0.00	5.17	8.12	10.57	24.49	37.48	53.86	87.35
	0:45:00	0.00	0.00	4.74	7.36	9.53	24.22	36.97	54.40	89.17
	0:50:00	0.00	0.00	4.33	6.72	8.68	22.52	34.05	50.57	84.36
	0:55:00	0.00	0.00	3.99	6.17	7.94	20.50	30.97	46.16	77.97
	1:00:00	0.00	0.00	3.67	5.63	7.22	18.61	28.05	42.23	71.86
	1:05:00	0.00	0.00	3.41	5.19	6.69	16.88	25.38	38.54	66.41
	1:10:00	0.00	0.00	3.18	4.85	6.31	15.27	22.97	34.88	60.58
	1:15:00	0.00	0.00	2.94	4.50	5.99	13.90	20.91	31.52	54.92
	1:20:00	0.00	0.00	2.71	4.13	5.56	12.60	18.92	28.34	49.31
	1:25:00	0.00	0.00	2.47	3.76	5.03	11.32	16.93	25.24	43.81
	1:30:00	0.00	0.00	2.24	3.39	4.49	10.06	14.98	22.26	38.59
	1:35:00	0.00	0.00	2.03	3.04	3.98	8.81	13.05	19.34	33.49
	1:40:00	0.00	0.00	1.88	2.80	3.67	7.64	11.25	16.63	28.81
	1:45:00	0.00	0.00	1.80	2.62	3.45	6.83	10.05	14.74	25.58
	1:50:00	0.00	0.00	1.71	2.46	3.25	6.26	9.18	13.38	23.10
	1:55:00	0.00	0.00	1.61	2.30	3.04	5.78	8.44	12.21	20.94
	2:00:00	0.00	0.00	1.48	2.14	2.82	5.31	7.72	11.12	18.96
	2:05:00	0.00	0.00	1.33	1.92	2.54	4.80	6.96	9.99	17.00
	2:10:00	0.00	0.00	1.18	1.70	2.23	4.26	6.18	8.86	15.05
	2:15:00	0.00	0.00	1.02	1.47	1.93	3.74	5.40	7.76	13.17
	2:20:00	0.00	0.00	0.88	1.26	1.64	3.23	4.65	6.70	11.38
	2:25:00	0.00	0.00	0.74	1.05	1.38	2.73	3.92	5.66	9.62
	2:30:00	0.00	0.00	0.61	0.86	1.12	2.24	3.20	4.62	7.87
	2:35:00	0.00	0.00	0.48	0.67	0.88	1.77	2.49	3.60	6.14
	2:40:00	0.00	0.00	0.37	0.50	0.65	1.30	1.80	2.59	4.43
	2:45:00	0.00	0.00	0.28	0.36	0.48	0.86	1.14	1.63	2.81
	2:50:00	0.00	0.00	0.22	0.29	0.39	0.54	0.70	0.96	1.73
	2:55:00	0.00	0.00	0.18	0.25	0.33	0.37	0.47	0.61	1.14
	3:00:00	0.00	0.00	0.16	0.21	0.28	0.28	0.35	0.43	0.78
	3:05:00	0.00	0.00	0.13	0.17	0.23	0.22	0.27	0.31	0.54
	3:10:00	0.00	0.00	0.11	0.15	0.20	0.18	0.21	0.23	0.38
	3:15:00	0.00	0.00	0.09	0.12	0.16	0.14	0.17	0.17	0.26
	3:20:00	0.00	0.00	0.08	0.10	0.13	0.12	0.13	0.12	0.17
	3:25:00	0.00	0.00	0.06	0.08	0.11	0.09	0.11	0.10	0.13
	3:30:00	0.00	0.00	0.05	0.07	0.08	0.08	0.09	0.08	0.10
	3:35:00	0.00	0.00	0.04	0.05	0.07	0.06	0.07	0.06	0.08
	3:40:00	0.00	0.00	0.03	0.04	0.05	0.05	0.05	0.05	0.06
	3:45:00	0.00	0.00	0.02	0.03	0.04	0.04	0.04	0.04	0.05
	3:50:00	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.03	0.03
	3:55:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.02
	4:00:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	4:05:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	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: Esteban Rodriguez Subdivision-PDR

Basin ID: Pond 4



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	129.00	acres
Watershed Length =	6,000	ft
Watershed Length to Centroid =	3,500	ft
Watershed Slope =	0.045	ft/ft
Watershed Imperviousness =	14.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.950	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.458	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.830	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.278	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.674	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	3.538	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	5.349	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	7.862	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	13.384	acre-feet		inches
Approximate 2-yr Detention Volume =	0.887	acre-feet		
Approximate 5-yr Detention Volume =	1.206	acre-feet		
Approximate 10-yr Detention Volume =	1.563	acre-feet		
Approximate 25-yr Detention Volume =	2.072	acre-feet		
Approximate 50-yr Detention Volume =	2.622	acre-feet		
Approximate 100-yr Detention Volume =	3.839	acre-feet		

Define Zones and Basin Geometry

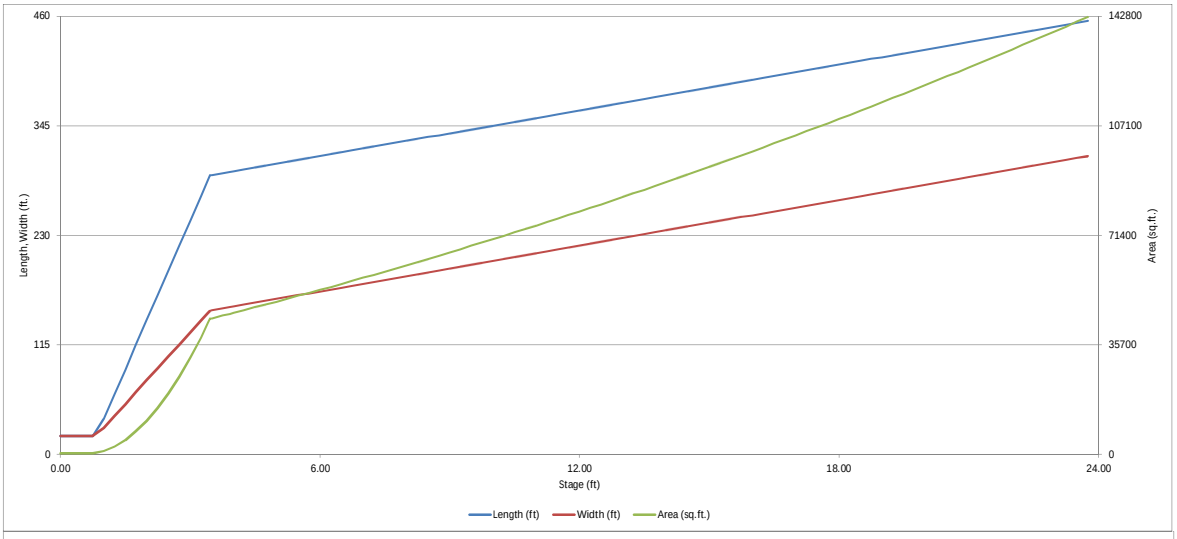
Zone 1 Volume (WQCV) =	0.950	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.508	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	2.381	acre-feet
Total Detention Basin Volume =	3.839	acre-feet
Initial Surcharge Volume (ISV) =	124	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	6.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.010	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio (R_{LW}) =	2	
Initial Surcharge Area (A_{ISV}) =	376	ft^2
Surcharge Volume Length (L_{ISV}) =	19.4	ft
Surcharge Volume Width (W_{ISV}) =	19.4	ft
Depth of Basin Floor (H_{FLOOR}) =	2.63	ft
Length of Basin Floor (L_{FLOOR}) =	292.9	ft
Width of Basin Floor (W_{FLOOR}) =	150.9	ft
Area of Basin Floor (A_{FLOOR}) =	44,200	ft^2
Volume of Basin Floor (V_{FLOOR}) =	42,653	ft^3
Depth of Main Basin (H_{MAIN}) =	2.54	ft
Length of Main Basin (L_{MAIN}) =	313.2	ft
Width of Main Basin (W_{MAIN}) =	171.2	ft
Area of Main Basin (A_{MAIN}) =	53,631	ft^2
Volume of Main Basin (V_{MAIN}) =	124,052	ft^3
Calculated Total Basin Volume (V_{total}) =	3.834	acre-feet

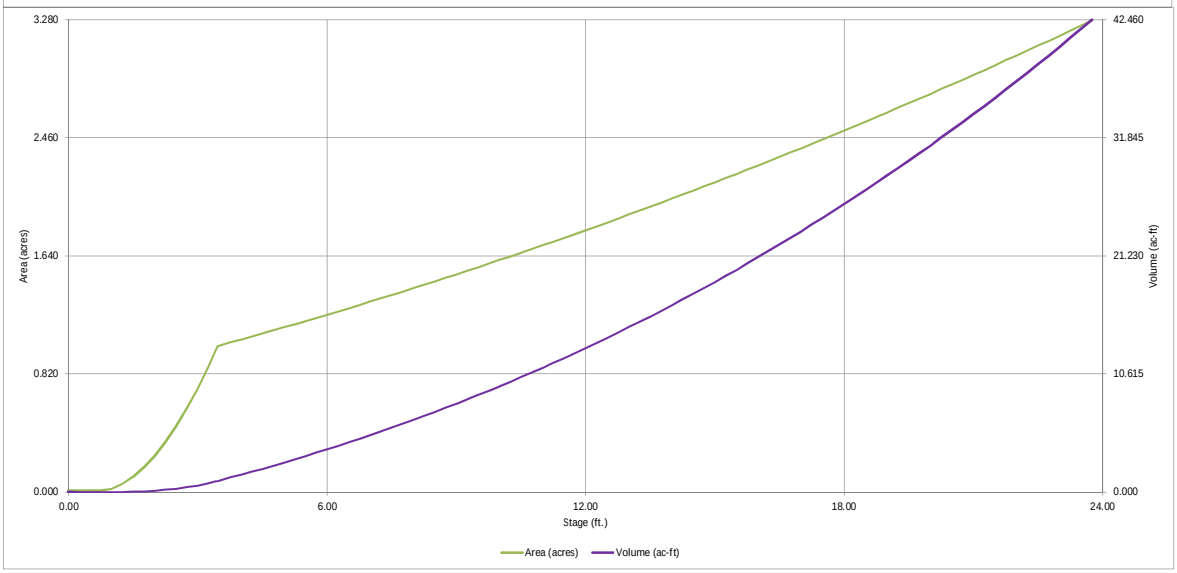
Depth Increment = 0.25 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		19.4	19.4	376		0.009		
ISV	0.33		19.4	19.4	376		0.009	124	0.003
	0.50		19.4	19.4	376		0.009	188	0.004
	0.75		19.4	19.4	376		0.009	282	0.006
	1.00		37.1	27.9	1,034		0.024	428	0.010
	1.25		63.1	40.4	2,548		0.058	862	0.020
	1.50		89.1	52.9	4,712		0.108	1,756	0.040
	1.75		115.1	65.4	7,526		0.173	3,272	0.075
	2.00		141.1	77.9	10,989		0.252	5,573	0.128
	2.25		167.1	90.4	15,103		0.347	8,821	0.203
	2.50		193.1	102.9	19,867		0.456	13,179	0.303
	2.75		219.1	115.4	25,280		0.580	18,809	0.432
	3.00		245.1	127.9	31,344		0.720	25,873	0.594
	3.25		271.1	140.4	38,058		0.874	34,535	0.793
Zone 1 (WQCV)	3.42		288.8	148.9	42,995		0.987	41,420	0.951
Floor	3.46		292.9	150.9	44,200		1.015	43,164	0.991
	3.50		293.2	151.2	44,342		1.018	44,935	1.032
	3.75		295.2	153.2	45,235		1.038	56,132	1.289
Zone 2 (EURV)	3.92		296.6	154.6	45,847		1.052	63,873	1.466
	4.00		297.2	155.2	46,136		1.059	67,553	1.551
	4.25		299.2	157.2	47,045		1.080	79,200	1.818
	4.50		301.2	159.2	47,962		1.101	91,076	2.091
	4.75		303.2	161.2	48,886		1.122	103,182	2.369
	5.00		305.2	163.2	49,819		1.144	115,520	2.652
	5.25		307.2	165.2	50,760		1.165	128,092	2.941
	5.50		309.2	167.2	51,709		1.187	140,900	3.235
	5.75		311.2	169.2	52,666		1.209	153,947	3.534
Zone 3 (100-year)	6.00		313.2	171.2	53,631		1.231	167,234	3.839
	6.25		315.2	173.2	54,604		1.254	180,763	4.150
	6.50		317.2	175.2	55,585		1.276	194,537	4.466
	6.75		319.2	177.2	56,574		1.299	208,556	4.788
	7.00		321.2	179.2	57,571		1.322	222,824	5.115
	7.25		323.2	181.2	58,576		1.345	237,342	5.449
	7.50		325.2	183.2	59,588		1.368	252,113	5.788
	7.75		327.2	185.2	60,609		1.391	267,137	6.133
	8.00		329.2	187.2	61,638		1.415	282,418	6.483

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



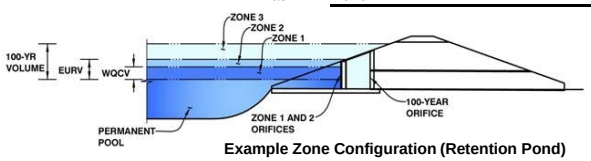


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Esteban Rodriguez Subdivision-PDR

Basin ID: Pond 4



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.42	0.950	Orifice Plate
Zone 2 (EURV)	3.92	0.508	Orifice Plate
Zone 3 (100-year)	6.00	2.381	Weir&Pipe (Restrict)
Total (all zones)		3.839	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	3.90	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 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.40	3.80	3.50				
Orifice Area (sq. inches)	4.10	1.50	1.00	1.00				

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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 =	4.50	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.50	N/A	feet
Overflow Weir Front Edge Length =	6.00	N/A	feet	Overflow Weir Slope Length =	6.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	5.80	N/A	
Horiz. Length of Weir Sides =	6.00	N/A	feet	Overflow Grate Open Area w/o Debris =	28.48	N/A	ft^2
Overflow Grate Type =	Close Mesh Grate	N/A		Overflow Grate Open Area w/ Debris =	14.24	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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 =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	4.91	N/A	ft^2
Outlet Pipe Diameter =	30.00	N/A	inches	Outlet Orifice Centroid =	1.25	N/A	feet
Restrictor Plate Height Above Pipe Invert =	30.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.44	feet
Spillway Crest Length =	75.00	feet	Stage at Top of Freeboard =	7.44	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.36	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	5.71	acre-ft

Calculated Parameters for Spillway

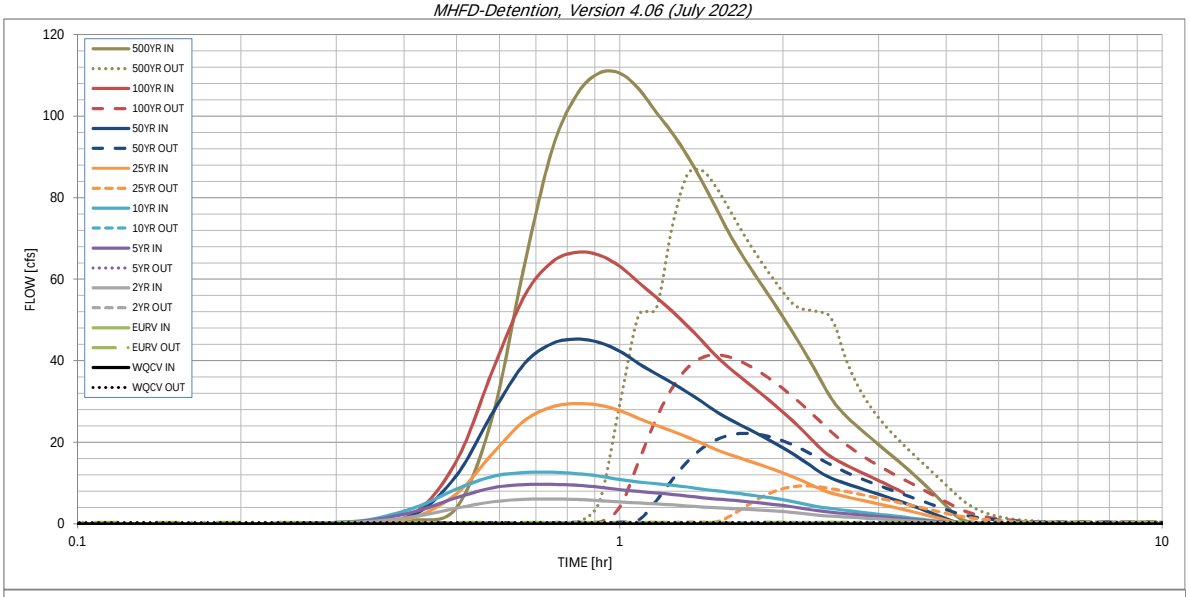
Routed Hydrograph Results

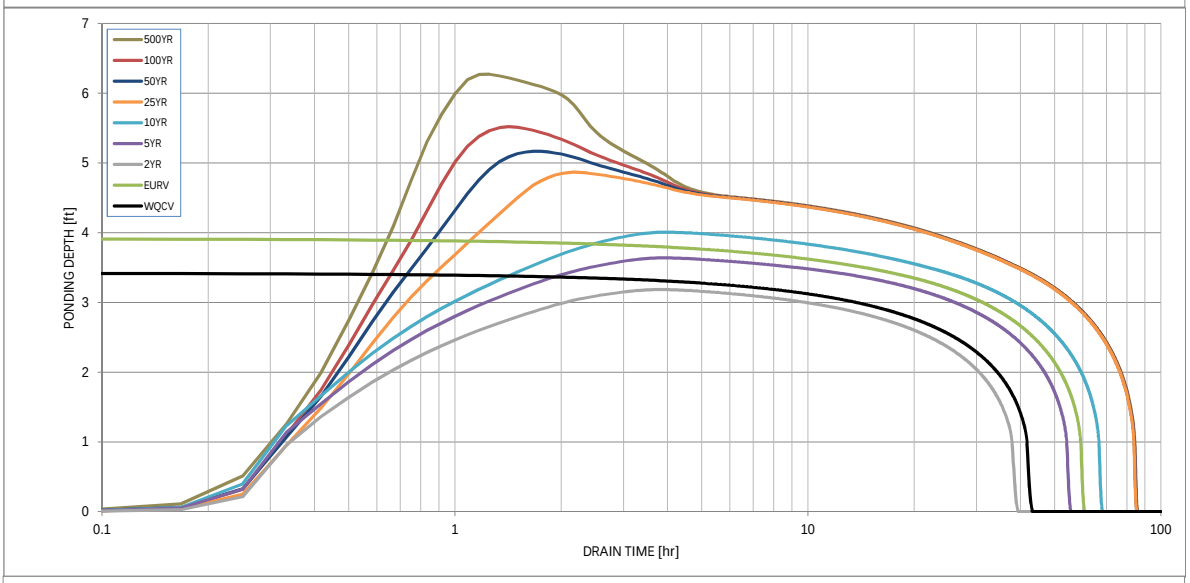
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

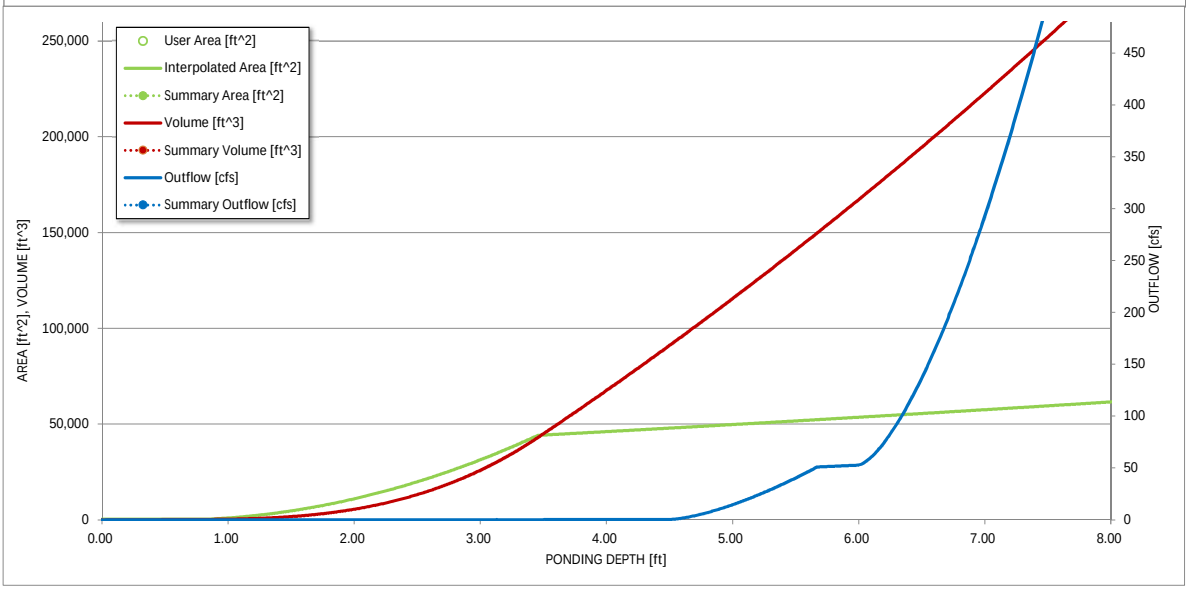
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.950	1.458	0.830	1.278	1.674	3.538	5.349	7.862	13.384
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.830	1.278	1.674	3.538	5.349	7.862	13.384
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.6	1.1	1.6	14.7	29.5	49.1	91.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.01	0.01	0.11	0.23	0.38	0.71
Peak Inflow Q (cfs) =	N/A	N/A	6.1	9.7	12.7	29.5	45.3	66.6	110.6
Peak Outflow Q (cfs) =	0.3	0.4	0.3	0.3	0.4	9.3	22.2	41.5	86.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.2	0.6	0.8	0.8	0.9
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.3	0.8	1.4	1.9
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	40	57	37	52	64	78	75	72	64
Time to Drain 99% of Inflow Volume (hours) =	42	59	38	54	66	82	81	80	77
Maximum Ponding Depth (ft) =	3.42	3.92	3.18	3.64	4.01	4.87	5.17	5.52	6.27
Area at Maximum Ponding Depth (acres) =	0.99	1.05	0.83	1.03	1.06	1.13	1.16	1.19	1.26
Maximum Volume Stored (acre-ft) =	0.951	1.466	0.733	1.165	1.551	2.493	2.836	3.247	4.175

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	0.01	0.00	0.03
	0:15:00	0.00	0.00	0.09	0.15	0.19	0.13	0.17	0.16	0.28
	0:20:00	0.00	0.00	0.46	0.65	0.78	0.51	0.62	0.63	0.89
	0:25:00	0.00	0.00	1.79	2.95	3.93	1.63	2.24	2.57	4.05
	0:30:00	0.00	0.00	3.88	6.47	8.58	7.48	11.96	15.56	26.81
	0:35:00	0.00	0.00	5.45	8.88	11.67	17.38	27.45	37.88	63.55
	0:40:00	0.00	0.00	6.04	9.66	12.62	25.33	39.30	55.92	91.84
	0:45:00	0.00	0.00	6.12	9.71	12.68	28.72	44.25	64.27	105.39
	0:50:00	0.00	0.00	6.01	9.48	12.34	29.53	45.33	66.65	110.63
	0:55:00	0.00	0.00	5.75	9.04	11.72	29.12	44.50	65.91	110.56
	1:00:00	0.00	0.00	5.41	8.43	10.88	27.79	42.34	63.17	106.68
	1:05:00	0.00	0.00	5.13	7.96	10.30	25.88	39.34	59.23	100.98
	1:10:00	0.00	0.00	4.91	7.60	9.87	24.21	36.81	55.60	95.82
	1:15:00	0.00	0.00	4.67	7.23	9.47	22.73	34.52	52.10	90.19
	1:20:00	0.00	0.00	4.42	6.84	9.05	21.26	32.26	48.50	84.06
	1:25:00	0.00	0.00	4.18	6.44	8.56	19.78	29.95	44.91	77.83
	1:30:00	0.00	0.00	3.98	6.14	8.15	18.34	27.69	41.39	71.74
	1:35:00	0.00	0.00	3.83	5.89	7.78	17.14	25.88	38.50	66.72
	1:40:00	0.00	0.00	3.68	5.64	7.41	16.14	24.31	36.07	62.34
	1:45:00	0.00	0.00	3.53	5.36	7.05	15.21	22.86	33.83	58.33
	1:50:00	0.00	0.00	3.39	5.08	6.68	14.29	21.43	31.66	54.47
	1:55:00	0.00	0.00	3.22	4.80	6.31	13.39	20.03	29.52	50.71
	2:00:00	0.00	0.00	3.03	4.51	5.93	12.50	18.64	27.40	47.00
	2:05:00	0.00	0.00	2.82	4.19	5.50	11.57	17.21	25.26	43.28
	2:10:00	0.00	0.00	2.59	3.83	5.04	10.60	15.73	23.10	39.57
	2:15:00	0.00	0.00	2.35	3.48	4.57	9.62	14.25	20.92	35.85
	2:20:00	0.00	0.00	2.14	3.17	4.17	8.66	12.80	18.79	32.22
	2:25:00	0.00	0.00	1.99	2.94	3.88	7.85	11.62	17.03	29.29
	2:30:00	0.00	0.00	1.86	2.76	3.63	7.27	10.77	15.76	27.12
	2:35:00	0.00	0.00	1.74	2.58	3.40	6.81	10.10	14.75	25.33
	2:40:00	0.00	0.00	1.63	2.42	3.19	6.39	9.50	13.85	23.73
	2:45:00	0.00	0.00	1.52	2.26	2.97	6.00	8.92	13.01	22.24
	2:50:00	0.00	0.00	1.41	2.11	2.77	5.63	8.36	12.19	20.82
	2:55:00	0.00	0.00	1.32	1.96	2.57	5.26	7.81	11.40	19.45
	3:00:00	0.00	0.00	1.22	1.82	2.38	4.90	7.28	10.63	18.14
	3:05:00	0.00	0.00	1.13	1.68	2.20	4.56	6.76	9.89	16.86
	3:10:00	0.00	0.00	1.04	1.54	2.02	4.21	6.25	9.14	15.60
	3:15:00	0.00	0.00	0.95	1.41	1.85	3.87	5.74	8.40	14.34
	3:20:00	0.00	0.00	0.86	1.28	1.68	3.53	5.23	7.66	13.08
	3:25:00	0.00	0.00	0.78	1.15	1.51	3.19	4.72	6.92	11.83
	3:30:00	0.00	0.00	0.70	1.03	1.35	2.86	4.22	6.19	10.58
	3:35:00	0.00	0.00	0.61	0.91	1.18	2.53	3.72	5.46	9.33
	3:40:00	0.00	0.00	0.53	0.78	1.02	2.20	3.22	4.73	8.08
	3:45:00	0.00	0.00	0.46	0.66	0.87	1.87	2.72	4.00	6.84
	3:50:00	0.00	0.00	0.38	0.55	0.71	1.54	2.23	3.27	5.60
	3:55:00	0.00	0.00	0.31	0.43	0.56	1.22	1.74	2.55	4.37
	4:00:00	0.00	0.00	0.23	0.32	0.42	0.90	1.26	1.84	3.14
	4:05:00	0.00	0.00	0.18	0.23	0.31	0.60	0.80	1.15	1.97
	4:10:00	0.00	0.00	0.14	0.19	0.25	0.37	0.47	0.67	1.21
	4:15:00	0.00	0.00	0.12	0.16	0.22	0.25	0.32	0.42	0.79
	4:20:00	0.00	0.00	0.11	0.14	0.19	0.19	0.24	0.30	0.54
	4:25:00	0.00	0.00	0.09	0.12	0.16	0.15	0.19	0.22	0.38
	4:30:00	0.00	0.00	0.08	0.10	0.14	0.12	0.15	0.16	0.26
	4:35:00	0.00	0.00	0.07	0.09	0.11	0.10	0.12	0.12	0.18
	4:40:00	0.00	0.00	0.06	0.07	0.09	0.08	0.09	0.09	0.12
	4:45:00	0.00	0.00	0.05	0.06	0.07	0.07	0.07	0.07	0.09
	4:50:00	0.00	0.00	0.04	0.05	0.06	0.05	0.06	0.05	0.07
	4:55:00	0.00	0.00	0.03	0.04	0.05	0.04	0.05	0.04	0.05
	5:00:00	0.00	0.00	0.02	0.03	0.04	0.03	0.04	0.03	0.04
	5:05:00	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.03	0.03
	5:10:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.02
	5:15:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	5:20:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
	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

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jul 31 2024

WF-8a Typical Section

User-defined

Invert Elev (ft)	= 100.00
Slope (%)	= 0.50
N-Value	= 0.044

Calculations

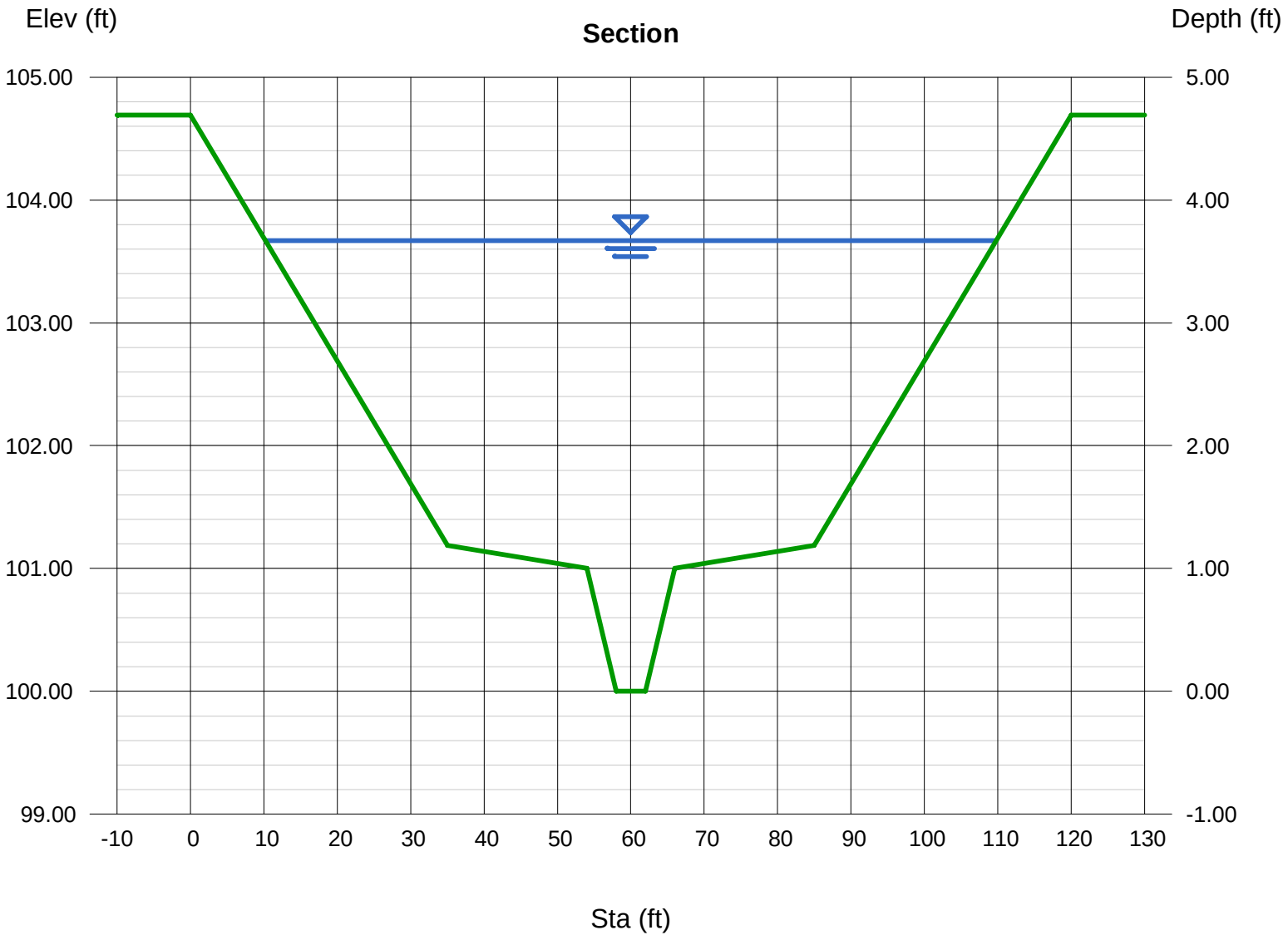
Compute by:	Known Q
Known Q (cfs)	= 753.00

Highlighted

Depth (ft)	= 3.67
Q (cfs)	= 753.00
Area (sqft)	= 199.39
Velocity (ft/s)	= 3.78
Wetted Perim (ft)	= 100.10
Crit Depth, Yc (ft)	= 2.71
Top Width (ft)	= 99.60
EGL (ft)	= 3.89

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

(0.00, 104.69) -(35.00, 101.19, 0.045) -(54.00, 101.00, 0.045) -(58.00, 100.00, 0.030) -(62.00, 100.00, 0.030) -(66.00, 101.00, 0.045) -(85.00, 101.19, 0.045) -(120.00, 104.69, 0.045)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jul 31 2024

WF-8a Typical Section-Max Slope

User-defined

Invert Elev (ft)	= 100.00
Slope (%)	= 1.05
N-Value	= 0.044

Calculations

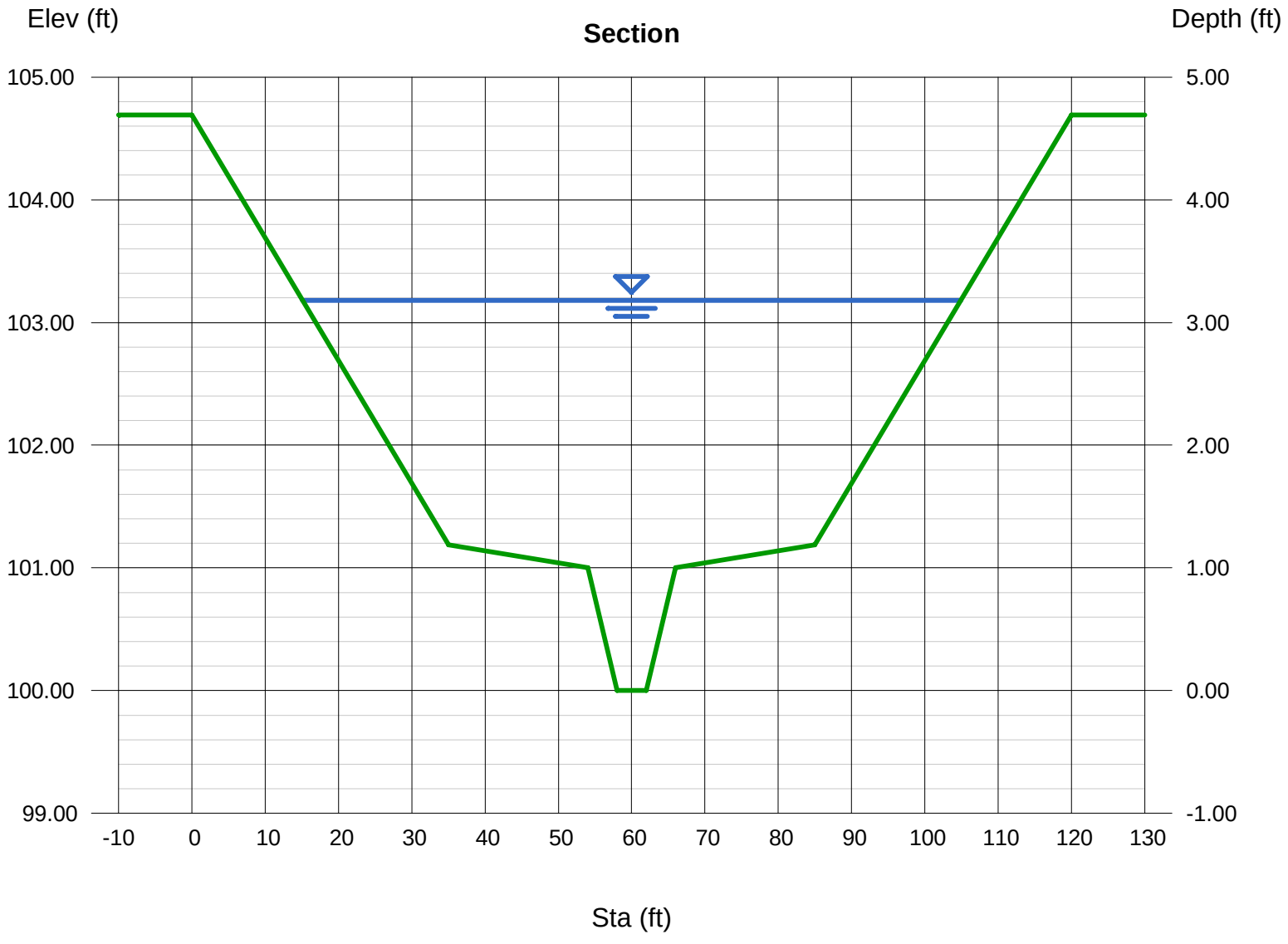
Compute by:	Known Q
Known Q (cfs)	= 753.00

Highlighted

Depth (ft)	= 3.18
Q (cfs)	= 753.00
Area (sqft)	= 152.99
Velocity (ft/s)	= 4.92
Wetted Perim (ft)	= 90.25
Crit Depth, Yc (ft)	= 2.71
Top Width (ft)	= 89.80
EGL (ft)	= 3.56

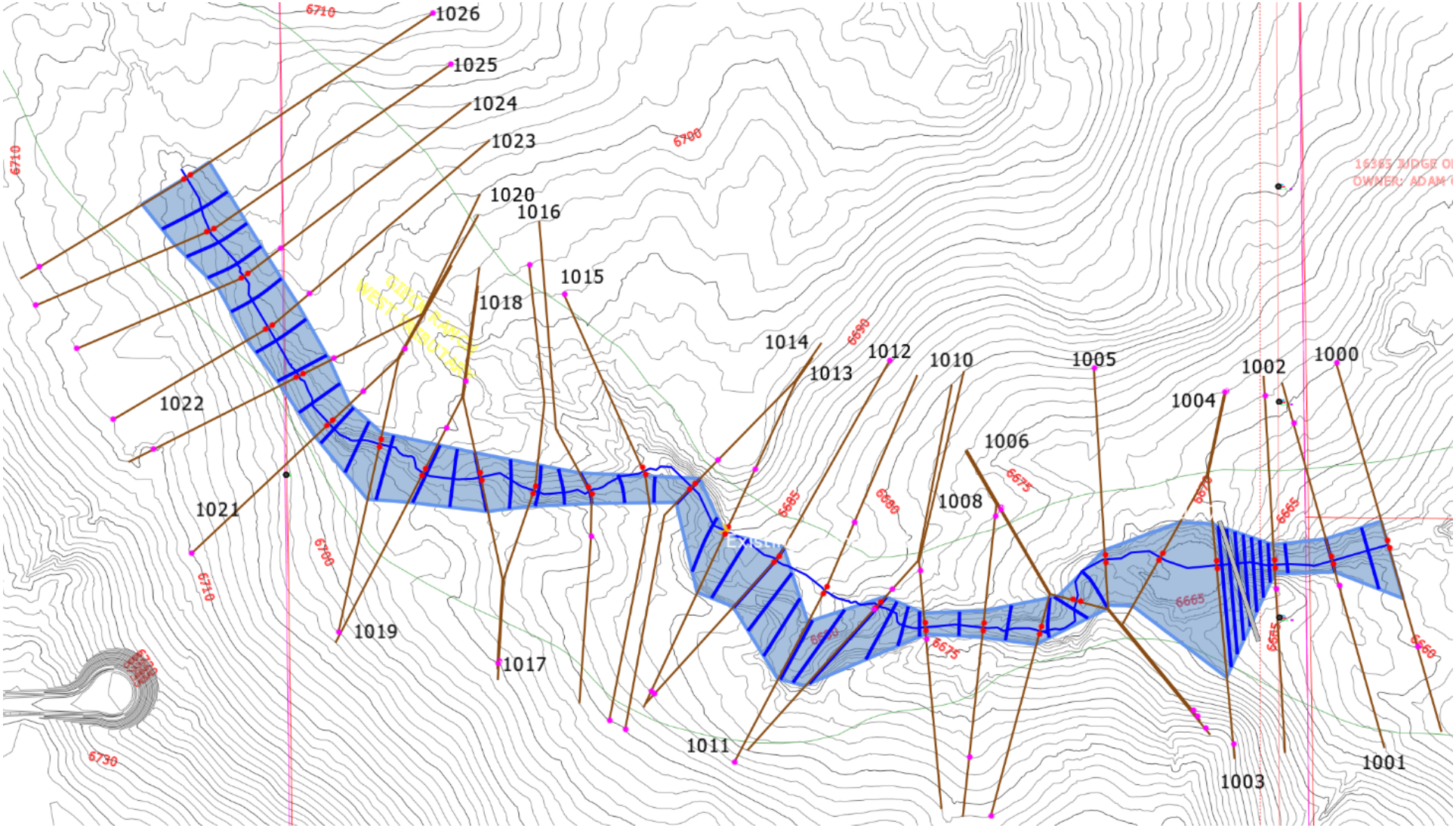
(Sta, El, n)-(Sta, El, n)...

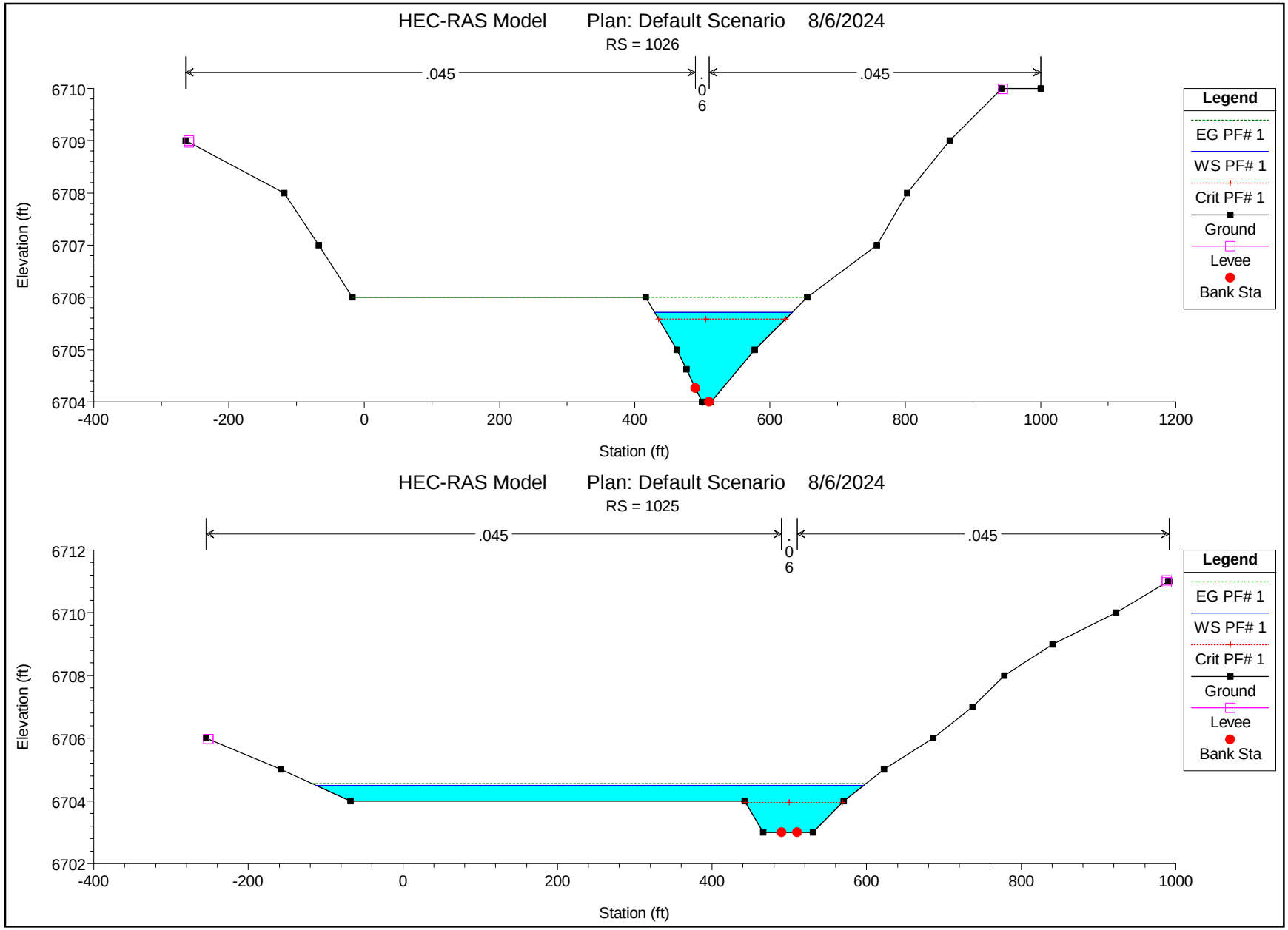
(0.00, 104.69) -(35.00, 101.19, 0.045) -(54.00, 101.00, 0.045) -(58.00, 100.00, 0.030) -(62.00, 100.00, 0.030) -(66.00, 101.00, 0.045) -(85.00, 101.19, 0.045) -(120.00, 104.69, 0.045)

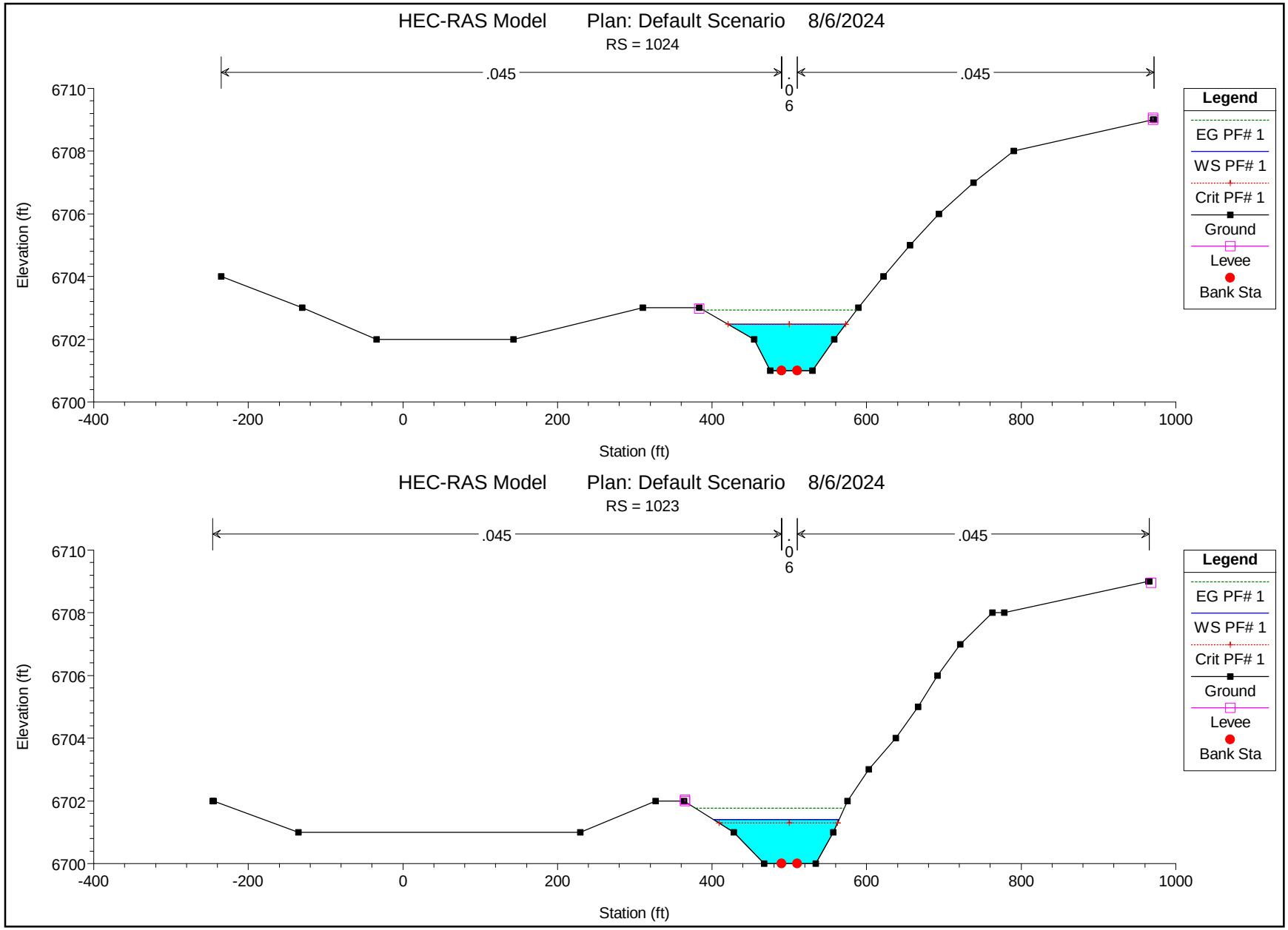


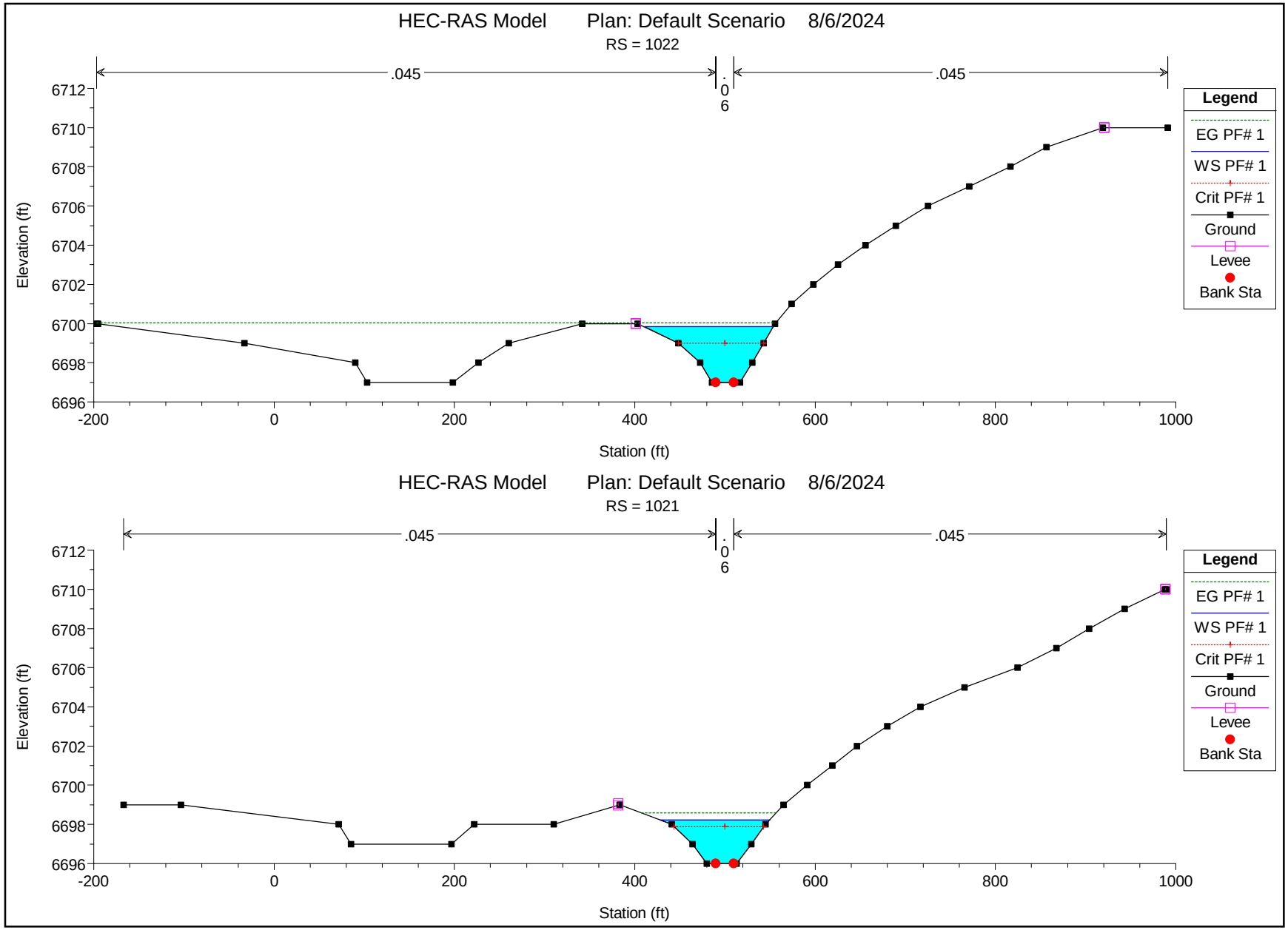
HEC-RAS Plan: Default Scenario River: Existing Channel Reach: 1 Profile: PF# 1

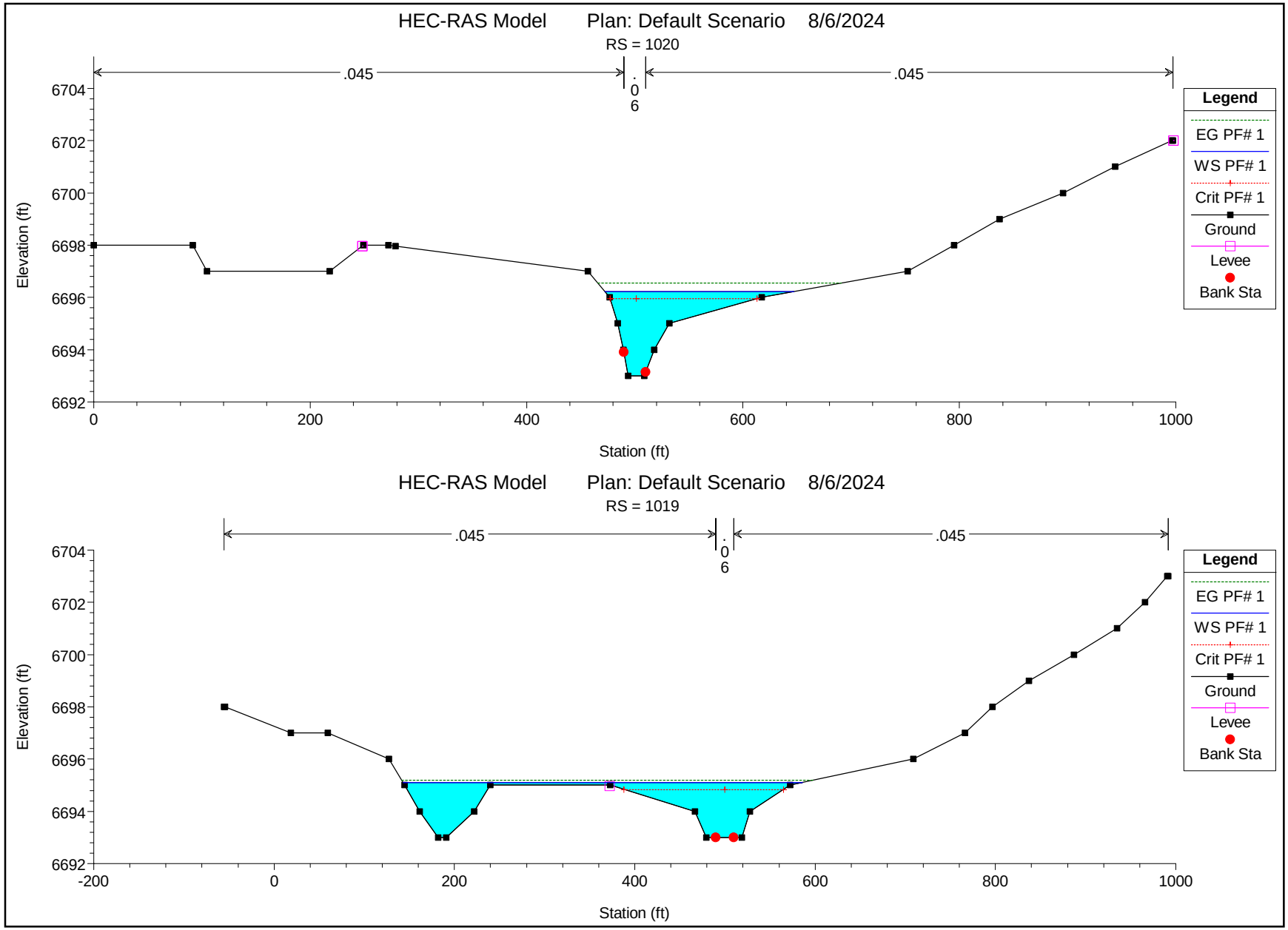
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear LOB	Shear Chan	Shear ROB
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)	(lb/sq ft)
1	1026	PF# 1	753.00	6704.00	6705.72	6705.59	6706.00	0.020598	4.97	177.96	203.77	0.68	0.88	2.13	1.08
1	1025	PF# 1	753.00	6703.00	6704.50	6703.95	6704.55	0.005174	2.33	432.84	709.10	0.34	0.17	0.48	0.29
1	1024	PF# 1	753.00	6701.00	6702.47	6702.47	6702.94	0.032142	5.74	139.51	151.91	0.83	1.45	2.95	1.92
1	1023	PF# 1	753.00	6700.00	6701.40	6701.30	6701.77	0.024287	4.82	155.74	161.56	0.72	1.25	2.12	1.56
1	1022	PF# 1	753.00	6697.00	6699.83	6699.00	6700.03	0.006406	3.97	219.11	142.26	0.42	0.46	1.13	0.66
1	1021	PF# 1	753.00	6696.00	6698.23	6697.88	6698.58	0.015583	5.28	160.05	121.76	0.62	1.07	2.17	1.15
1	1020	PF# 1	753.00	6693.00	6696.22	6695.95	6696.55	0.011829	5.74	188.49	174.71	0.57	0.66	2.30	0.59
1	1019	PF# 1	753.00	6693.00	6695.10	6694.84	6695.19	0.006470	3.27	336.52	442.89	0.40	0.27	0.85	0.32
1	1018	PF# 1	753.00	6691.00	6692.95	6692.95	6693.41	0.026496	6.29	145.17	154.78	0.79	1.75	3.22	1.00
1	1017	PF# 1	753.00	6688.00	6691.19	6690.01	6691.40	0.005345	3.92	210.92	141.17	0.39	0.29	1.06	0.70
1	1016	PF# 1	753.00	6687.00	6689.00	6689.00	6689.71	0.033645	7.22	112.38	86.21	0.90	2.30	4.21	2.27
1	1015	PF# 1	753.00	6685.00	6687.24	6686.53	6687.32	0.004092	2.71	385.06	643.91	0.32	0.33	0.57	0.08
1	1014	PF# 1	753.00	6683.00	6685.98	6685.37	6686.37	0.010382	5.23	156.44	85.93	0.53	1.40	1.93	0.75
1	1013	PF# 1	753.00	6684.54	6684.62	6684.21	6684.84	0.009447	0.29	203.77	167.20	0.25		0.02	0.73
1	1012	PF# 1	753.00	6682.62	6682.99	6682.70	6683.24	0.011975	1.18	191.74	200.70	0.39	0.08	0.22	0.89
1	1011	PF# 1	753.00	6681.00	6680.11	6680.11	6680.54	0.029771		144.69	165.59	0.00			1.62
1	1010	PF# 1	753.00	6677.00	6678.02	6678.02	6678.06	0.001549	0.99	448.08	308.00	0.17	0.06	0.10	0.15
1	1009	PF# 1	753.00	6673.00	6674.60	6675.36	6677.06	0.141052	11.55	61.29	54.72	1.73	10.11	12.19	3.53
1	1008	PF# 1	753.00	6671.00	6673.56	6673.56	6674.35	0.028897	7.71	107.89	68.76	0.86	2.34	4.47	1.76
1	1007	PF# 1	753.00	6669.00	6672.22	6670.98	6672.45	0.006132	4.23	229.63	194.15	0.42	0.27	1.23	0.84
1	1006	PF# 1	753.00	6669.00	6670.60	6670.38	6670.97	0.017857	4.53	156.63	128.96	0.63	1.01	1.78	1.41
1	1005	PF# 1	753.00	6667.00	6669.61	6668.73	6669.75	0.004229	2.85	249.61	141.45	0.33	0.25	0.62	0.46
1	1004	PF# 1	753.00	6665.00	6669.62	6666.51	6669.63	0.000190	0.93	785.78	246.70	0.08	0.04	0.05	0.04
1	1003	PF# 1	753.00	6665.00	6669.60	6666.16	6669.61	0.000142	0.82	1027.38	396.78	0.07	0.03	0.04	0.02
1	1002.7		Inl Struct												
1	1002	PF# 1	753.00	6659.00	6662.27	6661.66	6662.64	0.009242	5.25	156.86	74.39	0.51	0.88	1.89	1.16
1	1001	PF# 1	753.00	6658.00	6660.99	6660.13	6661.30	0.008447	4.73	171.54	88.46	0.48	0.91	1.58	0.74
1	1000	PF# 1	753.00	6657.00	6659.43	6658.94	6659.72	0.013329	5.17	192.30	206.46	0.58	1.06	2.02	0.48

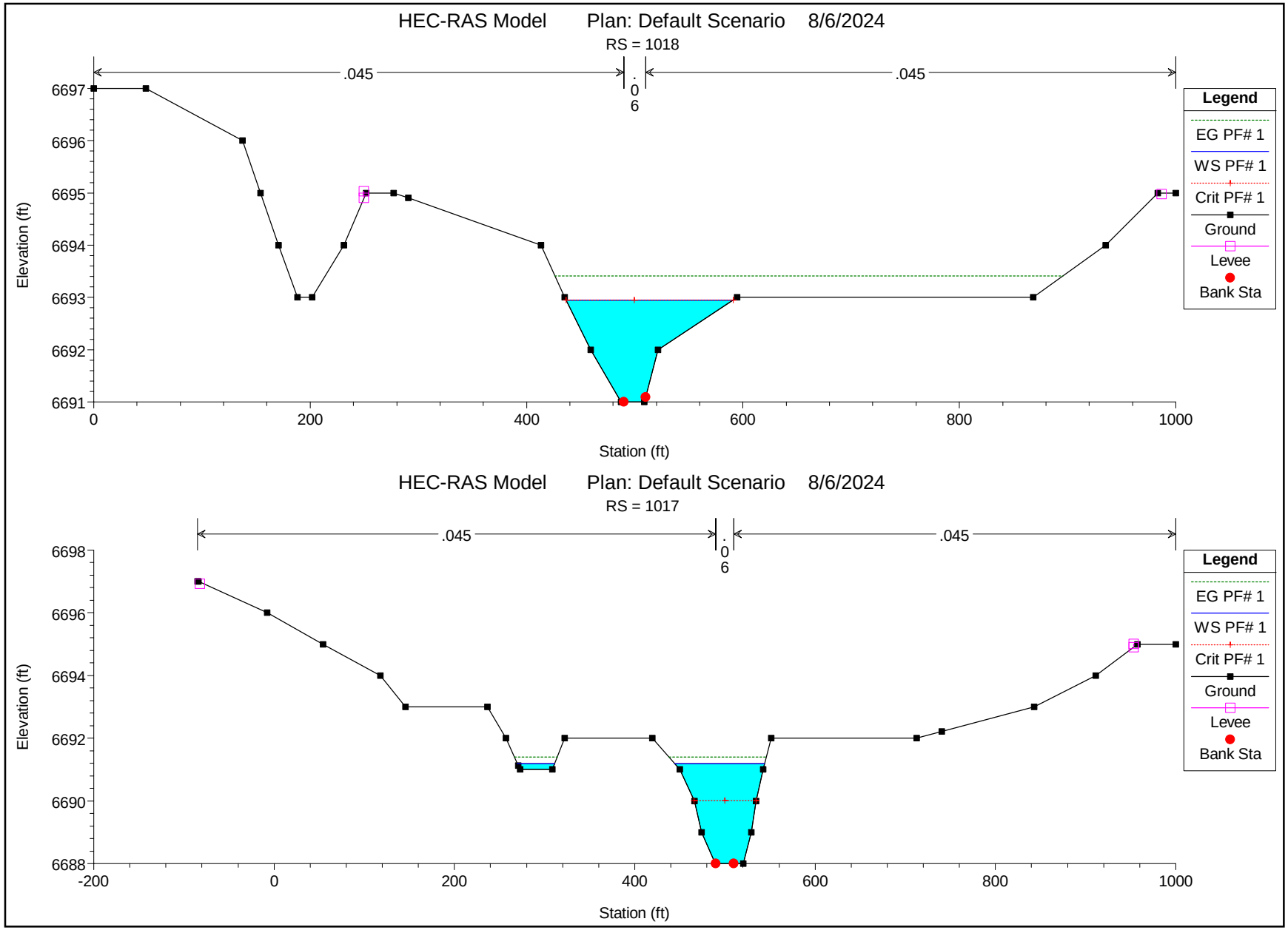


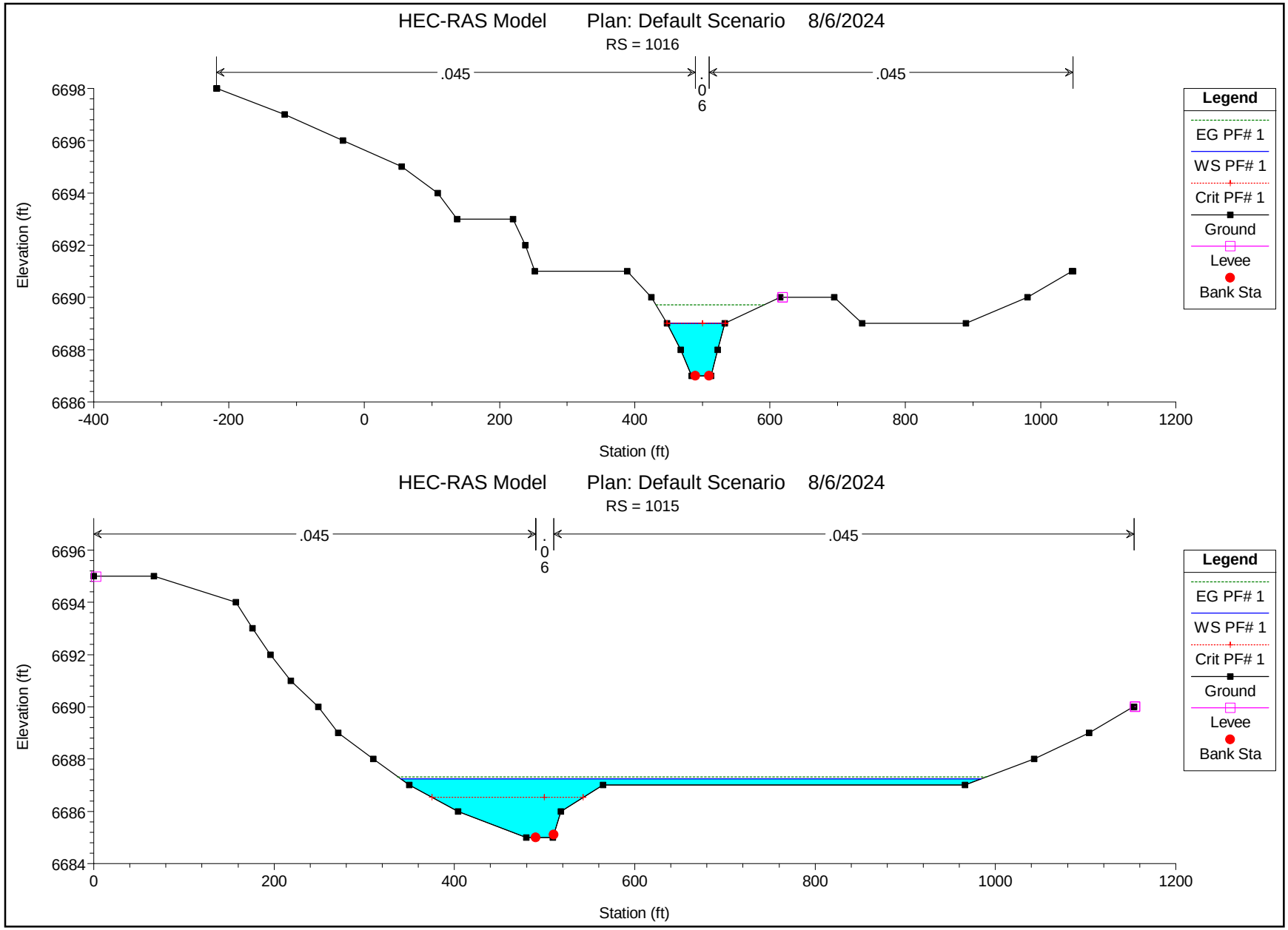

HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1026
.045
.06
.045
Elevation (ft)
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1025
.045
.06
.045
Elevation (ft)
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta

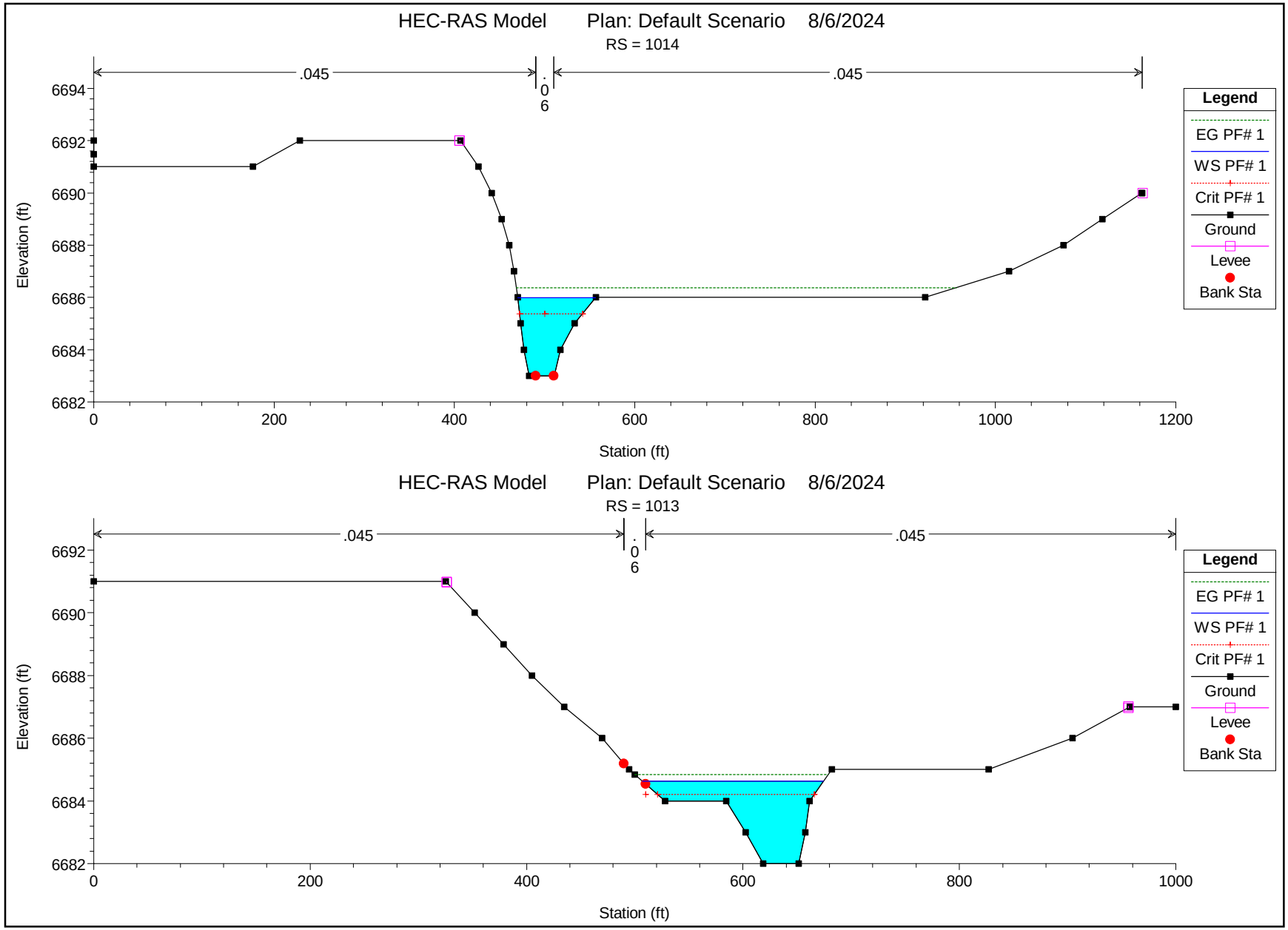

HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1024
.045
.06
.045
Elevation (ft)
6710
6708
6706
6704
6702
6700
-400
-200
0
200
400
600
800
1000
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1023
.045
.06
.045
Elevation (ft)
6710
6708
6706
6704
6702
6700
-400
-200
0
200
400
600
800
1000
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta

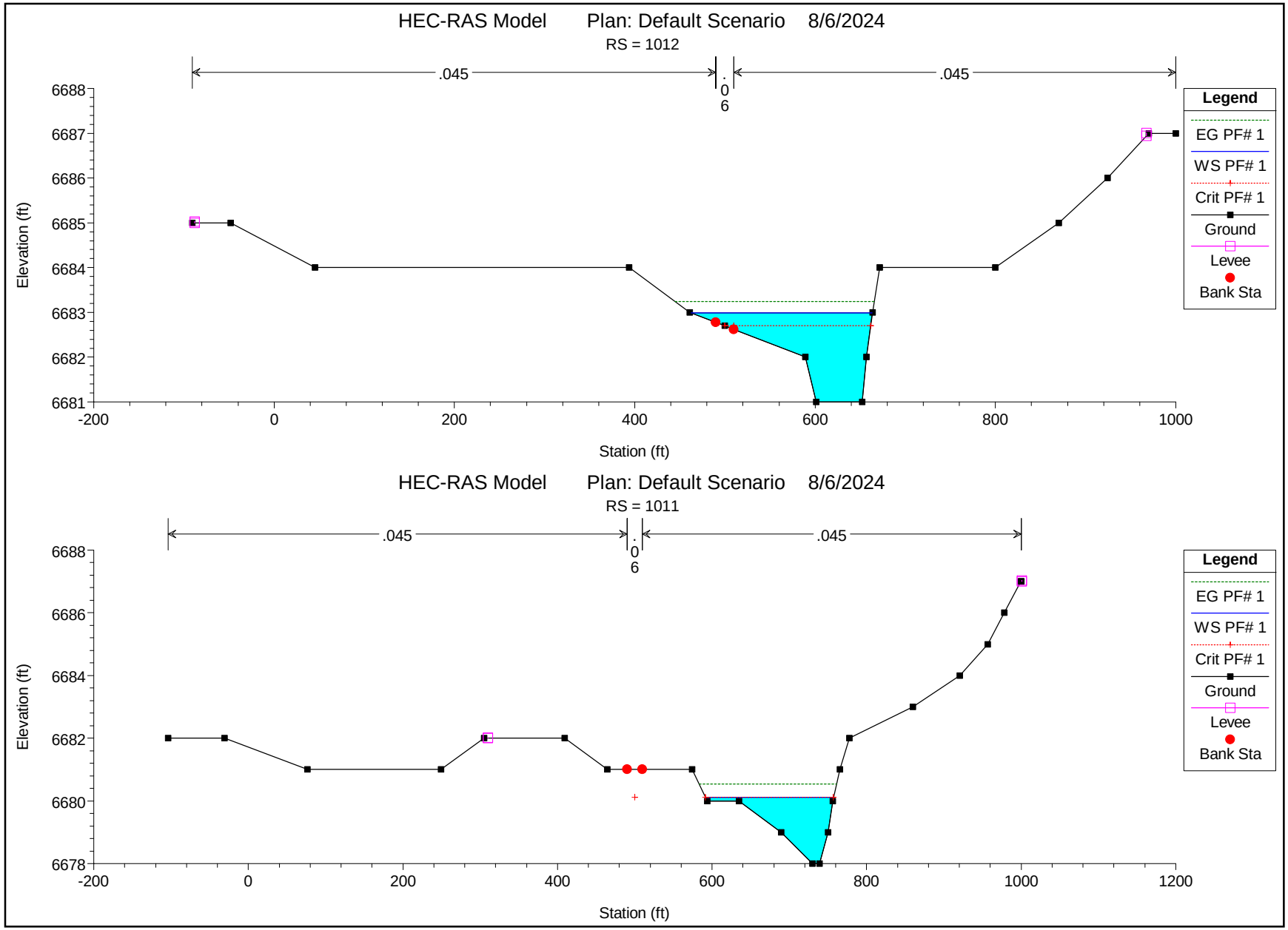

HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1022
.045
.06
.045
Elevation (ft)
6712
6710
6708
6706
6704
6702
6700
6698
6696
-200
0
200
400
600
800
1000
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1021
.045
.06
.045
Elevation (ft)
6712
6710
6708
6706
6704
6702
6700
6698
6696
-200
0
200
400
600
800
1000
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta

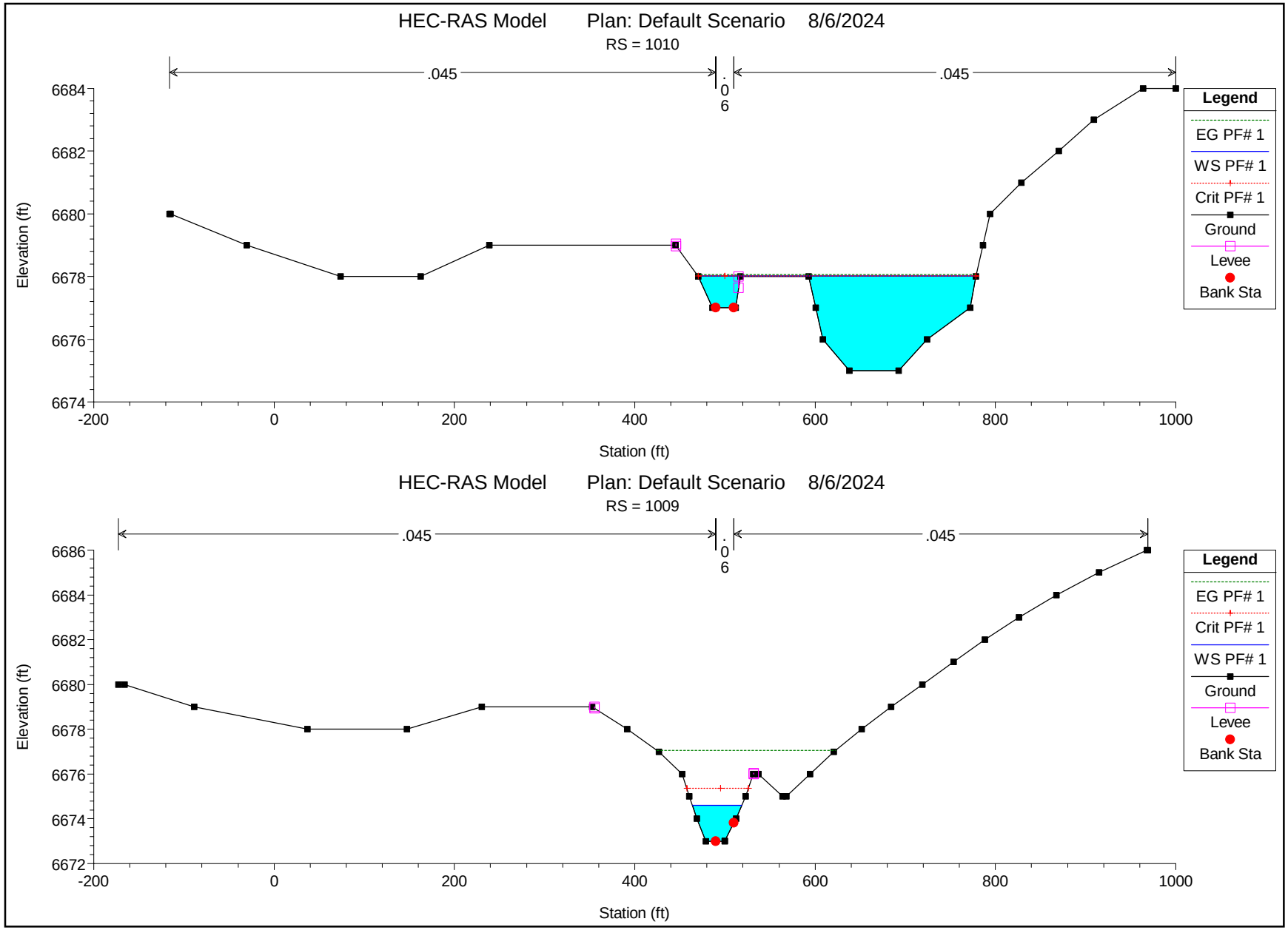

HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1020
.045
.06
.045
Elevation (ft)
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1019
.045
.06
.045
Elevation (ft)
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta

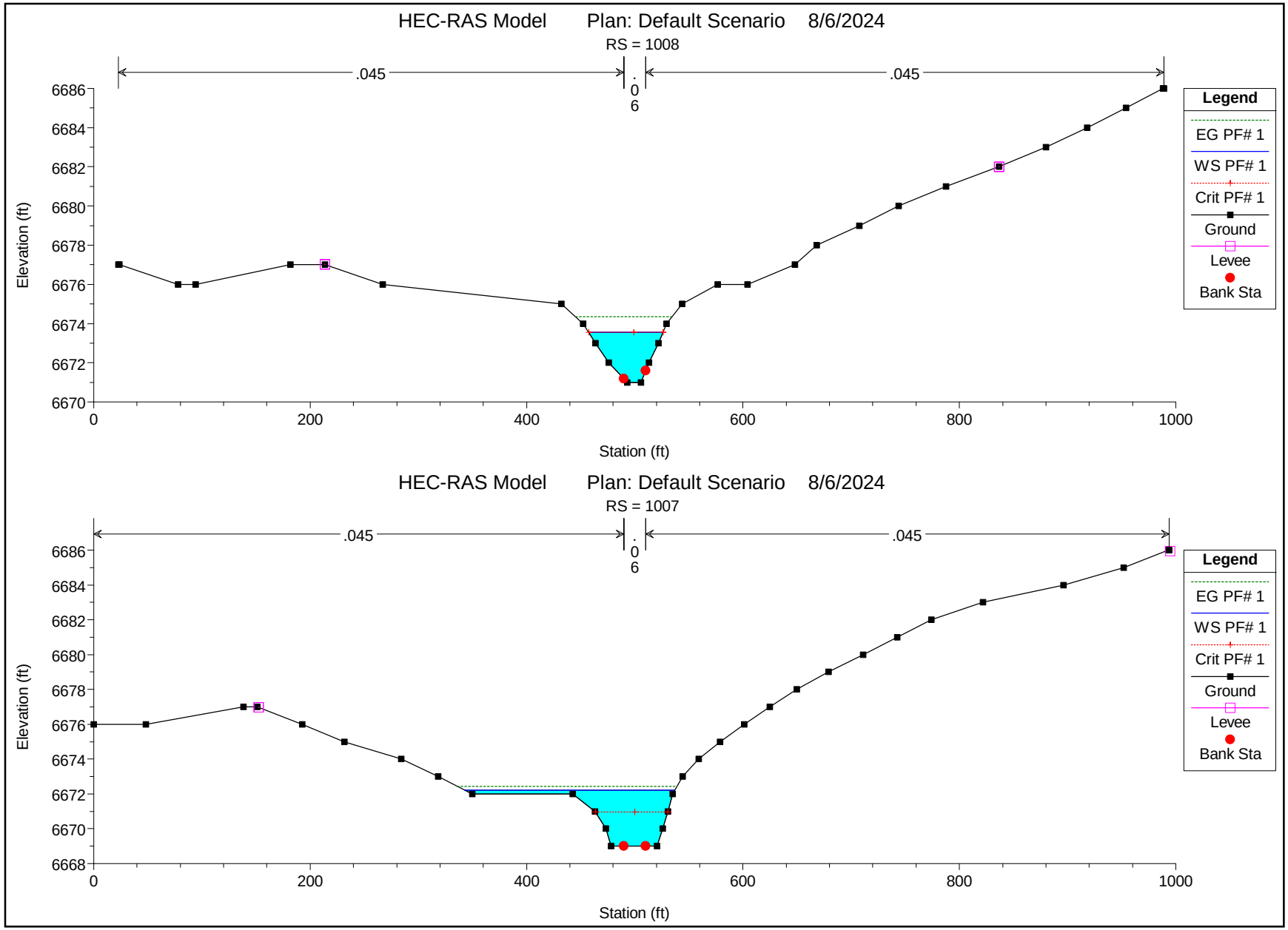

HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1018
.045
.06
.045
Elevation (ft)
6697
6696
6695
6694
6693
6692
6691
0
200
400
600
800
1000
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1017
.045
.06
.045
Elevation (ft)
6698
6696
6694
6692
6690
6688
-200
0
200
400
600
800
1000
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta

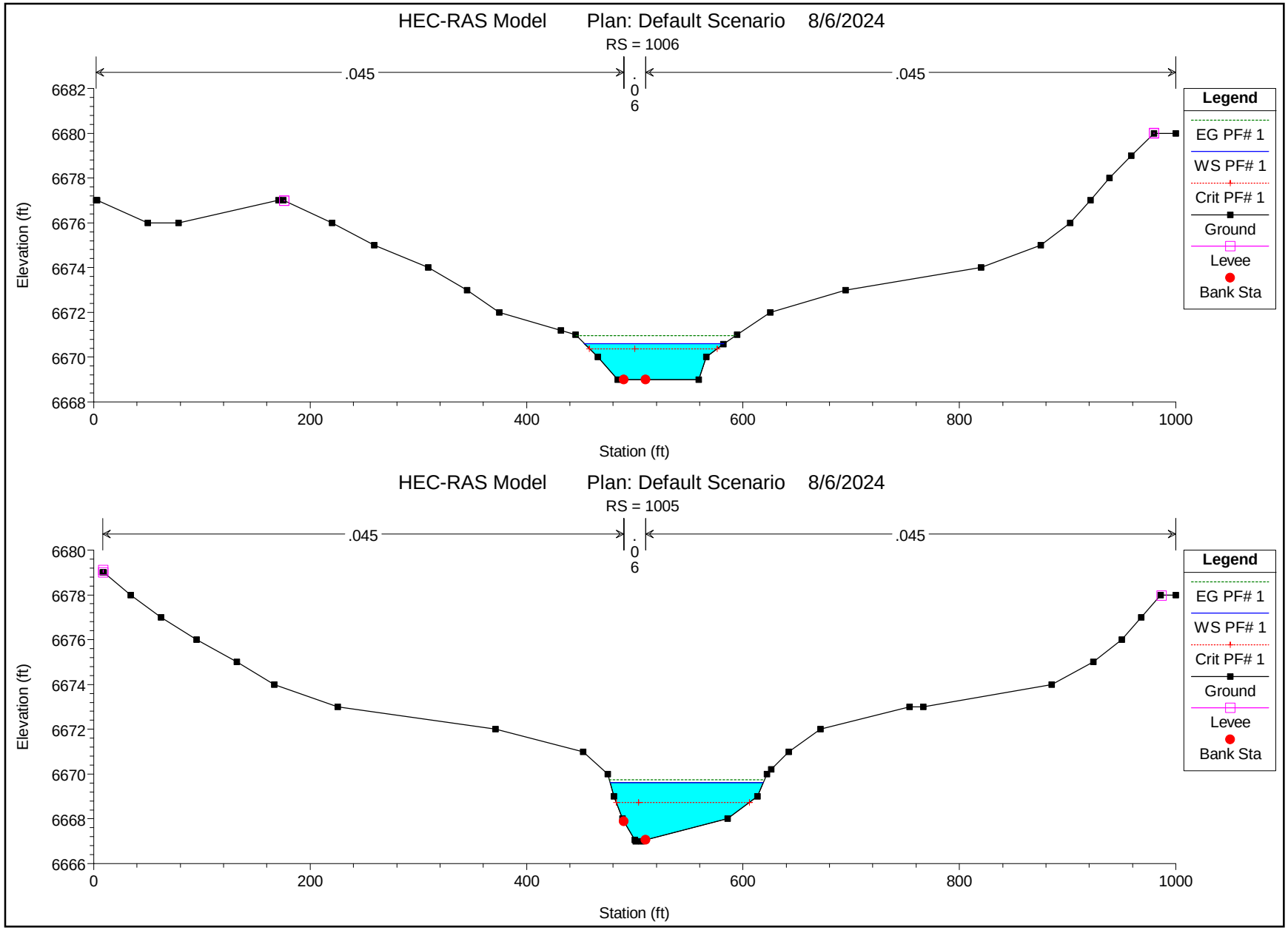

HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1016
.045
.06
.045
Elevation (ft)
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1015
.045
.06
.045
Elevation (ft)
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta

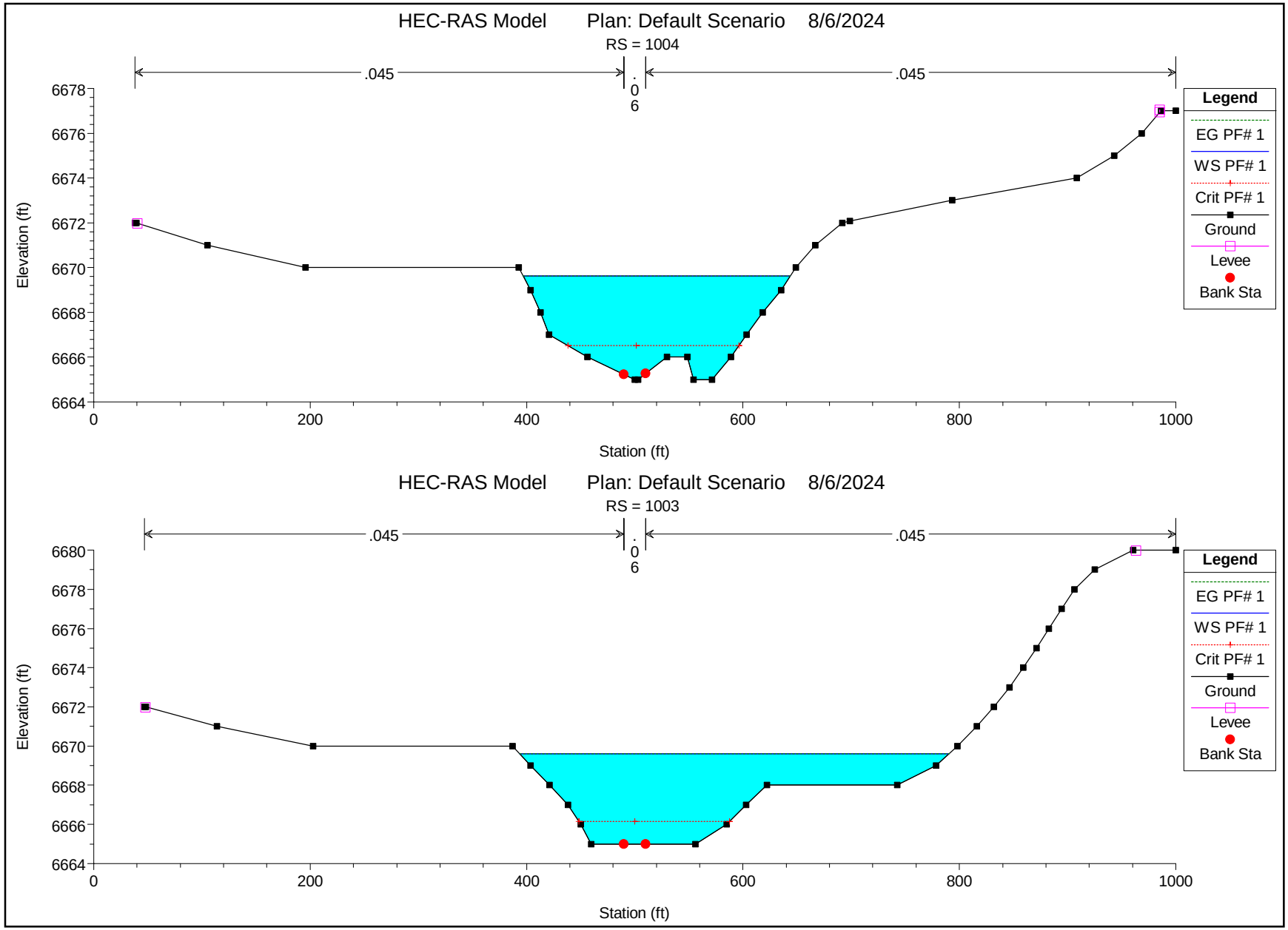

HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1014
.045
.06
.045
Elevation (ft)
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1013
.045
.06
.045
Elevation (ft)
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta

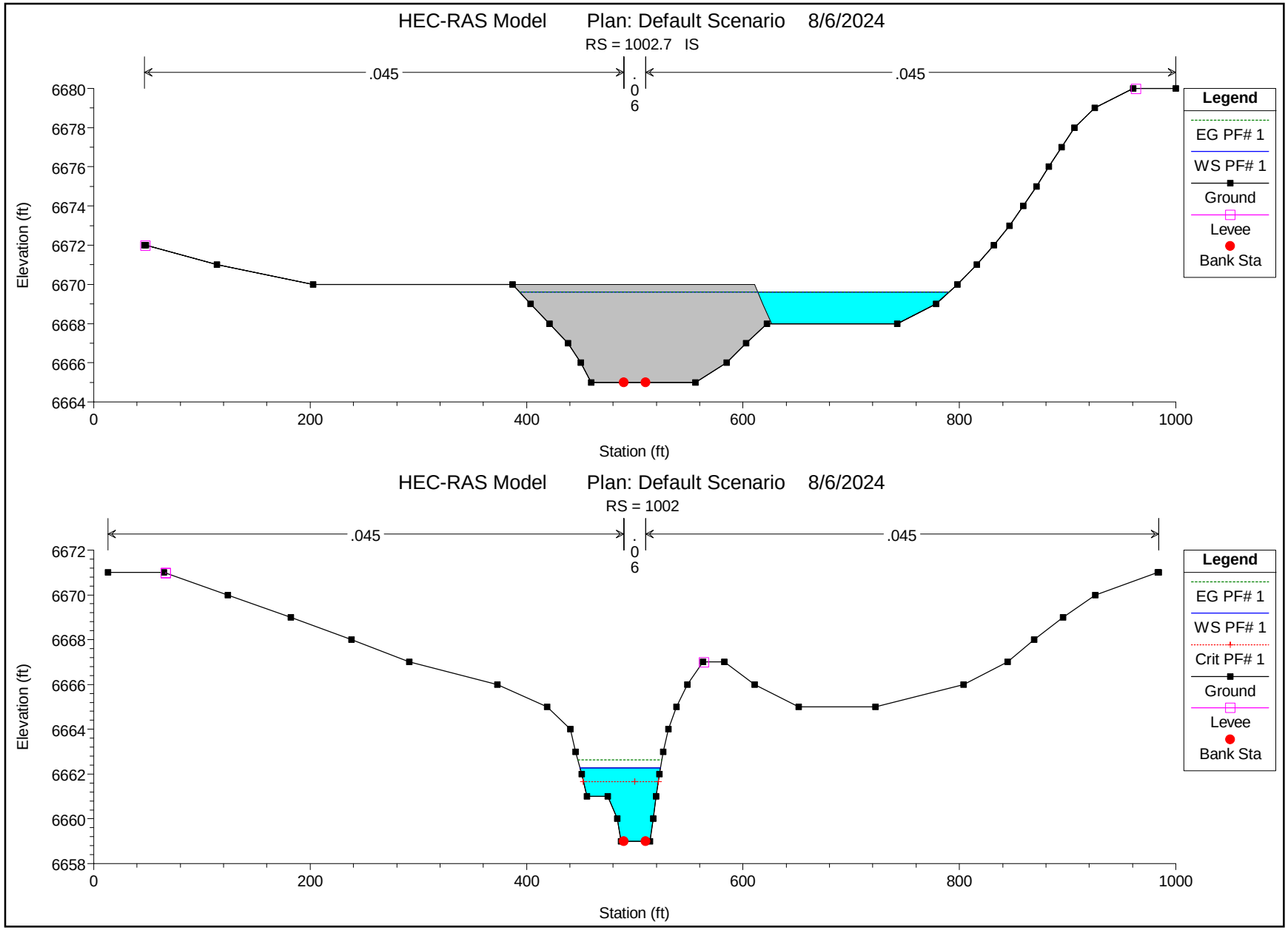

HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1012
.045
.06
.045
Elevation (ft)
6688
6687
6686
6685
6684
6683
6682
6681
-200
0
200
400
600
800
1000
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1011
.045
.06
.045
Elevation (ft)
6688
6686
6684
6682
6680
6678
-200
0
200
400
600
800
1000
1200
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta

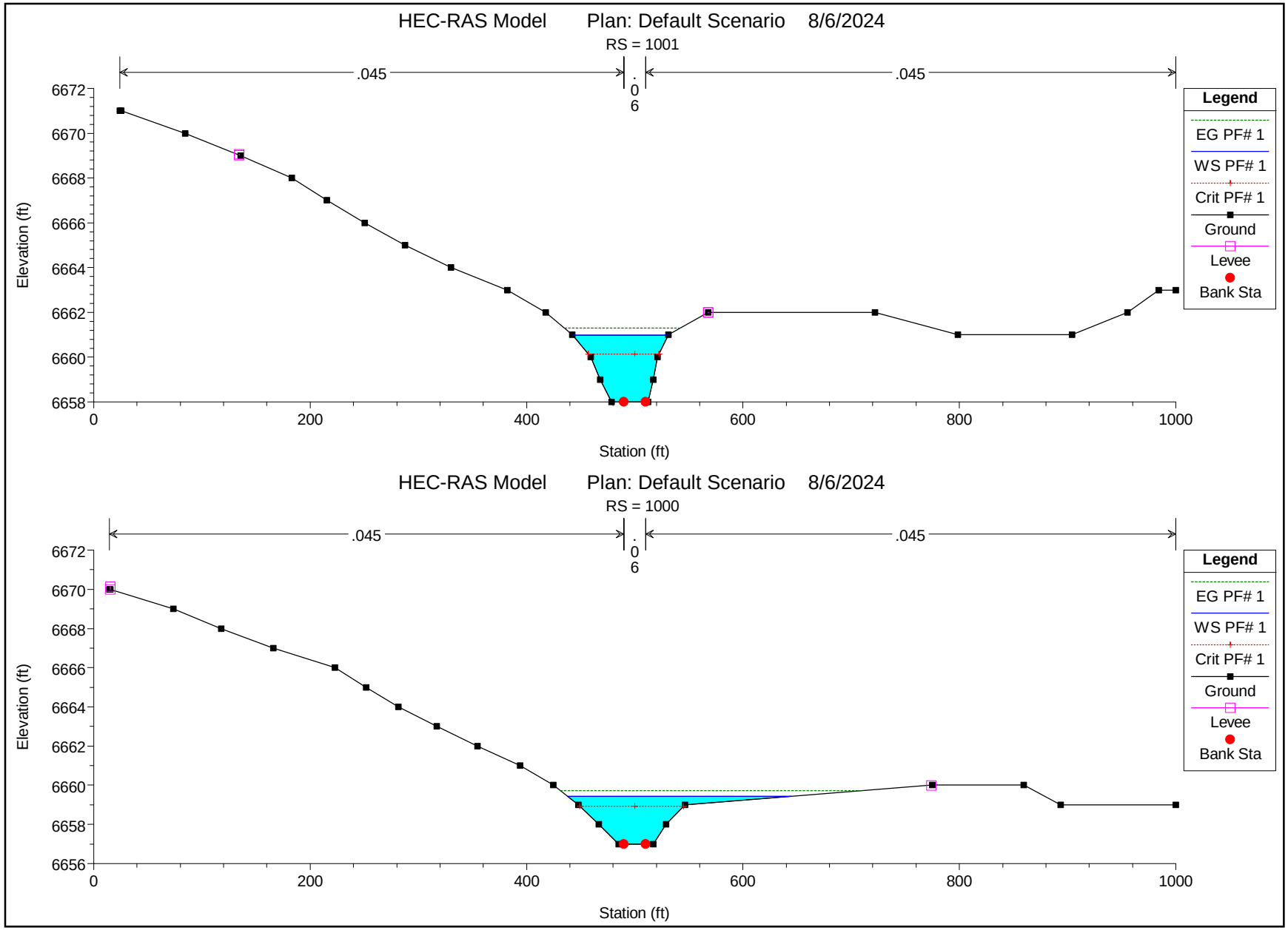

HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1010
.045
.06
.045
Elevation (ft)
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1009
.045
.06
.045
Elevation (ft)
Station (ft)
Legend
EG PF# 1
Crit PF# 1
WS PF# 1
Ground
Levee
Bank Sta

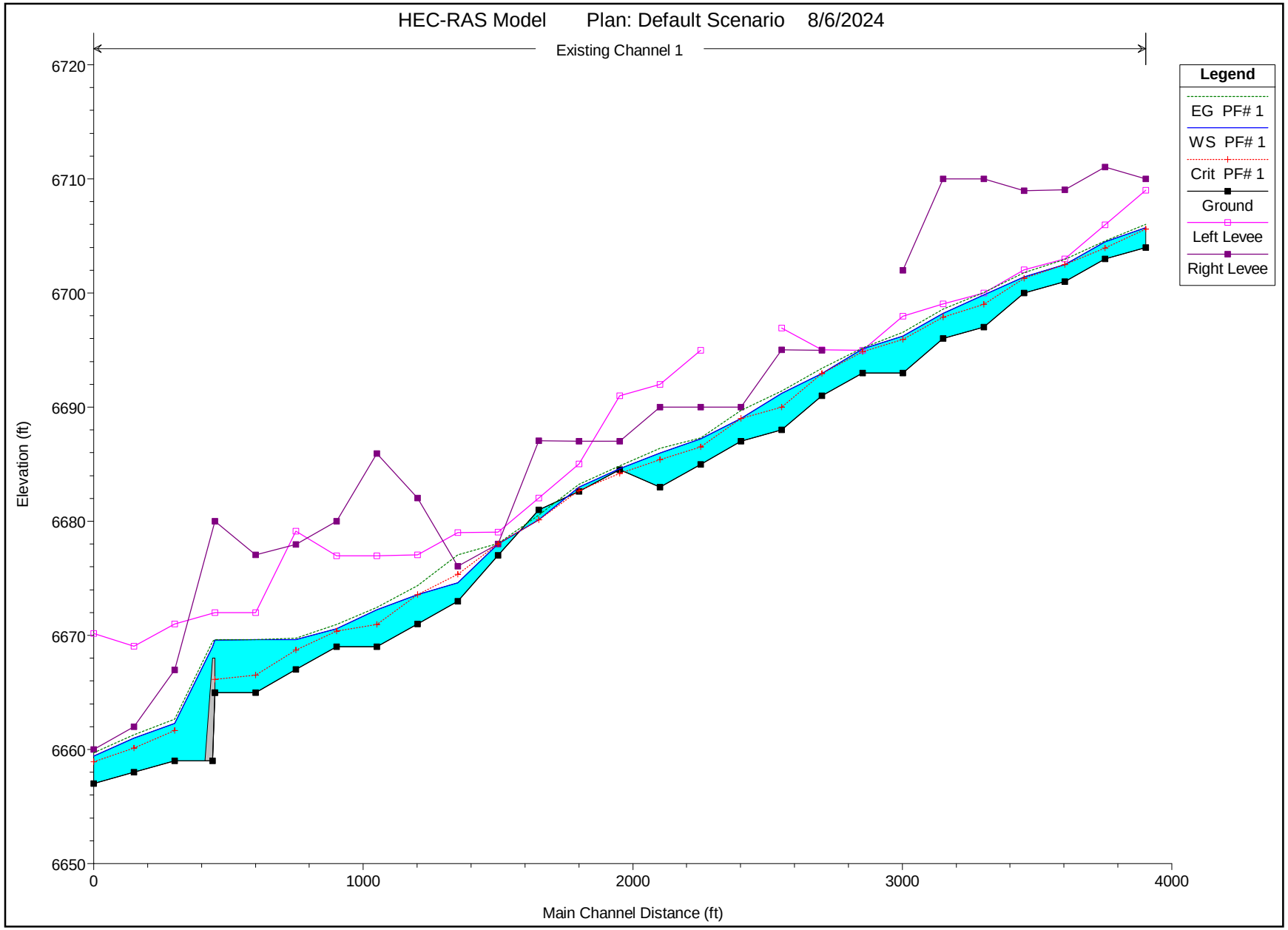

HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1008
.045
.06
.045
Elevation (ft)
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1007
.045
.06
.045
Elevation (ft)
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta


HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1006
.045
.06
.045
Elevation (ft)
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1005
.045
.06
.045
Elevation (ft)
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta


HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1004
.045
.06
.045
Elevation (ft)
6678
6676
6674
6672
6670
6668
6666
6664
0
200
400
600
800
1000
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1003
.045
.06
.045
Elevation (ft)
6680
6678
6676
6674
6672
6670
6668
6666
6664
0
200
400
600
800
1000
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta

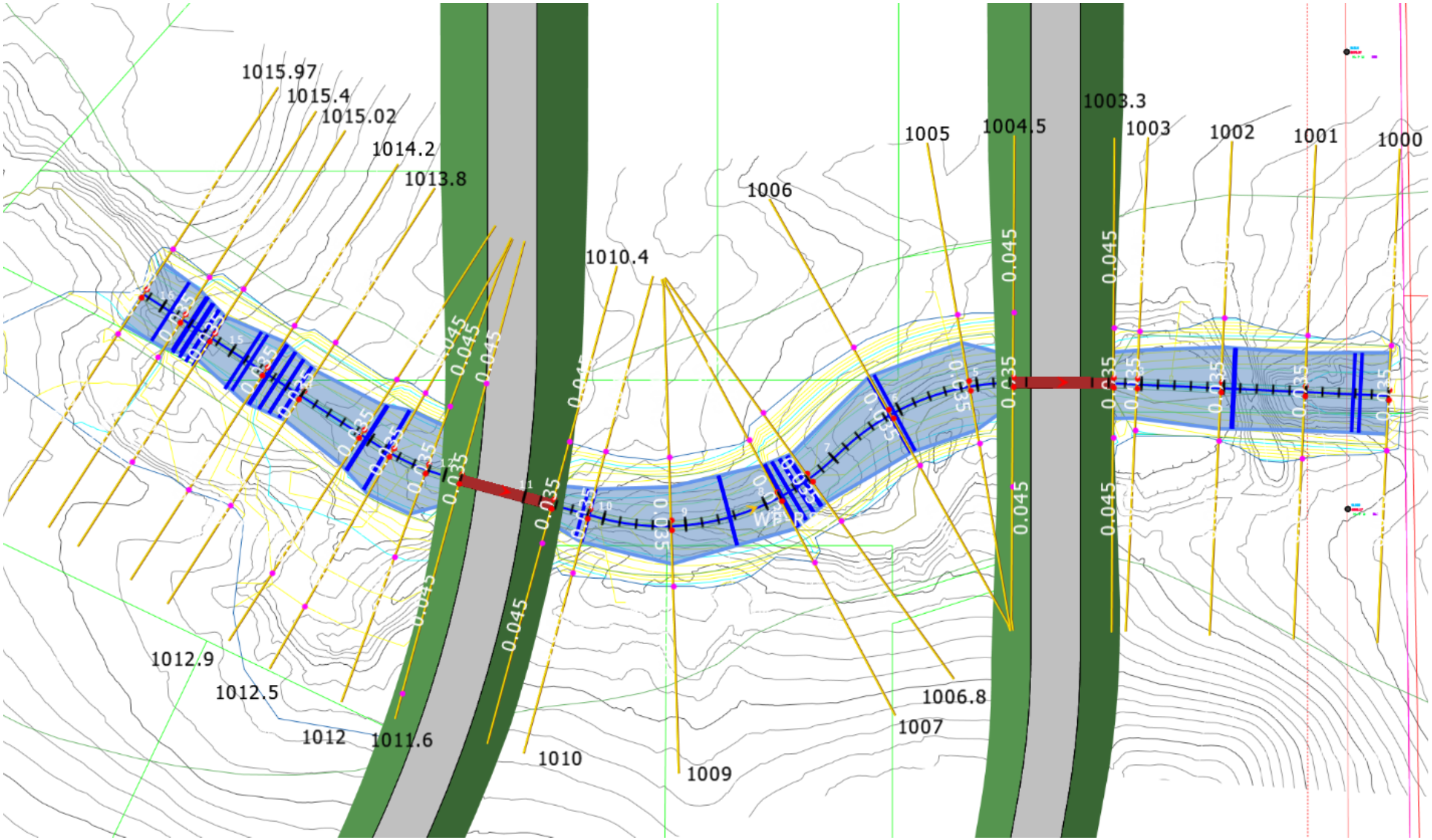

HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1002.7 IS
.045
.06
.045
Elevation (ft)
6680
6678
6676
6674
6672
6670
6668
6666
6664
0
200
400
600
800
1000
Station (ft)
Legend
EG PF# 1
WS PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1002
.045
.06
.045
Elevation (ft)
6672
6670
6668
6666
6664
6662
6660
6658
0
200
400
600
800
1000
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta

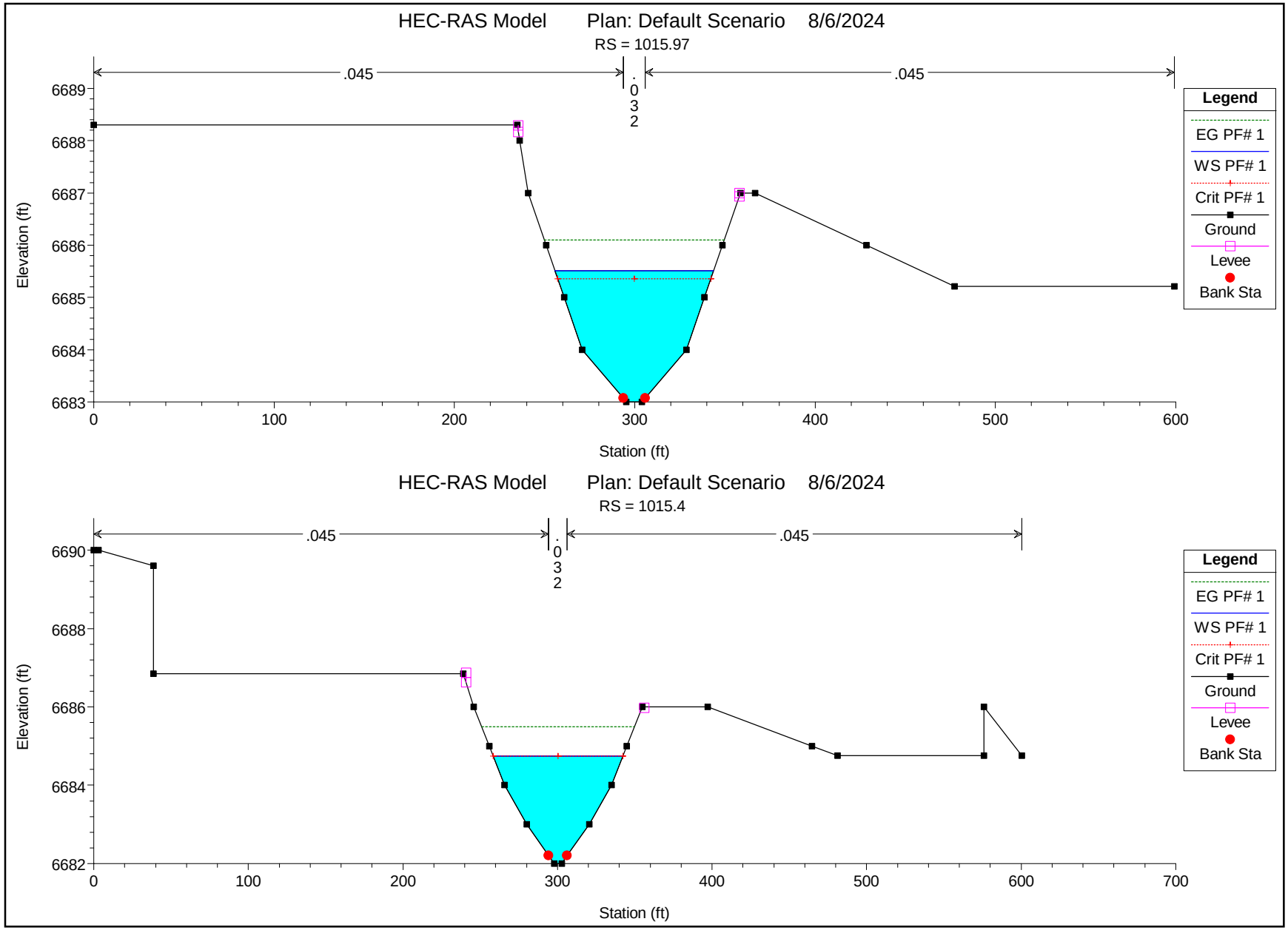

HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1001
.045
.06
.045
Elevation (ft)
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1000
.045
.06
.045
Elevation (ft)
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta


HEC-RAS Model Plan: Default Scenario 8/6/2024
Existing Channel 1
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Left Levee
Right Levee
Elevation (ft)
6720
6710
6700
6690
6680
6670
6660
6650
0
1000
2000
3000
4000
Main Channel Distance (ft)

HEC-RAS Plan: Default Scenario River: WF-R8a Reach: 1 Profile: PF# 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear LOB	Shear Chan	Shear ROB
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)	(lb/sq ft)
1	1015.97	PF# 1	753.00	6683.00	6685.51	6685.35	6686.10	0.010298	8.67	143.03	87.96	0.97	0.95	1.61	0.95
1	1015.4	PF# 1	753.00	6682.00	6684.75	6684.75	6685.49	0.011127	9.46	134.27	83.93	1.02	0.98	1.87	0.98
1	1015.02	PF# 1	753.00	6679.00	6680.69	6681.63	6684.18	0.088569	19.23	62.17	61.97	2.65	4.69	9.08	4.69
1	1014.2	PF# 1	753.00	6679.00	6681.20	6681.20	6681.90	0.014473	9.45	130.18	88.72	1.12	1.22	1.99	1.22
1	1013.8	PF# 1	753.00	6675.00	6677.18	6678.05	6680.31	0.056049	17.72	71.70	70.93	2.18	2.79	7.16	2.79
1	1012.9	PF# 1	753.00	6675.00	6677.19	6677.19	6677.91	0.014796	9.52	129.15	88.48	1.13	1.24	2.02	1.24
1	1012.5	PF# 1	753.00	6672.00	6675.63	6674.23	6675.79	0.001856	4.72	270.12	114.11	0.44	0.26	0.42	0.25
1	1012	PF# 1	753.00	6671.00	6675.59	6673.64	6675.72	0.001100	4.23	312.08	113.95	0.35	0.18	0.31	0.17
1	1011.6	PF# 1	753.00	6670.15	6675.21	6673.60	6675.62	0.002228	6.46	178.01	53.10	0.51	0.41	0.70	0.36
1	1011.1		Culvert												
1	1010.4	PF# 1	753.00	6668.99	6671.29	6672.29	6674.38	0.043528	16.89	65.30	44.18	1.96	3.12	6.26	3.18
1	1010	PF# 1	753.00	6669.00	6671.32	6671.61	6672.48	0.020616	11.60	105.26	72.79	1.35	1.60	2.95	1.68
1	1009	PF# 1	753.00	6668.00	6670.81	6670.40	6671.26	0.006738	7.56	165.65	92.00	0.80	0.70	1.18	0.69
1	1007	PF# 1	753.00	6667.00	6669.23	6669.23	6669.94	0.014197	9.44	130.33	87.97	1.11	1.21	1.98	1.21
1	1006.8	PF# 1	753.00	6664.00	6665.41	6666.17	6668.39	0.101500	18.57	65.25	72.18	2.76	5.09	8.91	5.09
1	1006	PF# 1	753.00	6663.00	6665.96	6665.20	6666.24	0.004098	6.13	204.91	104.45	0.63	0.47	0.76	0.47
1	1005	PF# 1	753.00	6662.00	6665.72	6664.44	6665.92	0.002162	5.18	248.74	106.75	0.47	0.29	0.50	0.29
1	1004.5	PF# 1	753.00	6660.73	6665.36	6664.00	6665.77	0.002621	6.61	176.69	57.79	0.54	0.41	0.76	0.44
1	1004		Culvert												
1	1003.3	PF# 1	753.00	6660.12	6663.91	6663.23	6664.36	0.004159	7.28	177.09	82.85	0.66	0.49	0.98	0.47
1	1003	PF# 1	753.00	6660.00	6663.39	6663.26	6664.16	0.008748	9.36	138.19	80.78	0.92	0.79	1.73	0.79
1	1002	PF# 1	753.00	6660.00	6663.10	6662.38	6663.42	0.004289	6.45	196.20	98.93	0.65	0.49	0.83	0.49
1	1001	PF# 1	753.00	6659.00	6662.30	6662.09	6662.85	0.006822	8.22	160.79	93.05	0.82	0.64	1.34	0.64
1	1000	PF# 1	753.00	6659.00	6661.77	6661.27	6662.15	0.005981	7.06	177.26	97.85	0.75	0.64	1.03	0.61

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.032
.045
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Station (ft)
Legend
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WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
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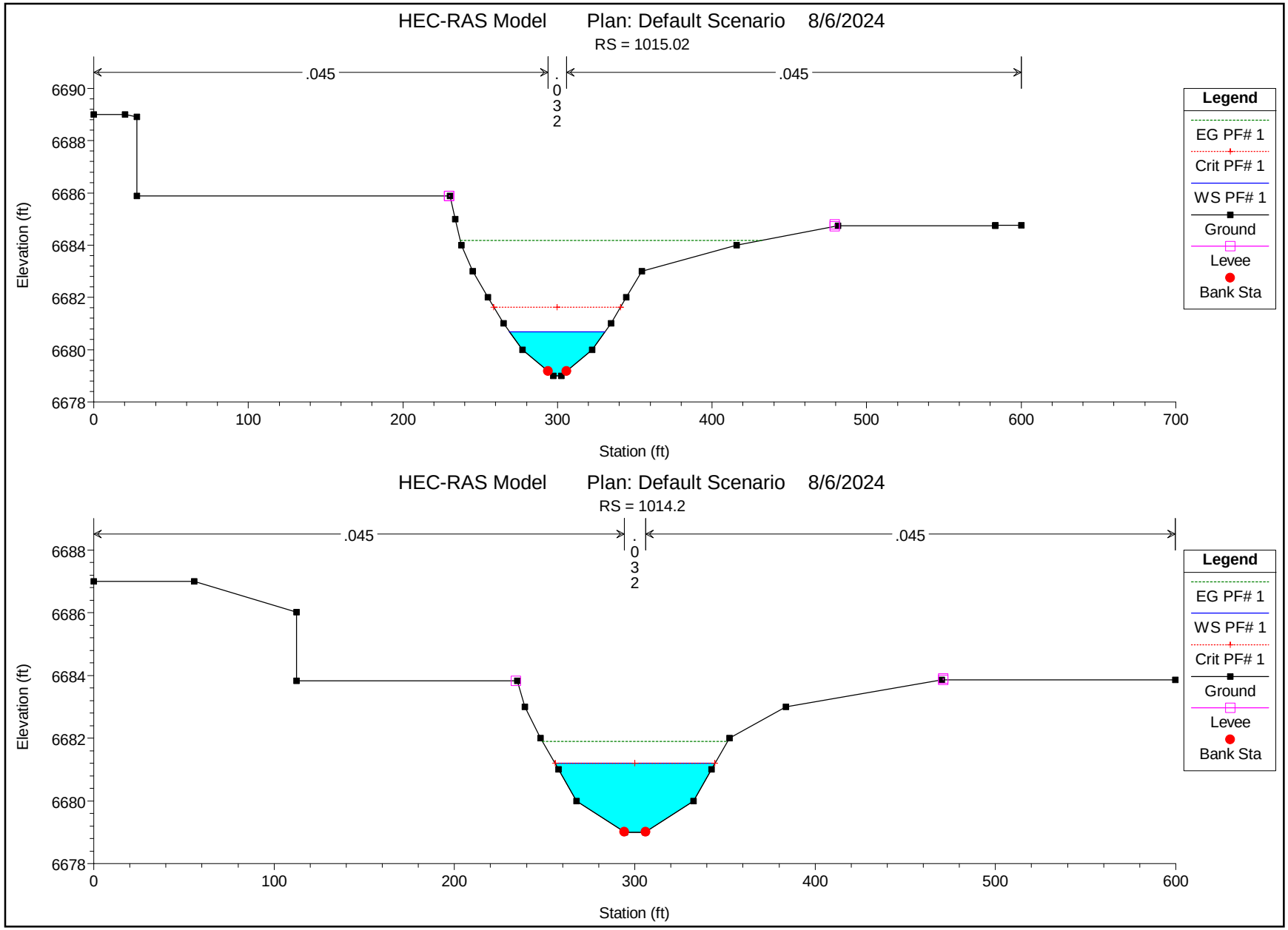
Levee
Bank Sta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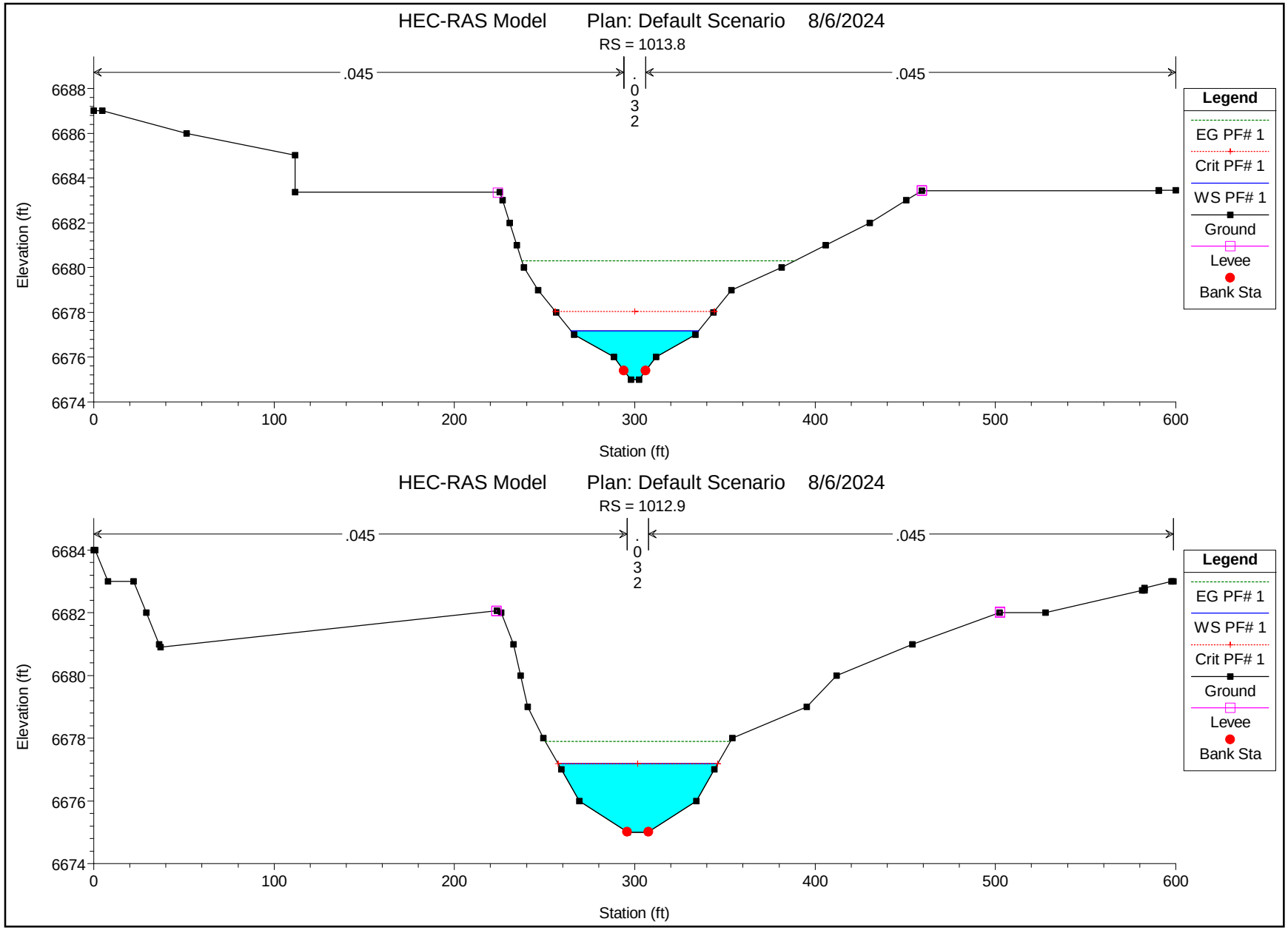
6688
6686
6684
6682
6680
6678
0
100
200
300
400
500
600
700
Station (ft)
Legend
EG PF# 1
Crit PF# 1
WS PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1014.2
.045
.032
.045
Elevation (ft)
6688
6686
6684
6682
6680
6678
0
100
200
300
400
500
600
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta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.032
.045
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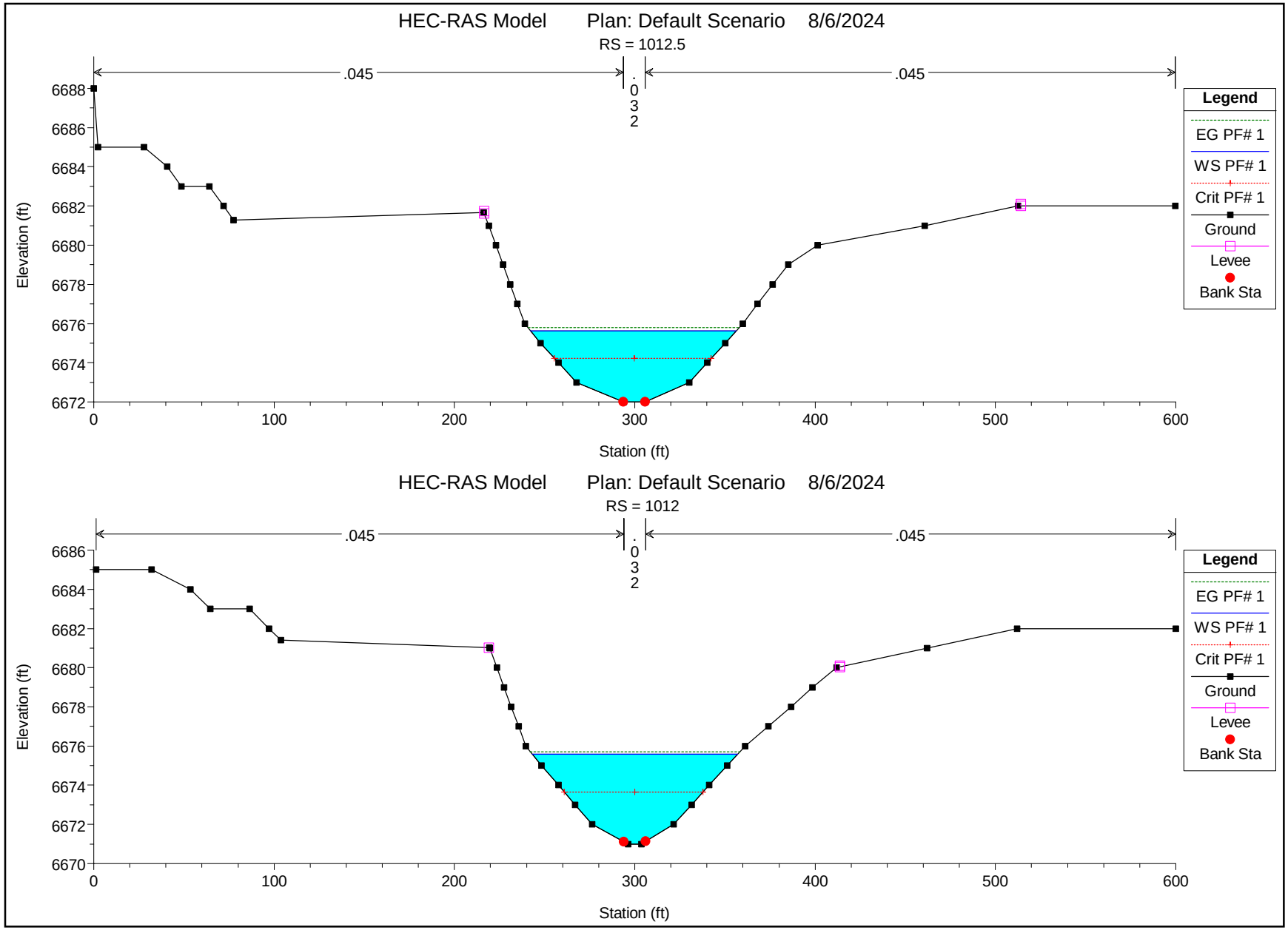
6686
6684
6682
6680
6678
6676
6674
0
100
200
300
400
500
600
Station (ft)
Legend
EG PF# 1
Crit PF# 1
WS PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1012.9
.045
.032
.045
Elevation (ft)
6684
6682
6680
6678
6676
6674
0
100
200
300
400
500
600
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta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.032
.045
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Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
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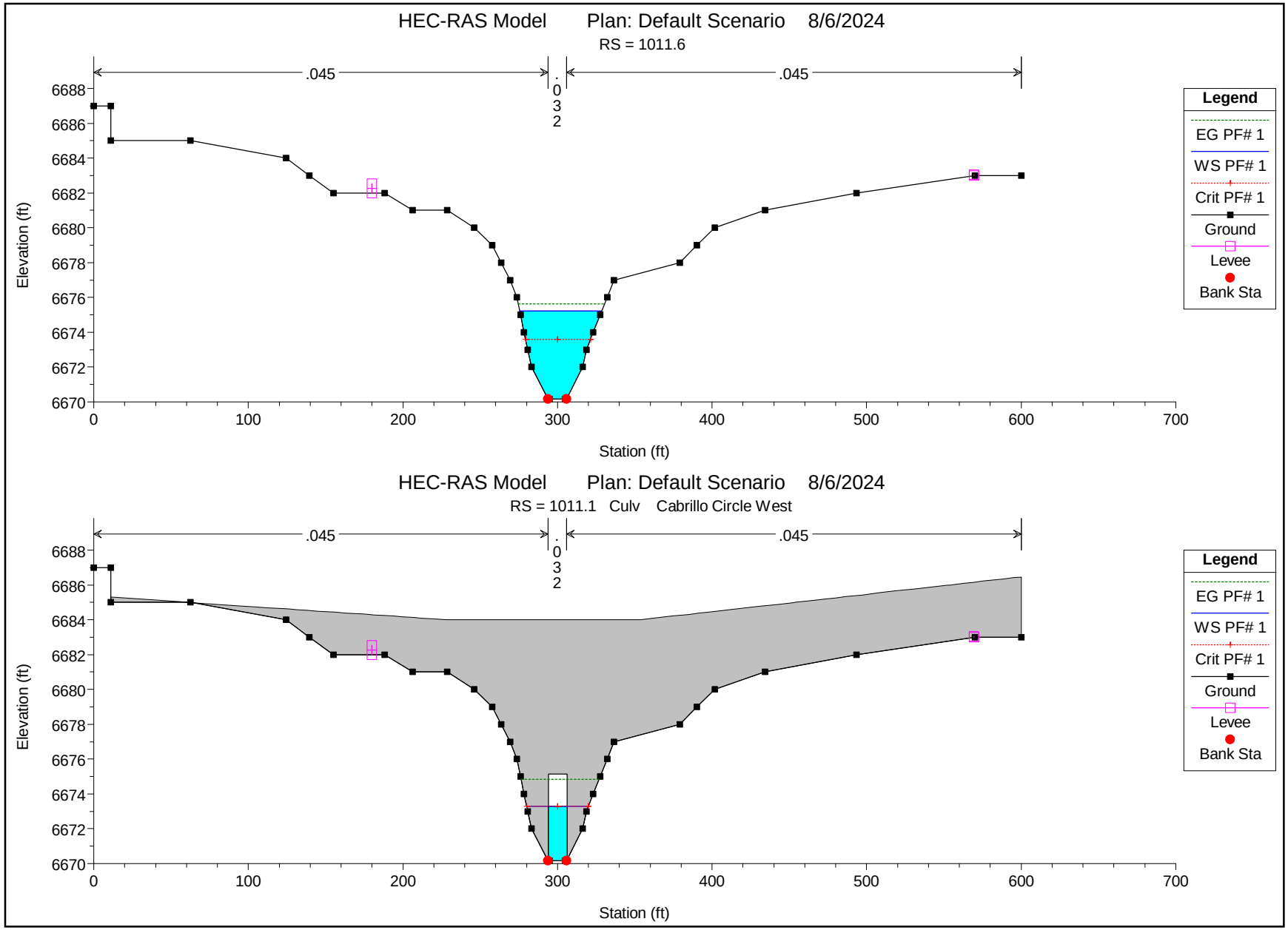
Elevation (ft)
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta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.045
.032
Elevation (ft)
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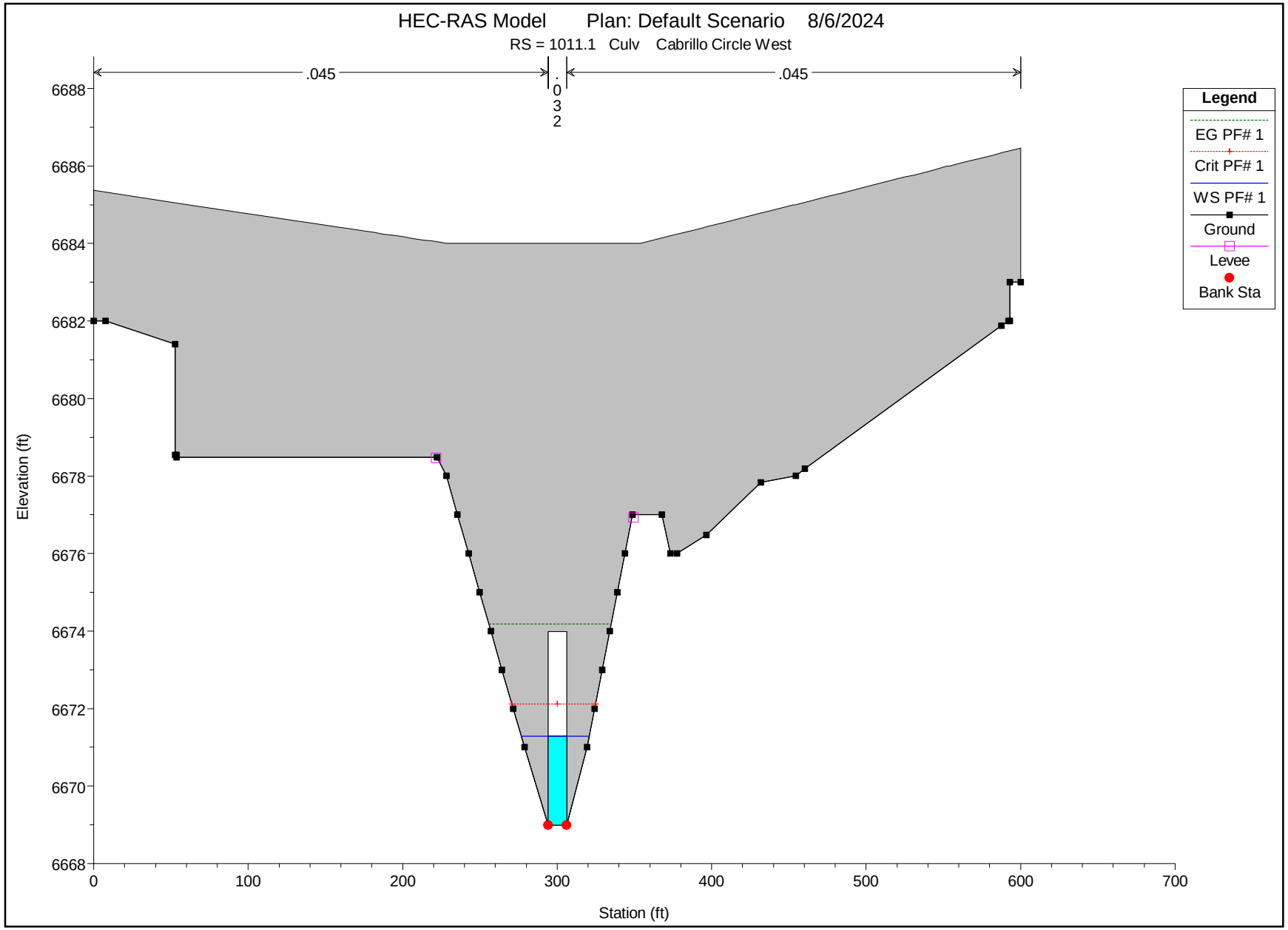
6686
6684
6682
6680
6678
6676
6674
6672
6670
0
100
200
300
400
500
600
700
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1011.1 Culv Cabrillo Circle West
.045
.045
.032
Elevation (ft)
6688
6686
6684
6682
6680
6678
6676
6674
6672
6670
0
100
200
300
400
500
600
700
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta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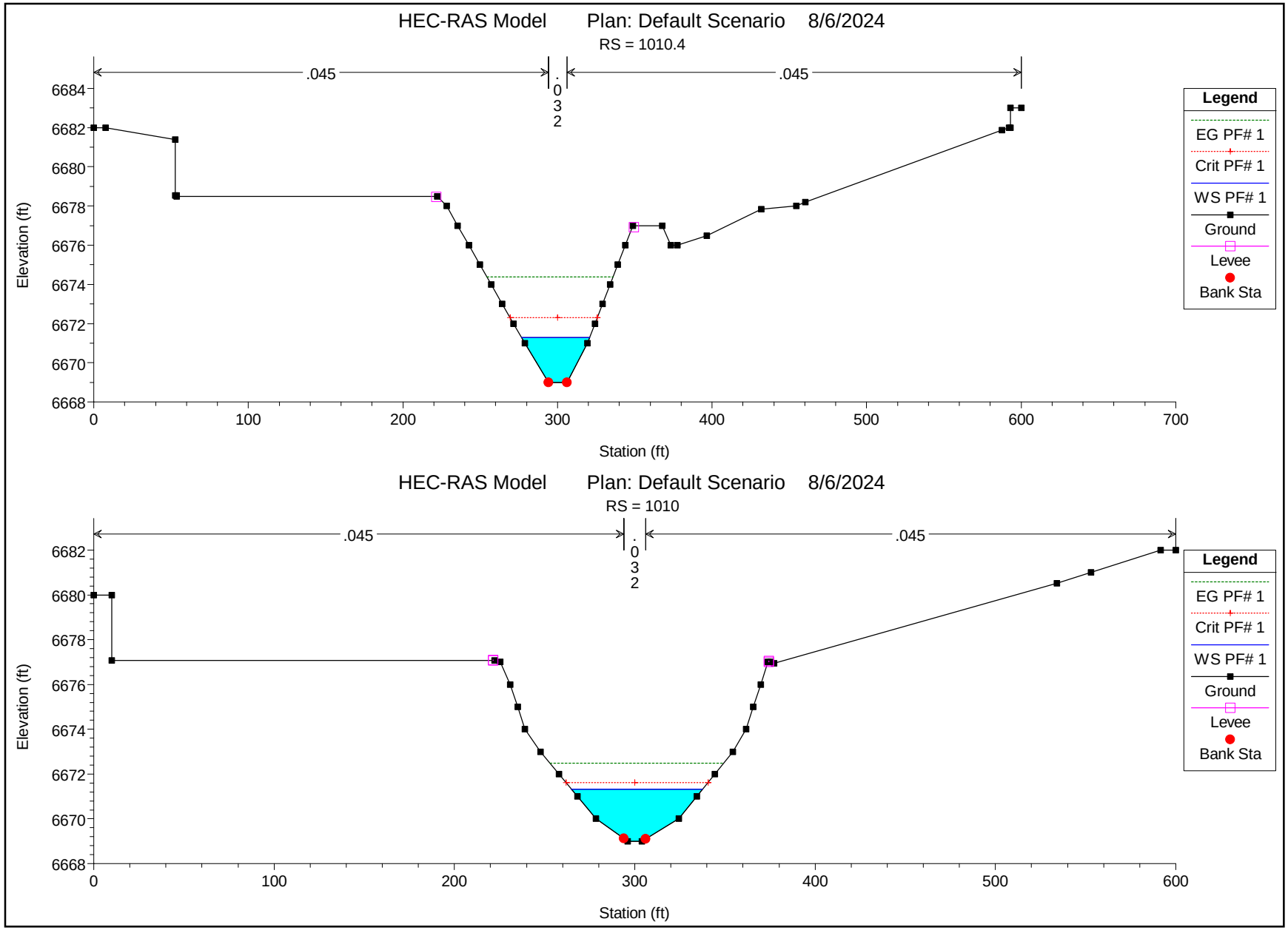
.045
.032
.045
Legend
EG PF# 1
Crit PF# 1
WS PF# 1
Ground
Levee
Bank Sta
Elevation (ft)
6688
6686
6684
6682
6680
6678
6676
6674
6672
6670
6668
0
100
200
300
400
500
600
700
Station (ft)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.032
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Station (ft)
Legend
EG PF# 1
Crit PF# 1
WS PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
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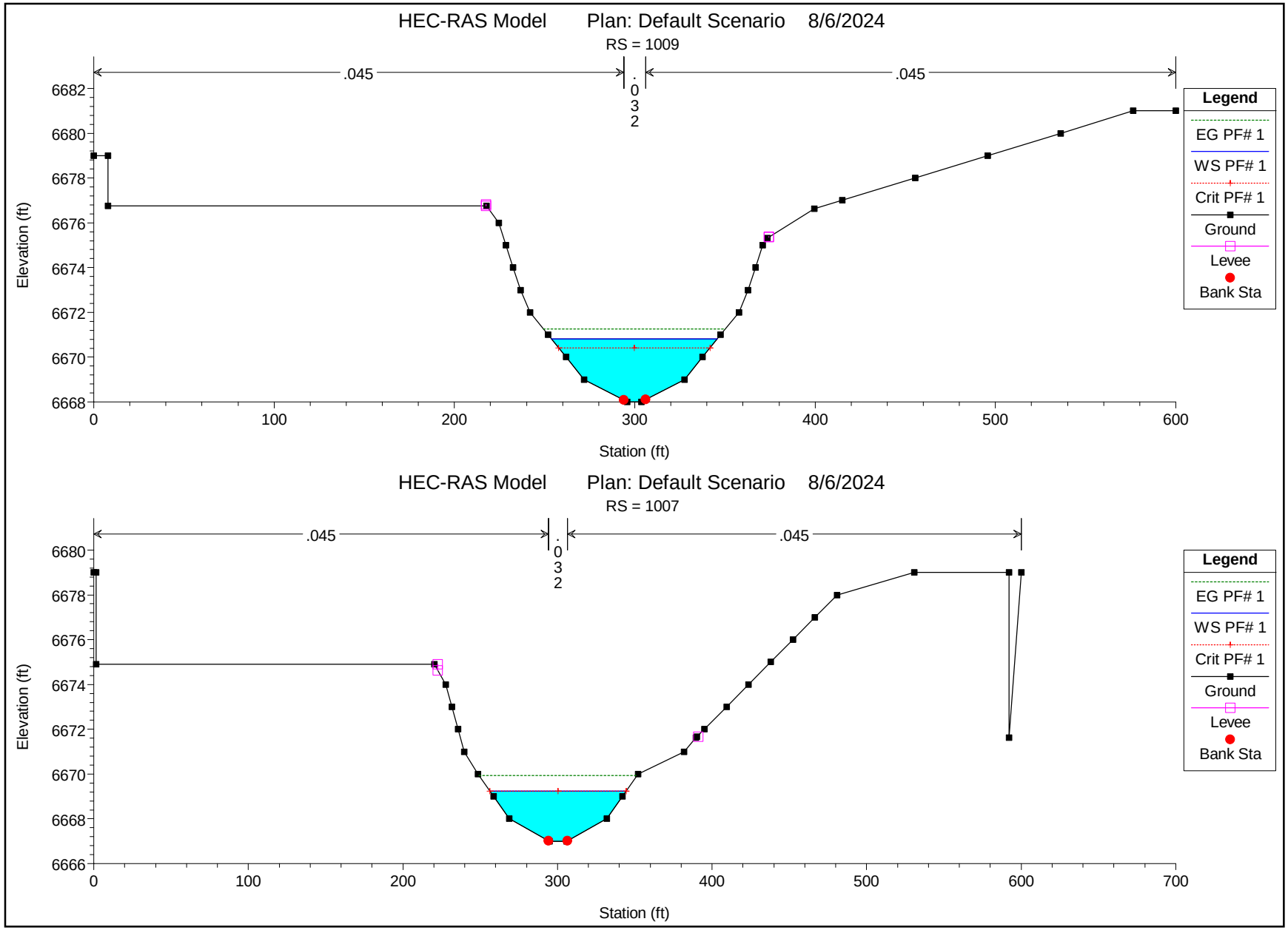
Elevation (ft)
Station (ft)
Legend
EG PF# 1
Crit PF# 1
WS PF# 1
Ground
Levee
Bank Sta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.045
.032
.045
Elevation (ft)
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1007
.045
.032
.045
Elevation (ft)
Station (ft)
Legend
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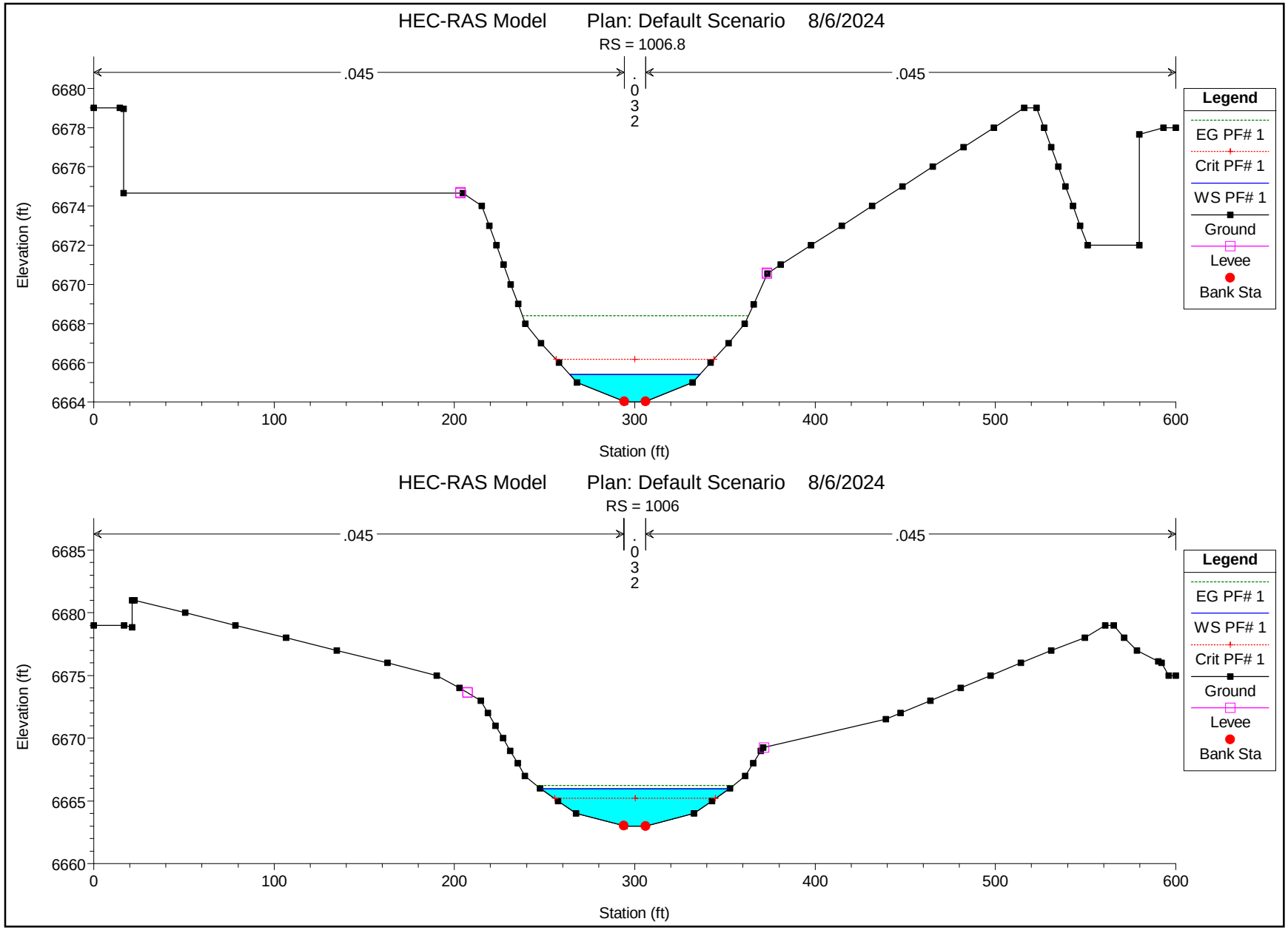
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta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.045
.032
.045
Elevation (ft)
Station (ft)
Legend
EG PF# 1
Crit PF# 1
WS PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1006
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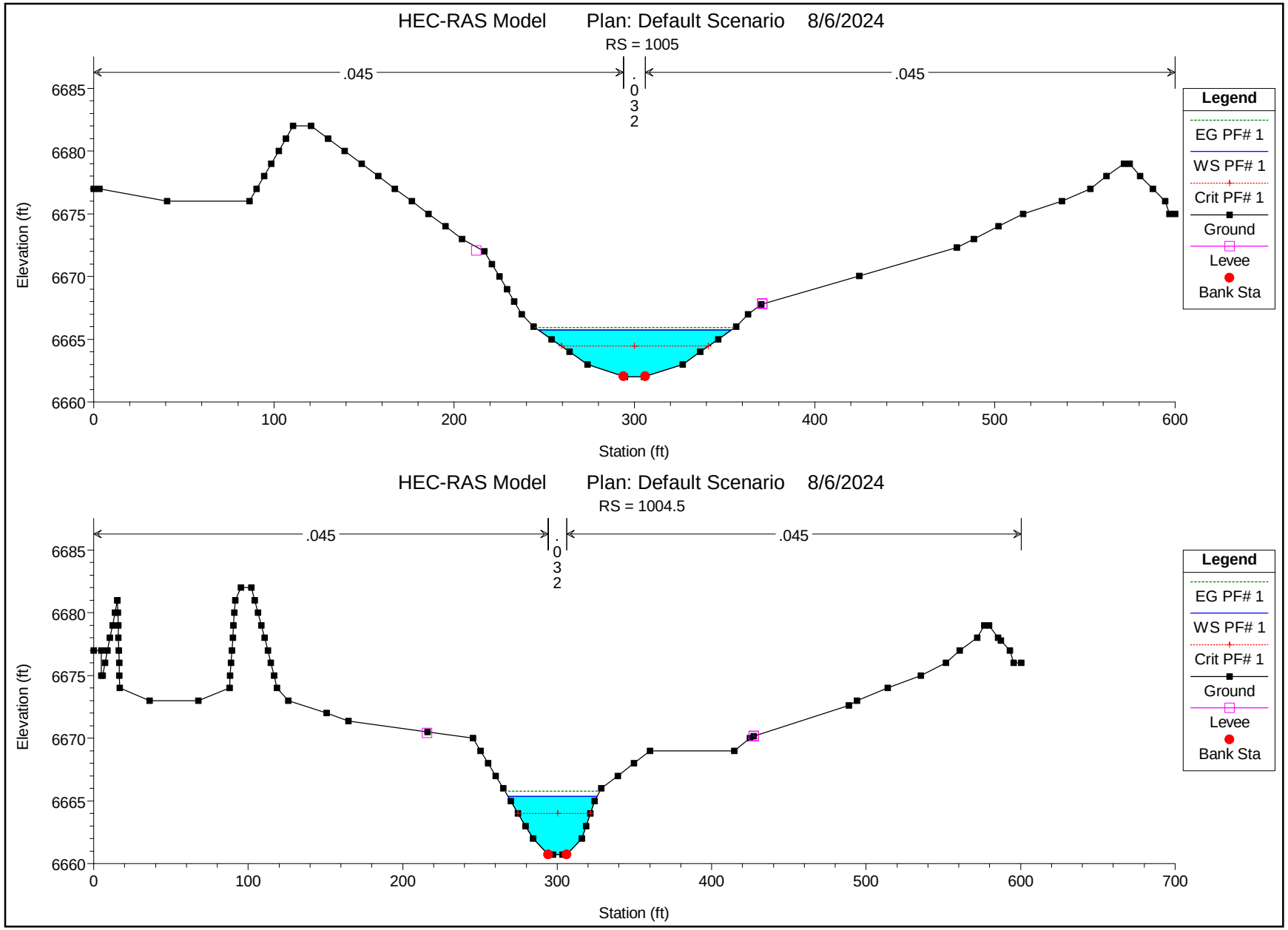
.032
.045
Elevation (ft)
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta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.032
.045
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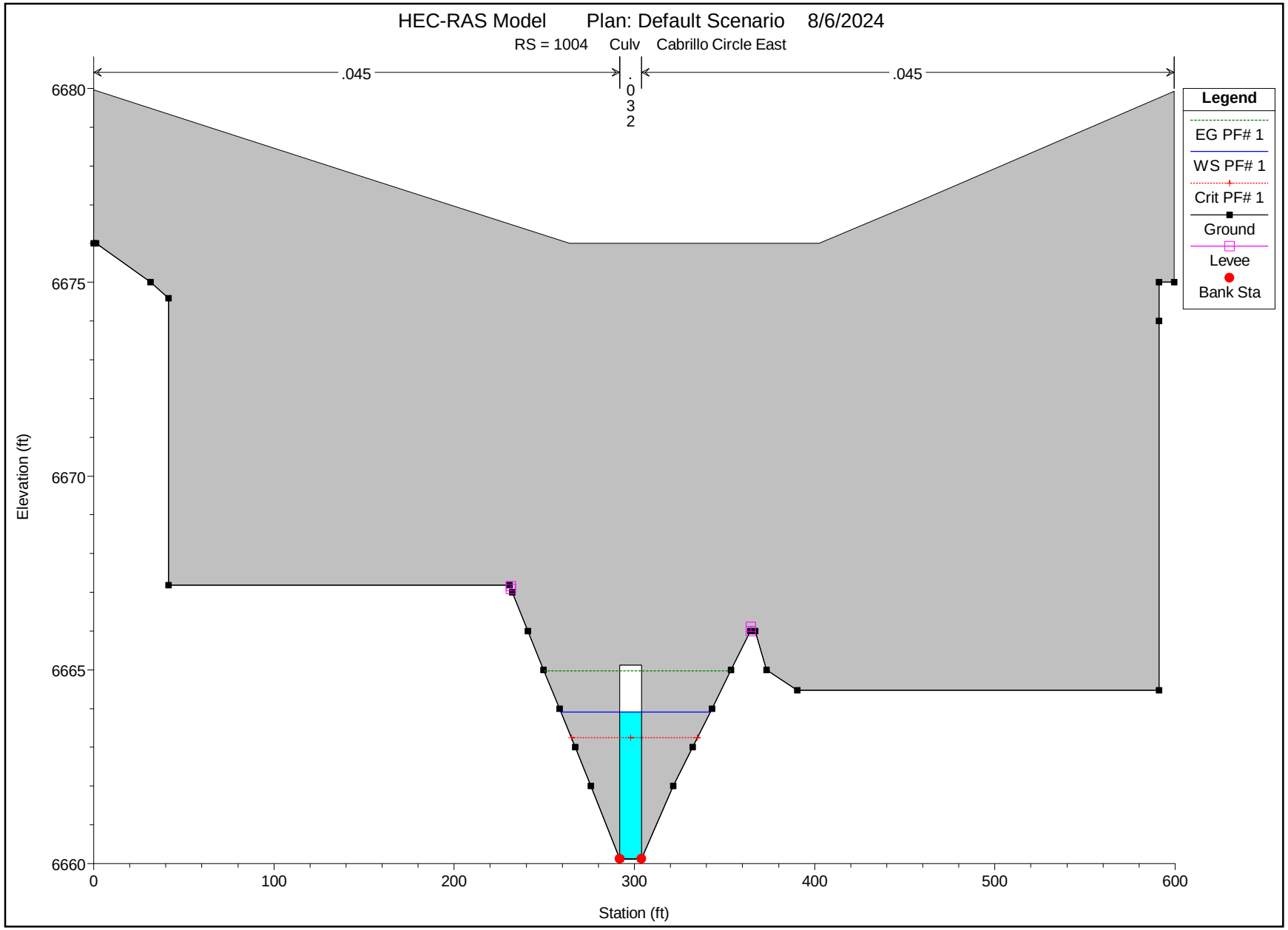
6680
6675
6670
6665
6660
0
100
200
300
400
500
600
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1004.5
.045
.032
.045
Elevation (ft)
6685
6680
6675
6670
6665
6660
0
100
200
300
400
500
600
700
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta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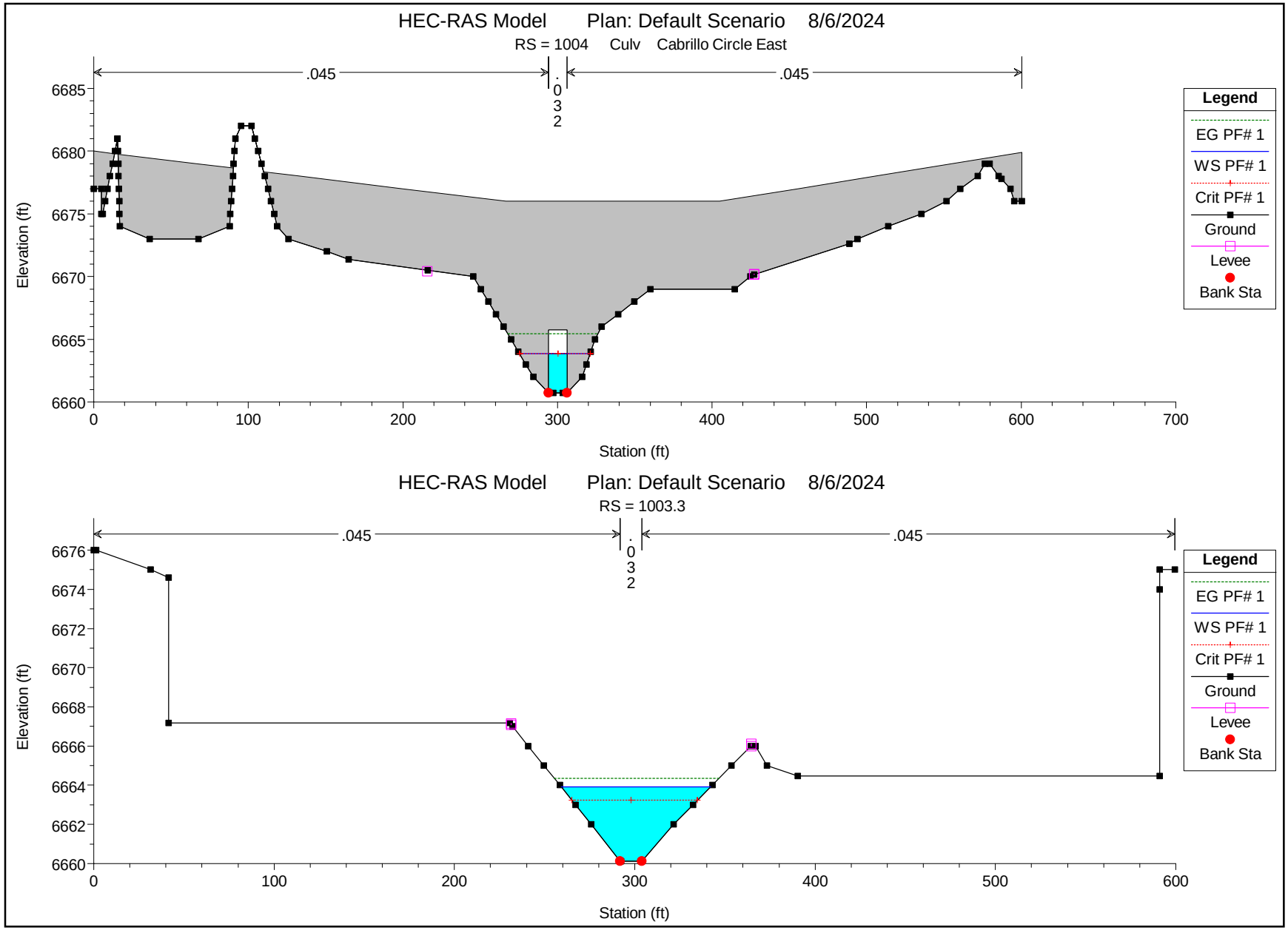
.032
.045
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
Elevation (ft)
6680
6675
6670
6665
6660
0
100
200
300
400
500
600
Station (ft)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.032
.045
Elevation (ft)
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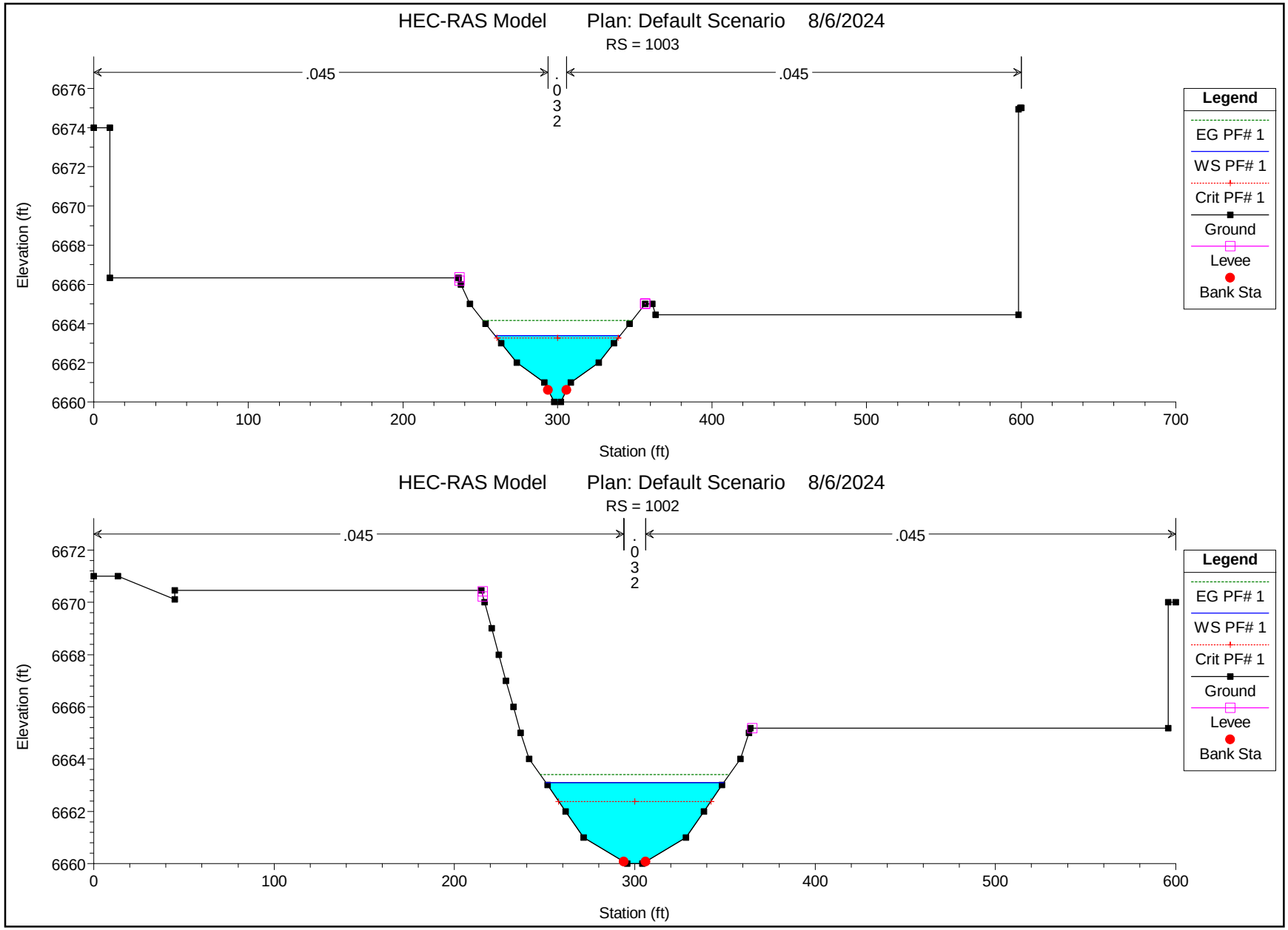
6680
6675
6670
6665
6660
0
100
200
300
400
500
600
700
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1003.3
.045
.032
.045
Elevation (ft)
6676
6674
6672
6670
6668
6666
6664
6662
6660
0
100
200
300
400
500
600
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta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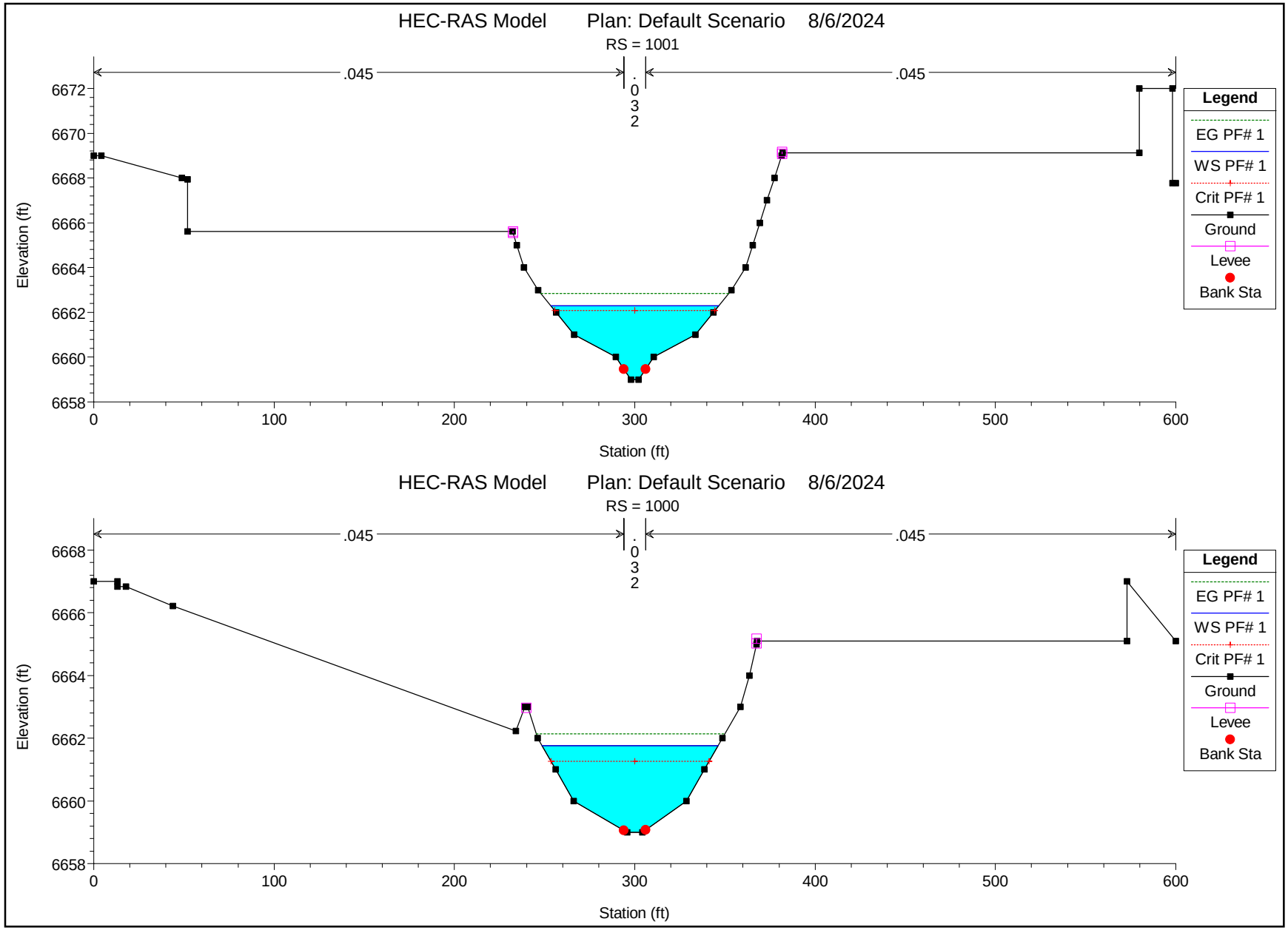
.045
.032
.045
Elevation (ft)
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1002
.045
.032
.045
Elevation (ft)
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta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Elevation (ft)
Station (ft)
Legend
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WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 8/6/2024
RS = 1000
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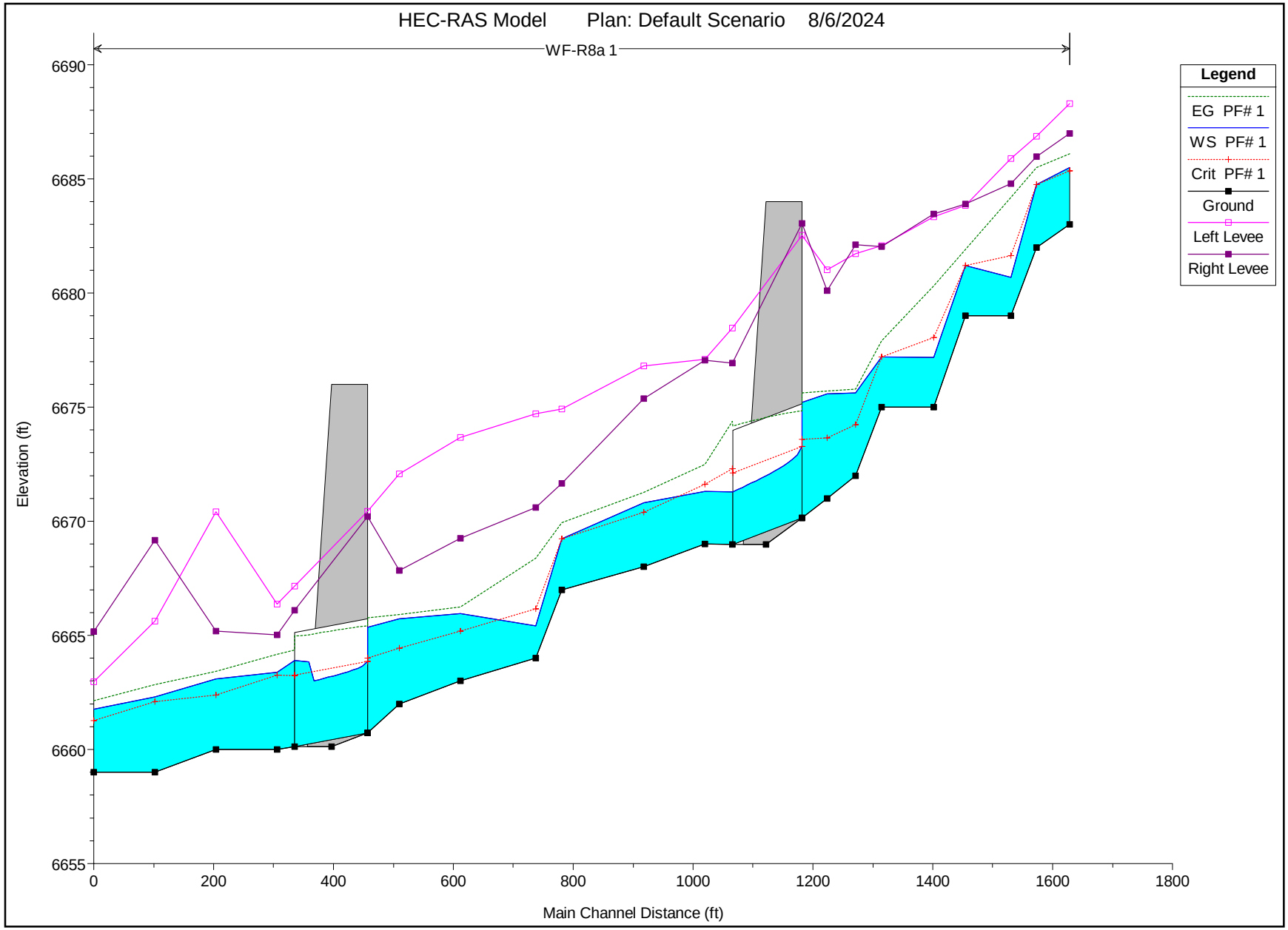
Elevation (ft)
Station (ft)
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Levee
Bank Sta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WF-R8a 1
Legend
EG PF# 1
WS PF# 1
Crit PF# 1
Ground
Left Levee
Right Levee
Elevation (ft)
6690
6685
6680
6675
6670
6665
6660
6655
0
200
400
600
800
1000
1200
1400
1600
1800
Main Channel Distance (ft)

APPENDIX D

REFERENCE MATERIALS

Wetland, Wildlife and Natural Features Report
for
Esteban Rodriguez Subdivision in El Paso County, Colorado

June 19, 2023

Prepared for:

Bill Guman, PLA, ASLA, APA
Willian Guman & Associates, Ltd.
731 North Weber Street
Colorado Springs, CO 80903

Prepared by:

1455 Washburn Street
Erie, Colorado 80516
(p): 970-812-3267

Project Number: 2022-23-1

- The Columbine gravelly sandy loam is not hydric; however, the 1% inclusion of Fluvaquentic Haplaquolls and 1% inclusion of Pleasant soils are both hydric;
- The Fluvaquentic Haplaquolls is hydric; and the 1% inclusion of Haplaquolls soil is hydric as well;
- The Truckton loamy sand, 1 to 9 percent slopes is not hydric and none of the soils types listed as inclusion are hydric;
- The Truckton sandy loam, 0 to 3 percent slopes is not hydric; however, the 2% inclusion of Pleasant soil is hydric

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS, 1994) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

If soils are wet enough for a long enough period of time to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators used to make onsite determinations of hydric soils are specified in *Field Indicators of Hydric Soils in the United States* (USDA, NRCS, 2010).

3.3 Vegetation

3.3.1 Short- and Mixed-grass Prairie

The vegetation within the Site is primarily comprised of herbaceous short-grass prairie species with herbaceous wetland vegetation in the drainages and ephemeral swales flowing through the Site. Given the presence of certain mid-grass prairie species mixed throughout the shortgrass prairie, we have referred to the vegetation community as “short- and mixed-grass prairie” (refer to Figure 4, Vegetation Community Map). The dominant prairie grass species is blue grama (*Bouteloua gracilis*), with occasional little bluestem (*Schizachyrium scoparium*) and Western wheatgrass (*Pascopyrum smithii*). The other most common associative prairie species are prairie aster (*Machaeranthera tenacetifolia*), smooth brome (*Bromus inermis*), fringed sage (*Artemisia frigida*), yucca (*Yucca spp.*) and prickly pear cactus (*Opuntia* sp.). Other species include Wood’s rose (Rosa woodsii), false indigo bush (*Amorpha fruticosa*), sticky geranium (*Geranium viscosissimum*) and yarrow (Achillea millefolium). The Site is moderately grazed and there are scattered weeds, including Canada thistle (*Cirsium arvense*), musk thistle (*Carduus nutans*), Scotch thistle (*Onopordum acanthium*), common mullein (*Verbascum thapsus*), horseweed (*Conyza canadensis*) and field bindweed (*Convolvulus arvensis*).

3.3.2 Hydrophytic Vegetation

Discontinuous patches of hydrophytic vegetation (wetland vegetation) is present within the North-central ephemeral drainage where saturated (hydric) soils are present. Dominant wetland vegetation includes Nebraska sedge (*Carex nebrascensis*), common threesquare bulrush (*Schoenoplectus americanus*) and spikerush (*Eleocharis palustris*) with inclusions of Baltic rush (*Juncus balticus*), water mint (*Mentha aquatica*), narrowleaf cattail (*Typha angustifolia*) and Canada thistle (*Cirsium arvense*). Willow is notably absent. Dominant upland vegetation at the margin of the wetland boundary includes little bluestem and blue grama (*Bouteloua gracilis*), upland grasses, fringed sage and other miscellaneous upland weeds.

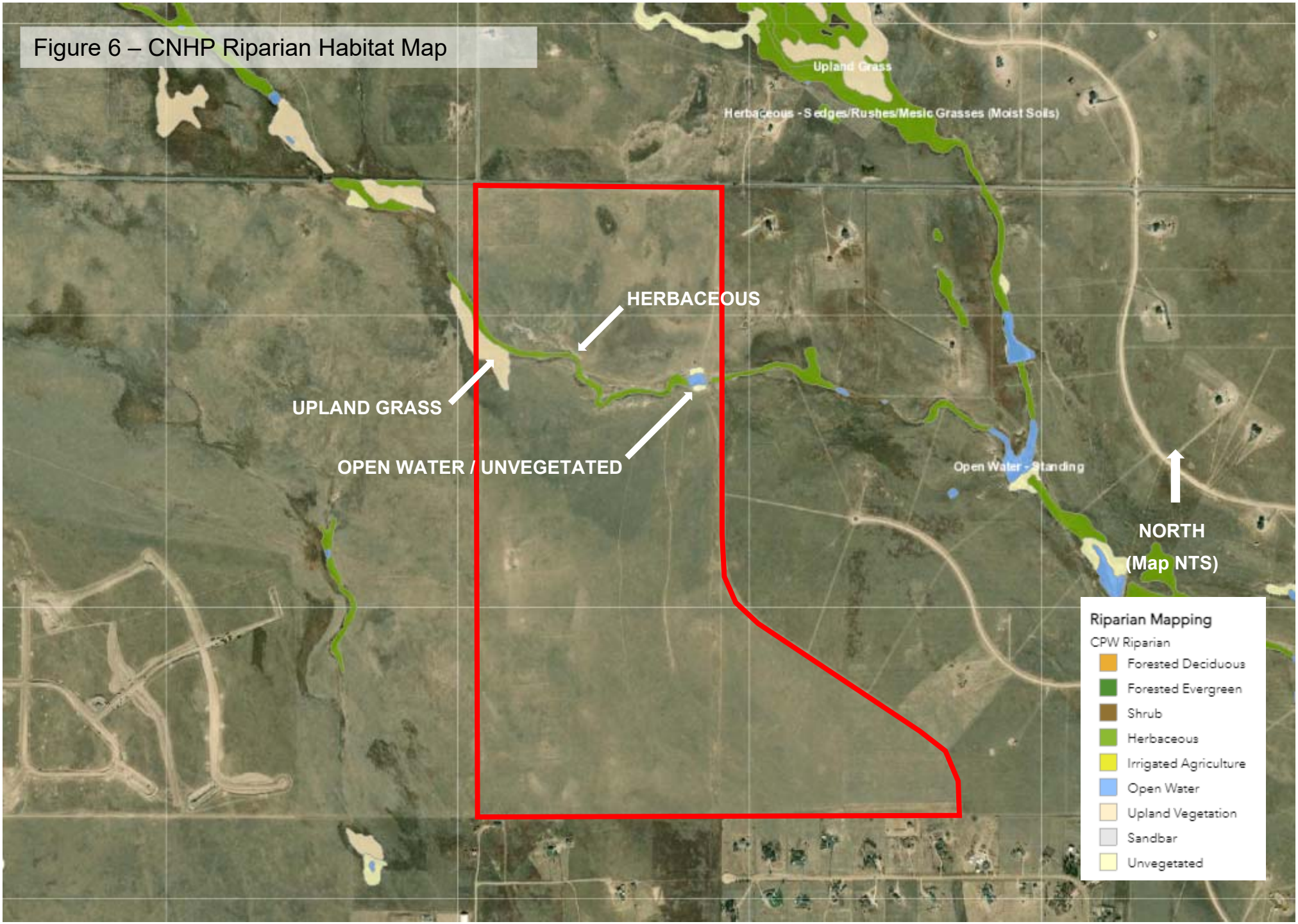
3.3.2 Riparian Vegetation

Riparian habitat within the Site is limited to one singe drainage in the North-central portion of the Site which consists of more robust short-grass prairie where moist, mesic soils are present adjacent to wetlands (described above). This North-central drainage does not support any riparian trees or shrubs.

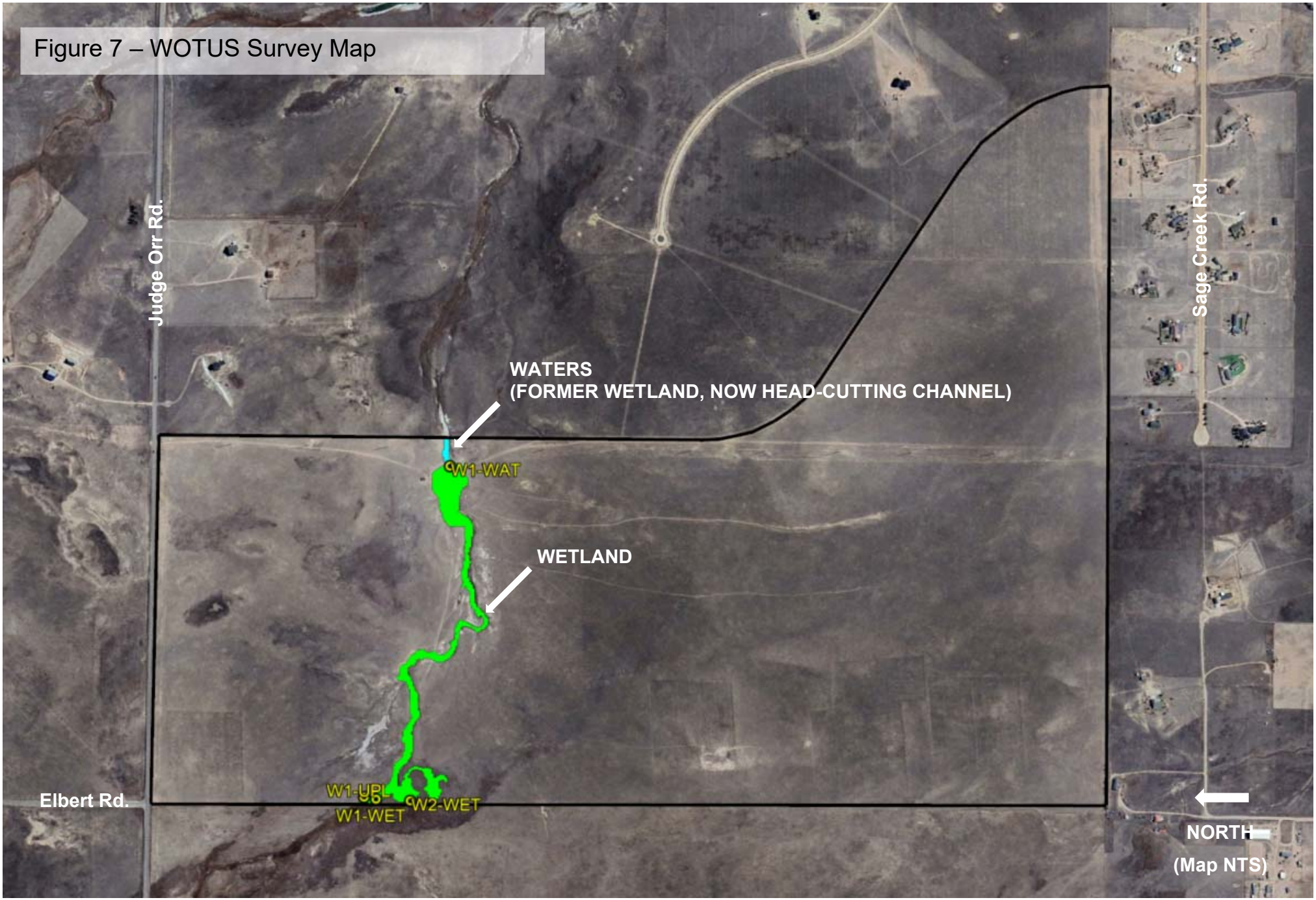
Figure 4 – Vegetation Community Map

Source: Google Earth Aerial Image, 10/31/2022 & Ecosystem Services, LLC Site Assessment, 5/23/2023

Figure 6 – CNHP Riparian Habitat Map



Source: Colorado Natural Heritage Program (CNHP) Wetland Mapper



Source: Google Earth Aerial Image, 10/31/2023 & Ecosystem Services, LLC Wetland Delineation, 5/23/2023

3.5 Wildlife

The stated purpose and intent of the "El Paso County Development Standards" wildlife section is to ensure that proposed development is reviewed with consideration of the impacts to wildlife and wildlife habitat, and to implement the provisions of the Master Plan (El Paso County, 2021). The two primary vegetation types within the Site are herbaceous prairie and wetlands. ECOS has determined that the wildlife impact potential for development of this stand-alone Site is expected to be moderate to low, as the Site currently provides poor to moderate habitat for wildlife. Taken in a regional, watershed or larger landscape context, as more and more prairie is developed over time impacts to wildlife are expected to be moderate to high as wildlife run out of space and habitat.

The Site provides habitat for prairie species such as pronghorn (*Antilocapra americana*), black-tailed prairie dog (*Cynomys ludovicianus*), thirteen-lined ground squirrel (*Ictidomys tridecemlineatus*), voles (*Microtus spp.*) and jackrabbit (*Lepus townsendii*). The Site also provides foraging and breeding habitat for predators such as coyote and fox. The Site also provides good habitat for reptiles and moderate habitat for amphibians such as Woodhouse toad (*Anaxyrus woodhousii*).

The USFWS IPaC Trust Resources Report (USFWS, 2023a) (Appendix B) reports that bald eagle (*Haliaeetus leucocephalus*), golden eagle (*Aquila chrysaetos*) and ferruginous hawk (*Buteo regalis*) may utilize the area. The Site provides limited tree nesting habitat for raptors; however, ferruginous hawks may also use ground nests.

The Site contains no Critical Habitat, Wildlife Refuges or Hatcheries according to the USFWS IPaC Trust Resources Report (USFWS, 2023a) (Appendix B).

The project proposes to develop most of the prairie; however, the drainages and immediately adjacent prairie would be preserved as Open Space. A noxious weed management plan will be implemented per State and County requirements to improve wildlife habitat; and a native plant re-vegetation plan for the Open Space is recommended to provide additional benefit to wildlife habitat.

4.0 FEDERAL LISTED SPECIES

A number of species that occur in El Paso County are listed as threatened and endangered (T&E) by the USFWS under the Endangered Species Act (ESA) (USFWS 2023). ECOS compiled the data regarding T&E species for the Site in Table 3 based on the Site-specific, USFWS IPaC Trust Resources Report we ran for the Project (Appendix B) and our onsite assessment. ECOS has provided our professional opinion regarding the probability that these species may occur within the Site and their probability of being impacted by the Project.

The likelihood that the Project would impact any of the species listed below is insignificant to none. Most are not expected occur in the project area and no downstream impacts are expected. The USFWS also states that there is no Critical Habitat for T&E species in the Site locations.

TABLE 3 - FEDERAL LISTED SPECIES POTENTIALLY IMPACTED BY THE PROJECT

Species	Status	Habitat Requirements and Presence	Probability of Impact by Project
FISH			
Greenback cutthroat trout (*Oncorhynchus clarki stomias*)	Threatened	Cold, clear, gravely headwater streams and mountain lakes that provide an abundant food supply of insects.	None. Suitable habitat does not exist on the Site.
Pallid sturgeon (*Scaphirhynchus albus*)	Endangered	Water-related activities/use in the N. Platte, S. Platte and Laramie River Basins may affect listed species in Nebraska.	None. The proposed project will not affect any of the listed river basins.
BIRDS			

5.0 RAPTORS AND MIGRATORY BIRDS

Raptors and most birds are protected by the Colorado Nongame Wildlife Regulations, as well as by the federal Migratory Bird Treaty Act. Additionally, eagles are protected by the Bald and Golden Eagle Protection Act (BGEPA).

5.1 COGCC Database

ECOS utilized the Colorado Oil and Gas Conservation Commissions (COGCC) GIS Online data (https://cogccmap.state.co.us/cogcc_gis_online/) (COGCC, 2023) to screen the Site for potential raptor nests. No raptor nests have been mapped within one mile of the Site (COGCC, 202). The closest raptor nests to the Site are one Golden Eagle active nest and one Ferruginous Hawk active nest, both of which are located 2.39 miles east/northeast of the eastern edge of the Site.

5.2 USFWS IPaC Data

The USFWS IPaC data for the Site indicates the probability of presence of the four bird species (refer to Appendix B) in the vicinity of the Site. The birds listed by IPaC are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in the Project location. The 1988 amendment to the Fish and Wildlife Conservation Act mandates the USFWS to “identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the ESA. "Birds of Conservation Concern 2021 (BCC 2021)" is the most recent effort to carry out this mandate. The birds listed by IPaC include:

- Bald Eagle (*Haliaeetus leucocephalus*) - This is not a BCC but is vulnerable and warrants attention because of the BGEPA.
- Ferruginous Hawk (*Buteo regalis*) - This is a BCC only in particular Bird Conservation Regions (BCRs) including Colorado. Per the USFWS Environmental Conservation Online System data (USFWS 2022b) (https://ecos.fws.gov/ecp/species/6038), ideal habitat for Ferruginous Hawks is grassland and shrub-steppe habitat including pastures, hayland and cropland. Their nests can be found in trees and large shrubs and on roofs, utility structures and artificial platforms, or near the ground on river cutbanks, or less frequently other ground locations such as rockpiles and riverbed mounds. ECOS has observed their nests open prairie habitat in this vicinity.
- Long-eared Owl (*Asio otus*) - This is a BCC throughout its range in the continental USA and Alaska. Per the USFWS Per the Nature Serve Explorer database (Nature Serve 2022) (https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.101120/Asio_otus) this species habitat is deciduous and evergreen forests, orchards, wooded parks, farm woodlots, river woods, desert oases. Wooded areas with dense vegetation needed for roosting and nesting, open areas for hunting; therefore, it is often associated with deciduous woods near water

in West. The Site does not comprise suitable habitat for roosting and nesting for this species but may provide hunting opportunities. However, the probability of presence in the Project vicinity is limited to the 2nd week of May.

5.3 Field Assessment

The prairie, riparian corridors and wetland habitat provides ground-nesting and foraging habitat for migratory birds such as western meadowlark (*Sturnella neglecta*). No existing nest sites or prairie dog burrows for raptors, including burrowing owl were found during the Site visit.

6.0 SUMMARY OF IMPACTS

6.1 Vegetation

The vegetation within the Site is primarily comprised of herbaceous shortgrass prairie species. Given the presence of certain tallgrass prairie and non-native species mixed throughout the shortgrass prairie, we have referred to the vegetation community as “short- and mixed-grass prairie”. Wetland vegetation is comprised primarily of emergent, herbaceous, hydrophytic species in the ephemeral drainages and swales. Riparian habitat within the Site is comprised of upland grassland, herbaceous wetland species with small pockets of shallow open water. Refer to Figure 6, CNHP Riparian Habitat Map. Trees and shrubs are ~~primarily~~ absent. Refer to Figure 4, Vegetation Community Map.

The short and mixed grass prairie will be the primary vegetation/habitat type impacted by the proposed development. The proposed residential parcels are all planned to be low-density. Tthat should provide ample opportunity to preserve high quality, native habitat within private lots if building envelopes/disturbance footprints are limited. Parcel J, the only park proposed, will have no value for wildlife if isolated within a sea of housing and if completely developed for tot-lots, field sports, etc. If, however, it were to be located adjacent to the North-Central drainage floodplain and some portions of it were preserved as native habitat, this park would provide open space functions for wildlife and feel more expansive. The proposed Commercial parcels and the internal road system will have a maximum impact on short and mixed grass prairie (e.g., 100% of area beneath their footprint). The three Detention Ponds will result in the loss/impact primarily of short and mixed grass prairie. The Parcel E Detention Pond stormwater outfall will likely cause minor impacts to wetland habitat where it feeds into the North-Central drainage. Detention Pond impacts could be temporary and mitigated if prairie, riparian and wetland habitat are restored after construction.

In addition to preserving the highest value existing native vegetation on public and private open space, in order to reduce overall direct impacts from the development, proposed landscaping (private and public) should consist of native species from the same ecosystem that provide food and cover for wildlife. High, solid fences if proposed are a major impediment and impact wildlife movement through the landscape. Short, wildlife friendly fences that allow large and small

species to move freely are recommended wherever fences are desired which will allow future residents to enjoy wildlife experiences in their everyday lives.

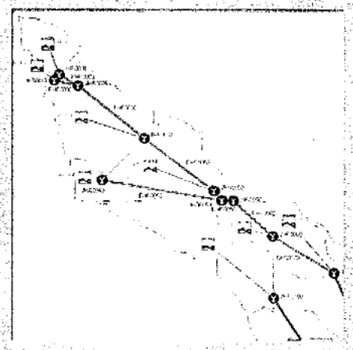
Over 80 percent of all wildlife species use riparian areas during some part of their life cycle. As such, floodplains, riparian areas including wetlands that together form linear natural corridors (i.e., greenways) should not be impacted by development and left intact. If necessary, road, trail and utility corridors (i.e., crossings) that must cut through riparian areas should be avoided or minimized to only a few locations where the riparian corridor are the narrowest and wetlands are absent. Any proposed crossings should be designed perpendicular to greenways. Greenways are ideal locations for trails that run parallel with the floodplain/riparian corridor to provide future neighborhood residents with positive natural outdoor and wildlife experiences such as bird watching (i.e., ecological benefits). The layout of the development at a sketch plan level is nebulous regarding the avoidance and minimization of impacts to greenways. During more detailed preliminary and final design, all man-made structures, including detention ponds should avoid impacting riparian areas and wetlands.

The creek channel at the downstream, eastern most end of the North-Central drainage below the stock pond was previously a wet swale. This portion of the creek is head-cutting severely, a result of recent large rainfall events. This headcut is about to completely breach and drain the stock pond and start migrating up the channel. This headcut, if left unaddressed, will completely degrade this valuable aquatic/open space resource, including all abutting wetlands and should be stabilized immediately.

Detention/water quality ponds, where required should be located adjacent to riparian areas and vegetated to the maximum extent possible utilizing native riparian and wetland vegetation in the pond bottoms; upland grasses, shrubs and trees along side-slopes, spillways and run-downs to expand riparian habitat for wildlife. Outfall structures from detention ponds with scour aprons are typically designed to extend into and impact wetlands and stream beds. These impacts can be mitigated by locating the outfall outside of riparian and/or wetland habitat then creating a riparian/wetland swale that extends to the receiving stream.

Soils in this region are very sandy and highly permeable which provides ideal conditions for implementing Low Impact Development (LID) systems and practices that mimic natural processes that result in the infiltration, evapotranspiration or use of stormwater throughout a development rather than a waste product. LID practices such as bioretention facilities, wetland swales, rain gardens, rain barrels and permeable pavements implemented throughout the development are recommended to help improve water quality through groundwater infiltration and to reduce and delay the quantity and erosive power of stormwater discharging from traditional single point detention ponds into natural streams.

Ground disturbance /removal of vegetation and exposure of soil instigates the invasion of common and noxious weeds, one of the most detrimental processes to the quality of any kind of habitat. As such, minimization of ground disturbing



Traylor Ranch Basin

Drainage Basin Planning Study

May 2009

El Paso County Colorado Public Works Division EST. 1861

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3.0 AREA DESCRIPTION

The Haegler Ranch (El Paso County Basin Number CHMS0200) is an unnamed tributary to Ellicott Consolidated Drainage Basin unnamed tributary, which is a tributary of Black Squirrel Creek. Haegler Ranch lies in the central portion of El Paso County. Figure 1-1 shows the location of the Haegler Ranch in respect to El Paso County, Colorado. Haegler Ranch Basin is located in Sections 29, 32 and 33 of Township 12 South Range 64 West and sections 2, 3, 4, 9, 10, 11, 12, 13, 14, 15, 22, 23, and 24 of Township 13 South, Range, 64 West and sections 18, 19, 20, 28, 29, 30, 31, 32, 33, and 34 of Township 13 South, Range 63 West and sections 2, 3, and 4 of Township 14 South, Range 63 West.

3.1. Basin Description

The Haegler Ranch flows to the southeast from north of Eastonville Road to McDaniels Road with a total of 16.6 sq mi in unincorporated El Paso County, Colorado. In 2005, approximately 14% of the basin was developed. Mucb of the existing development consists of 2- and 5-acre (ac) residential lots surrounded by open space range land used for agriculture and large parcels with homes south of U.S. Highway 24 (US 24). High-density residential developments are being planned in the northern portions of the basin.

The maximum basin elevation is approximately 7,054 ft in the headwaters and falls to approximately 6,085 ft at the downstream confluence of the basin. The basin is typified by rolling rangeland with poor vegetative cover associated with semi-arid climates.

3.2. Climate

This area of El Paso County can be described as high plains with total precipitation amounts typical of a semi-arid region. Winters are generally cold and dry, while the springs and summer receive a majority of this precipitation in the form of rainfall. The average precipitation ranges from 14 to 16 in. per year. Thunderstorms are common during the summer months and are quick-moving low-pressure cells that draw moisture from the Gulf of Mexico into the region. The County has an average temperature ranging from a low of 14°F in the winter to a high of 81°F in the summer. The relative humidity ranges from 25% in the summer to 45% in the winter (SCS 1981).

3.3. Soils and Geology

Soils within the Haegler Ranch are classified according to the NRCS soil classification system. The predominant soils are in the Blakeland soil series, which consist of deep, somewhat excessively drained soils that formed in sandy alluvium and sediment on uplands. The soil series has high infiltration rates, and are extremely susceptible to wind and water erosion where poor vegetation cover exists. Figure 3-1 shows the soil distribution map for the Haegler Ranch (SCS 1981). The bedrock geology is predominately flat lying sandstone and siltstone, some of which is covered with recent alluvium.

3.4. Property Ownership and Land Use Information

Property ownership along the major drainageways within the Haegler Ranch varies from public to private. Along recent developments, drainage right-of-ways and greenbelts have been dedicated during the development of the adjacent residential and commercial land. A portion of Haegler Ranch has already been developed with 2- and 5-ac residential lots. The drainageways in the lower part of the basin remain under private ownership with no delineated drainage right-of-way or easements. A drainage easement or right-of-way must be granted to the County in order for DOT to perform any recommended improvements.

Roadway and utility easements abutting or crossing the major drainageways occur most frequently in the developed portions of the basin. The locations of roadways were obtained from the El Paso County Major Transportation Corridors Plan dated September 21, 2004 (EPC 2004). The El Paso County Rock Island Trail System runs parallel along the north side of US 24. The trail follows the abandoned Chicago and Rock Island Railroad between Falcon and Peyton, Colorado.

Land use information for the existing and future conditions models was obtained from El Paso County Planning Department in 2005. This information is used in the hydrologic analysis to predict runoff rates and volumes for the purposes of stormwater facility evaluation. The identification of land uses abutting the drainageways is also useful in the identification of feasible plans for stabilization and aesthetic treatment of the basin. Presented in Figure 3-2 and Figure 3-3 are the land use maps used for the evaluation of impervious land densities discussed in Section 4.0. These figures are not intended to reflect the future zoning or land use policies of the County.

3.5. Environmental Analysis

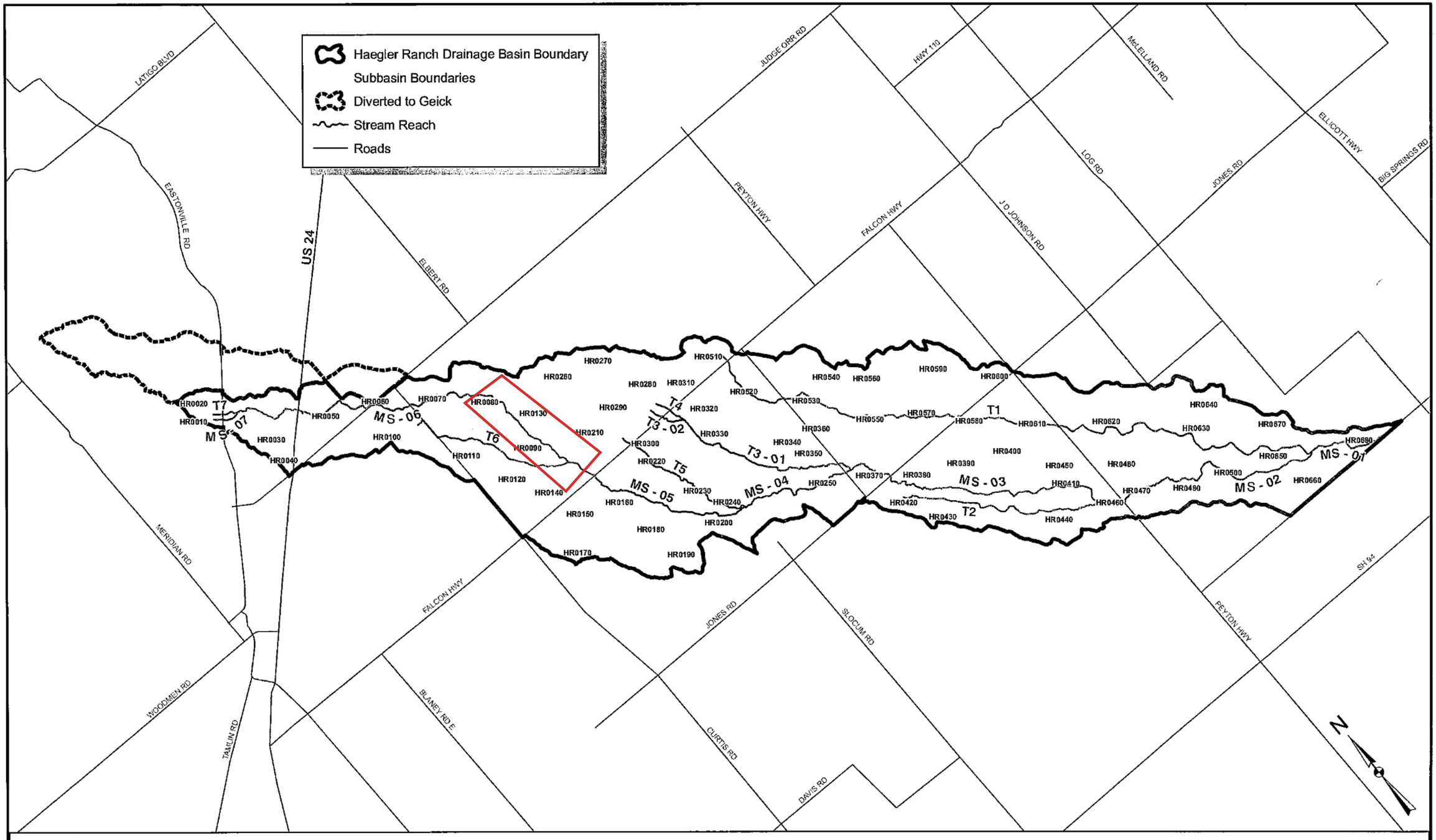
An environmental analysis was conducted for this DBPS to assess the present condition of the biological and environmental resources in the Haegler Ranch. Site visits were conducted to study these elements of the basin. Particular attention was paid to the drainageways and spring/seep areas to determine biological resources in riparian zones and wetlands.

The Haegler Ranch consists of indistinct ephemeral streams that flow after storms for a short period of time. The main stem of Haegler Ranch consists of dry natural grass swales with some poor quality riparian zones and small wetlands in the floodplains. Most of the wetlands surround stock reservoirs and are heavily grazed in some of the rangeland pastures. As a result, the wetlands and riparian drainageways have been degraded in vegetative cover and ecological value. The existing wetlands are neither large nor extensive, and are mostly discontinuous. In their present condition, the wetlands are not a significant habitat resource within the basin. Figure 3-4 and Figure 4-4 show and potential wetlands that may require further study.

Most of the open space is used for agriculture or rangeland. Drainageways have been channelized principally only at roadway crossings. These areas of concentrated flow have defined channels that tend to become indistinct as they flow downstream. Vegetation in the Haegler Ranch in the open space does not vary dramatically. Vegetation patterns generally follow tbe physiographic region of the plains dominated by a short- to mid-height prairie grass with a few shrubs and sporadic trees such as cottonwoods. Wetlands consist of rushes and sedges such as little bluestem, grama grasses, needle and thread and western wbeat grass.

Wildlife and animal species common to the open plains inhabit the basin. They consist of animals that tolerate the presence of roads and people including large and small mammals such as deer, antelope, coyotes and rodents, and several species of birds such as killdeer and red-winged blackbirds. Preliminary review indicates that the DBPS will not affect any threatened or endangered species or critical habitat.

Because of the sensitivity of wetlands, riparian areas, and wildlife to stormwater runoff, sedimentation and erosion should be evaluated and planned for in the alternatives. Wetland and riparian areas provide a habitat resource that should be preserved during the alternative development. These areas can be protected and enhanced to improve ecological value.



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HAEGLER RANCH DRAINAGE BASIN

SUBBASIN DELINEATION
FIGURE 4-1

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- Main Stem (MS-05) – This channel extends from the confluence of the main stem with Tributary 6 north of Falcon Highway in subbasin HR0140 to the confluence of the main stem with Tributary 5 in subbasin HR0200. The channel is a grass swale with one culvert crossing at Falcon Highway.
- Main Stem (MS-06) – This channel extends from the confluence of the main stem with Tributary 7, southeast of Eastonville Road in subbasin HR0030, to the confluence of the main stem with Tributary 6, just north of Falcon Highway in subbasin HR0090. The channel is a grass swale with two culvert crossings, one bridge crossing, and one overtopped roadway at Judge Orr Road.
- Main Stem (MS-07) – This channel extends from subbasin HR0010 northwest of Eastonville Road to the confluence of the main stem with Tributary 7, southeast of Eastonville Road in subbasin HR0030. The channel is a grass swale with one culvert crossing at Eastonville Road.
- Tributary 1 (T1) – This channel extends from subbasin HR0510 just north of Falcon Highway to the confluence of the main stem at subbasin HR0650. The channel is long, dominated by a grass swale with low points along the channel, and has 4 culvert crossings.
- Tributary 2 (T2) – This channel extends from subbasin HR0420 just south of Jones Road to the confluence of the main stem at subbasin HR0440 to the northwest of Peyton Highway. The channel is parallel to MS-03, and varies between a grass swale and an alluvial sand bed channel with diversion structures such as pond embankments and berms.
- Tributary 3 (T3-01) – This channel extends from subbasin HR0330 at the confluence with Tributary 4, just south of Falcon Highway, to the confluence with the main stem east of Murr Road, at subbasin HR0360. The channel is a grass swale with two culvert crossings in a large lot residential development.
- Tributary 3 (T3-02) – This channel extends from subbasin HR0290 just north of Falcon Highway to the confluence with Tributary 4, just south of Falcon Highway, in subbasin HR0300. The channel is a grass swale with one culvert crossing at Falcon Highway.
- Tributary 4 (T4) – This channel extends from subbasin HR0280 north of Falcon Highway to the confluence with Tributary 3, just south of Falcon Highway, in subbasin HR0300. The channel is a grass swale with one culvert crossing at Falcon Highway.
- Tributary 5 (T5) – This channel extends from subbasin HR0210 just north of Falcon Highway to to the confluence with the main stem in subbasin HR0230. The channel is a grass swale with one culvert crossing at Falcon Highway.
- Tributary 6 (T6) – This channel extends from subbasin HR0100 west of Curtis Road to the confluence of the main stem north of Falcon Highway in subbasin HR0120. The channel is a grass swale with one culvert crossing at Curtis Road.
- Tributary 7 (T7) – Tbis cbannel extends from subbasin HR0020 northwest of Eastonville Road to the confluence of the main stem, southeast of Eastonville Road, in subbasin HR0030. The channel is a grass swale with one culvert crossing at Eastonville Road.

5.6. Manning's Roughness Coefficients

Manning's roughness coefficients for each cross-section were estimated based on site visits and aerial photographs. Multiple Manning's roughness coefficients were used across the cross-section as necessary to accurately describe cbanges in vegetative cover between the main channel and overbank areas. The values for the Manning's roughness coefficients in the channel and the floodplains are taken from the Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Floodplains by the USGS (WSP 2339). This manual was used since the Manning's roughness coefficients can be adjusted for surface irregularities, variation in cross-sections, obstructions, vegetation, and meandering. The Manning's roughness coefficients for the channels and floodplains associated with different types of land cover are summarized in Table 5-1.

Table 5-1 Manning's Roughness Coefficients for the Haegler Ranch Drainage Basin

Land Surface Type	Manning's Roughness Coefficients
Channel	
Grass swale	0.055
Grass-lined ditch	0.032
Sand bed	0.025
Floodplain	
Grass	0.065
Trees	0.150
Light Brush	0.074
Brush	0.100
Earth	0.038
Asphalt / Concrete	0.020

Notes:
[1]Source: Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Floodplains by the USGS (WSP 2339)

5.7. Cross-sections

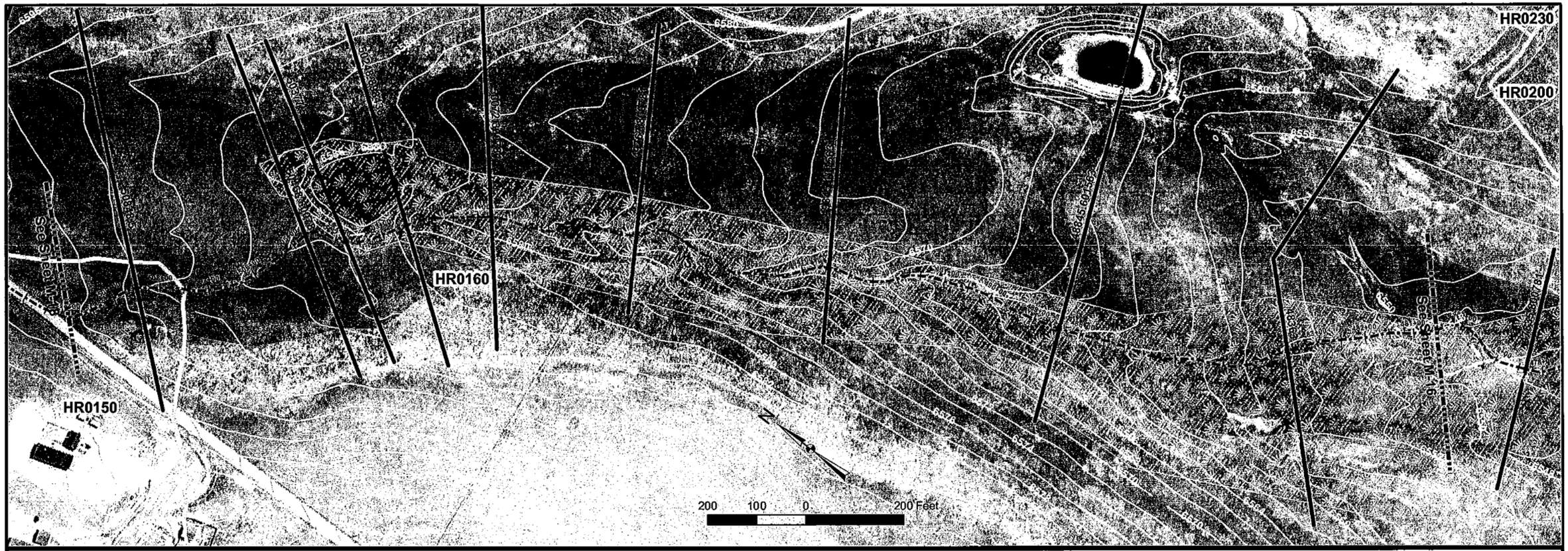
Hydraulic cross-sections were initially placed approximately 500-ft apart along reaches, and additional cross-sections were added to represent confluences, road crossings and changes in channel form. Cross-sections were automatically stationed from downstream to upstream along the reacb. Each cross-section was adjusted to extend across the entire floodplain and was placed perpendicular to the anticipated direction of flow in both the main channel and left/right overbanks. The cross-sections were bent in some locations to meet this requirement, as described in Chapter 3 of HEC-RAS Hydraulic Reference Manual (Version 3.1, November 2002).

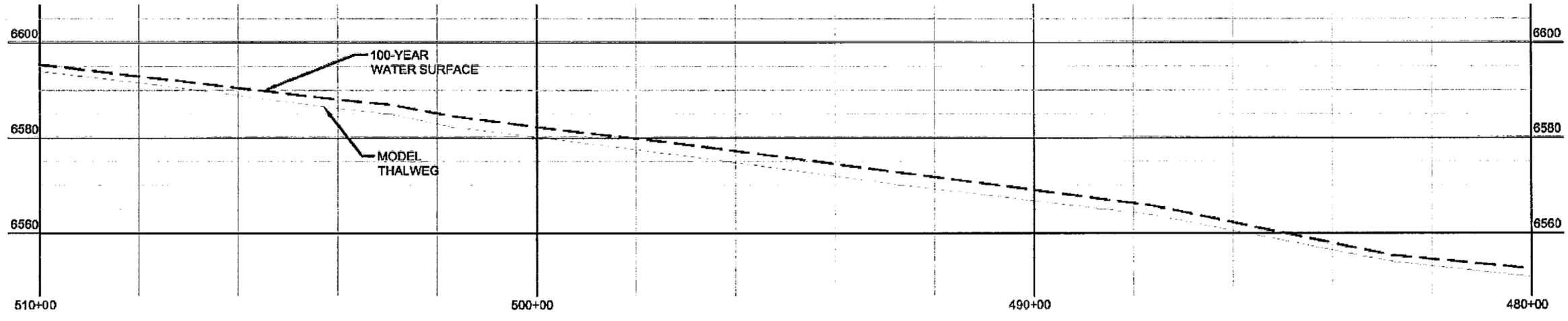
Additional cross-sections were added at structures such as bridges and culverts. At eacb structure, four cross-sections were added to the HEC-RAS model. These four cross-sections included an upstream cross-section prior to flow contraction, a cross-section at the upstream face of the structure, a cross-section at the downstream face of the structure, and a downstream cross-section where flow is fully expanded. All bridge and culvert crossings were field surveyed to determine their size, inverts, and material.

Expansion and contraction coefficients were estimated based on the ratio of expansion and contraction of the effective flow area in the floodplain occurring at cross-sections and at roadway crossings. For subcritical flow conditions and wbere tbe change in the stream cross-section was gradual, contraction and expansion coefficients of 0.1 and 0.3, respectively, were used. Wherever the change in effective

Table 5-4 Existing Conditions HEC-RAS Model

Key Location	Reach and Station	HEC-RAS Result	Recurrence Intervals			
			2-yr	5-yr	10-yr	100-yr
Main stem at US 24	MS-06 72276	Channel velocity (ft/sec)	1.1	1.63	1.98	2.92
		Water surface depth in channel (ft)	1.36	2.44	3.24	6.49
		Top width (ft)	18.23	24.85	29.7	255.62
Main stem at Judge Orr Road	MS-06 67666	Channel velocity (ft/sec)	3.33	4.09	1.76	3.48
		Water surface depth in channel (ft)	0.52	1.04	1.05	1.35
		Top width (ft)	174.53	534.34	535.52	569.34
Main stem at Falcon Highway	MS-05 52353	Channel velocity (ft/sec)	1.05	1.6	2.04	3.59
		Water surface depth in channel (ft)	1.79	3.69	4.96	5.74
		Top width (ft)	31.42	83.76	556.41	592.33
Main stem at Jones Road	MS-03 33189	Channel velocity (ft/sec)	2.45	3.7	1.27	2.51
		Water surface depth in channel (ft)	3.2	5.83	9.25	10.46
		Top width (ft)	47.98	105.51	580.28	667.17
Main stem at Peyton Highway	MS-02 18474	Channel velocity (ft/sec)	0.16	0.4	0.59	1.43
		Water surface depth in channel (ft)	4.14	4.35	4.51	5.15
		Top width (ft)	813.21	871.68	882.22	925.27
Southeast Tributary at Jones Road	T1 22297	Channel velocity (ft/sec)	0.62	1.02	1.47	3.2
		Water surface depth in channel (ft)	2.45	3.52	3.59	3.82
		Top width (ft)	197.35	345.68	351.74	372.17
Southeast Tributary at Peyton Highway	T1 16611	Channel velocity (ft/sec)	1.67	2.25	2.65	4.05
		Water surface depth in channel (ft)	0.08	0.17	0.24	0.51
		Top width (ft)	239.82	241.36	242.51	247.41
Southeast Tributary at Confluence with Main stem	T1 410	Channel velocity (ft/sec)	3.44	0.11	0.18	0.67
		Water surface depth in channel (ft)	1.69	2.01	2.01	2.01
		Top width (ft)	31.89	1169.3	1169.3	1169.3
At Confluence with Geick Basin	MS-01 82	Channel velocity (ft/sec)	2.68	3.85	19.89	17.33
		Water surface depth in channel (ft)	1.45	2.17	1.11	2.36
		Top width (ft)	75.88	255.32	60.67	262.84





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Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

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HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-17
FIGURE 5-4

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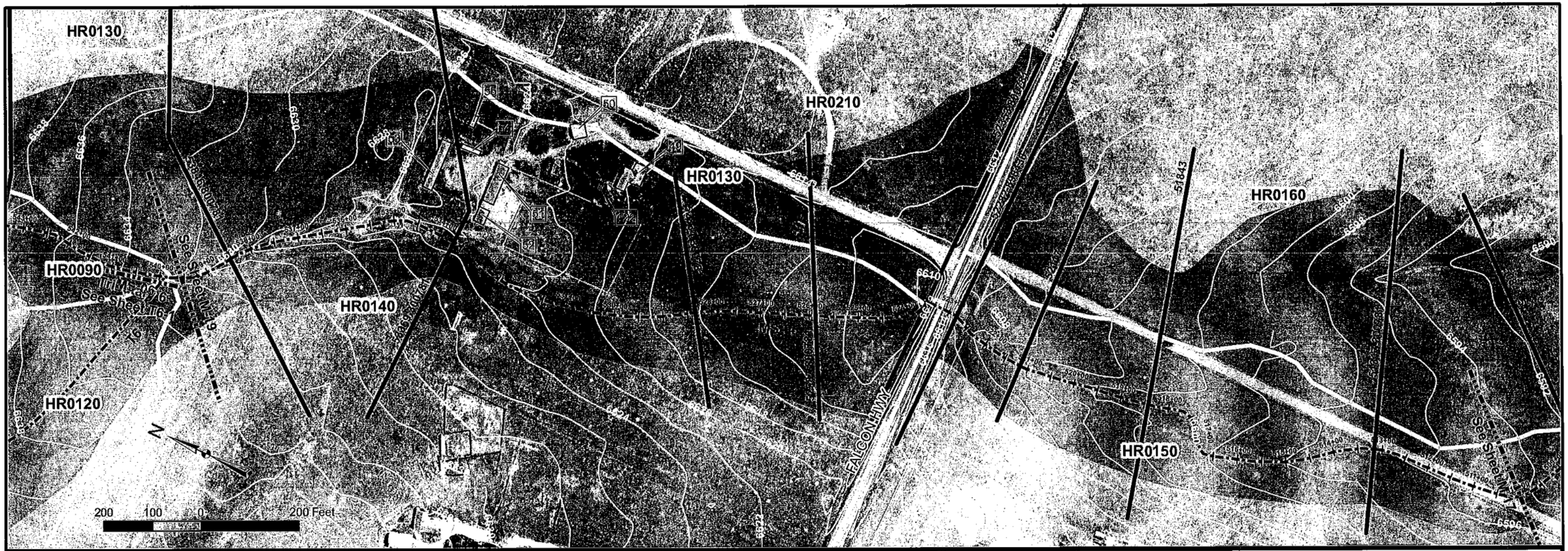

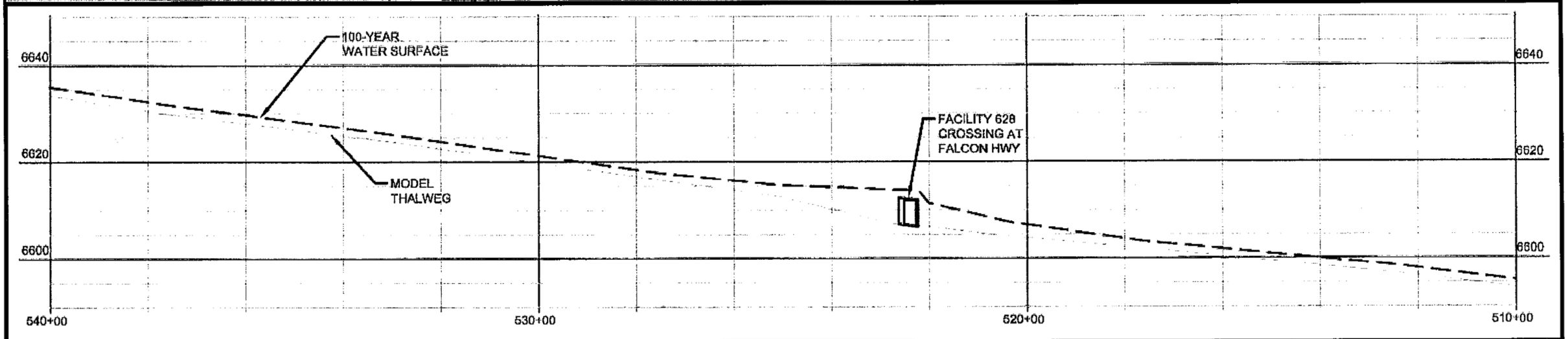

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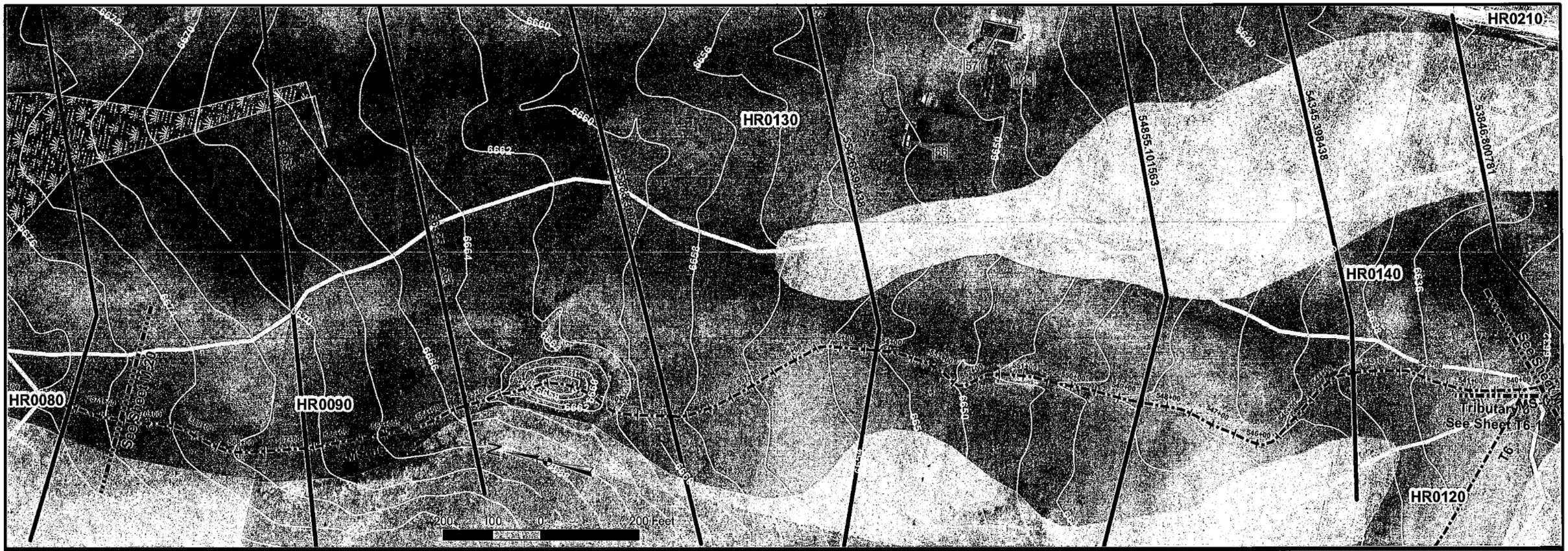
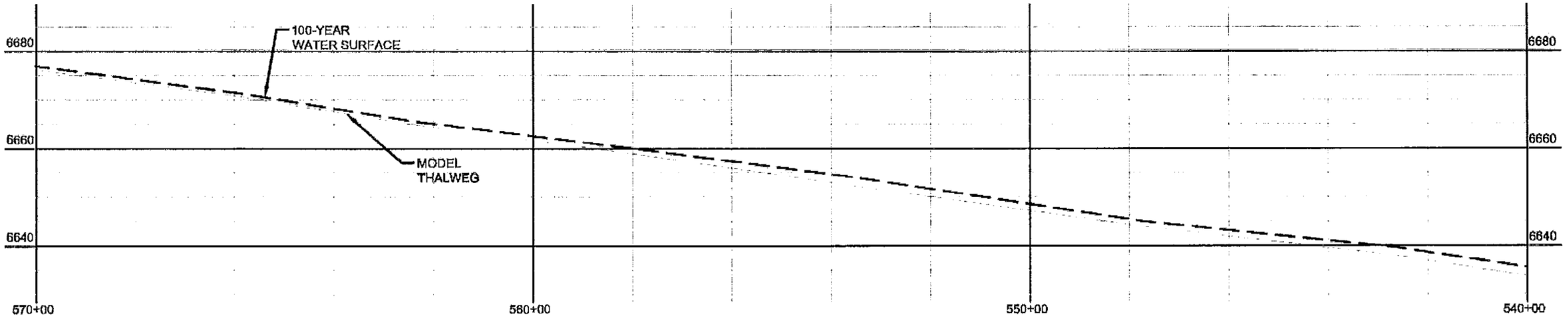
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-18
FIGURE 5-4

URS NO. 21711039





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Colorado Springs, CO 80921
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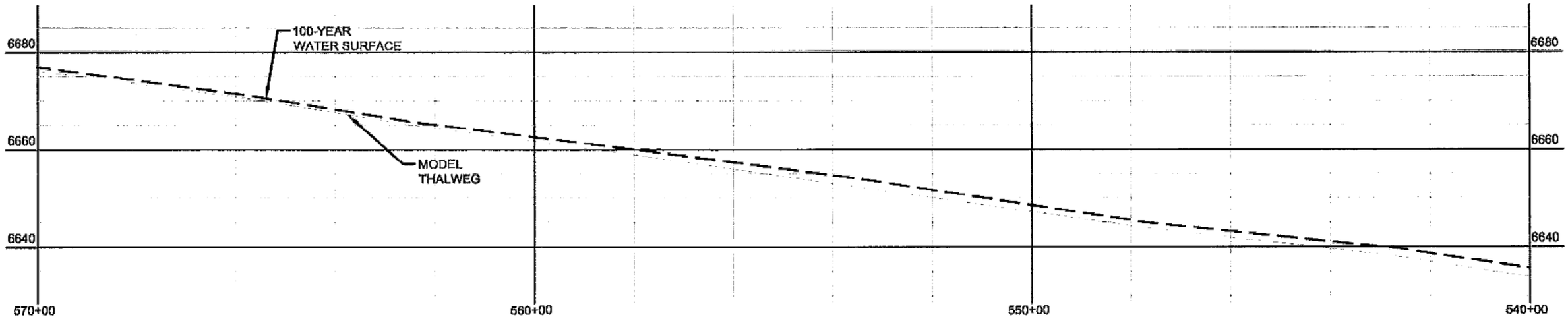
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN

APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-19
FIGURE 5-4

URS NO. 21711039



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Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-19A
FIGURE 5-4

URS NO. 21711039

Table 6-8 Subregional Detention Pond Summary

Pond	Size (AF)	Peak Inflow (cfs)		Peak Outflow (cfs)	
		2-yr	100-yr	2-yr	100-yr
SR-01	10	100	320	8	90
SR-02	5	14	300	3	250
SR-03	16	210	640	29	530
SR-04	25	200	1120	33	740
SR-05	24	76	570	9	250
SR-06	9	14	180	1	20
SR-07	5	6	140	1	88
SR-08	5	23	240	15	210
SR-09	20	50	430	3	66
SR-10	23	85	860	23	600
SR-11	2	3	70	1	61
SR-12	9	19	140	1	35
SR-13	3	12	120	6	110

Subregional ponds have been sized using the hydrograph routing method described above. In this alternative, all proposed channels and culverts are sized for the existing 100-year peak flow rates, except within proposed developments where it is necessary to provide conveyance for developed flow rates. Flood impacts for the 100-year peak flow downstream of the subregional, full spectrum detention ponds will not increase.

6.3.2.1. Channels

In this alternative, only channel improvements through proposed developments are included, unless an area is undersized for existing conditions. Existing deficiencies are the responsibility of the current land owner or the County, and not the developer, and corrective measures for existing deficiencies are not included in the cost estimates. Proposed channel improvements along the corresponding reaches are summarized in Table 6-9.

Table 6-9 Channel Design for Subregional Detention Alternative

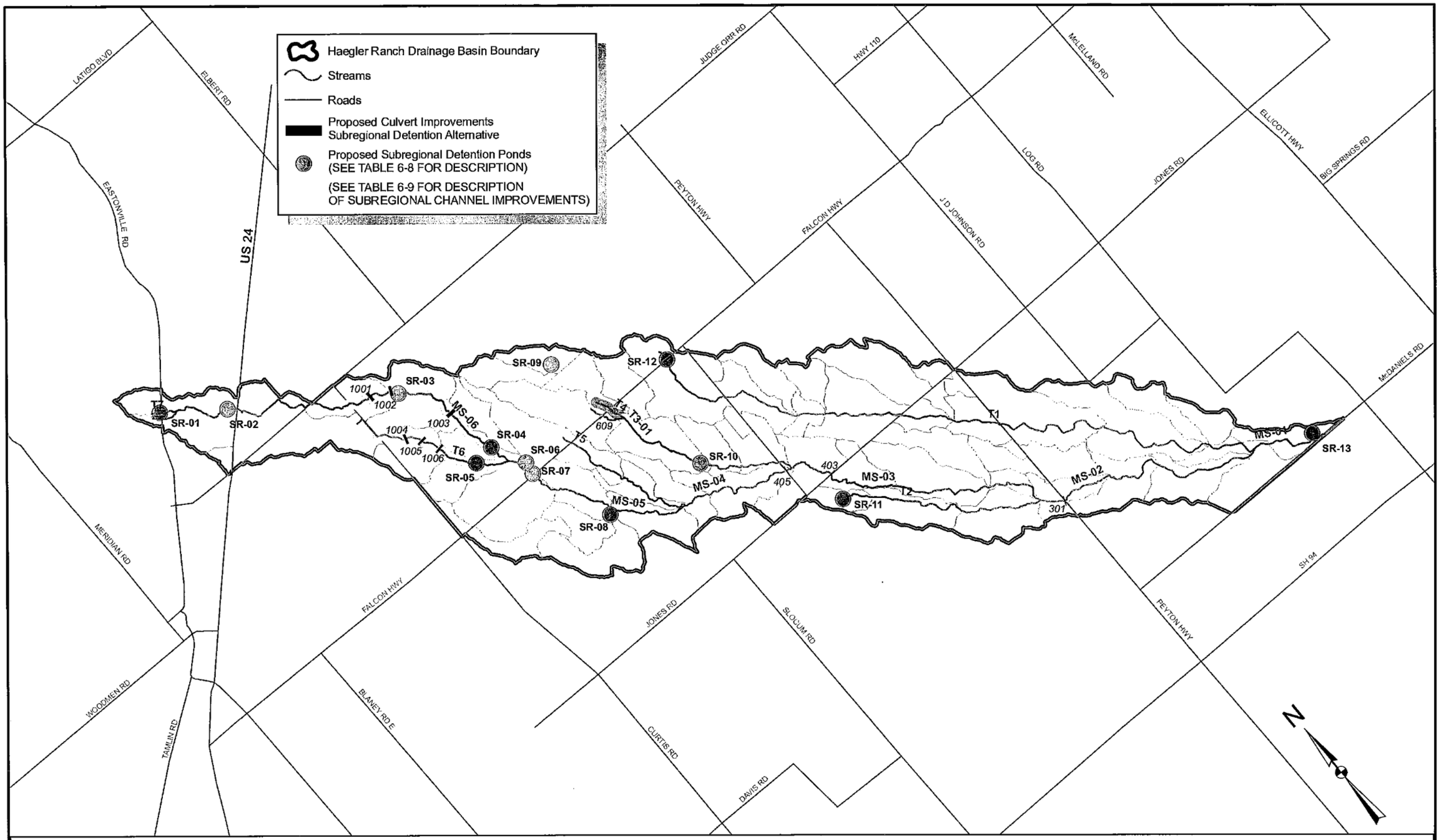
Channel	Existing 100-yr Flow (cfs)	Proposed 100-yr Flow (cfs)	Design Flow (cfs)	Channel Length (ft)	Material
Main Stem (MS-05)	1460	1680	2000	1560	Grass
Main Stem (MS-06)	660	530	600	3120	Grass
Main Stem (MS-06)	720	970	1000	4535	Grass
Main Stem (MS-06)	750	740	800	3190	Grass
Tributary 3 (T3-01)	600	600	600	5000	Grass
Tributary 3 (T3-02)	220	500	500	420	Grass
Tributary 4 (T4)	220	500	500	940	Grass
Tributary 6 (T6)	200	440	500	4280	Grass
Tributary 6 (T6)	240	250	300	1400	Grass

6.3.2.2. Culverts

As with the channels, only the culverts through proposed developments will be effected unless an area is undersized for existing conditions. Any existing deficiencies in the roadway culverts are the responsibility of the County and not the developer, and required culvert improvements are not included in the cost estimates for the alternative. Proposed culvert improvements are summarized in Table 6-10.

Table 6-10 Culvert Design for Subregional Detention Alternative

Facility Number	Road Crossing	Channel	Proposed 100-yr Flow (cfs)	Deficiency	Necessary Facility for Proposed 100-year Flow
301	Peyton Highway	Main Stem (MS-02)	3,370	Overtops	9-6'X6' RCBs
403	Jones Road	Main Stem (MS-03)	2,970	Overtops	8-6'X6' RCBs
405	Murr Road	Main Stem (MS-04)	2,870	Overtops	8-6'X6' RCBs
609	Falcon Highway	Tributary 3 (T3-02)	460	Overtops	2-6'X6' RCBs
1001	Future Pastura Street	Main Stem (MS-06)	930	Future Road	3-6'X6' RCBs
1002	Future Arroyo Hondo Blvd. N.	Main Stem (MS-06)	930	Future Road	3-6'X6' RCBs
1003	Future Arroyo Hondo Blvd. S.	Main Stem (MS-06)	1500	Future Road	4-6'X6' RCBs
1004	Future Pastura Street	Tributary 6 (T6)	440	Future Road	2-66" RCPs
1005	Future El Vado Road	Tributary 6 (T6)	440	Future Road	2-66" RCPs
1006	Future Socorro Trail	Tributary 6 (T6)	440	Future Road	2-66" RCPs



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Colorado Springs, CO 80921
719.531.0001

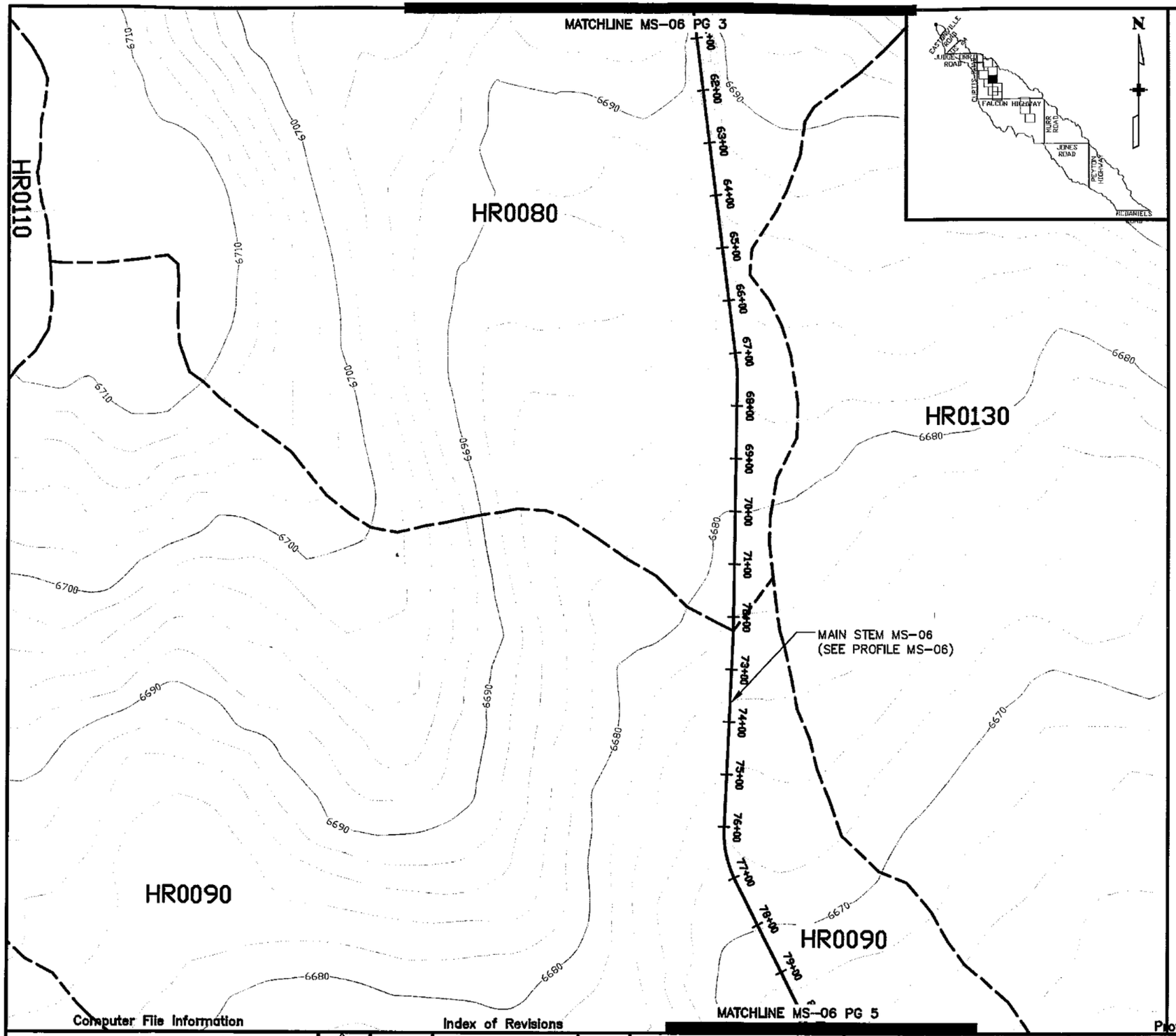
5,000 2,500 0 5,000 Feet

1" = 5,000'

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
SUBREGIONAL DETENTION ALTERNATIVES
FIGURE 6-2

URS NO. 21711039



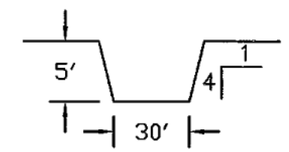
LEGEND

6630	CONTOURS – MAJOR ELEVATION
	CONTOURS – MINOR ELEVATION
	WATERSHED BOUNDARY
	BASIN BOUNDARY
	ROADS
20+00	RIVER AND ALIGNMENT

1"=200'

200 0 200 400

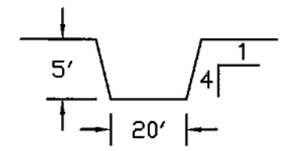
CHANNEL: MAIN STEM (MS-06)
BASIN: HR0080



STA: 31+34 TO STA: 74+61

Q: 1000 CFS

CHANNEL: MAIN STEM (MS-06)
BASIN: HR0090



STA: 74+61 TO STA: 103+62

Q: 800 CFS

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Drawing File Name: CHANNEL.DWG
Acad. Ver. 2006 Scale: 1"=200' Units: Feet

Index of Revisions

Profiles

URS 8960 Federal Drive, Suite 300 Colorado Springs, CO. 80921 (719) 531-0001 Fax (719) 531-0007

Designed by: KAP
Detailed by: DRM
Checked by: JAJ

Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL CHANNELS

Sheet Number MAIN STEM PG 4

MATCHLINE MS-06 PG 4

MAIN STEM MS-06
(SEE PROFILE MS-06)

HR0090

HR0130

HR0210

HR0140

POND SR-05
(SEE SHEET SR05)

POND SR-04
(SEE SHEET SR04)

MAIN STEM MS-06
(SEE MAINSTEM PAGE 5)

TRIBUTARY 6 (T6)
(SEE PROFILE TRIBUTARY 6)

MATCHLINE MS-06 PG 6

Index of Revisione

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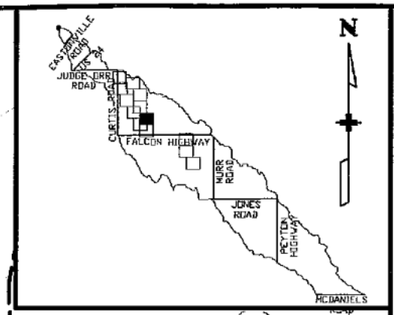
Acad. Ver. 2006	Scale: 1"=200' Units: Feet



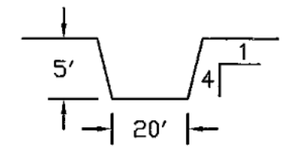
LEGEND

6630	CONTOURS – MAJOR ELEVATION
	CONTOURS – MINOR ELEVATION
	WATERSHED BOUNDARY
	BASIN BOUNDARY
	ROADS
20+00	RIVER AND ALIGNMENT

1"=200'

200 0 200 400

CHANNEL: MAIN STEM (MS-06)
BASIN: HR0090



STA: 74+61 TO STA: 103+62

Q: 800 CFS

Profiles

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Detailed by:	DRM
Checked by:	JAJ

Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION
ALTERNATIVE CONCEPTUAL CHANNELS

Sheet Number MAIN STEM PG 5

MS–06 HR0080

SLOPE = 0.60%

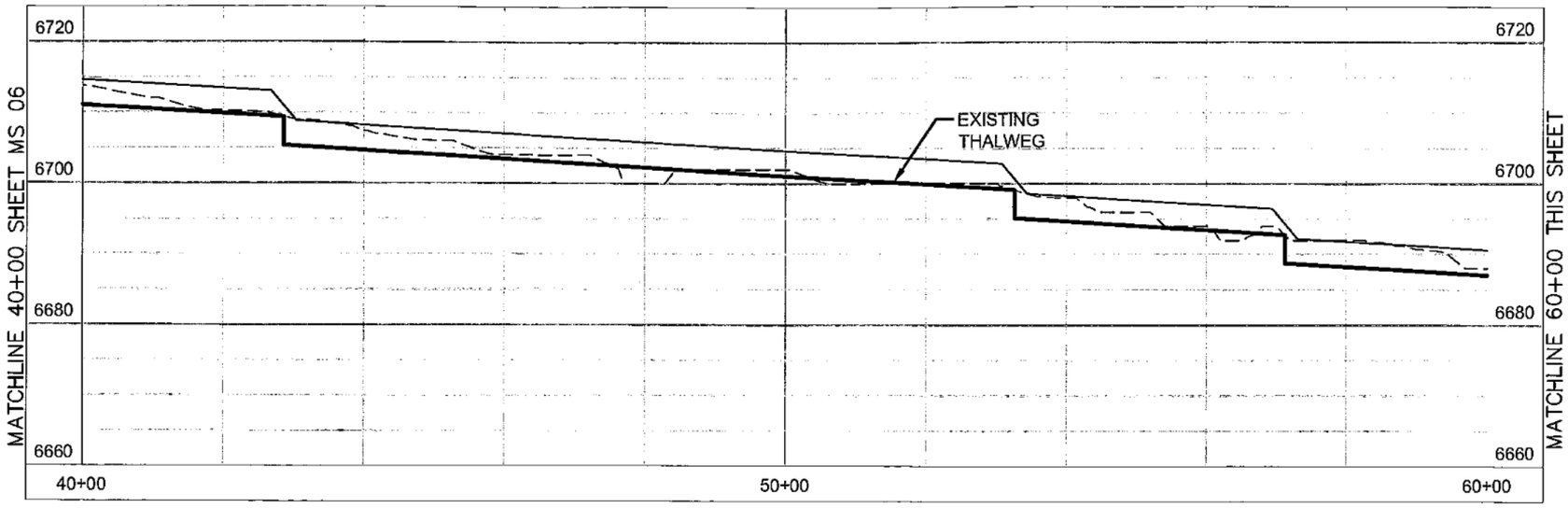
(7) 4' DROPS

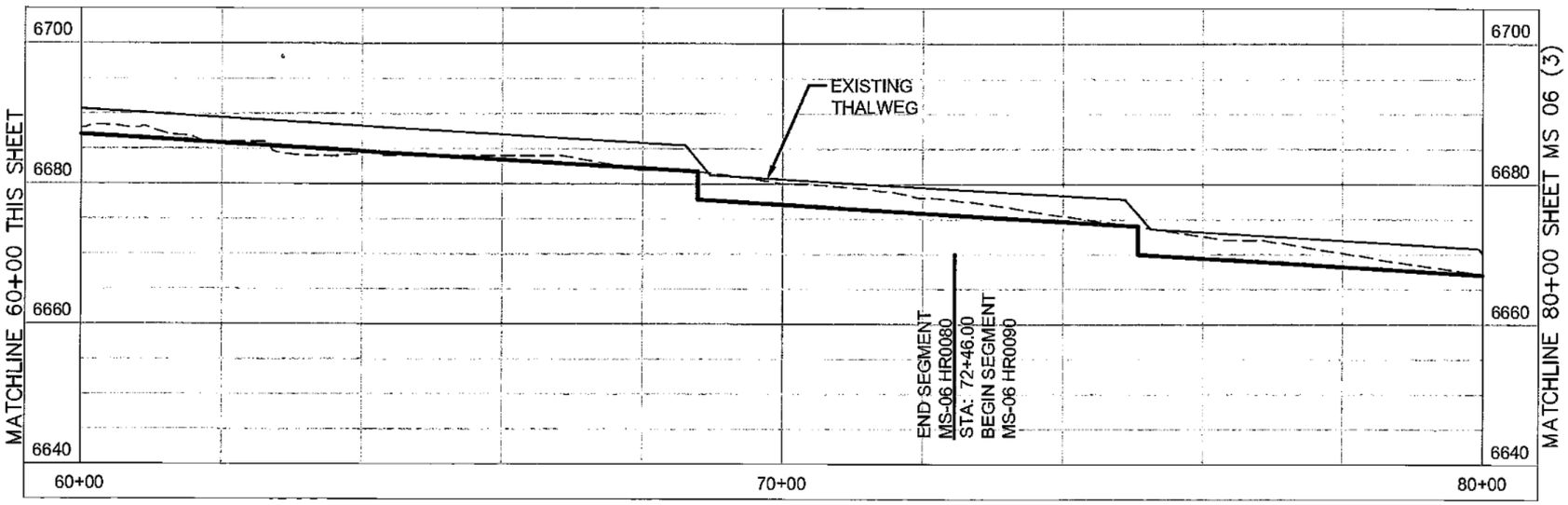
MS–06 HR0090

SLOPE = 0.60%

(8) 4' DROPS

PROFILE MAIN STEM (MS–06 & MS–05)





LEGEND

- PROPOSED DROP STRUCTURE
- EXISTING THALWEG
- HYDRAULIC GRADE LINE

Computer File Information

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Drawing File Name:	MAINSTEM PROFILES_PROPOSED.DWG
Acad. Ver. 2006	Scale: 1"=20' Units: Feet

Index of Revisions

3			
2			
1			

EL PASO COUNTY DEPARTMENT OF TRANSPORTATION

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Profiles

Designed by:	KAP
Detailed by:	DRM
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Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL PROFILES

Sheet Number MS06 (2)

MS–06 HR0090

SLOPE = 0.60%

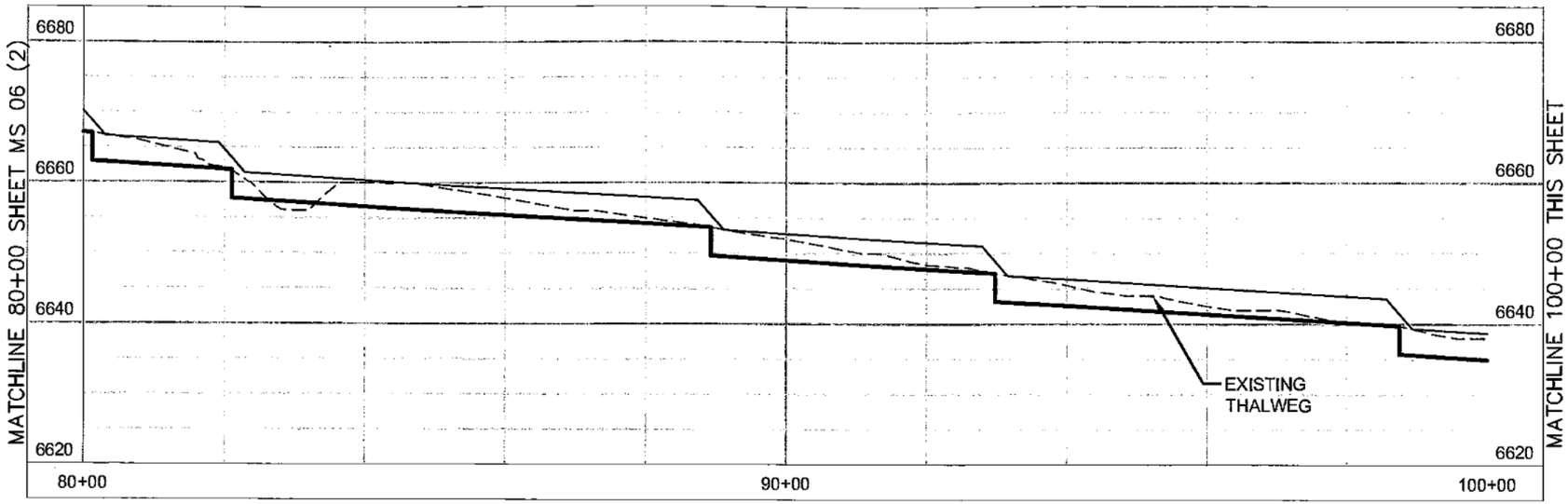
(8) 4' DROPS

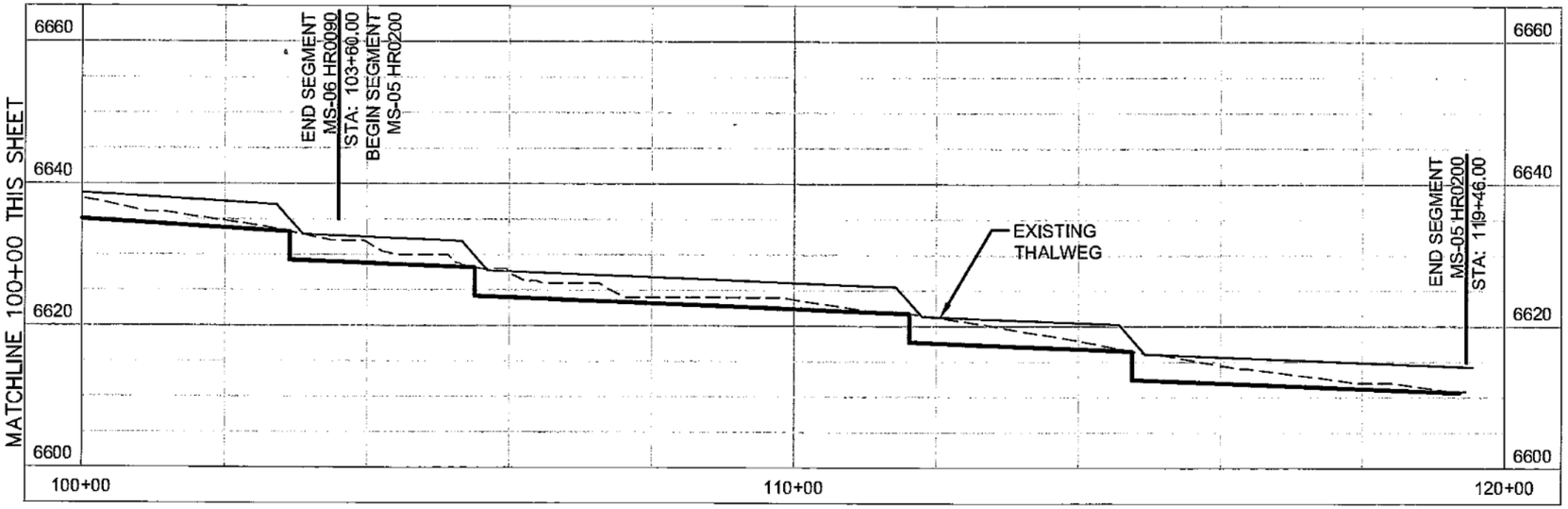
MS–05 HR0200

SLOPE = 0.40%

(4) 4' DROPS

PROFILE MAIN STEM (MS–06 & MS–05)





LEGEND

- PROPOSED DROP STRUCTURE
- EXISTING THALWEG
- HYDRAULIC GRADE LINE

Computer File Information

Full Path: P:\21711039\CAD\PLANSHTS

Drawing File Name: MAINSTEM PROFILES_PROPOSED.DWG

Acad. Ver. 2006 Scale: 1"=20' Units: Feet

Index of Revisions

Profiles

Designed by: KAP

Detailed by: DRM

Checked by:

Structure Numbers

EL PASO COUNTY DEPARTMENT OF TRANSPORTATION

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HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL PROFILES

Sheet Number MS06 & MS05 (3)

GIECK RANCH
DRAINAGE BASIN PLANNING STUDY
El Paso County, Colorado

Volume 1 – Final Report

October 1, 2007
Revised: February 10, 2010

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DBC Project Number: C-7706-2

I. Project Description, Location and Drainage

A. Basin Description and Location

Figure 1.0 shows the location of the Gieck Ranch Drainage Basin. The basin covers a total area of 22.05 square miles within unincorporated El Paso County. The basin begins approximately five miles northeast of the Town of Falcon in El Paso County at an elevation of approximately 7,300 feet above mean sea level (msl). From this point, drainage from the basin travels approximately 15 miles to the southeast. An aerial photograph of the basin is included as Figure 1.1 which is located in Volume 2 of this report. The minimum elevation within the basin is approximately 6,100 feet above msl. Channel slope varies considerably across the basin with average channel slopes ranging from 0.5% to 5%. In general, steeper slopes are located at the northern reaches of the basin, while the flatter slopes are located at the southern reaches. The Gieck Ranch Drainage Basin is tributary to Black Squirrel Creek which drains south to its confluence with the Arkansas River near the city of Pueblo, Colorado. The area encompassing the basin is characterized by rolling range land typically associated with Colorado's semi-arid climates. Existing vegetative cover in undeveloped areas is considered fair for the purposes of this report.

While developing this Drainage Basin Planning Study it was determined that a portion of the adjacent Haegler Ranch Basin, approximately 1.4 square miles, is diverted into the Gieck Ranch Basin as shown in Figure 1.0. This diversion occurs just east and immediately upstream of the intersection of Judge Orr Road and Curtis Road. The diversion exists because no culvert was constructed to convey the runoff from the north side of Judge Orr Road to the south side when the road was originally built. Instead, runoff flows east along the northern edge of the road to a culvert located within the Gieck Basin. This condition has existed since the construction of Judge Orr Road. A stakeholder's meeting was held April, 2005 to discuss the impacts of maintaining the diversion or removing it and restoring historic flows. It was decided to maintain the diversion as is, Documentation and correspondence related to the diversion can be found in Section 1 of the Technical Addenda. In addition to the diversion, while delineating the drainage basins using LIDAR based topography, it was determined that there is an additional 1.35 square miles of area in the southeast section that drains into the Gieck Ranch Basin that was previously thought to drain into adjacent basins. The total square miles of drainage area for the Gieck Ranch Basin (22.05) includes the 1.4 square miles of drainage area diverted from the Haegler Ranch Basin and the 1.35 square miles of additional drainage area in the southeast section of the basin.

The drainage basin has been subdivided into six major sub-watersheds or drainageways. These include the Main Stem Channel (MS) and five main tributaries, the Haegler Diversion (HD), West Fork (WF), East Fork (EF), South Fork (SF), and Southeast Fork (SE). These major drainageways were determined as those existing drainageways that carry runoff from at least 100 to 160 acres. Figure 2.0 shows the locations of the six main drainageways.

There are several open water storage areas that exist within the basin. They appear to be remnants of former irrigation structures and/or stock watering ponds. They do not appear to be constructed for the purposes of flood control. For modeling purposes they were not evaluated as effective storage. Additionally, remnants of several irrigation facilities associated with former ranch lands can be found within the drainage basin. It is not apparent whether or not these irrigation structures are still used. There do not appear to be any active irrigation ditches within the basin.

B. Climate and Flood History

The region surrounding the City of Falcon is generally classified as semi-arid, with annual precipitation in the range of 14 to 16 inches. The bulk of the precipitation is received during the spring and summer months in the form of thundershowers. Most of the flood-producing storms in El Paso County occur during the summer months when thunderstorms are most intense. Available flood history for El Paso County is almost exclusively concerned with the aspects of flooding on Fountain Creek or Monument Creek urbanized areas, so there is no history of flooding in the Gieck Ranch Basin listed in the El Paso County Flood Insurance Study. However, significant flooding events resulting in damage to roadways and drainage structures have been documented in nearby basins, such as that which occurred in the Haegler Basin in 1995. This indicates that flooding and related damage within the Gieck Ranch Drainage Basin and its tributaries is possible in the future.

Table 6.4: Summary of Flows at Selected Design Points – 100-year Storm Event

Design Point ID	Design Point Location	Hydrologic Element	Accumulative Area (mi^2)	Existing Peak Flow (cfs)	Future Peak Flow (cfs)	% Difference Peak Flow	Existing Volume (ac-ft)	Future Volume (ac-ft)	% Difference Volume
1	Haegler Diversion at Eastonville Road	HD-J2	0.8	431	1060	146%	77	96	25%
2	West Fork at Eastonville Road	WF-J1	0.3	146	389	166%	29	39	33%
3	Main Channel at Eastonville Road	MS-J4	1.3	730	1233	69%	112	135	20%
4	Haegler Diversion at Highway 24	HD-J4	1.3	521	1223	135%	97	121	24%
5	West Fork at Highway 24	WF-J3	0.4	224	605	170%	49	62	26%
6	Main Channel at Highway 24	MS-J6	2.5	997	1896	90%	194	225	16%
7	East Fork at Highway 24	EF-J4	1.2	1054	1113	6%	124	126	1%
8	Main Channel at Elbert Road	MS-J7	3.0	1010	1896	88%	220	253	15%
9	East Fork at Elbert Road	EF-J6	2.1	1120	1172	5%	183	187	2%
10	West Fork at Judge Orr Road	WF-J6	1.5	1017	2213	117%	244	291	19%
11	Confluence of East Fork and Main Channel	MS-J9	5.7	1817	3068	69%	429	467	9%
12	Main Channel at Judge Orr Road	MS-J11	6.7	1968	3383	72%	487	564	16%
13	Confluence of West Fork and Main Channel	MS-J12	11.2	2732	6104	123%	805	993	23%
14	Main Channel at Falcon Highway	MS-J16	13.4	3045	6784	123%	936	1191	27%
15	Main Channel at Peyton Highway	MS-J19	15.1	3200	6946	117%	1012	1269	25%
16	Main Channel at Jones Road	MS-J20	15.6	3250	7056	117%	1040	1308	26%
17	South Fork at Jones Road	SF-J4	1.3	454	454	0%	133	133	0%
18	Confluence of South Fork and Main Channel	MS-J22	17.9	3650	7392	103%	1210	1489	23%
19	Southeast Fork at McDaniels Road	SE-J3	2.4	547	546	0%	210	210	0%
20	Main Channel at McDaniels Road	MS-J29	19.6	3791	7525	99%	1293	1597	23%
21	Total Combined Outfall	SE-J3 plus MS-J29	22.0	4326	7687	78%	1503	1807	20%

The 100-year storm event future undetained peak flow is estimated to increase by 78% over the existing peak flow while the future volume of runoff is estimated to increase by 20%.

During the hydrologic analysis it was observed that the Black Squirrel Creek lies very close to the eastern boundary of the Gieck Ranch Basin from Falcon Highway downstream to Log Road. It is possible that flow from Black Squirrel Creek could spill into the Gieck Ranch Basin during extreme storm events. The flows in Black Squirrel Creek in this area are expected to be more than 5,000 cfs for the 100-year event. If the Black Squirrel Creek were to overflow its' banks and flow into the Gieck Ranch Basin it could increase the flows shown in the above tables. Possible improvements to address this potential problem include channel improvements to increase the Black Squirrel Creek conveyance in this area or constructing berms on the east bank to prevent overflow.

Table 8.0: Structure Inventory and Evaluation Summary (Cont.)

35	Elbert Road south of structure 34	24" CMP	Good	100%	Y	---
36	Elbert Road at Main Channel	2 - 48" CMP	Good	19%	N	3 - 12' x 4' CBC
37	Elbert Road south of structure 36	24" CMP	Poor	55%	Y	---
38	Judge Orr Road at West Fork	67" x 95" CMP	Good	20%	N	4 - 12' x 5' CBC
39	Judge Orr Road east of structure 38	36" CMP	Good	100%	Y	---
40	Judge Orr Road west of structure 41	24" CMP	Poor	90%	Y	---
41	Judge Orr Road at Main Channel	Bridge	Good	100%	Y	---
42	Falcon Hwy at Main Channel	Bridge	Good	57%	N	85' Span
43	Peyton Road at headwaters of South Fork	24" CMP	Fair	75%	Y	---
44	Peyton Road at Main Channel	4 - 24" RCP	Good	2%	N	5 - 12' x 7' CBC
45	Peyton Road south of structure 44	36" CMP	Poor	100%	Y	---
46	Peyton Road south of structure 45	24" CMP	Good	100%	Y	---
47	East Garrett Road west of structure 48	24" CMP	Poor	100%	Y	---
48	East Garrett Road at South Fork	48" CMP	Good	14%	N	2 - 5' x 4' CBC
49	J.D. Johnson Road at South Fork	4 - 42" RCP	Good	63%	N	2 - 12' x 4' CBC
50	J.D. Johnson Road south of structure 49	30" CMP	Fair	56%	N	36" CMP
51	J.D. Johnson Road south of structure 50	30" CMP	Fair	100%	Y	---
52	Jones Road at Main Channel	60" CMP	Fair	4%	N	6 - 12' x 7' CBC
53	J.D. Johnson Road at Jones Road	30" CMP	Fair	55%	Y	---
54	Jones Road east of J.D. Johnson Road	30" CMP	Good	73%	Y	---
55	Jones Road at South Fork	36" CMP	Good	6%	N	2 - 7' x 5' CBC
56	Jones Road east of structure 55	30" CMP	Fair	67%	Y	---
57	J.D. Johnson Road at Main Channel US of structure 58	3 - 60" RCP	Good	14%	N	85' Span
58	J.D. Johnson Road at Main Channel	30" CMP	Good	1%	N	120' Span
59	J.D. Johnson Road and Log Road	24" CMP	Fair	23%	N	2 - 6' x 3' CBC
60	Main Channel at private driveway	48" CMP (est.)	Unknown	2%	N.E.	---
61	Log Road at Main Channel	Bridge	Good	36%	N	120' Span
62	McDaniel Road at Main Channel	30" x 48" Oval CMP	Good	1%	N	120' Span
63	Log Road and McDaniels Road	24" CMP	Good	2%	N	5 - 6' x 3' CBC

* Road over-topping not included

** Allowable road over-topping included in adequacy analysis

*** Based on proposed (with selected drainage basin plan) flows

N.E. Not Evaluated, not EPCDOT responsibility

VII. Drainage Basin Plan Development

A. Selected Plan

The selected plan consists of integrating the selected alternative outlined in the previous section. This includes the construction of the small regional full spectrum detention basins and the recommended channel improvements shown on the plan and profile sheets located in the Appendices. The future conditions hydrologic and hydraulic models were updated to determine the affect of the full spectrum regional ponds on peak flows, volumes and channel velocities. Revised hydrologic and hydraulic modeling results are provided in Sections 17 and 18 of the Technical Addenda. Table 11 presents a summary of discharge rates for the selected plan incorporating the full spectrum regional detention facilities.

Table 11: Summary of Flows at Selected Design Points – Selected Plan Developed Conditions

Design Point ID	Design Point Location	Hydrologic Element	Q2 (cfs)	Q5 (cfs)	Q10 (cfs)	Q100 (cfs)
1	Haegler Diversion at Eastonville Road	POND HD-S1	5	25	32	338
2	West Fork at Eastonville Road	WF-J2	2	17	45	114
3	Main Channel at Eastonville Road	POND MS-S1	28	119	253	573
4	Main Channel Tributary 2 at Eastonville Road	POND MST2-S1	21	65	126	271
5	East Fork Tributary at Eastonville Road	EFT1-B1	25	46	73	134
6	East Fork at Eastonville Road	EF-B1	33	59	92	168
7	Haegler Diversion at Highway 24	HD-J4	7	33	138	429
8	West Fork at Highway 24	WF-J3	6	38	97	242
9	West Fork Tributary at Highway 24	POND WFT1-S1	1	8	24	66
10	Main Channel at Highway 24	MS-J6	49	190	391	877
11	Main Channel Tributary 3 at Highway 24	MST3-B1	1	3	7	19
12	East Fork Tributary at Highway 24	EFT1-J2	43	95	164	337
13	East Fork at Highway 24	EF-J4	160	334	564	1102
14	Main Channel at Elbert Road (Further South of)	MS-B10	1	2	6	16
15	Main Channel at Elbert Road (South of)	MS-J8	1	3	6	18
16	Main Channel at Elbert Road	MS-J7	50	193	399	896
17	East Fork at Elbert Road	EF-J6	162	344	588	1169
18	Confluence of East Fork and Main Channel	MS-J9	160	390	775	1774
19	West Fork at Judge Orr Road	POND WF-SR1	18	86	273	753
20	Main Channel at Judge Orr Road (West of)	POND WF-S3	1	2	4	11
21	Main Channel at Judge Orr Road	MS-J11	154	407	828	1920
22	Confluence of West Fork and Main Channel	MS-J12	160	500	1085	2679
23	Main Channel at Falcon Highway	MS-J16	141	494	1103	2842
24	Main Channel at Falcon Highway (East of)	MS-B20	2	7	15	38
25	South Fork at Falcon Highway	SF-B1	4	13	27	65
26	Main Channel at Peyton Highway	MS-J19	150	520	1163	3003
27	South Fork at Peyton Highway	SF-J1	18	40	70	148
28	South Fork at J.D. Johnson Road	SF-J4	51	117	212	455
29	Main Channel at Jones Road	MS-J20	154	528	1179	3054
30	South Fork at Jones Road	SF-J5	54	124	226	484
31	South Fork Tributary at Jones Road	SET1-B1	24	47	78	152
32	Main Channel at J.D. Johnson Road (North)	MS-J21	154	529	1184	3068
33	Confluence of South Fork and Main Channel	MS-J22	188	602	1341	3449
34	Main Channel at J.D. Johnson Road (South)	MS-J23	193	612	1367	3520
35	South Fork Tributary at J.D. Johnson Road	SET1-J1	38	77	131	272
36	Main Channel at Log Road (North)	MS-J25	195	616	1375	3546
37	Main Channel at Log Road (South)	MS-J26	196	618	1378	3557
38	Southeast Fork at Log Road	SE-J2	70	145	247	498
39	Main Channel at McDaniels Road	MS-J29	199	626	1395	3594
40	Southeast Fork at McDaniels Road	SE-J3	73	153	263	537
41	Total Combined Outfall	MS-J29 and SE-J3	272	779	1657	4131

Comparison to the existing conditions flows presented in Tables 6.1 through 6.4 shows that implementation of the selected plan will result in developed peak discharge rates that are slightly lower than existing discharge rates. This should reduce potential for flood damage within the basin.

B. Small Regional Detention Basins

The recommended plan includes the construction of 17 small regional detention storage basins, 15 of which would incorporate full spectrum detention. Ponds WF-SR1 and MS-SR1 exceed the contributing area size limitation for full spectrum detention. For these two ponds, the water quality

control volume should be provided. Pond WFT1-S1 will only provide detention for the property located in Basin WFT1-B1 and the pond should be constructed when this property is developed. The locations of the basins shown on the plan sheets are conceptual. The final location and sizes of the basins are to be determined during final design of proposed development projects. It is possible that the location and basin size may vary from the conceptual design as long as sufficient detention storage is provided to meet required discharge rates and the excess urban runoff volumes are provided as outlined in the Urban Drainage and Flood Control District Criteria for full spectrum detention. Table 12 lists the detention basin data for the selected plan. Some areas of the drainage basin may encounter seasonal high ground water tables. Final sizing of the detention basins should be done in such a way as to minimize the need for underdrains.

Table 12: Detention Basin Data

Basin ID	Excess Urban Runoff Volume (ac-ft)	Detention Storage Volume (ac-ft)	Discharge Rate (cfs)
HD-S1	21.4	41.0	345
HD-S2	2.4	7.0	92
WF-S1	7.3	17.0	115
WF-S2	2.7	13.8	134
WF-S3	4.3	9.0	11
WF-S4	29.7	52.0	359
WFT1-S1	2.2	9.0	70
WF-SR1	WQCV*	30.0	802
MS-S1	12.2	42.0	583
MS-S2	0.6	5.2	58
MS-S3	4.8	19.0	147
MS-S4	11.8	30.0	29
MS-S5	2.9	6.1	26
MS-SR1	WQCV*	50.0	2,900
MST2-S1	3.9	21.5	275
MST4-S1	6.4	20.0	137
MST5-S1	11.6	30.0	90

* Use Water Quality Control Volume

C. Channel Improvements

Recommended channel improvements consist of vegetation augmentation, selective channel stabilization such as selectively armoring existing channel banks with riprap at outside channel bends and at bridge and culvert outlets, bio-engineered stabilization treatment, and low flow linings, some channelization, and construction of grade control structures. The recommended channel improvements have been selected to minimize environmental impacts and retain natural channel characteristics as much as possible since the basin is mostly undeveloped and the majority of the existing drainageways have not been disturbed at this time. There are large areas of the basin that are to remain as vacant or agricultural land based on the El Paso County 2030 Land Use Codes. Specific channel improvements to the drainageways in these areas were not recommended. It is assumed that these channels will remain in private ownership which lowers the feasibility of channel improvements that require permanent right-of-way or easements for construction and maintenance. The recommended approach for these areas is to provide as-needed improvements.

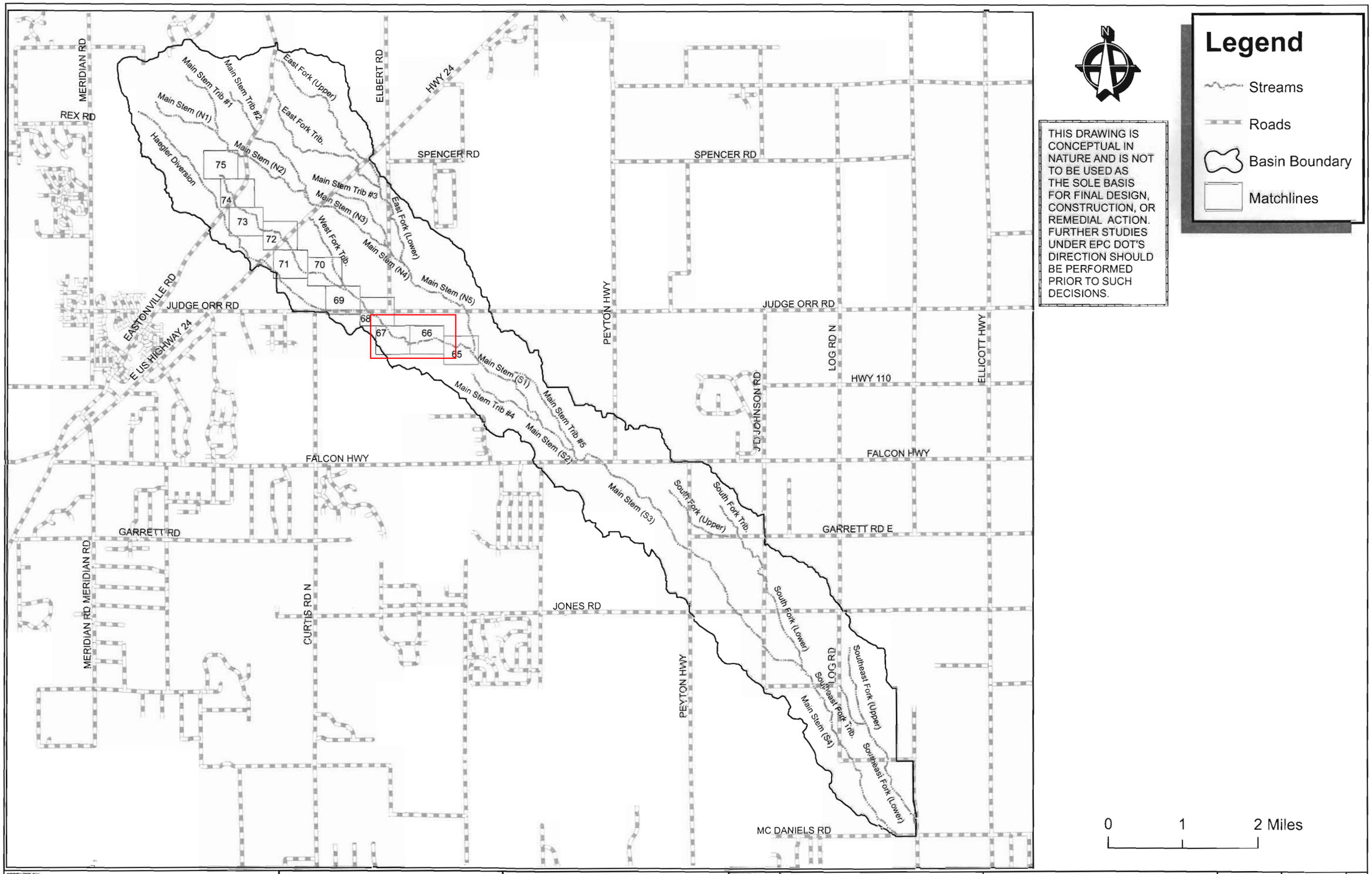
Table 13 lists the recommended approach to channel improvements on a reach by reach basis. As land development projects proceed within the drainage basin the location and specific type of selective channel improvements will need to be identified during the project design phase based on site specific conditions. There may be some overlapping of approaches between reaches. For example, some selective stabilization may be needed in reaches designated for vegetation augmentation and vice-versa. The methods outlined in the City/County Drainage Criteria Manual and the El Paso County Engineering Manual should be applied during final design analysis. Some specific channel improvements have been identified for several areas such as the Haegler Diversion channel upsizing and realignment at Judge Orr Road. These improvements are called out on the selected plan drawings.

Table 13: Channel Improvements By Reach

Drainageway	Reach ID	Reach Length (ft)	Channel Approach
Haegler Diversion	HD-R1a	3875	Selective Stabilization
Haegler Diversion	HD-R1b	5737	Channelization
Haegler Diversion	HD-R2	2826	Vegetation Augmentation
Haegler Diversion	HD-R3	2207	Selective Stabilization
Haegler Diversion	HD-R4	5161	Vegetation Augmentation
Haegler Diversion	HD-R5	3784	Selective Stabilization
West Fork	WF-R1	1775	Channelization
West Fork	WF-R2	2281	Vegetation Augmentation
West Fork	WF-R3	3029	Selective Stabilization
West Fork	WF-R4a	1717	Vegetation Augmentation
West Fork	WF-R4b	2001	Vegetation Augmentation
West Fork	WF-R4c	1601	Selective Stabilization
West Fork	WF-R4d	1198	Selective Stabilization
West Fork	WF-R5	1200	Selective Stabilization
West Fork	WF-R6	863	Selective Stabilization
West Fork	WF-R7a	2341	Vegetation Augmentation
West Fork	WF-R7b	1594	Vegetation Augmentation
West Fork	WF-R8a	4002	Selective Stabilization
West Fork	WF-R8b	1600	Selective Stabilization
West Fork - Trib. WF1	WFT1-RI	5601	Vegetation Augmentation
Gieck Main	MS-R1	2400	Vegetation Augmentation
Gieck Main	MS-R2	2000	Selective Stabilization
Gieck Main	MS-R3	1200	Selective Stabilization
Gieck Main	MS-R4a	1278	Channelization
Gieck Main	MS-R4b	1341	Channelization
Gieck Main	MS-R5	6181	Vegetation Augmentation
Gieck Main	MS-R6	804	Selective Stabilization
Gieck Main	MS-R7a	1554	Vegetation Augmentation
Gieck Main	MS-R7b	3191	Vegetation Augmentation
Gieck Main	MS-R7c	1354	Vegetation Augmentation
Gieck Main	MS-R8a	314	Vegetation Augmentation
Gieck Main	MS-R8b	783	Selective Stabilization
Gieck Main	MS-R8c	568	Selective Stabilization
Gieck Main	MS-R11a	3376	Selective Stabilization
Gieck Main	MS-R11b	2405	Selective Stabilization
Gieck Main	MS-R12	620	Selective Stabilization
Gieck Main	MS-R13	3158	Vegetation Augmentation
Gieck Main	MS-R14	7422	Selective Stabilization
Gieck Main	MS-R15	3306	Selective Stabilization
Gieck Main	MS-R16	2294	As-needed Improvements
Gieck Main	MS-R17	542	As-needed Improvements
Gieck Main	MS-R18	5457	As-needed Improvements
Gieck Main	MS-R19	1604	As-needed Improvements
Gieck Main	MS-R20a	1197	As-needed Improvements

Table 13: Channel Improvements By Reach, cont.

Drainageway	Reach ID	Reach Length (ft)	Channel Approach
Gieck Main	MS-R20b	1227	As-needed Improvements
Gieck Main	MS-R21a	1990	As-needed Improvements
Gieck Main	MS-R21b	1584	As-needed Improvements
Gieck Main	MS-R21c	2242	As-needed Improvements
Gieck Main	MS-R22	3360	As-needed Improvements
Gieck Main	MS-R23	3268	As-needed Improvements
Gieck Main	MS-R24	1927	As-needed Improvements
Gieck Main	MS-R25a	1603	As-needed Improvements
Gieck Main	MS-R25b	1615	As-needed Improvements
Gieck Main	MS-R25c	384	As-needed Improvements
Gieck Main	MS-R26	803	As-needed Improvements
Gieck Main	MS-R27	1597	As-needed Improvements
Gieck Main	MS-R28	3599	As-needed Improvements
Gieck Main	MS-R29	797	As-needed Improvements
Gieck Main	MS-R30	2004	As-needed Improvements
Gieck Main - Sub Trib M1	MST1-R1	4799	Selective Stabilization
Gieck Main - Sub Trib M2	MST2-R1	3896	Selective Stabilization
Gieck Main - Sub Trib M2	MST2-R2	6504	Vegetation Augmentation
Gieck Main - Sub Trib M3	MST3-R1	5599	As-needed Improvements
Gieck Main - Sub Trib M4	MST4-R1	6000	Selective Stabilization
Gieck Main - Trib. M5	MST5-R1	7200	Selective Stabilization
East Fork	EF-R1	2659	As-needed Improvements
East Fork	EF-R2	2400	As-needed Improvements
East Fork	EF-R3	4800	As-needed Improvements
East Fork	EF-R4	1122	As-needed Improvements
East Fork	EF-R5	2161	As-needed Improvements
East Fork	EF-R6	1410	As-needed Improvements
East Fork	EF-R7	4876	As-needed Improvements
East Fork - Trib. EF1	EFT1-R1	3200	As-needed Improvements
East Fork - Trib. EF1	EFT1-R2a	2400	As-needed Improvements
East Fork - Trib. EF1	EFT1-R2b	4041	As-needed Improvements
East Fork - Trib. EF1	EFT1-R3	2394	As-needed Improvements
South Fork	SF-R1	2017	As-needed Improvements
South Fork	SF-R2	4120	As-needed Improvements
South Fork	SF-R3	3063	As-needed Improvements
South Fork	SF-R4	1167	As-needed Improvements
South Fork	SF-R5	2434	As-needed Improvements
South Fork	SF-R6	4799	As-needed Improvements
South Fork - Trib. SF1	SFT1-R1	2400	As-needed Improvements
Southeast Fork	SE-R1	5596	As-needed Improvements
Southeast Fork	SE-R2	2786	As-needed Improvements
Southeast Fork	SE-R3a	3209	As-needed Improvements
Southeast Fork	SE-R3b	2940	As-needed Improvements
Southeast Fork - Trib. SEF1	SET1-R1	3301	As-needed Improvements



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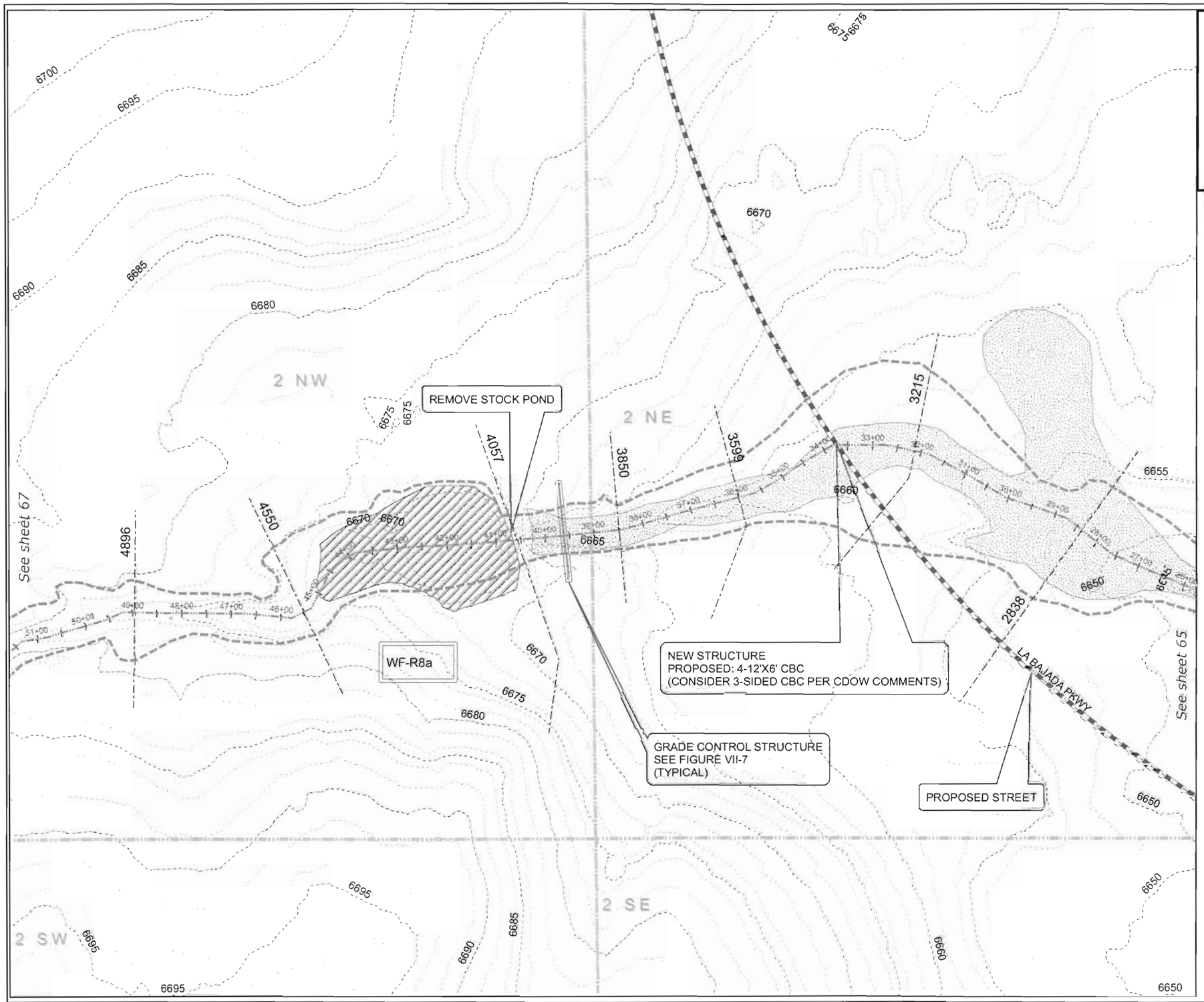
PROJECT INFO:
GIECK RANCH
DRAINAGE BASIN PLANNING STUDY
EL PASO COUNTY, COLORADO

DESIGNED BY: RJB
DRAWN BY: BLF
CHECKED BY: RJB

REVISION DESCRIPTIONS | DATE

DRAWING INFO:
GIECK RANCH
KEY MAP
WEST FORK

DATE: AUGUST 2007
JOB NO: C7706-1
SET: PL
SCALE: H: 1" = 6000' V:
DRAWING NO.: 6D 038
SHEET: K8



Environmental Key

- Ponds
- Riparian: Good
- Riparian: Poor
- Potential Wetlands

The channel is considered dry unless shown as one of the above environmental categories.

Legend

- *Proposed Future Conditions 100-yr Flood Limits*
- Streams
- Reaches
- Reach Breaklines
- Cross-sections
- Roads
- Structures
- Section Lines
- 5-ft contours
- 2-ft contours

0 100 200 Feet

Reach	Slope (%)	Q_{100} (cfs)	V_{100} (ft/s)
WF-R8a	1.36	753	4.05

RECOMMENDED PLAN IMPROVEMENTS

Reach	
WF-R8a	Selective Stabilization

Note:
See Technical Addenda for grade control data.

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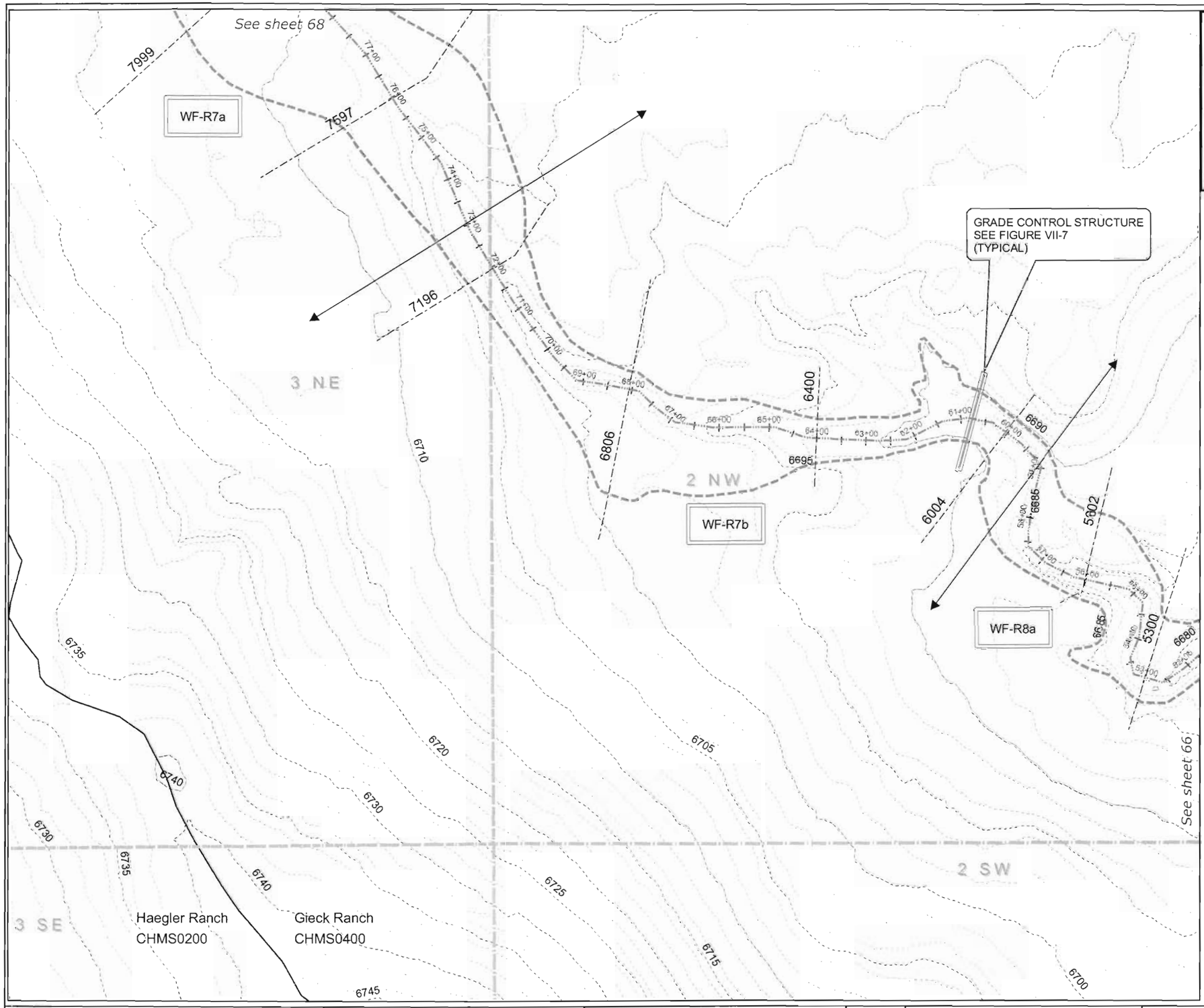
DRAINAGE BASIN PLANNING STUDY
EL PASO COUNTY, COLORADO

DESIGNED BY:	REVISION DESCRIPTIONS	DATE
RJB	PER EPCDOT COMMENTS	FEBRUARY 2008
DRAWN BY: BLF/MLM	PER EPC FINAL REVIEW	JANUARY 2010
CHECKED BY: RJB/TML		

DRAWING INFO: GIECK RANCH DBPS
PLAN VIEW
WEST FORK #2

DATE:	JOB NO:	SET
AUGUST 2007	C7706-2	PL
SCALE: H: 1" = 200' V: NONE	DRAWING NO.: 6D 038	SHEET 66



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- Reaches
- Reach Breaklines
- Cross-sections
- Roads
- Structures
- Section Lines
- 5-ft contours
- 2-ft contours

N

0 100 200 Feet

Reach	Slope (%)	Q_{100} (cfs)	V_{100} (ft/s)
WF-R7a	1.18	753	2.19
WF-R7b	1.14	753	4.21
WF-R8a	1.36	753	4.05

RECOMMENDED PLAN IMPROVEMENTS

Reach	
WF-R7a	Vegetation Augmentation
WF-R7b	Vegetation Augmentation
WF-R8a	Selective Stabilization

Note:
See Technical Addenda for grade control data.

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REVISION DESCRIPTIONS	DATE
PER EPCDOT COMMENTS	FEBRUARY 2008
PER EPC FINAL REVIEW	JANUARY 2010

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PLAN VIEW
WEST FORK #3

DATE: AUGUST 2007
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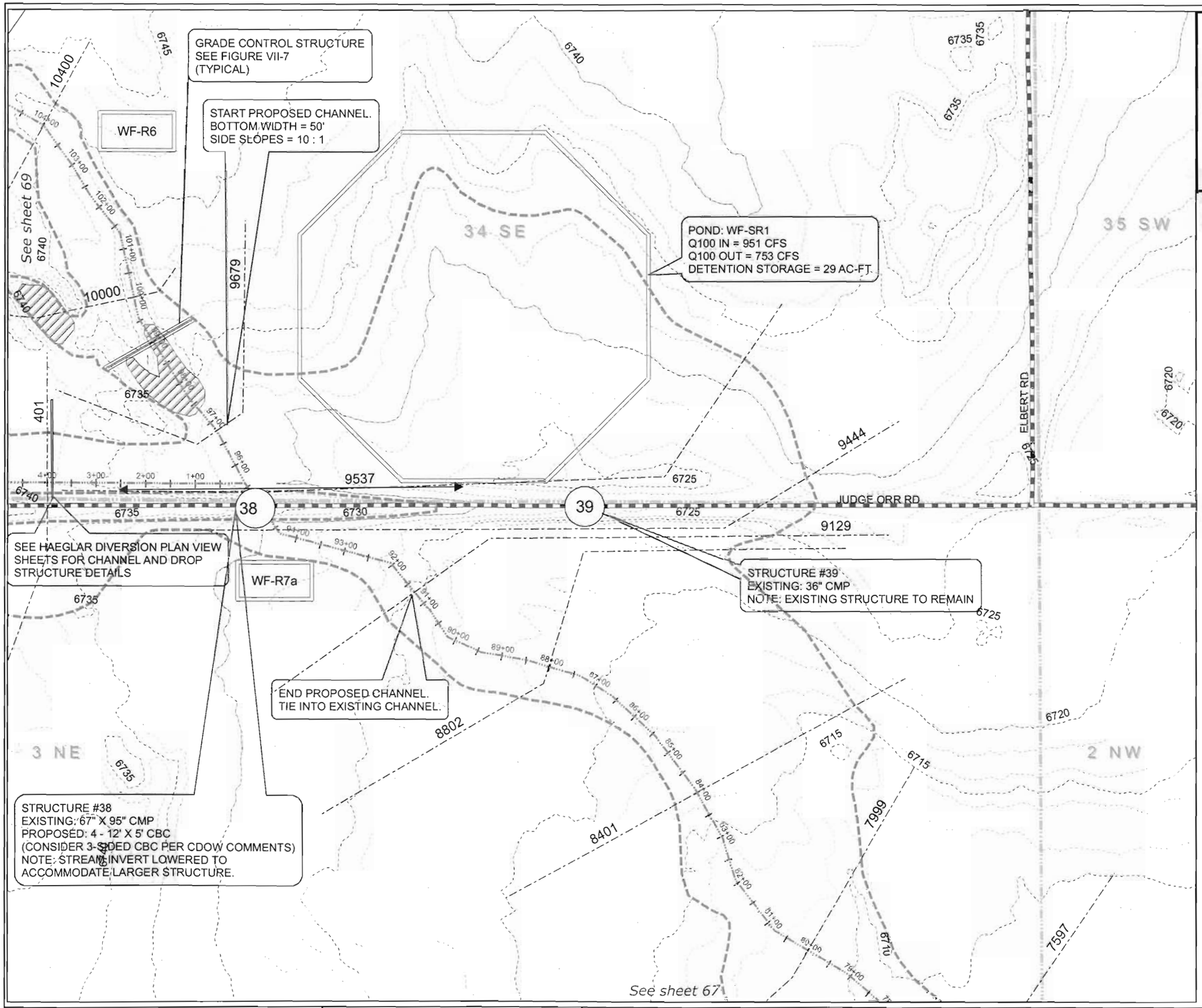
JOB NO: C7706-2
DRAWING NO.: 6D 038
SET PL
SHEET 67



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Legend

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- Streams
- Reaches
- Reach Breaklines
- Cross-sections
- Roads
- Structures
- Section Lines
- 5-ft contours
- 2-ft contours

0 100 200 Feet

Reach	Slope (%)	Q_{100} (cfs)	V_{100} (ft/s)
WF-R6	1.04	698	3.45
WF-R7a	1.18	753	2.19

RECOMMENDED PLAN IMPROVEMENTS

Reach	
WF-R6	Selective Stabilization
WF-R7a	Vegetation Augmentation

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CHECKED BY: RJB/TML

REVISION DESCRIPTIONS	DATE
PER EPCDOT COMMENTS	FEBRUARY 2008
PER EPC FINAL REVIEW	JANUARY 2010

DRAWING INFO: GIECK RANCH DBPS
PLAN VIEW
WEST FORK #4

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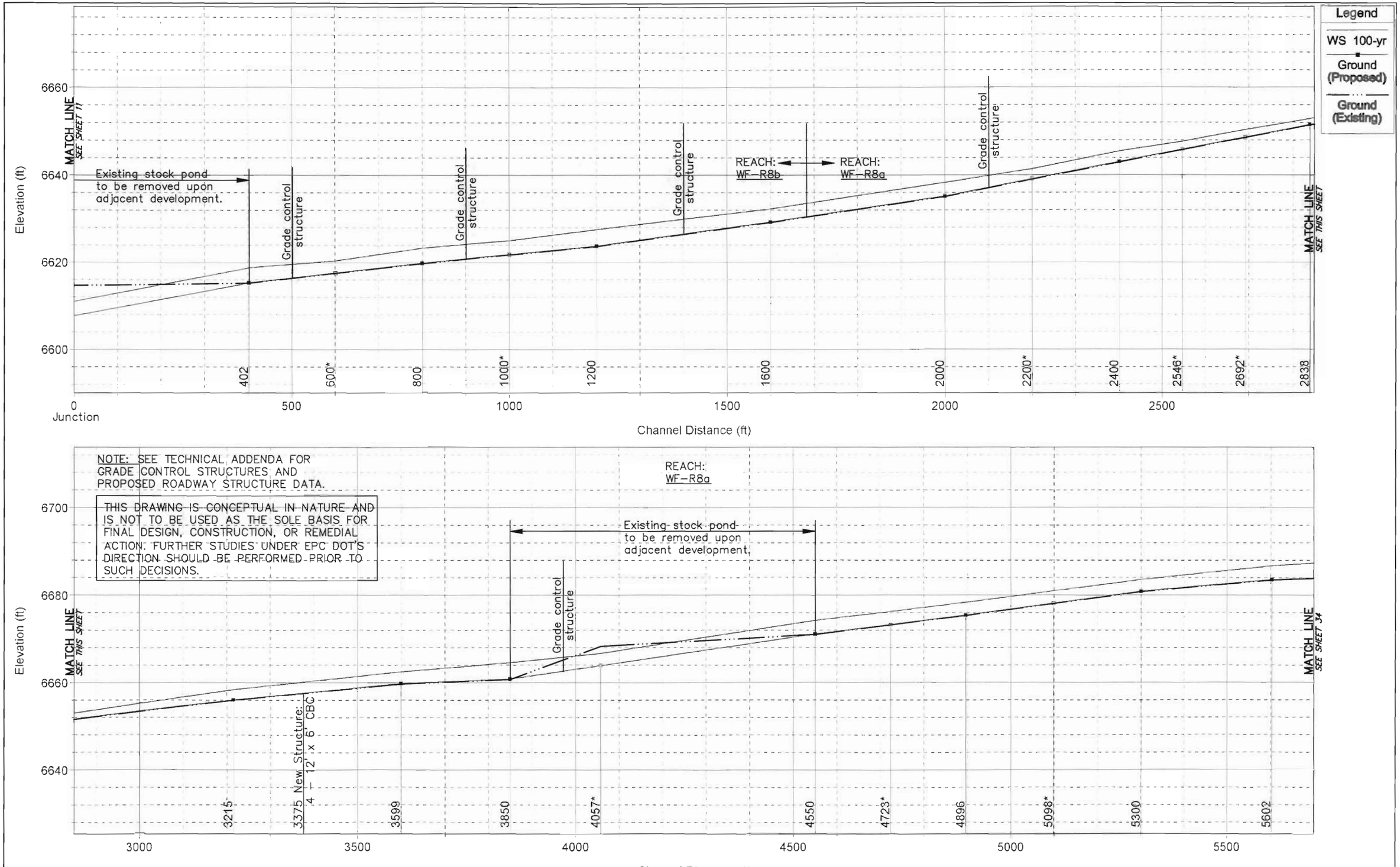

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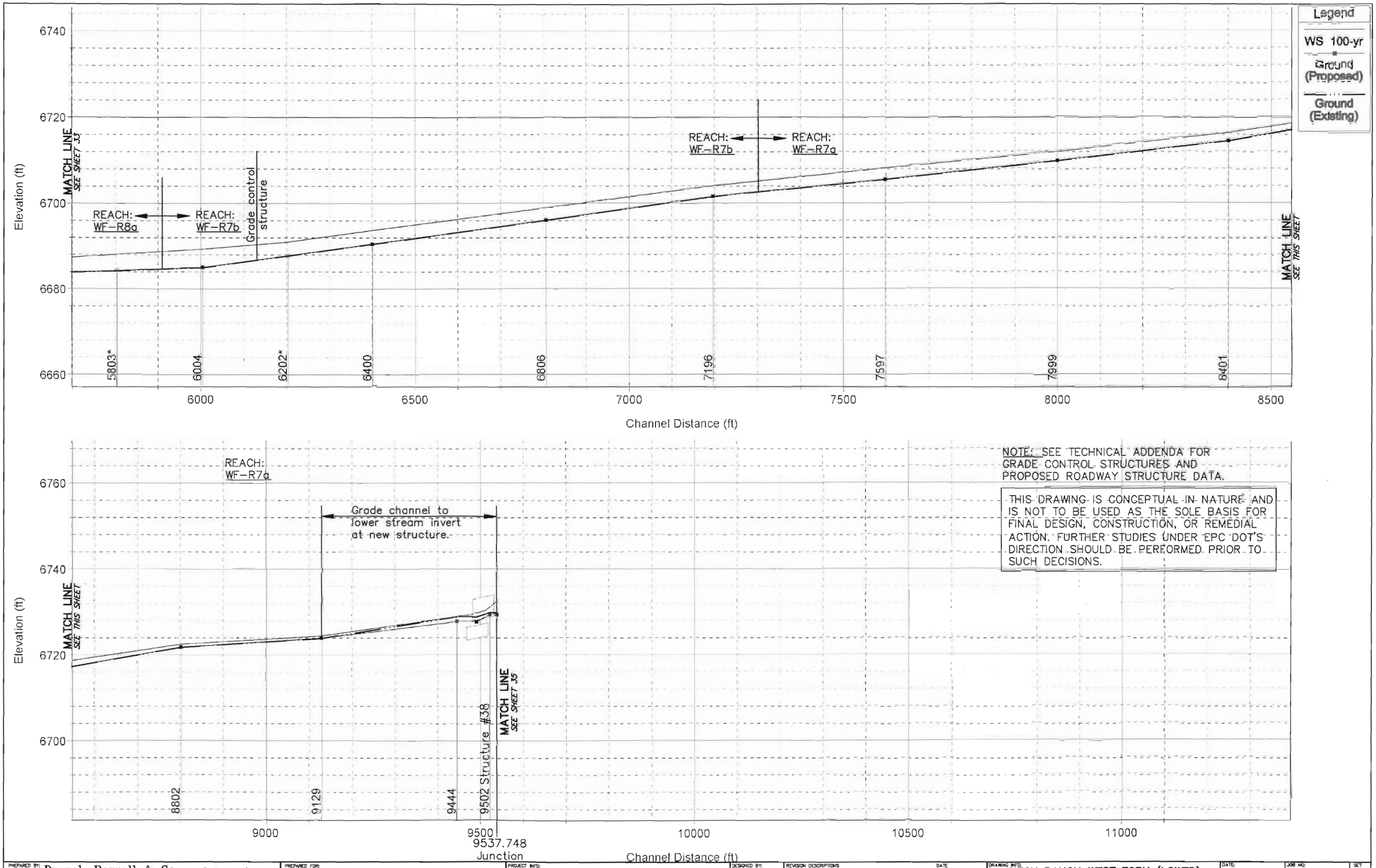
DESIGNED BY:	REVISION DESCRIPTIONS	DATE
RJB	PER EPC FINAL REVIEW	JANUARY 2010
DRAWN BY: BLF/MLM		
CHECKED BY: RJB/TML		

DRAWING INFO: GIECK RANCH WEST FORK (LOWER) FLOOD PROFILES (REACH: WF-R8a & WF-R8b)

DATE:	JOB NO:	SET
AUGUST 2007	C7706-2	PR
SCALE: H: 1" = 200' V: 1" = 20'	DRAWING NO.: 6D 038	SHEET 33



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DRAINAGE BASIN PLANNING STUDY
EL PASO COUNTY, COLORADO

DESIGNED BY: RJB
DRAWN BY: BLF/MLM
CHECKED BY: RJB/TML

REVISION DESCRIPTIONS: PER EPC FINAL REVIEW — DATE: JANUARY 2010

DRAWING INFO: GIECK RANCH WEST FORK (LOWER) FLOOD PROFILES (REACH: WF-R7a TO WF-R8a)

DATE: AUGUST 2007
SCALE: H: 1" = 200' V: 1" = 20'
JOB NO: C7706-2
DRAWING NO: 6D 038
SET: PR
SHEET: 34

Architectural
Structural
Geotechnical

RMG
Engineers / Architects

Materials Testing
Forensic
Civil/Planning

SOIL AND GEOLOGY STUDY

Esteban Subdivsion
3 parcels totaling 496.25 acres
EL Paso County, Colorado

PREPARED FOR:

William Guman & Associates, Ltd
731 North Weber Street, Ste 10
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JOB NO. 190388

April 27, 2023

Respectfully Submitted,
RMG – Rocky Mountain Group

Kelli Zigler

Kelli Zigler
Project Geologist

Reviewed by,
RMG – Rocky Mountain Group

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4/27/23
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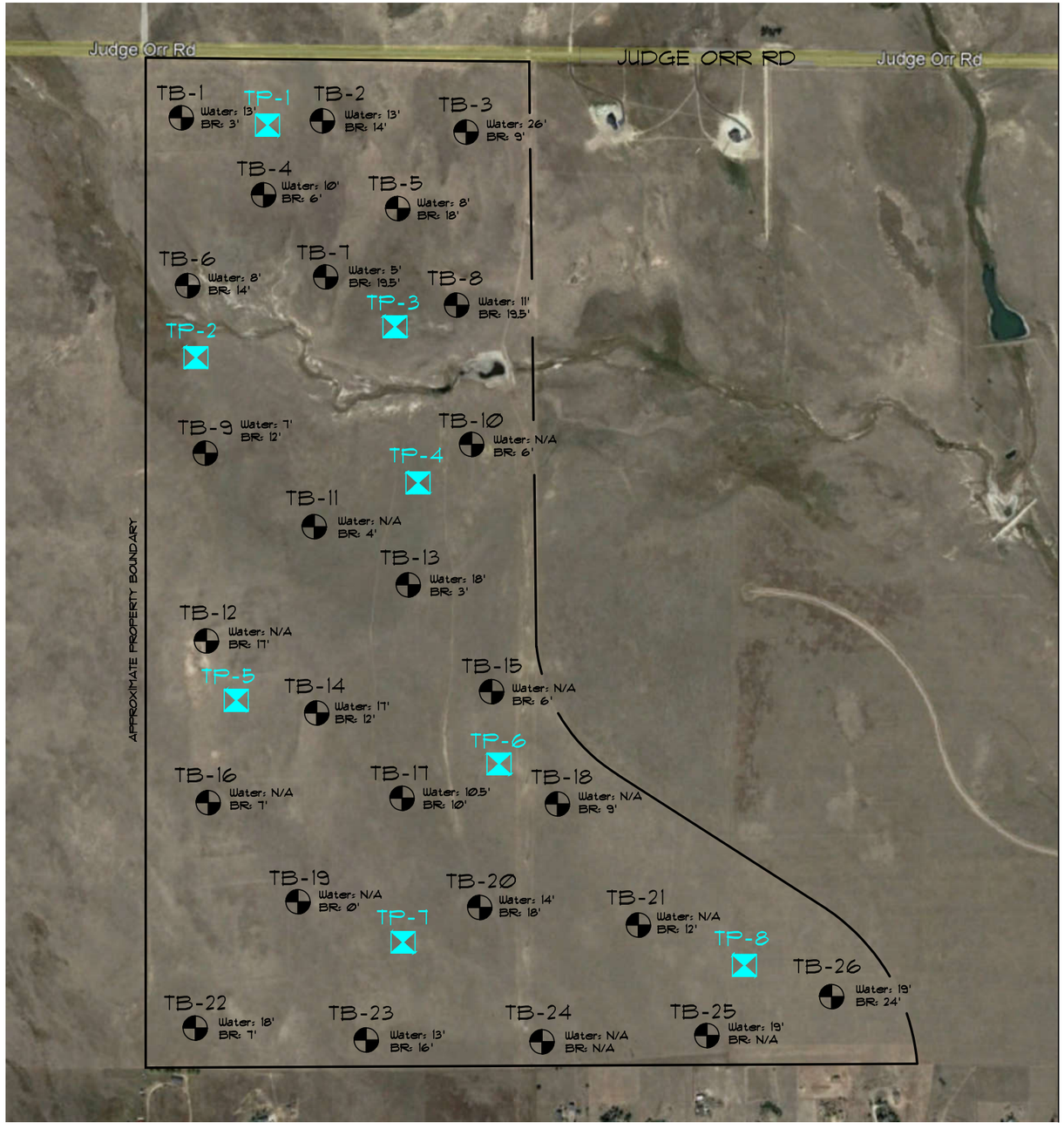

DENOTES APPROXIMATE LOCATION OF TEST BORINGS

DENOTES APPROXIMATE LOCATION OF TEST PITS

Water: Groundwater Depth on 2/28/23
BR: Bedrock depth at time of drilling

NOT TO SCALE

JOB No. 190388

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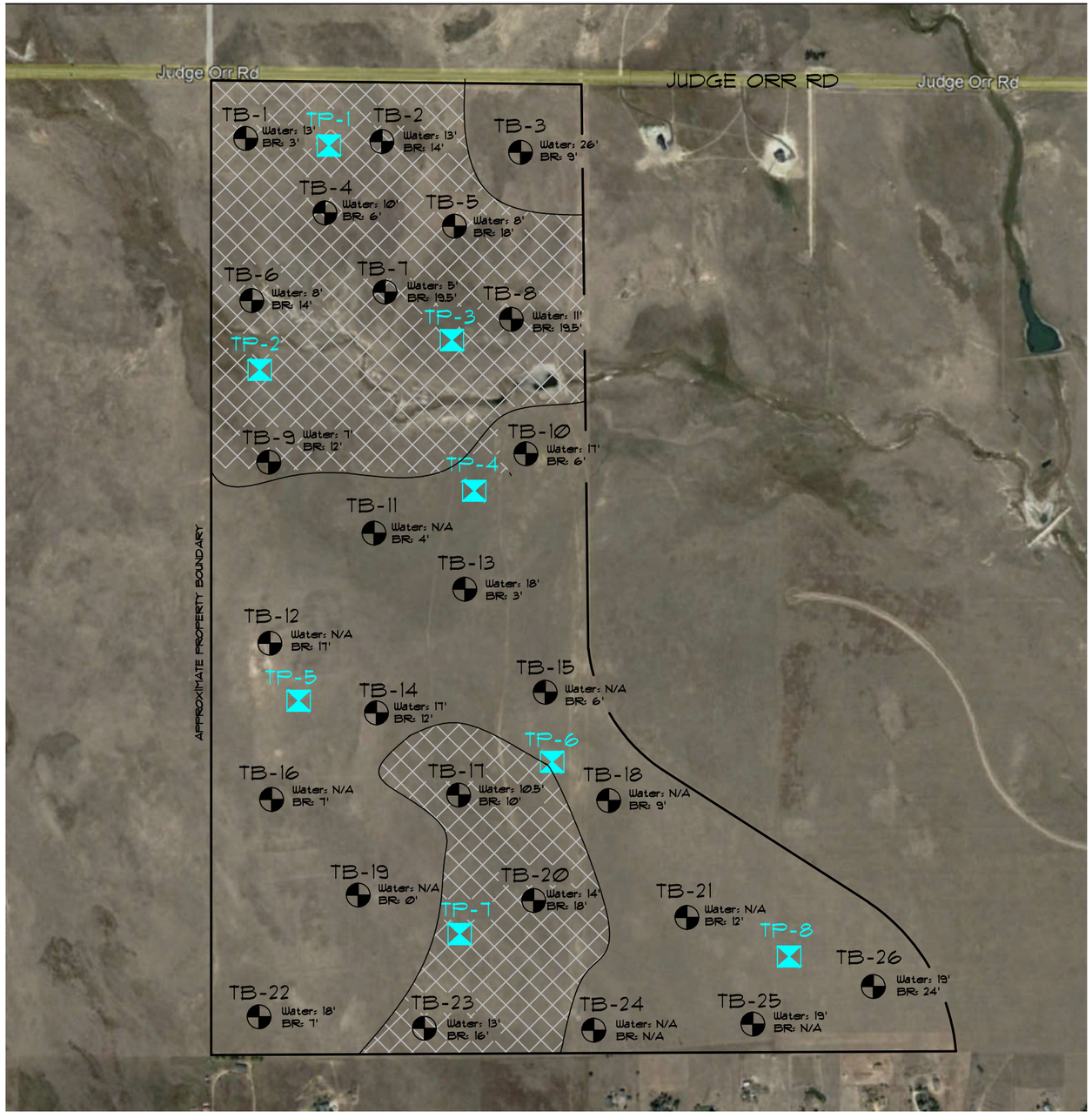
ESTEBAN SUBDIVISION

EL PASO COUNTY, COLORADO
WILLIAM GUMAN AND
ASSOCIATES, LTD

ENGINEER:	TM
DRAWN BY:	NM
CHECKED BY:	TM
ISSUED:	4-27-2023

TEST BORING/TEST PIT LAYOUT PLAN

SHEET No.
FIG-3



DENOTES APPROXIMATE LOCATION OF TEST BORINGS

Water: Groundwater Depth on 2/28/23
BR: Bedrock depth at time of drilling

DENOTES APPROXIMATE LOCATION OF TEST PITS

AREAS WHERE GROUNDWATER IS LESS THAN 15 FEET FROM THE SURFACE. ADDITIONAL INVESTIGATIONS MAY BE PROPOSED TO DETERMINE BASEMENT FEASIBILITY.

NOT TO SCALE

JOB No. 190388

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EL PASO COUNTY, COLORADO
WILLIAM GUMAN AND ASSOCIATES, LTD

ENGINEER:	TM
DRAWN BY:	NM
CHECKED BY:	TM
ISSUED:	4-27-2023

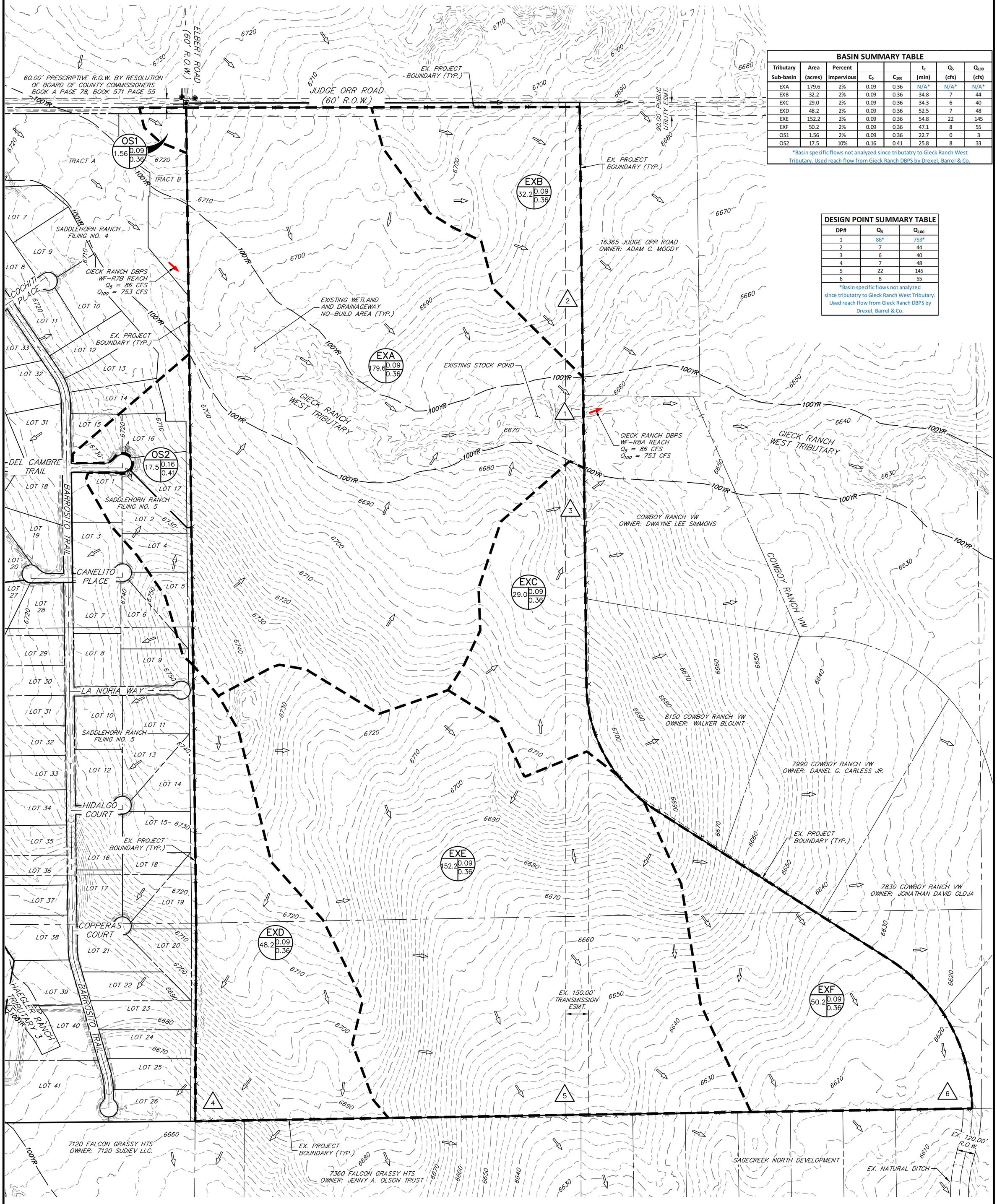
BASEMENT FEASIBILITY MAP

SHEET No.
FIG-31

APPENDIX E

DRAINAGE MAPS

ESTEBAN RODRIGUEZ SUBDIVISION
EXISTING DRAINAGE MAP



BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
EXA	179.6	2%	0.09	0.36	N/A*	N/A*	N/A*
EXB	32.2	2%	0.09	0.36	34.8	7	44
EXC	29.0	2%	0.09	0.36	34.3	6	40
EXD	48.2	2%	0.09	0.36	52.5	7	48
EXE	152.2	2%	0.09	0.36	54.8	22	145
EXF	50.2	2%	0.09	0.36	47.1	8	55
OS1	1.56	2%	0.09	0.36	22.7	0	3
OS2	17.5	10%	0.16	0.41	25.8	8	33

*Basin specific flows not analyzed since tributatry to Gieck Ranch West Tributary. Used reach flow from Gieck Ranch DBPS by Drexel, Barrel & Co.

DESIGN POINT SUMMARY TABLE

DP#	Q_5	Q_{100}
1	86*	753*
2	7	44
3	6	40
4	7	48
5	22	145
6	8	55

*Basin specific flows not analyzed since tributatry to Gieck Ranch West Tributary. Used reach flow from Gieck Ranch DBPS by Drexel, Barrel & Co.

LAYER LINETYPE LEGEND

	EXISTING	PROPOSED
BOUNDARY LINE		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
CENTERLINE		
STORM SEWER		
SWALE/WATERWAY FLOWLINE		
INDEX CONTOUR	6100	6100
INTERMEDIATE CONTOUR		
CURB & GUTTER		
FEMA FLOODPLAIN	100YR	100YR
SUB-BASIN DRAINAGE AREA		

BASIN TAG: BASIN ID (#), AREA [AC] (#.#), C_{100} (#), C_5 (#)

1 DESIGN POINT DESIGNATION

FLOW DIRECTION (EXISTING) ⇨ FLOW DIRECTION (PROPOSED) ➡

N

300 150 0 300 600

ORIGINAL SCALE: 1" = 300'

EXISTING DRAINAGE MAP
ESTEBAN RODRIGUEZ SUBDIVISION
JOB NO. 25277.00
08/06/2024
SHEET 1 OF 1

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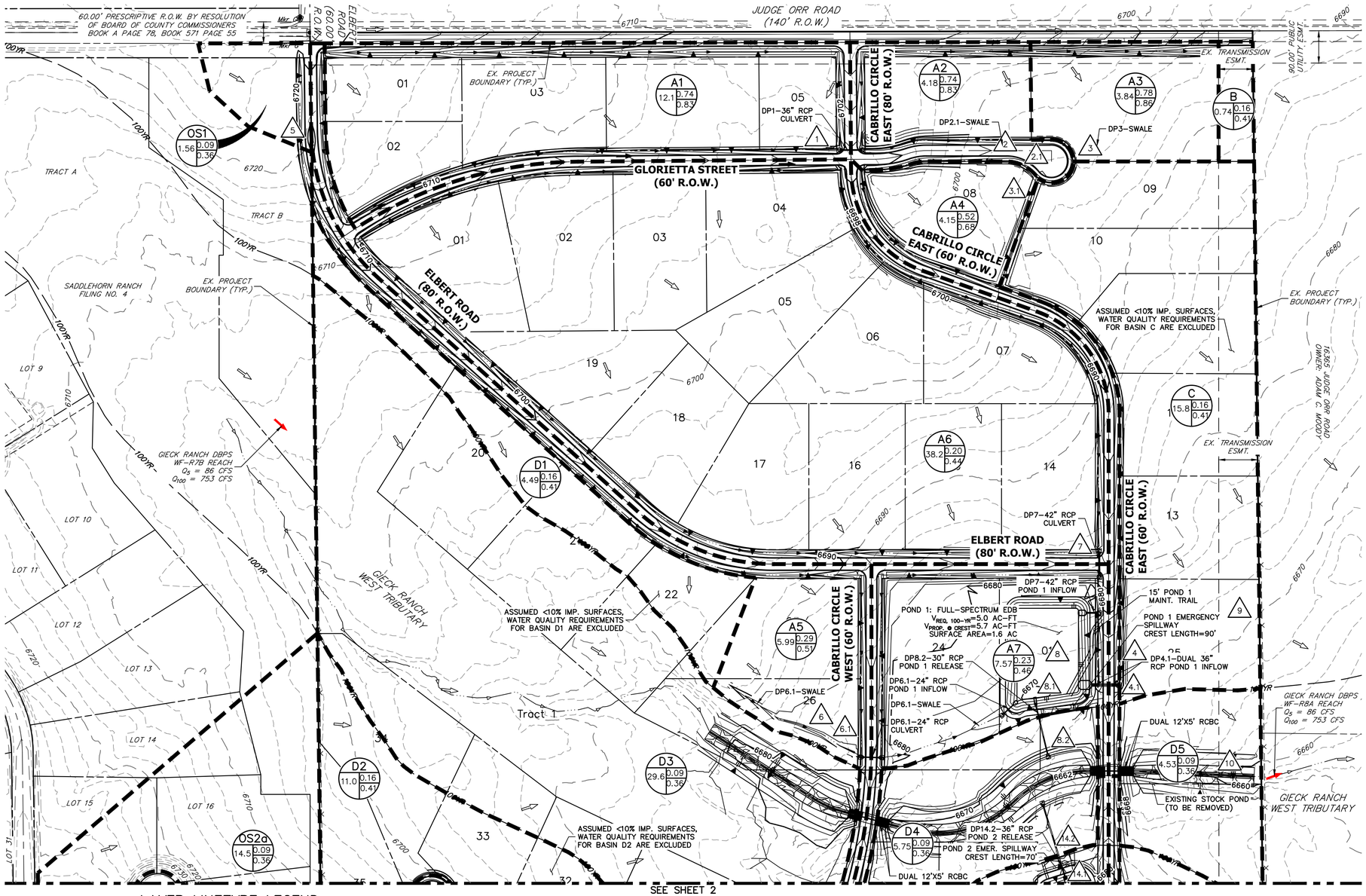
ESTEBAN RODRIGUEZ SUBDIVISION
PROPOSED DRAINAGE MAP



BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A1	12.1	85%	0.74	0.83	13.4	33	62
A2	4.18	72%	0.64	0.76	8.7	12	23
A3	3.84	88%	0.76	0.85	9.5	12	23
A4	4.15	26%	0.29	0.50	25.4	3	10
A5	5.99	26%	0.29	0.51	28.8	4	13
A6	38.2	15%	0.20	0.44	29.7	19	70
A7	7.57	21%	0.25	0.47	13.2	7	22
B	0.74	2%	0.09	0.36	17.0	0	2
C	15.8	10%	0.16	0.41	19.1	8	34
D1	4.49	10%	0.16	0.41	14.6	3	11
D2	11.0	10%	0.16	0.41	17.2	6	25
D3	29.6	2%	0.09	0.36	N/A*	N/A*	N/A*
D4	5.75	2%	0.09	0.36	N/A*	N/A*	N/A*
D5	4.53	2%	0.09	0.36	N/A*	N/A*	N/A*
E1	28.7	16%	0.21	0.44	18.0	19	69
E2	1.63	55%	0.53	0.68	15.6	3	6
E3	43.5	16%	0.21	0.44	23.2	26	93
F	22.0	10%	0.16	0.41	27.0	9	40
G1	17.6	13%	0.19	0.43	24.6	9	35
G2	17.6	15%	0.20	0.44	28.4	9	33
G3	5.70	22%	0.26	0.49	17.8	5	15
G4	20.4	14%	0.19	0.43	27.4	10	39
G5	10.4	12%	0.17	0.42	20.0	6	23
H1	24.0	12%	0.17	0.42	24.4	12	47
H2	41.8	12%	0.17	0.42	34.2	17	67
H3	21.3	15%	0.20	0.44	27.8	11	41
H4	1.96	54%	0.52	0.68	29.2	3	6
H5	3.18	50%	0.49	0.65	28.2	4	9
H6	36.6	11%	0.17	0.41	37.9	13	54
I	46.8	10%	0.16	0.41	18.6	24	103
OS1	1.56	10%	0.16	0.41	21.3	1	3
OS2a	14.5	2%	0.09	0.36	27.3	3	23
OS2b	3.06	2%	0.09	0.36	23.5	1	5

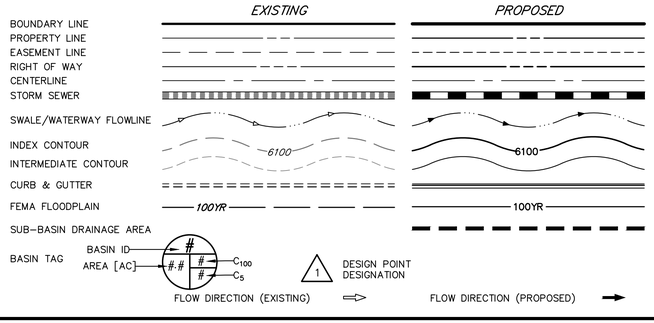
*Basin specific flows not analyzed since tributary to Gieck Ranch West Tributary. Used reach flow from Gieck Ranch DBPS by Drexel, Barrel & Co.

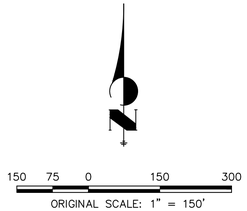
DESIGN POINT SUMMARY TABLE

DP#	Q_5	Q_{100}
1	33	62
2	12	23
2.1	43	82
3	12	23
3.1	54	102
4	3	10
4.1	56	111
5	1	3
6	4	13
6.1	5	16
7	19	70
8	7	22
8.1	68	178
8.2	1	32
9	8	36
10	86*	753*
11	1	5
12	19	69
12.1	20	75
13	3	6
14	26	93
14.1	46	165
14.2	0	45
15	9	40
16	9	35
17	9	33
17.1	16	63
18	5	15
18.1	19	72
19	10	39
19.1	27	108
20	6	23
20.1	29	120
20.2	0	32
21	12	47
22	17	67
22.1	26	106
23	11	41
23.1	34	139
24	3	6
24.1	37	144
25	4	9
25.1	37	145
26	13	54
26.1	47	196
26.2	0	42
27	24	103

*Basin specific flows not analyzed since tributary to Gieck Ranch West Tributary. Used reach flow from Gieck Ranch DBPS by Drexel, Barrel & Co.

LAYER LINETYPE LEGEND





NOTES:

1. PROPOSED DEVELOPMENT SHALL RELEASE FLOWS AT OR BELOW EXISTING CONDITIONS. SEE DRAINAGE REPORT TEXT FOR MORE INFORMATION.
2. SEE WATER QUALITY MAP FOR PBMP SUMMARY TABLE.

PROPOSED DRAINAGE MAP
ESTEBAN RODRIGUEZ SUBDIVISION
JOB NO. 25277.00
10/22/2024
SHEET 1 OF 4

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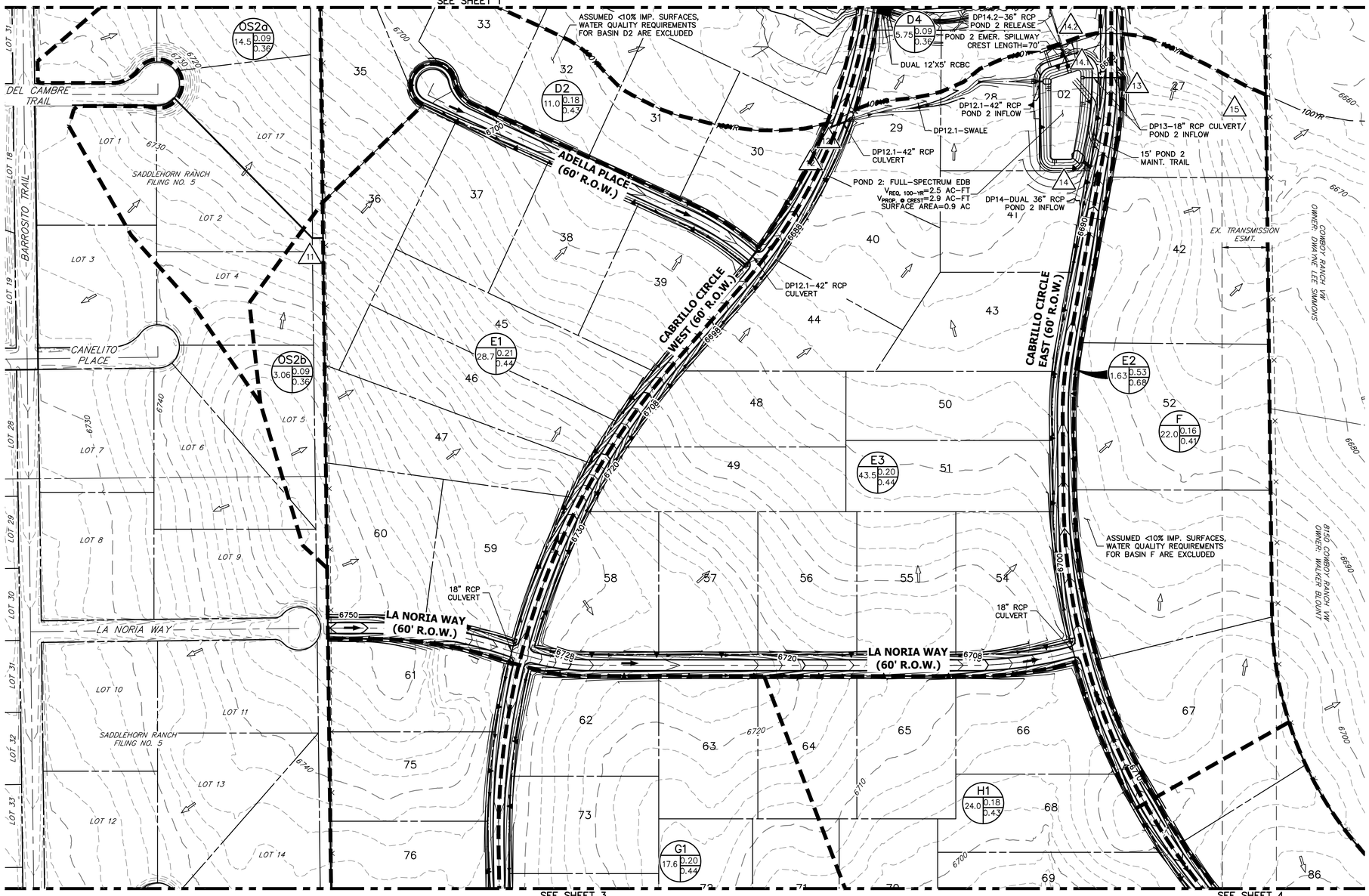
ESTEBAN RODRIGUEZ SUBDIVISION
PROPOSED DRAINAGE MAP



LAYER LINETYPE LEGEND

	EXISTING	PROPOSED
BOUNDARY LINE		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
CENTERLINE		
STORM SEWER		
SWALE/WATERWAY FLOWLINE		
INDEX CONTOUR	6100	6100
INTERMEDIATE CONTOUR		
CURB & GUTTER		
FEMA FLOODPLAIN	100YR	100YR
SUB–BASIN DRAINAGE AREA		

BASIN TAG: BASIN ID (#), AREA [AC] (#.#), C_{100} (#), C_5 (#)

1 DESIGN POINT DESIGNATION

FLOW DIRECTION (EXISTING)

FLOW DIRECTION (PROPOSED)

150 75 0 150 300

ORIGINAL SCALE: 1" = 150'

NOTES:

1. PROPOSED DEVELOPMENT SHALL RELEASE FLOWS AT OR BELOW EXISTING CONDITIONS. SEE DRAINAGE REPORT TEXT FOR MORE INFORMATION.
2. SEE WATER QUALITY MAP FOR PBMP SUMMARY TABLE.

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A1	12.1	85%	0.74	0.83	13.4	33	62
A2	4.18	72%	0.64	0.76	8.7	12	23
A3	3.84	88%	0.76	0.85	9.5	12	23
A4	4.15	26%	0.29	0.50	25.4	3	10
A5	5.99	26%	0.29	0.51	28.8	4	13
A6	38.2	15%	0.20	0.44	29.7	19	70
A7	7.57	21%	0.25	0.47	13.2	7	22
B	0.74	2%	0.09	0.36	17.0	0	2
C	15.8	10%	0.16	0.41	19.1	8	34
D1	4.49	10%	0.16	0.41	14.6	3	11
D2	11.0	10%	0.16	0.41	17.2	6	25
D3	29.6	2%	0.09	0.36	N/A*	N/A*	N/A*
D4	5.75	2%	0.09	0.36	N/A*	N/A*	N/A*
D5	4.53	2%	0.09	0.36	N/A*	N/A*	N/A*
E1	28.7	16%	0.21	0.44	18.0	19	69
E2	1.63	55%	0.53	0.68	15.6	3	6
E3	43.5	16%	0.21	0.44	23.2	26	93
F	22.0	10%	0.16	0.41	27.0	9	40
G1	17.6	13%	0.19	0.43	24.6	9	35
G2	17.6	15%	0.20	0.44	28.4	9	33
G3	5.70	22%	0.26	0.49	17.8	5	15
G4	20.4	14%	0.19	0.43	27.4	10	39
G5	10.4	12%	0.17	0.42	20.0	6	23
H1	24.0	12%	0.17	0.42	24.4	12	47
H2	41.8	12%	0.17	0.42	34.2	17	67
H3	21.3	15%	0.20	0.44	27.8	11	41
H4	1.96	54%	0.52	0.68	29.2	3	6
H5	3.18	50%	0.49	0.65	28.2	4	9
H6	36.6	11%	0.17	0.41	37.9	13	54
I	46.8	10%	0.16	0.41	18.6	24	103
OS1	1.56	10%	0.16	0.41	21.3	1	3
OS2a	14.5	2%	0.09	0.36	27.3	3	23
OS2b	3.06	2%	0.09	0.36	23.5	1	5

*Basin specific flows not analyzed since tributary to Gieck Ranch West Tributary. Used reach flow from Gieck Ranch DBPS by Drexel, Barrel & Co.

DESIGN POINT SUMMARY TABLE

DP#	Q_5	Q_{100}
1	33	62
2	12	23
2.1	43	82
3	12	23
3.1	54	102
4	3	10
4.1	56	111
5	1	3
6	4	13
6.1	5	16
7	19	70
8	7	22
8.1	68	178
8.2	1	32
9	8	36
10	86*	753*
11	1	5
12	19	69
12.1	20	75
13	3	6
14	26	93
14.1	46	165
14.2	0	45
15	9	40
16	9	35
17	9	33
17.1	16	63
18	5	15
18.1	19	72
19	10	39
19.1	27	108
20	6	23
20.1	29	120
20.2	0	32
21	12	47
22	17	67
22.1	26	106
23	11	41
23.1	34	139
24	3	6
24.1	37	144
25	4	9
25.1	37	145
26	13	54
26.1	47	196
26.2	0	42
27	24	103

*Basin specific flows not analyzed since tributary to Gieck Ranch West Tributary. Used reach flow from Gieck Ranch DBPS by Drexel, Barrel & Co.

PROPOSED DRAINAGE MAP
ESTEBAN RODRIGUEZ SUBDIVISION
JOB NO. 25277.00
10/22/2024
SHEET 2 OF 4

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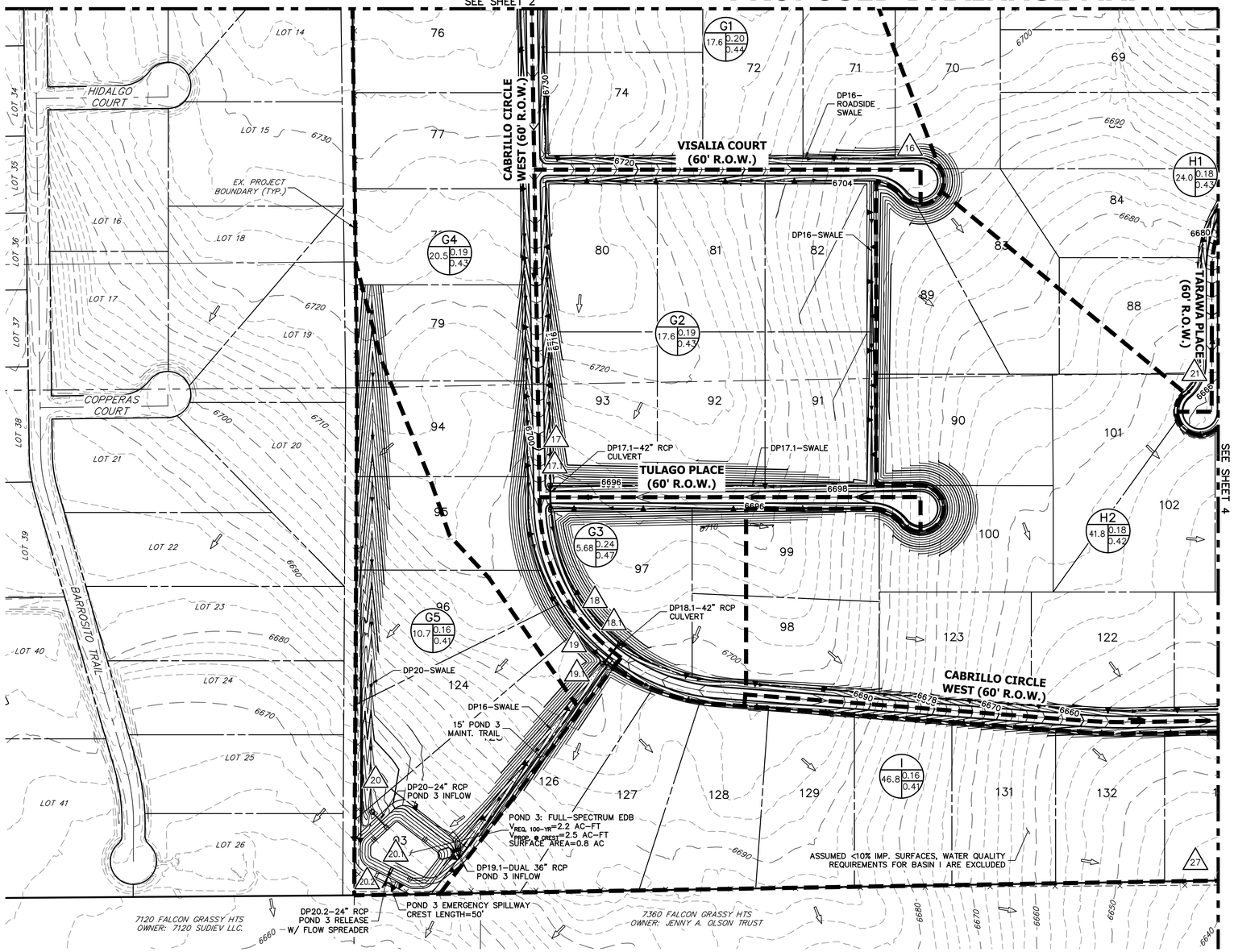
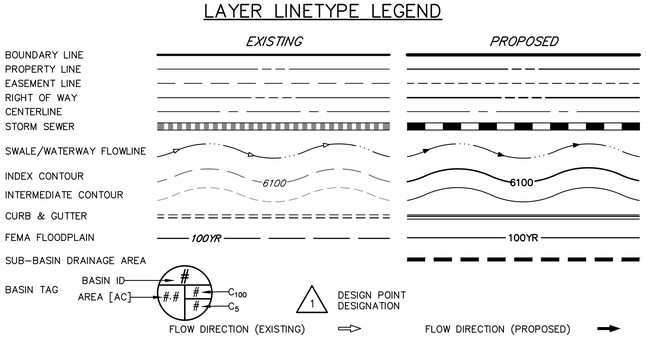
ESTEBAN RODRIGUEZ SUBDIVISION
PROPOSED DRAINAGE MAP



LAYER LINETYPE LEGEND



150 75 0 150 300
ORIGINAL SCALE: 1" = 150'

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A1	12.1	85%	0.74	0.83	13.4	33	62
A2	4.18	72%	0.64	0.76	8.7	12	23
A3	3.84	88%	0.76	0.85	9.5	12	23
A4	4.15	26%	0.29	0.50	25.4	3	10
A5	5.99	26%	0.29	0.51	28.8	4	13
A6	38.2	15%	0.20	0.44	29.7	19	70
A7	7.57	21%	0.25	0.47	13.2	7	22
B	0.74	2%	0.09	0.36	17.0	0	2
C	15.8	10%	0.16	0.41	19.1	8	34
D1	4.49	10%	0.16	0.41	14.6	3	11
D2	11.0	10%	0.16	0.41	17.2	6	25
D3	29.6	2%	0.09	0.36	N/A*	N/A*	N/A*
D4	5.75	2%	0.09	0.36	N/A*	N/A*	N/A*
D5	4.53	2%	0.09	0.36	N/A*	N/A*	N/A*
E1	28.7	16%	0.21	0.44	18.0	19	69
E2	1.63	55%	0.53	0.68	15.6	3	6
E3	43.5	16%	0.21	0.44	23.2	26	93
F	22.0	10%	0.16	0.41	27.0	9	40
G1	17.6	13%	0.19	0.43	24.6	9	35
G2	17.6	15%	0.20	0.44	28.4	9	33
G3	5.70	22%	0.26	0.49	17.8	5	15
G4	20.4	14%	0.19	0.43	27.4	10	39
G5	10.4	12%	0.17	0.42	20.0	6	23
H1	24.0	12%	0.17	0.42	24.4	12	47
H2	41.8	12%	0.17	0.42	34.2	17	67
H3	21.3	15%	0.20	0.44	27.8	11	41
H4	1.96	54%	0.52	0.68	29.2	3	6
H5	3.18	50%	0.49	0.65	28.2	4	9
H6	36.6	11%	0.17	0.41	37.9	13	54
I	46.8	10%	0.16	0.41	18.6	24	103
OS1	1.56	10%	0.16	0.41	21.3	1	3
OS2a	14.5	2%	0.09	0.36	27.3	3	23
OS2b	3.06	2%	0.09	0.36	23.5	1	5

*Basin specific flows not analyzed since tributary to Gieck Ranch West Tributary. Used reach flow from Gieck Ranch DBPS by Drexel, Barrel & Co.

DESIGN POINT SUMMARY TABLE

DP#	Q_5	Q_{100}
1	33	62
2	12	23
2.1	43	82
3	12	23
3.1	54	102
4	3	10
4.1	56	111
5	1	3
6	4	13
6.1	5	16
7	19	70
8	7	22
8.1	68	178
8.2	1	32
9	8	36
10	86*	753*
11	1	5
12	19	69
12.1	20	75
13	3	6
14	26	93
14.1	46	165
14.2	0	45
15	9	40
16	9	35
17	9	33
17.1	16	63
18	5	15
18.1	19	72
19	10	39
19.1	27	108
20	6	23
20.1	29	120
20.2	0	32
21	12	47
22	17	67
22.1	26	106
23	11	41
23.1	34	139
24	3	6
24.1	37	144
25	4	9
25.1	37	145
26	13	54
26.1	47	196
26.2	0	42
27	24	103

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NOTES:

1. PROPOSED DEVELOPMENT SHALL RELEASE FLOWS AT OR BELOW EXISTING CONDITIONS. SEE DRAINAGE REPORT TEXT FOR MORE INFORMATION.
2. SEE WATER QUALITY MAP FOR PBMP SUMMARY TABLE.

PROPOSED DRAINAGE MAP
ESTEBAN RODRIGUEZ SUBDIVISION
JOB NO. 25277.00
10/22/2024
SHEET 3 OF 4

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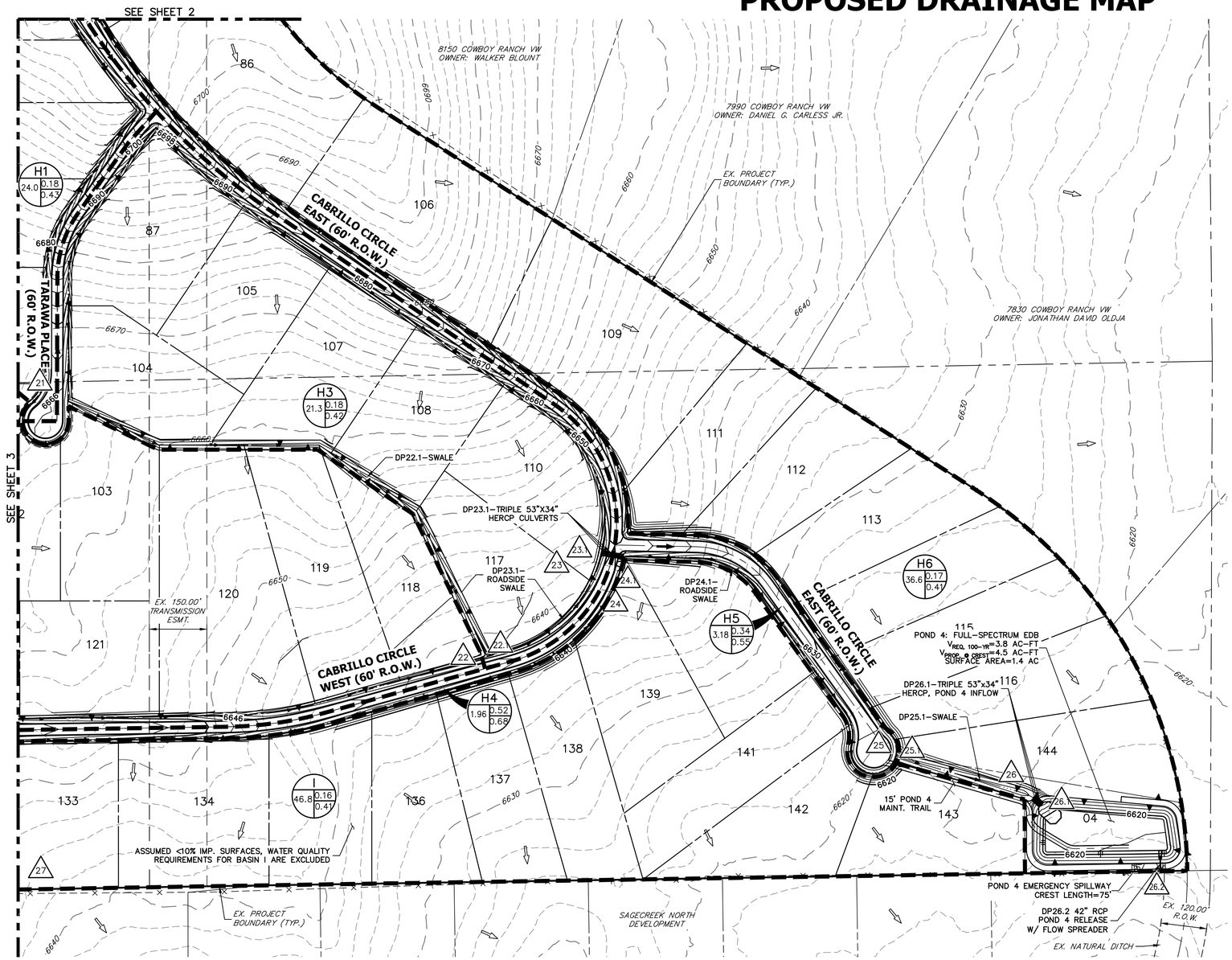
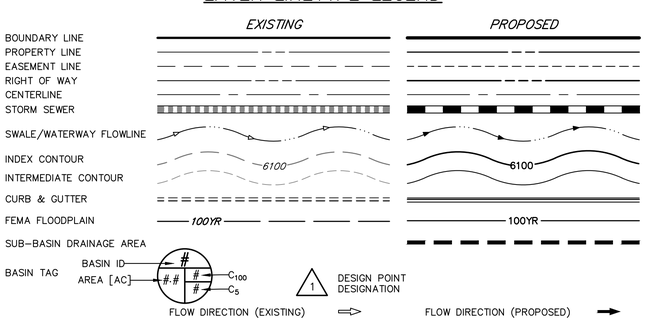
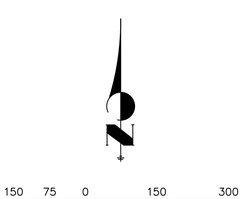
ESTEBAN RODRIGUEZ SUBDIVISION
PROPOSED DRAINAGE MAP



LAYER LINETYPE LEGEND





BASIN SUMMARY TABLE

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A2	4.18	72%	0.64	0.76	8.7	12	23
A3	3.84	88%	0.76	0.85	9.5	12	23
A4	4.15	26%	0.29	0.50	25.4	3	10
A5	5.99	26%	0.29	0.51	28.8	4	13
A6	38.2	15%	0.20	0.44	29.7	19	70
A7	7.57	21%	0.25	0.47	13.2	7	22
B	0.74	2%	0.09	0.36	17.0	0	2
C	15.8	10%	0.16	0.41	19.1	8	34
D1	4.49	10%	0.16	0.41	14.6	3	11
D2	11.0	10%	0.16	0.41	17.2	6	25
D3	29.6	2%	0.09	0.36	N/A*	N/A*	N/A*
D4	5.75	2%	0.09	0.36	N/A*	N/A*	N/A*
D5	4.53	2%	0.09	0.36	N/A*	N/A*	N/A*
E1	28.7	16%	0.21	0.44	18.0	19	69
E2	1.63	55%	0.53	0.68	15.6	3	6
E3	43.5	16%	0.21	0.44	23.2	26	93
F	22.0	10%	0.16	0.41	27.0	9	40
G1	17.6	13%	0.19	0.43	24.6	9	35
G2	17.6	15%	0.20	0.44	28.4	9	33
G3	5.70	22%	0.26	0.49	17.8	5	15
G4	20.4	14%	0.19	0.43	27.4	10	39
G5	10.4	12%	0.17	0.42	20.0	6	23
H1	24.0	12%	0.17	0.42	24.4	12	47
H2	41.8	12%	0.17	0.42	34.2	17	67
H3	21.3	15%	0.20	0.44	27.8	11	41
H4	1.96	54%	0.52	0.68	29.2	3	6
H5	3.18	50%	0.49	0.65	28.2	4	9
H6	36.6	11%	0.17	0.41	37.9	13	54
I	46.8	10%	0.16	0.41	18.6	24	103
OS1	1.56	10%	0.16	0.41	21.3	1	3
OS2a	14.5	2%	0.09	0.36	27.3	3	23
OS2b	3.06	2%	0.09	0.36	23.5	1	5

*Basin specific flows not analyzed since tributary to Gieck Ranch West Tributary. Used reach flow from Gieck Ranch DBPS by Drexel, Barrel & Co.

DESIGN POINT SUMMARY TABLE

DP#	Q_5	Q_{100}
1	33	62
2	12	23
2.1	43	82
3	12	23
3.1	54	102
4	3	10
4.1	56	111
5	1	3
6	4	13
6.1	5	16
7	19	70
8	7	22
8.1	68	178
8.2	1	32
9	8	36
10	86*	753*
11	1	5
12	19	69
12.1	20	75
13	3	6
14	26	93
14.1	46	165
14.2	0	45
15	9	40
16	9	35
17	9	33
17.1	16	63
18	5	15
18.1	19	72
19	10	39
19.1	27	108
20	6	23
20.1	29	120
20.2	0	32
21	12	47
22	17	67
22.1	26	106
23	11	41
23.1	34	139
24	3	6
24.1	37	144
25	4	9
25.1	37	145
26	13	54
26.1	47	196
26.2	0	42
27	24	103

*Basin specific flows not analyzed since tributary to Gieck Ranch West Tributary. Used reach flow from Gieck Ranch DBPS by Drexel, Barrel & Co.

NOTES:

1. PROPOSED DEVELOPMENT SHALL RELEASE FLOWS AT OR BELOW EXISTING CONDITIONS. SEE DRAINAGE REPORT TEXT FOR MORE INFORMATION.
2. SEE WATER QUALITY MAP FOR PBMP SUMMARY TABLE.

PROPOSED DRAINAGE MAP
ESTEBAN RODRIGUEZ SUBDIVISION
JOB NO. 25277.00
10/22/2024
SHEET 4 OF 4

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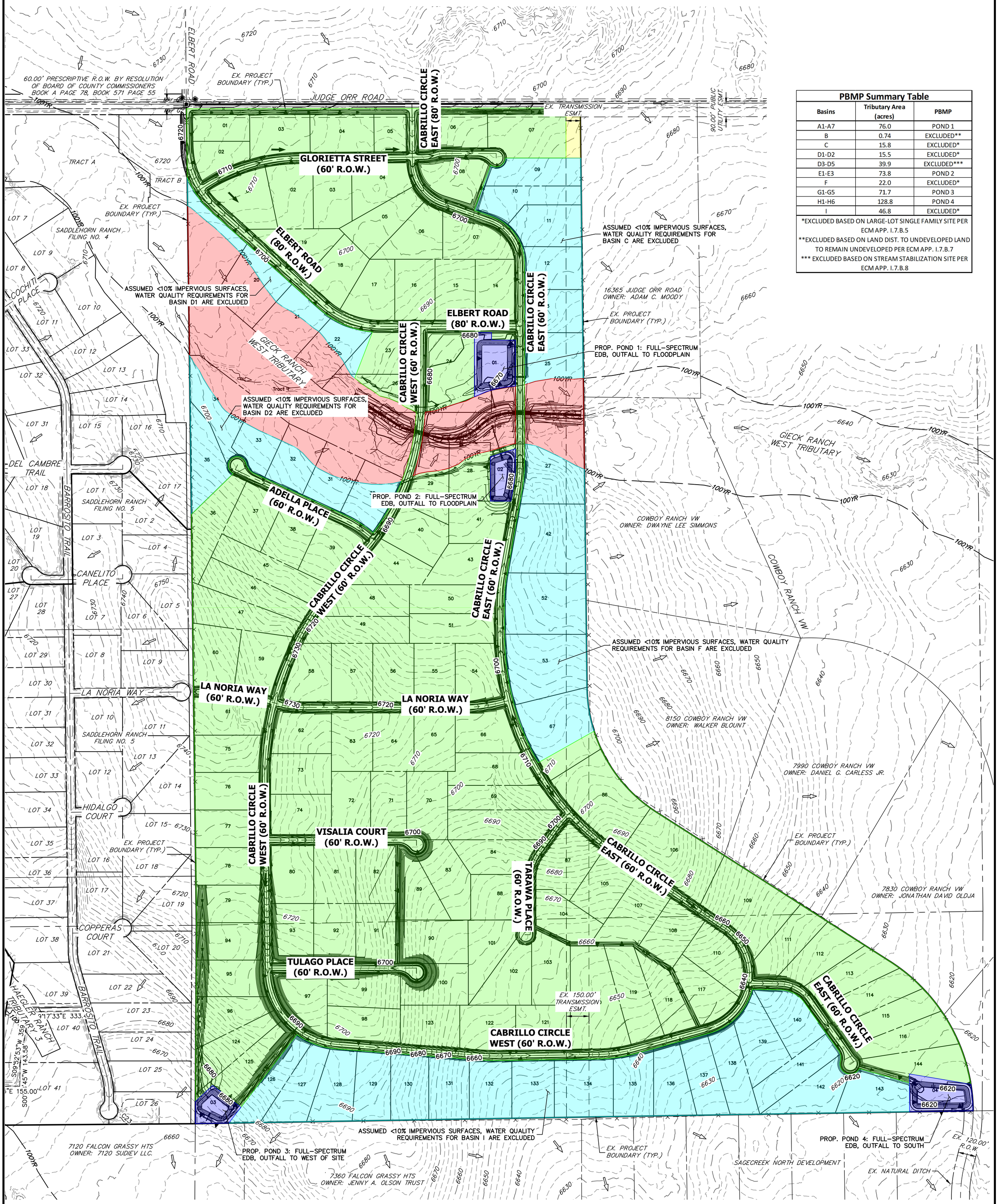
ESTEBAN RODRIGUEZ SUBDIVISION
PROPOSED WATER QUALITY MAP



PBMP Summary Table		
Basins	**Tributary Area (acres)**	**PBMP**
A1-A7	76.0	POND 1
B	0.74	EXCLUDED**
C	15.8	EXCLUDED*
D1-D2	15.5	EXCLUDED*
D3-D5	39.9	EXCLUDED***
E1-E3	73.8	POND 2
F	22.0	EXCLUDED*
G1-G5	71.7	POND 3
H1-H6	128.8	POND 4
I	46.8	EXCLUDED*

*EXCLUDED BASED ON LARGE-LOT SINGLE FAMILY SITE PER ECM APP. I.7.B.5
**EXCLUDED BASED ON LAND DIST. TO UNDEVELOPED LAND TO REMAIN UNDEVELOPED PER ECM APP. I.7.B.7
*** EXCLUDED BASED ON STREAM STABILIZATION SITE PER ECM APP. I.7.B.8

LAYER LINETYPE LEGEND

	EXISTING	PROPOSED
BOUNDARY LINE		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
CENTERLINE		
STORM SEWER		
SWALE/WATERWAY FLOWLINE		
INDEX CONTOUR	6100	6100
INTERMEDIATE CONTOUR		
CURB & GUTTER		
SUB-BASIN DRAINAGE AREA		
FLOW DIRECTION	FLOW DIRECTION (EXISTING)	FLOW DIRECTION (PROPOSED)
FEMA FLOODPLAIN	100YR	100YR

- LARGE-LOT SINGLE FAMILY DEVELOPMENT UNDETAINED AREA
- EX. FLOODPLAIN ONLY STREAM STABILIZATION
- APPROXIMATE EDB FOR DETENTION & WATER QUALITY
- DETAINED & TREATED AREAS WITHIN PROPOSED EDB'S
- LAND DISTURBANCE TO UNDEV. LAND TO REMAIN UNDEV.

300 150 0 300 600
ORIGINAL SCALE: 1" = 300'

PROPOSED WATER QUALITY MAP
ESTEBAN RODRIGUEZ SUBDIVISION
JOB NO. 25277.00
10/22/2024
SHEET 1 OF 1

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