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# Final Drainage Report

**Boyd Subdivision  
Filing No. 1**

**Project No. 61170**

**August 18, 2022**

PCD File No. MS224

# **Final Drainage Report**

for

**Boyd Subdivision Filing No. 1**

**Project No. 61170**

**August 18, 2022**

prepared for

**Christopher and Jessica Boyd**

6238 Gilmer Way  
Weserville, OH 43081

prepared by

**MVE, Inc.**

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61170-Boyd Subdivision-Minor Plat-FDR.odt

# Statements and Acknowledgments

## Engineer's Statement

The attached drainage plan and report were 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 the County for drainage reports and said report is in conformity with the applicable 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.

\_\_\_\_\_  
David R. Gorman, P.E.  
For and on Behalf of MVE, Inc.

Colorado No. 31672

\_\_\_\_\_  
Date

## Developer's Statement

I, the owner/developer have read and will comply with all of the requirements specified in this drainage report and plan.

\_\_\_\_\_  
Christopher Boyd  
6238 Gilmer Way  
Weserville, OH 43081

\_\_\_\_\_  
Date

## El Paso County

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

\_\_\_\_\_  
Joshua Palmer, P.E.,  
Interim County Engineer / ECM Administrator

\_\_\_\_\_  
Date

Conditions:

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# Final Drainage Report

The purpose of this Final Drainage Report is to identify drainage patterns and quantities within and affecting the proposed Boyd Subdivision Filing No. 1 site. The development project is a large-lot rural residential subdivision zoned RR-5. The report will examine existing and proposed developed drainage conditions of the site and contributing off-site areas. The report and included maps present results of hydrologic and drainage facilities analyses. The report will discuss any recommended drainage improvements to the site and identify drainage requirements relative to the proposed project. This report has been prepared and submitted in accordance with the requirements of the El Paso County development approval process. An Appendix is included with this report with pertinent calculations and graphs used in the drainage analyses and design.

## 1 General Location and Description

### 1.1 Location

The proposed Boyd Subdivision Filing No. 1 site is located within the south one-half of Lot 2 of Section 7, Township 11 South, Range 65 west of the 6th Principal Meridian in El Paso County, Colorado. The 35.88± acre site is situated at the end of Brown Road, north of Walker Road. Brown Road, an existing unpaved public road, ends at a cul-de-sac at the northwest corner of the site. This parcel is currently undergoing platting consideration under the name "Prairie Ridge". The site is undeveloped prairie. An undeveloped unplatted parcel (zoned RR5) lies west of the site. To the north, east and south of the site, there are unplatted parcels (zoned RR-5) with existing single family residential development. The El Paso County Assessor's Schedule Number for the site is 5100000433. The proposed site has never been platted. A **Vicinity Map** is included in the **Appendix**. The site is located East Cherry Creek Drainage Basin.

### 1.2 Description of Property

The Boyd Subdivision Filing No. 1 site is 35.88± acres and is zoned RR-5 (Residential Rural (5 Acres)). Proposed Boyd Subdivision Filing No. 1 will create a total of three (3) rural residential lots. Lot 1, on the west portion of the site, will be 15.26± acres. Lot 2 is located in the middle portion of the site will be 10.00± acres. Lot 3 will be 10.62± acres and located on the eastern portion of the site.

The ground cover is in fair to good condition and consists of native grasses and weeds. A singular tree is located on the dividing line between lots 2 and 3.

The existing site topography varies throughout the site. The northern portion of the site slopes southeast with grades that range from 3% to 15%. The existing site topography on the southern side of the site slopes north with grades that range from 5% to 13%. A drainage way and small holding pond traverse the southern portion of the site from west to east.

There is a large drainage way in the Boyd Subdivision Filing No. 1 site, which as mentioned above, crosses the southern portion of the site. All storm runoff flows drain south and north to this drainage way and then off the property towards the east. There is no storm drain system in the surrounding area.

According to the National Resource Conservation Service, there are two (2) soil types in the Boyd Subdivision Filing No. 1 site. Brussett loam (map unit 15) makes up the north 25% of the site. The soil is deep and well drained. Permeability is moderately rapid, surface runoff is slow, and the hazard of erosion is slight to moderate. Brussett loam is classified as being part of Hydrologic Soil Group B. Peyton sandy loam makes up the south 75% of the site. The soil is deep and well drained. Permeability is moderately rapid, surface runoff is moderate, and the hazard of erosion is moderate. Peyton sandy loam is classified as being part of Hydrologic Soil Group B.

A portion of the Soil Map and data tables from the National Cooperative Soil Survey and relevant Official Soil Series Descriptions (OSD) are included in the **Appendix**.<sup>1 2</sup>

The Soils and Geology Study for the site was prepared by RMG Engineers / Architects.<sup>3</sup> soils report was also prepared for the site. Soils found on the site, especially near the surface, are described as Silty Clay (Strong, Blocky) or Silty Clay Loam (Strong, Blocky) overlying Sandy Clay Loam (Moderate). These soils are generally considered to be cohesive, that is, soils that do not crumble, can be excavated with vertical sideslopes, and are plastic when moist. Cohesive soils are hard to break up when dry, and exhibit significant cohesion when submerged.

## 2 Drainage Basins and Sub-Basins

### 2.1 Major Basin Descriptions

The Boyd Subdivision Filing No. 1 site is located in the unstudied East Cherry Creek Drainage Basin (CYCY0200).

The current Flood Insurance Study of the region includes Flood Insurance Rate Maps (FIRM), effective on December 7, 2018.<sup>4</sup> The proposed subdivision is included in the Community Panel Numbered 08041C0305 G of the Flood Insurance Rate Maps for the El Paso County. No part of the site is shown to be included in a 100-year flood hazard area as determined by FEMA. A portion of the current FEMA Flood Insurance Rate Maps with the site delineated is included in the **Appendix**.

### 2.2 Sub-Basin Description

The existing drainage patterns of the Boyd Subdivision Filing No. 1 project are described by three (3) on-site drainage basins. All of these basins are previously undisturbed or developed to a degree as described below. All existing basin delineations and data are depicted on the attached **Existing Drainage Map**.

#### 2.2.1 Existing Drainage Patterns (Off-Site)

The Boyd Subdivision Filing No. 1 site receives drainage flows from approximately 0.5 square miles of area to the west of the site. That enters from a large drainage way along the south west edge of the site. There is also a small off-site basin that deposits flows onto the site at the northwest edge.

#### 2.2.2 Existing Drainage Patterns (On-Site)

Existing sub-basin EX-A, located in the western portion of the site, containing an existing stock pond, drains easterly from the western edge of the site before collecting into an existing stock pond. From there runoff exits the pond and continues east through sub-basin EX-B.

Existing sub-basin EX-B is located in the middle and eastern portion of the site. The sub-basin contains existing prairie and the afore mentioned drainage way. All flows from sub-basin B exit the site to the east via the drainage way into the adjacent site. These flows continue east through adjacent properties and eventually enter East Cherry Creek.

Existing sub-basin EX-C, located on the northeast side of the site, containing prairie, drains to the southeast and exits the site into the adjacent site. These flows continue southeast through the

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1 WSS  
2 OSD  
3 SGS  
4 FIRM

adjacent property and combine with the flows in the drainage way eventually entering East Cherry Creek.

### 3 Drainage Design Criteria

#### 3.1 Development Criteria Reference

This Final Drainage Report for Boyd Subdivision Filing No. 1 has been prepared according to the report guidelines presented in the latest edition of *El Paso County Drainage Criteria Manual* (DCM)<sup>5</sup>. The County has also adopted portions of the City of Colorado Springs Drainage Criteria Manual Volumes 1 and 2, especially concerning the calculation of rainfall runoff flow rates.<sup>6 7</sup> The hydrologic analysis is based on a collection of data from the DCM, the NRCS Web Soil Survey<sup>8</sup>, and existing topographic data by Polaris Surveying, Inc.

#### 3.2 Previous Drainage Studies

A drainage report has been submitted and approved for the proposed subdivision located west of the site (Prairie Ridge Filing No. 1). The Prairie Ridge report was used for information only. Drainage calculations for Boyd Subdivision were performed independently of the Prairie Ridge Filing No. 1 report, but results are comparable.

#### 3.3 Hydrologic Criteria

For the on-site and local sub-basins in this Final Drainage Report, the Rational Method as described in the *Drainage Criteria Manual* has been used for all Storm Runoff calculations, as the development and all sub-basins are less than 130 acres in area. "Colorado Springs Rainfall Intensity Duration Frequency" curves, Figure 6-5 in the DCM, was used to obtain the design rainfall values; a copy is included in the **Appendix**. The "Overland (Initial) Flow Equation" (Eq. 6-8) in the DCM, and Manning's equation with estimated depths were used in time of concentration calculations. "Runoff Coefficients for Rational Method", Table 6-6 in the DCM, was utilized as a guide in estimating runoff coefficient and Percent Impervious values; a copy is included in the **Appendix**. Peak runoff discharges were calculated for each drainage sub-basin for both the 5-year storm event and the 100-year storm event with the Rational Method formula, (Eq. 6-5) in the DCM.<sup>9</sup>

For the overall site and large upstream basins flowing through the site in the drainage way, the NRCS Curve Number Loss and Dimensionless Unit Hydrograph Method as described in the (DCM) was applied to calculate the 5-year and 100-year peak storm runoff rates for each drainage sub-basin using the "Hydrologic Engineering Center - Hydrologic Modeling System" (HEC-HMS) Version 4.3 computer program by U.S. Army Corps of Engineers.<sup>10</sup>

Rainfall depths for 5-year and 100-year, 24-hour rainfall event were estimated using the National Oceanic and Atmospheric Administration, Precipitation-Frequency Atlas of the Western United States, Volume III-Colorado (NOAA Atlas 2).<sup>11</sup> Precipitation depth maps shown in the NOAA Atlas were used to determine the representative 24-hour point rainfall value of 4.6 inches over the drainage basin. The NOAA Atlas 2 map is included in the appendix. The rainfall depth is applied to the NRCS 24-Hour Type II Rainfall Distribution to produce a design storm with Depth-Area Reduction Factors (DARF) correction factors determined by the HEC-HMS program based on the return period of the storm and basin area.

The NRCS Curve Numbers used to calculate the volume of runoff from the 5-year and 100-year storm events in each sub-basin are estimated using the predominate Hydrologic Soil Group, discussed in the section above, the land cover, land use condition and the Antecedent Runoff

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5 DCM Section 4.3 and Section 4.4

6 CS DCM Vol 1

7 CS DCM Vol 2

8 WSS

9 DCM

10 HEC-HMS

11 NOAA

Condition (ARC) of each basin. ARC II is used for all sub-basin Curve Numbers in this analysis. The NRCS Curve numbers for the individual sub-basins range from 66 to 66.5. The appendix contains the NRCS Curve number calculations and summary.

Times of Concentration for sub-basin runoff is calculated using three flow components: Overland Flow Time, Shallow Concentrate Flow Time, and Concentrated Flow Time. The Overland Flow Component is calculated using the Overland Flow Equation as required (DCM Eq 6-15) with maximum overland flow length of 300 feet and the appropriate Manning's Roughness Coefficient according to the surface description (DCM Table 6-11). Shallow Concentrated Flow times are determined based on watercourse slope, ground cover and flow velocity using DCM Table 6-25. Concentrated flow velocities and times are estimated using the Manning' Equation with channel waterway characteristics taken from the basin mapping. The referenced equations, coefficients and tables are included in the appendix. Calculations for Times of Concentration and Lag Times are also included in the appendix.

The Muskingum-Cunge method was utilized for hydrograph channel routing as applied in the HEC-HMS program using waterway course length, slope, channel shape, bottom width and side slopes as determined from the basin mapping. Lower Manning's roughness coefficients were used to represent the thicker vegetation found in the center of the drainage path and higher values for the vegetation on the outer portions of the drainage path.

## 4 Drainage Facility Design

### 4.1 General Concept

The intent of the drainage concept presented in this Final Drainage Report is to allow for the development of the three rural residential lots while maintaining the existing drainage patterns on the site. There will be no significant grading on the site and no public facilities constructed. The site will be in compliance with the County's Stormwater Management regulations without the need for permanent water quality treatment facilities due to the site being entirely large lot rural residential lots, which are excluded from water quality requirements. No roadways are being constructed and disturbance will be less than 1 acre. Major and minor storm flows will continue to be safely conveyed through the site and downstream.

The existing and proposed drainage hydrologic conditions are described in more detail below. Input data and results for all calculations are included in the **Appendix**. Drainage maps for the hydrology are also included in the **Appendix**.

### 4.2 Specific Details

#### 4.2.1 Existing Main Stem Drainage Way Hydrologic Conditions

The existing drainage way that that crossing the southern portion of the site flows from the west edge of the site, through a stock pond just inside the western edge and continuing across to the east and off the site along the eastern edge.

Approximately 0.25 square miles of area drain to the stock pond approximately 2,000 feet west of the site at the beginning of the drainage way. The off-site will generate peak storm runoff discharges of  $Q_5 = 49.4$  cfs and  $Q_{100} = 236.9$  cfs (existing flow) which drains easterly into the stock pond at Design Point 1 (DP1) which includes sub-basins OS-1 and OS-2.

These flows continue easterly in the drainage way and combine with the flows from OS-3 and OS-4 just west of Brown Road. The drainage way has a peak storm runoff discharge of  $Q_5 = 60.8$  cfs and  $Q_{100} = 293.4$  cfs (existing flow) at this Design Point 2 (DP2) which includes sub-basins OS-1, OS-2, OS-3 and OS-4.

These flows continue easterly in the drainage way and combine with the flows from OS-5 just inside the western edge of the site at an existing stock pond. The drainage way has a peak storm runoff discharge of  $Q_5 = 73.1$  cfs and  $Q_{100} = 354.4$  cfs (existing flow) at this Design Point 3 (DP3) which includes sub-basins OS-1, OS-2, OS-3, OS-4 and OS-5.

These flows continue in the drainage way and combine with the flows of this site (SCS sub-basin B) at Design Point 4 (DP4). The flows will generate peak storm runoff discharges of  $Q_5 = 87.0$  cfs and  $Q_{100} = 423.8$  cfs (existing flow) that leave the site in the existing drainage way to the east.

#### 4.2.2 Existing On-Site Hydrologic Conditions

The Boyd Subdivision Filing No. 1 site includes three (3) sub-basins. The northern and southern portions of the site drain southerly and northerly into a drainage way before draining east toward East Cherry Creek. The sub-basins are described in more detail below without looking at the existing flows in the drainage way. Those flows are described later in this report.

There is no significant signs of erosion along the drainageway and is considered to be in a stable condition. The drainageway features thick vegetation on average of 1-2 feet with the tallest vegetation (2-3 feet) found in the center of the drainageway.

Existing sub-basin OS-A1, located off-site on the southwest side of the site, is  $2.45\pm$  acres in area. Sub-basin OS-A1 is undeveloped prairie. Peak storm runoff rates are  $Q_5 = 0.7$  cfs and  $Q_{100} = 5.4$  cfs (existing flows) which drain onto the site from the south into sub-basin EX-A.

Existing sub-basin EX-A, located in the western portion of the site, is  $4.90\pm$  in area. Sub-basin EX-A contains an existing stock pond. Peak storm runoff rates are  $Q_5 = 1.4$  cfs and  $Q_{100} = 10.6$  cfs (existing flows) which drain east into sub-basin EX-B. This sub-basin contains an existing livestock watering pond. Although the pond in actuality provides some peak flow attenuation during storm events, it does not have an outlet structure. Therefore, the presence of the pond is not considered in the hydrologic analysis and detention effects are not accounted for in the downstream drainageway peak flow rates. The pond is more fully discussed in a section below.

Existing sub-basin OS-B1, located off-site on the northwest side of the site, is  $4.34\pm$  acres in area. Sub-basin OS-B1 is undeveloped prairie with a gravel drive along the northern edge. Peak storm runoff rates are  $Q_5 = 1.5$  cfs and  $Q_{100} = 9.5$  cfs (existing flows) which drain onto the site from the west and into sub-basin EX-B.

Existing sub-basin OS-B2, located off-site on the south side of the site, is  $26.81\pm$  acres in area. Sub-basin OS-B2 is undeveloped prairie. Peak storm runoff rates are  $Q_5 = 7.0$  cfs and  $Q_{100} = 51.6$  cfs (existing flows) which drain onto the site from the south and into sub-basin EX-B.

Existing sub-basin EX-B, located in the central and southeastern portion of the site, is  $26.86\pm$  acres in area. Sub-basin EX-B contains a gravel driveway along the northern edge, prairie and the drainage way. Peak storm runoff rates are  $Q_5 = 7.0$  cfs and  $Q_{100} = 50.0$  cfs (existing flows) which drain off-site to the east. These flows continue to drain east through adjacent properties and eventually flow into East Cherry Creek.

Existing sub-basin EX-C, located on the northeast corner of the site, is  $4.12\pm$  acres in area. Sub-basin EX-C contains a gravel driveway along the northern edge and prairie. Peak storm runoff rates are  $Q_5 = 1.5$  cfs and  $Q_{100} = 9.1$  cfs (existing flows) which drain southeast off of the site. The flows will continue flowing southeasterly through the adjacent property and into the drainage way eventually flowing into East Cherry Creek.

#### 4.2.3 Proposed On-Site Hydrologic Conditions

The proposed drainage basins for Boyd Subdivision Filing No. 1 mirror the existing basins as no changes will be made to the site that affect the layout of the basins. Three (3) sub-basins have been identified in the Boyd Subdivision Filing No. 1 project site for analysis of the developed drainage condition. The site is to contain three rural residential lots. Lot 1 will be 15.26 acres. Lot 2 will be 10.00 acres and Lot 3 will be 10.62 acres. Access to all three lots will be from the cul-de-sac at the end of Brown Road at the northwest corner of the site and on an existing shared driveway along the north edge of the site. The existing driveway is located on the northern border of Lots 1, 2 and 3. Lots 1, 2 and 3 are assumed to each contain a 5,000 sf house footprint, 1,000 sf of exterior hardscape and 200 foot long 12' wide gravel driveway. The resulting percent imperviousness was used in the hydrologic calculations and the Drainage and Bridge Fee calculations. The sub-basins are described in more detail below.

Proposed sub-basin A (4.90 acres), located on the southwestern corner of the site, will continue to drain south and north to the existing natural drainageway as in existing conditions. An existing livestock pond is located in Sub-basin A near the the southwestern corner of the site and runoff from the sub-basin drains directly into the pond. This pond is an existing approved livestock tank and will not have any necessary modifications. No detention is required for this site and the pond is not designed to provide detention. Ownership and maintenance of the livestock pond will be vested to Lot 1. Access to said pond shall be through Lot 1 exclusively. The sub-basin is not expected to contain any improvements. Proposed sub-basin A will continue to generate peak storm runoff discharges of  $Q_5 = 1.4$  cfs and  $Q_{100} = 10.6$  cfs (historic flows) which exit the pond and flow east into sub-basin B.

Proposed sub-basin B (26.86 acres) will continue to drain southeast and northeast to the existing natural drainageway as in existing conditions. Proposed sub-basin B is expected to contain two (2) single family residences with assumed gravel driveways. Sub-basin B will generate peak storm runoff discharges of  $Q_5 = 7.8$  cfs and  $Q_{100} = 50.9$  cfs (proposed flow) which drains easterly out of the site. This represents increases of 0.8 cfs for the 5-year storm and 0.9 cfs for the 100-year storm. These flows will continue to drain easterly through adjacent properties and eventually flow into East Cherry Creek.

Proposed sub-basin C (4.12 acres) will continue to drain off the site as in existing conditions. The proposed sub-basin C is expected to contain one (1) single family residence, and assumed gravel driveway. Sub-basin C will generate peak storm runoff discharges of  $Q_5 = 2.0$  cfs and  $Q_{100} = 9.6$  cfs (proposed flow) which drains easterly out of the site. This represents increases of 0.5 cfs for the 5-year storm and 0.5 cfs for the 100-year storm. The flows will continue flowing southeasterly through the adjacent property and into the drainage way eventually flowing into East Cherry Creek.

#### **4.2.4 Developed Main Stem Drainage Way Hydrologic and Hydraulic Conditions**

A natural existing drainage way crosses the southern portion of the site and flows from the west edge of the site, through a livestock pond located just inside the western edge and continues to the east and then off-site at the eastern edge of the site.

Approximately 0.46 square miles of area drain to the livestock pond just inside the western edge of the site. The off-site basins generate peak storm runoff discharges of  $Q_5 = 73.1$  cfs and  $Q_{100} = 354.0$  cfs (existing flow) which drains easterly into the site at Design Point 3 (DP3) which includes sub-basins OS-1, OS-2, OS-3, OS-4 and OS-5. The pond has one 15" CMP outlet pipe located in the upper elevation of the pond embankment. Due to the location and size of the outlet pipe, it is largely ineffectual in draining flows from the pond and can be ignored hydrologic or hydraulic purposes. When the pond reaches capacity, overflows exit the pond at the opening provided at the south side of the embankment and continue east in the drainageway in accordance with the design associated with the livestock pond permit.

The flows exit the pond and continue easterly in the drainage way, combining with the developed flows from SCS sub-basin B at Design Point 4 (DP4). Having peak storm runoff discharges of  $Q_5 = 88.0$  cfs and  $Q_{100} = 425.8$  cfs (developed flow). This represents increases of 1.0 cfs for the 5-year storm and 2.0 cfs for the 100-year storm leaving the site in the drainage way. This is an insignificant and inconsequential increase in flows.

Drainage easements and no-build areas are established in the final plat to contain this drainage way, existing ponds and the seasonably high ground water areas of the site. The boundary of the drainage easement was determined by a hydraulic analysis of the drainage way. Calculations and results of the analysis are included in the **Appendix**.

#### **4.2.5 Detention Facilities**

The existing livestock water tank (pond) is located in the southwestern portion of the subdivision within proposed Lot 1. The pond was constructed and maintained in accordance to the "Application for Approval of Livestock Water Tank" which was approved by the State Engineer's Office on December 27, 1957. A copy of this document is included in the Appendix. The pond has an east-west facing embankment that is well vegetated and stable. The Pond overflows at the spillway opening provided at the south side of the embankment in accordance with the design associated

with the livestock pond permit. The pond has one 15" CMP outlet culvert pipe located in the upper elevation of the pond embankment (about one foot below the embankment top) on the south side. Due to the position and size of the outlet pipe, it is largely ineffectual in draining flows from the pond and can be ignored for hydrologic or hydraulic purposes. The owners of the Boyd Subdivision property, Christopher and Jessica Boyd, own the pond and are responsible for maintenance. In the developed and platted condition, the owner of Lot 1 Boyd Subdivision will own and maintain the pond. Access to the pond by vehicle or foot is available from proposed Lot 1. No additional access easements will be needed to access the pond from Lot 1.

A permanent detention facility is not recommended for this site. The site is classified and large lot residential by both zoning and plat implementation. All three proposed lots are at least 10 acres in size. No public or private roadways will be constructed. Water Quality Treatment is not required by the ECM. The development's effect on peak runoff discharges is negligible with an increase of 2.0 cfs in the 100-year rainfall event. Therefore, a permanent detention facility is not recommended.

#### **4.2.6 Drainageway Hydraulic Analysis**

A hydraulic analysis of the significant drainageway flowing west to east through the site was conducted utilizing HEC-RAS computer modeling. Cross sections were sampled through the project site in approximately 50' intervals as well as a short distance upstream and downstream of the site. The drainageway exhibits minor winding and vegetated by long and dense native grasses in the channel and overbanks. Manning's roughness coefficient of 0.040 is selected due to the channel characteristics, vegetation and flow depths. Channel velocities range from 1 to 6 fps and average 4.1 fps. Three dispersed and isolated cross sections approach 6.5 fps, however these cross sections are located upstream or downstream of the site boundaries. Several gathered sources note permissible flow velocities of up to 6 pfs for channels lined with long native grasses for channel stability. The source is included in the Appendix of this report.

The drainageway was examined for signs of sedimentation or erosion. It is found that the flow path is vegetated with thick natural grasses without signs of erosion within the site boundaries. The existing drainageway is in a stable condition and flows are only negligibly increased as a result of the development. Photos of the reach are included in the Appendix. We recommend no channel stabilization measures for the project site.

#### **4.3 Erosion Control**

There is no public infrastructure construction associated with this subdivision. Any required best management practices (BMP's) for the individual lot home construction will be handled on the BESQCP for each lot at time of building permit.

#### **4.4 Four Step Process**

El Paso County Engineering Criteria Manual, Appendix I, contains the policies and procedures for Stormwater Quality. Section I.7.1.B provides for exclusions to the requirements to provide Post Construction Stormwater Quality facilities. All areas of proposed Boyd Subdivision Filing No. 1 qualify for the allowed exemptions. The project consists of large (2.5-acre or larger) single-family rural residential lots. No public roadway improvements are proposed. There are no activities or improvements that require permanent water quality facilities for this project.

According to Section I.7.1.B.5, "A single-family residential lot, or agricultural zoned lands, greater than or equal to 2.5 acres in size per dwelling and having a total lot impervious area of less than 10 percent" is excluded. The total area of the site is 35.88± acres. All 35.88± acres is comprised of large lot single-family rural residential units. The total lot imperviousness for rural residential lots is less than 10%. The entire site is excluded.

The El Paso County Engineering Criteria Manual (Appendix I, Section I.7.2 ) requires the consideration of a "Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways, and implementing long term source controls". It is determined in the section above that this project is exempt from the requirements of Section I.7.1 to provide Post Construction Stormwater Management

Facilities with Water Quality Capture Volume (WQCV). However, aspects of the Four Step Process are considered and implemented in the Boyd Subdivision Filing No. 1 project.

1) Runoff Reduction Practices are employed in this project. Impervious surfaces have been reduced as much as practically possible. There is only minimal concrete or other hard surfaces proposed. Minimized Directly Connected Impervious Areas (MDCIA) is employed on the project because runoff passes through an open space forest and meadow areas before leaving the site.

2) All existing swales will remain covered with the existing natural grasses. All of the onsite swales are "U" shaped with wide bottoms widths and flat side slopes. Based on visual observations the swales are very stable with only negligible indications of erosion. The vegetation for each swale includes medium height prairie grasses that are periodically mowed. It is not anticipated that any of the swales will be modified in the future. It can be safely assumed that the negligible increase in flow as a result of development will have minimal negative impacts on the existing onsite swales.

3) The project contains no potentially hazardous uses. The site is exempted from the use of WQCV BMPs by ECM 1.7.1.B.5 by virtue of the large lot rural residential nature of the site having percent imperviousness of less than 10%.

4) The rural residential site is not anticipated to contain storage of potentially harmful substances or use of potentially harmful substances. No site specific or other source control BMPs are required.

## **5 Drainage and Bridge Fees**

The site is located within the East Cherry Creek Drainage Basin which is a no fee basin.

## **6 Government Agency Requirements**

A Wetlands Analysis Report was prepared for this project and submitted to the US Army Corps of Engineers (USACE).<sup>12</sup> The Corps of Engineer's has concurred with the wetland boundary contained within in the report and the boundary is contained within the Drainage Easement with No-Build and No Storage of Materials. No disturbance is planned within the easement.

## **7 Conclusion**

This Final Drainage Report presents existing and proposed drainage conditions for the proposed Boyd Subdivision Filing No. 1 project. The development will have negligible and inconsequential effects on the existing site drainage and drainage conditions downstream. The proposed project will not, with respect to stormwater runoff, negatively impact the adjacent properties and downstream properties.

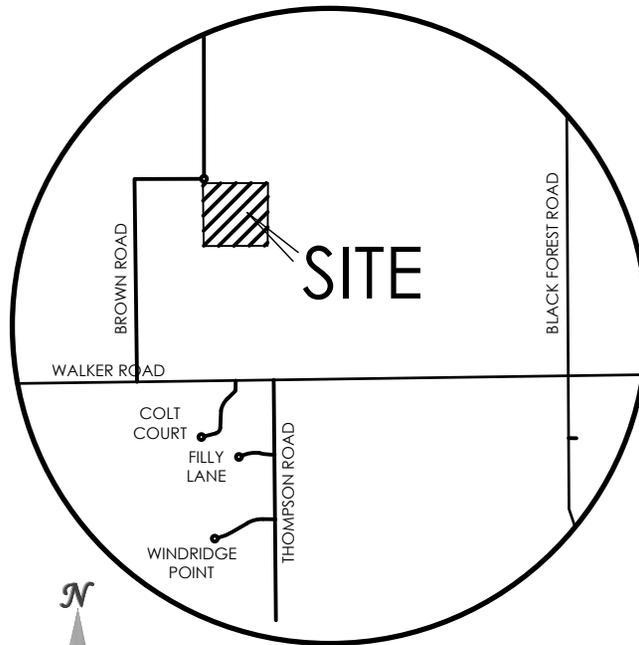
# References

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# | Appendices

## **8 General Maps and Supporting Data**

- Vicinity Map
- Portions of Flood Insurance Rate Map
- Portion of Drainage Area Identification Study Map
- NRCS Soil Map and Tables
- SCS Soil Type Descriptions
- Hydrologic Soil Group Map and Tables
- Existing Livestock Pond Application
- Urban Drainage Natural Stream Hydraulic Parameters



**VICINITY MAP**

NOT TO SCALE

# National Flood Hazard Layer FIRMette



104°43'26"W 39°6'27"N



104°42'48"W 39°5'59"N

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

## Legend

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

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



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

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

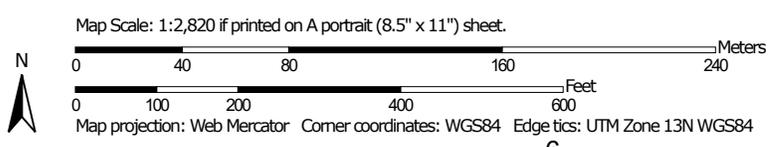
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **1/7/2022 at 10:28 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

Custom Soil Resource Report  
Soil Map (18735 Brown Road)



Soil Map may not be valid at this scale.



### MAP LEGEND

**Area of Interest (AOI)**

 Area of Interest (AOI)

**Soils**

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

**Special Point Features**

-  Blowout
-  Borrow Pit
-  Clay Spot
-  Closed Depression
-  Gravel Pit
-  Gravelly Spot
-  Landfill
-  Lava Flow
-  Marsh or swamp
-  Mine or Quarry
-  Miscellaneous Water
-  Perennial Water
-  Rock Outcrop
-  Saline Spot
-  Sandy Spot
-  Severely Eroded Spot
-  Sinkhole
-  Slide or Slip
-  Sodic Spot

-  Spoil Area
-  Stony Spot
-  Very Stony Spot
-  Wet Spot
-  Other
-  Special Line Features

**Water Features**

 Streams and Canals

**Transportation**

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

**Background**

 Aerial Photography

### MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado  
 Survey Area Data: Version 19, Aug 31, 2021

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

Date(s) aerial images were photographed: Sep 8, 2018—May 26, 2019

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

## Map Unit Legend (18735 Brown Road)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
15	Brussett loam, 3 to 5 percent slopes	8.9	24.7%
67	Peyton sandy loam, 5 to 9 percent slopes	0.1	0.3%
69	Peyton-Pring complex, 8 to 15 percent slopes	27.0	74.9%
<b>Totals for Area of Interest</b>		<b>36.0</b>	<b>100.0%</b>

## Map Unit Descriptions (18735 Brown Road)

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

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

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

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or

## Custom Soil Resource Report

landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

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

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

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

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

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

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

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

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

## El Paso County Area, Colorado

### 15—Brussett loam, 3 to 5 percent slopes

#### Map Unit Setting

*National map unit symbol:* 367k  
*Elevation:* 7,200 to 7,500 feet  
*Frost-free period:* 115 to 125 days  
*Farmland classification:* Prime farmland if irrigated

#### Map Unit Composition

*Brussett and similar soils:* 85 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Brussett

##### Setting

*Landform:* Hills  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Eolian deposits

##### Typical profile

*A - 0 to 8 inches:* loam  
*BA - 8 to 12 inches:* loam  
*Bt - 12 to 26 inches:* clay loam  
*Bk - 26 to 60 inches:* silt loam

##### Properties and qualities

*Slope:* 3 to 5 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Well drained  
*Runoff class:* Low  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Calcium carbonate, maximum content:* 5 percent  
*Maximum salinity:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)  
*Available water supply, 0 to 60 inches:* High (about 9.1 inches)

##### Interpretive groups

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 4e  
*Hydrologic Soil Group:* B  
*Ecological site:* R048AY222CO - Loamy Park  
*Hydric soil rating:* No

#### Minor Components

##### Other soils

*Percent of map unit:*  
*Hydric soil rating:* No

## 67—Peyton sandy loam, 5 to 9 percent slopes

### Map Unit Setting

*National map unit symbol:* 369d  
*Elevation:* 6,800 to 7,600 feet  
*Mean annual air temperature:* 43 to 45 degrees F  
*Frost-free period:* 115 to 125 days  
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Peyton and similar soils:* 85 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Peyton

#### Setting

*Landform:* Hills  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Arkosic alluvium derived from sedimentary rock and/or arkosic residuum weathered from sedimentary rock

#### Typical profile

*A - 0 to 12 inches:* sandy loam  
*Bt - 12 to 25 inches:* sandy clay loam  
*BC - 25 to 35 inches:* sandy loam  
*C - 35 to 60 inches:* sandy loam

#### Properties and qualities

*Slope:* 5 to 9 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Well drained  
*Runoff class:* Medium  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water supply, 0 to 60 inches:* Moderate (about 7.3 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 4e  
*Hydrologic Soil Group:* B  
*Ecological site:* R049XY216CO - Sandy Divide  
*Hydric soil rating:* No

**Minor Components**

**Pleasant**

*Percent of map unit:*  
*Landform:* Depressions  
*Hydric soil rating:* Yes

**Other soils**

*Percent of map unit:*  
*Hydric soil rating:* No

**69—Peyton-Pring complex, 8 to 15 percent slopes**

**Map Unit Setting**

*National map unit symbol:* 369g  
*Elevation:* 6,800 to 7,600 feet  
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Peyton and similar soils:* 40 percent  
*Pring and similar soils:* 30 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Peyton**

**Setting**

*Landform:* Hills  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Arkosic alluvium derived from sedimentary rock and/or arkosic residuum weathered from sedimentary rock

**Typical profile**

*A - 0 to 12 inches:* sandy loam  
*Bt - 12 to 25 inches:* sandy clay loam  
*BC - 25 to 35 inches:* sandy clay loam  
*C - 35 to 60 inches:* sandy loam

**Properties and qualities**

*Slope:* 8 to 9 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Well drained  
*Runoff class:* Medium  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water supply, 0 to 60 inches:* Moderate (about 7.3 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 4e  
*Hydrologic Soil Group:* B  
*Ecological site:* R049XY216CO - Sandy Divide  
*Hydric soil rating:* No

**Description of Pring**

**Setting**

*Landform:* Hills  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Arkosic alluvium derived from sedimentary rock

**Typical profile**

*A - 0 to 14 inches:* coarse sandy loam  
*C - 14 to 60 inches:* gravelly sandy loam

**Properties and qualities**

*Slope:* 8 to 15 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Well drained  
*Runoff class:* Low  
*Capacity of the most limiting layer to transmit water (Ksat):* High (2.00 to 6.00 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water supply, 0 to 60 inches:* Low (about 6.0 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 6e  
*Hydrologic Soil Group:* B  
*Ecological site:* R048AY222CO - Loamy Park  
*Hydric soil rating:* No

**Minor Components**

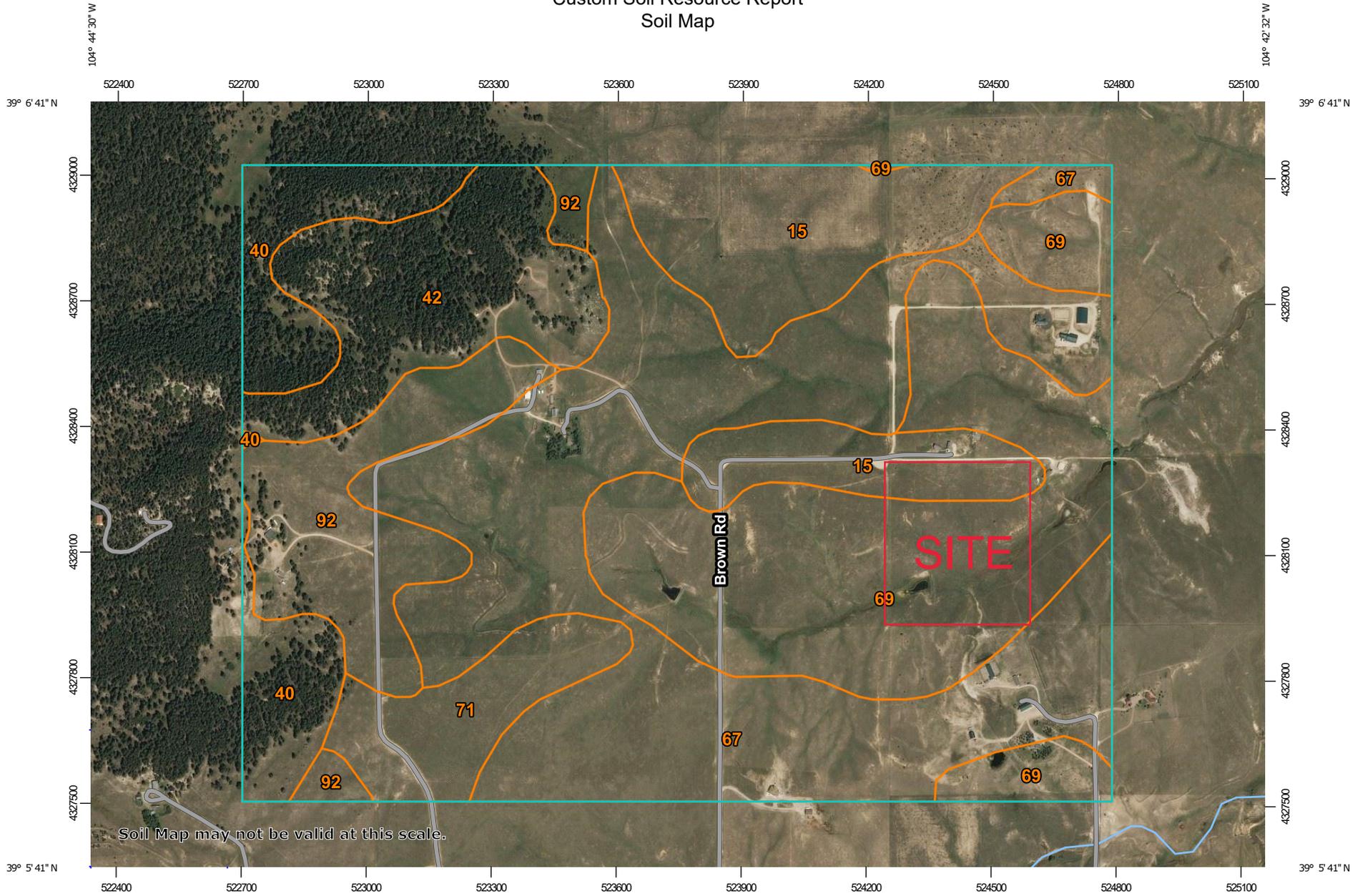
**Pleasant**

*Percent of map unit:*  
*Landform:* Depressions  
*Hydric soil rating:* Yes

**Other soils**

*Percent of map unit:*  
*Hydric soil rating:* No

# Custom Soil Resource Report Soil Map



Soil Map may not be valid at this scale.

Map Scale: 1:12,900 if printed on A landscape (11" x 8.5") sheet.

0 150 300 600 900 Meters  
0 500 1000 2000 3000 Feet

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

### MAP LEGEND

**Area of Interest (AOI)**

 Area of Interest (AOI)

**Soils**

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

**Special Point Features**

-  Blowout
-  Borrow Pit
-  Clay Spot
-  Closed Depression
-  Gravel Pit
-  Gravelly Spot
-  Landfill
-  Lava Flow
-  Marsh or swamp
-  Mine or Quarry
-  Miscellaneous Water
-  Perennial Water
-  Rock Outcrop
-  Saline Spot
-  Sandy Spot
-  Severely Eroded Spot
-  Sinkhole
-  Slide or Slip
-  Sodic Spot

-  Spoil Area
-  Stony Spot
-  Very Stony Spot
-  Wet Spot
-  Other
-  Special Line Features

**Water Features**

 Streams and Canals

**Transportation**

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

**Background**

 Aerial Photography

### MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado  
 Survey Area Data: Version 19, Aug 31, 2021

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

Date(s) aerial images were photographed: Sep 8, 2018—May 26, 2019

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

## Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
15	Brussett loam, 3 to 5 percent slopes	96.4	12.2%
40	Kettle gravelly loamy sand, 3 to 8 percent slopes	56.5	7.2%
42	Kettle-Rock outcrop complex	76.2	9.7%
67	Peyton sandy loam, 5 to 9 percent slopes	265.9	33.8%
69	Peyton-Pring complex, 8 to 15 percent slopes	181.8	23.1%
71	Pring coarse sandy loam, 3 to 8 percent slopes	38.3	4.9%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	72.4	9.2%
<b>Totals for Area of Interest</b>		<b>787.4</b>	<b>100.0%</b>

**STATE OF COLORADO**  
**DEPARTMENT OF WATER RESOURCES**  
**Office of State Engineer**

**Standard Plans, Drawings**  
**and**  
**SPECIFICATIONS**  
**Including**  
**RULES AND REGULATIONS**  
**Pertaining to**  
**THE FILING OF APPLICATIONS**  
**for**  
**THE APPROVAL**  
**of**  
**LIVESTOCK WATER TANKS**



**PURSUANT TO H.B. No. 750**  
**SESSION LAWS OF 1941**  
**DENVER, COLORADO, MAY 1, 1941**

1-5  
6 21

# APPLICATION FOR APPROVAL OF LIVESTOCK WATER TANK

This application and Statement is made in conformity with provisions of the Livestock Water Tank Act of Colorado.

This application must be accompanied by a filing fee of one dollar, payable to the State Engineer of Colorado. 5385

Name of Owner G. S. Davison Motor Rte #3, Colo. Spgs, Colo.  
P. O. Address  
Location of Tank SW 1/4 Section 7, Township 11 50, Range 65 W 6th P.M.  
Name of water course on which tank is located Trib. to East Cherry Creek  
Is water course normally dry Yes  
Approximate area of drainage basin above tank 50 acres.  
Nature of vegetative cover over drainage basin above tank Grass, Farmland

Character of topography of drainage basin (steep, medium or flat) Medium

Character of surface formation of drainage basin (rock, rocky soil, or soil) Soil

Approximate elevation of drainage basin above sea level 7470 feet.

Is water course subject to floods at times No

Height of top of dam above bottom of water course 9.0 feet.

Height of bottom of spillway above bottom of water course 5.0 feet.

Approximate capacity of tank 0.12 1.35 acre feet.

Location of spillway with respect to dam Around right side facing downstream

Bottom width of spillway at narrowest point 23 feet.

Distance of lower end of spillway below dam 400 feet.

Kind of formations in which spillway is located (rock, shale, clay, earth or mixture of soil and rock) Earth

Width of top of dam 8.0 feet.

Length of top of dam 194 feet.

Slope of upstream face of dam 3:1

Slope of downstream face of dam 2:1

Nature of riprap or other protection to be placed over water face of dam

Is the reservoir to be provided with an outlet pipe No  
If so, give kind and size of pipe

Give location by section, township and range, and size of every other stock tank now constructed in drainage basin in which this tank will be located

NOTE—Remainder of statements to be furnished by State Engineer's office.  
Date of receipt of application by State Engineer DEC 17 '57, 19  
Date of notice from applicant of completion of tank, 19  
Tank or site inspected by, 19  
Recommendation of Inspector  
Date of return of plans and specifications to applicant for correction or revision

Reasons therefor

Filing Fee Paid DEC 17 '57, 19  
Application approved this 27 day of December, 19 57  
Number assigned this stock tank is

By J. E. Whitten  
State Engineer  
G. C. Marshall  
Deputy



5385

**STATE OF COLORADO**  
**DEPARTMENT OF WATER RESOURCES**  
**OFFICE OF STATE ENGINEER**

**SPECIFICATIONS TO GOVERN THE CONSTRUCTION OF A LIVESTOCK WATER TANK  
 IN COLORADO CONSTRUCTED AFTER APRIL 17, 1941**

The following specifications and attached general plans shall be followed in the construction of stock water tank No. \_\_\_\_\_, located in Sec. 7, Township 11 S, Range 6.5 W 6<sup>th</sup> P.M. for which the undersigned on December 10, 1957 filed an application with the State Engineer, as required by law.

**Preparation of Foundation for Dam**—All vegetable matter of every description, including roots to a depth of two feet, shall be removed from the entire area upon which the dam will rest, following which the top six-inch layer of soil, together with boggy or unstable materials shall be removed and deposited outside the toes of the dam. The banks of the stream channel shall be dressed to a slope of about 1½:1. A bonding trench, with sloping sides and a bottom width of not less than 5 feet and depth of 4 feet, shall then be excavated beneath the center line of the dam the full length thereof, which trench shall be refilled with the most impervious materials available. The foundation of the dam shall then be lightly plowed lengthwise of the dam, to provide proper contact between the foundation and the dam embankment.

**Placing of Dam Embankment**—The materials shall be placed in the bonding trench and in the embankment of the dam in layers not exceeding 6 inches in thickness, after which each layer shall be thoroughly compacted by a heavily loaded disc cultivator, a corrugated or sheep's foot roller, the treads of a caterpillar or trucks, or by livestock used in the construction. During the construction period, the top of the embankment shall be maintained as a horizontal plane the full width and length thereof, and no side dumping of materials shall be permitted. The materials shall at all times contain just sufficient moisture to provide proper compaction. Puddling of material with water shall not be permitted. No frozen material or large clods or stones shall be incorporated in the dam. The upstream face of the dam shall be constructed with a slope not steeper than 2½:1, and the downstream face on a slope not steeper than 2:1. The crest or top of the finished dam shall be not less than 8 feet in width.

The upstream two-thirds of the dam shall be constructed of the most impervious materials, such as clay loam, or a mixture of clay and sand, and the downstream one third of more pervious material, such as sand or gravel. The upstream face of the dam shall be adequately protected against wave action by stone riprap, or other suitable materials.

**Outlet**—Should the state engineer so require, there shall be located beneath the dam a galvanized, corrugated steel pipe of No. 14 gauge and not less than 8 inches in diameter, equipped with a suitable control valve attached to the upstream end of the pipe, together with suitable mechanism for operating the valve. Such outlet pipe, when required, shall be provided with concrete collars enclosing each joint of the pipe. The pipe shall be placed in a trench bottomed in stable formations, and shall be completely surrounded with well compacted impervious materials.

**Spillway**—For the protection of the dam, an adequate spillway or channel shall be constructed around one or both ends of the dam, of sufficient width to provide a capacity to carry the entire discharge from the drainage basin above the dam during periods of unusual runoff. The spillway shall be located in stable formations not easily eroded, and shall extend to a point well downstream from the dam. The following table shall be used to determine the necessary depth and width of spillway to meet the above requirements. The top of the dam at all points shall be not less than 4 feet above the bottom of the spillway.

Table Showing Required Freeboard, Widths and slopes of Spillways for small Earth Dams, with Drainage Areas above the Same as Shown, Based upon a maximum Peak Runoff of 640 Second Feet per Square Mile, or 1 Second Foot per Acre, with an Allowance of a Minimum Freeboard between the Maximum High Water Line and Top of Dam, of 2.3 Feet, and Maximum Velocities of 3.5 Feet per Second of Time.

AREA OF DRAINAGE BASIN ABOVE DAM IN ACRES	PEAK RUNOFF IN CU. FT. PER SECOND	ASSUMED VELOCITY THROUGH SPILLWAY IN FEET PER SECOND	REQUIRED WIDTH OF SPILLWAY "W" AT NARROWEST POINT IN FEET	DEPTH OF SPILLWAY IN FEET	SLOPE OF SPILLWAY IN FEET PER 100 FEET OF LENGTH
100	100	3.0	22	1.5	0.25
200	200	3.0	44	1.5	0.25
300	300	3.0	66	1.5	0.25
400	400	3.0	88	1.5	0.25
500	500	3.0	110	1.5	0.25
600	600	3.0	132	1.5	0.25
700	700	3.0	155	1.5	0.25
800	800	3.0	177	1.5	0.25
900	900	3.0	200	1.5	0.25
1000	1000	3.0	222	1.5	0.25
1100	1100	3.0	244	1.6	0.25
1200	1200	3.2	266	1.7	0.25
1300	1300	3.3	288	1.7	0.25
1400	1400	3.4	310	1.7	0.25
1500	1500	3.4	332	1.7	0.25
1600	1600	3.5	354	1.7	0.25
1700	1700	3.5	376	1.7	0.25
1800	1800	3.5	398	1.7	0.25
1900	1900	3.5	420	1.7	0.25
2000	2000	3.5	442	1.7	0.25

The above spillway widths may be reduced at a point 50 feet below intake, by 25 per cent, where the spillway is located the full length thereof in hard clay or shale, and by 50 per cent when located in hard rock formations, if the slope or grade of the bottom is increased accordingly. The grade for clay and shale formations should be 0.30 foot per 100 feet, and for rock formations 0.9 foot per 100 feet. The width of the entrance to the spillway must in all cases be one-third wider than shown in the Table, and the bottom should slope from the lower end of the funnel section, toward the reservoir 1.0 foot in the distance of 50 feet.

**Borrow Pits**—Borrow pits, from which materials are taken to build the dam, shall be cleared of all vegetable matter, and no material shall be borrowed within a distance of 50 feet of any part of the dam. Materials excavated from the spillway, when suitable, are to be used in building the dam.

Date 12-10-57

Gus Dawson ✓  
 Owner  
 P. 3 Colo. Dept. of Water Resources  
 Post Office Address

**9 Supporting Photos**

- Photos of Existing Livestock Pond
- Photos of Conditions of Drainageway



Figure 1: Upstream Photo of Existing Livestock Pond Facing West



Figure 2: Top of the Livestock Pond Facing South



Figure 3: North Side of Livestock Pond Facing North (Upstream of Pond)



Figure 4: North Side of Livestock Pond Facing North (Upstream of Pond) pond outlet pipe



Figure 4: Existing 15" Diameter Spillway Pipe



Figure 5: Measurement of Existing 15" Diameter Pipe



Figure 6: Downstream Drainageway with large brush found in its center



Figure 7: Downstream Brush Found Along Drainage Path  
From Bottom of Pond Downstream Facing East



Figure 8: Ground Cover Throughout Drainageway



Figure 9: Density of Brush downstream (Taken along path facing west toward on-site Pond)



Figure 10: Erosion Found At Drainage Path 5 to 10 feet from East Property Line  
(Approximately 1-1.5 foot drop)



Figure 11: Land Cover Downstream of East Property Line

## **10 Hydrologic Calculations**

Runoff Coefficients and Percent Imperviousness Table 6-6

Colorado Springs Rainfall Intensity Duration Frequency Figure 6-5

Hydrologic Calculations Summary Form SF-1 for Existing & Developed Conditions

Hydrologic Calculations Summary 5-yr Form SF-2 for Existing & Developed Conditions

Hydrologic Calculations Summary 100-yr Form SF-2 for Existing & Developed Conditions

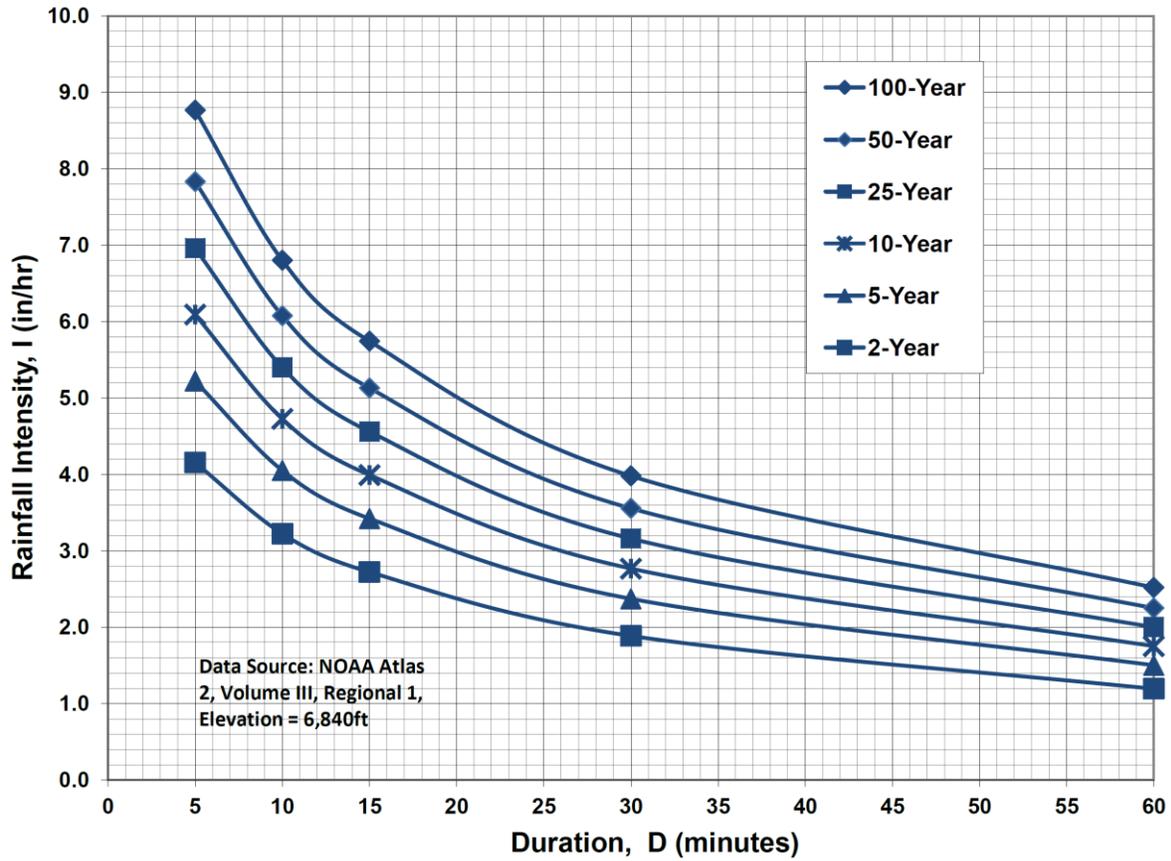
CN Calculations

Time of Concentration Calculations

HEC-HMS Calculations Summary 5-yr Existing & Developed Conditions

HEC-HMS Calculations Summary 100-yr Existing & Developed Conditions

**Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency**



**IDF Equations**

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

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

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

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

$$I_5 = -1.50 \ln(D) + 7.583$$

$$I_2 = -1.19 \ln(D) + 6.035$$

Note: Values calculated by equations may not precisely duplicate values read from figure.

**Table 6-6. Runoff Coefficients for Rational Method**  
(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis-- Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

Job No.: 61170  
 Project: Boyd Subdivision

Date: 8/18/2022 9:00  
 Calcs By: TJW  
 Checked By: \_\_\_\_\_

**Time of Concentration** (Modified from Standard Form SF-1)

Sub-Basin	Sub-Basin Data				Overland			Shallow Channel				Channelized				t <sub>c</sub> Check		t <sub>c</sub> (min)
	Area (Acres)	C <sub>5</sub>	C <sub>100</sub> /CN	% Imp.	L <sub>0</sub> (ft)	S <sub>0</sub> (%)	t <sub>i</sub> (min)	L <sub>0t</sub> (ft)	S <sub>0t</sub> (ft/ft)	v <sub>0sc</sub> (ft/s)	t <sub>t</sub> (min)	L <sub>0c</sub> (ft)	S <sub>0c</sub> (ft/ft)	v <sub>0c</sub> (ft/s)	t <sub>c</sub> (min)	L (min)	t <sub>c,alt</sub> (min)	
OS-A1	2.45	0.08	0.35	0%	100	15%	7.5	556	0.063	1.8	5.3	0	0.000	0.0	0.0	656	13.6	12.8
OS-B1	4.34	0.10	0.38	7%	100	4%	11.4	946	0.037	1.3	11.7	0	0.000	0.0	0.0	1046	15.8	15.8
OS-B2	26.81	0.08	0.35	0%	100	4%	11.7	1273	0.053	1.6	13.2	0	0.000	0.0	0.0	1373	17.6	17.6
EX-A	4.90	0.08	0.35	0%	100	6%	10.2	466	0.112	2.3	3.3	50	0.020	2.2	0.4	616	13.4	13.4
EX-B	26.86	0.08	0.35	0%	100	5%	10.8	1120	0.070	1.8	10.1	440	0.023	3.5	2.1	1660	19.2	19.2
EX-C	4.12	0.10	0.37	4%	100	5%	10.6	672	0.086	2.1	5.4	0	0.000	0.0	0.0	772	14.3	14.3
A	4.90	0.08	0.35	0%	100	6%	10.2	466	0.112	2.3	3.3	50	0.020	2.2	0.4	616	13.4	13.4
B	26.86	0.09	0.36	2%	100	5%	10.7	1120	0.070	1.8	10.1	440	0.023	3.5	2.1	1660	19.2	19.2
C	4.12	0.13	0.39	8%	100	5%	10.3	672	0.086	2.1	5.4	0	0.000	0.0	0.0	772	14.3	14.3

Job No.: **61170**  
 Project: **Boyd Subdivision**  
 Design Storm: **5-Year Storm (20% Probability)**  
 Jurisdiction: **DCM**

Date: **8/18/2022 9:00**  
 Calcs By: **TJW**  
 Checked By: \_\_\_\_\_

**Sub-Basin and Combined Flows** (Modified from Standard Form SF-2)

DP	Sub-Basin	Area (Acres)	C5	Direct Runoff				Combined Runoff				Streetflow			Pipe Flow				Travel Time			
				t <sub>c</sub> (min)	CA (Acres)	I5 (in/hr)	Q5 (cfs)	t <sub>c</sub> (min)	CA (Acres)	I5 (in/hr)	Q5 (cfs)	Slope (%)	Length (ft)	Q (cfs)	Q (cfs)	Slope (%)	Mnngs n	Length (ft)	D <sub>Pipe</sub> (in)	Length (ft)	V <sub>Disc</sub> (ft/s)	t <sub>t</sub> (min)
	OS-A1	2.45	0.08	12.8	0.20	3.76	0.74															
	OS-B1	4.34	0.10	15.8	0.43	3.44	1.50															
	OS-B2	26.81	0.08	17.6	2.14	3.28	7.03															
	EX-A	4.90	0.08	13.4	0.39	3.69	1.45															
	EX-B	26.86	0.08	19.2	2.22	3.15	7.00															
	EX-C	4.12	0.10	14.3	0.42	3.59	1.52															
	OS-A1 + EX-A	7.35	0.08					16.2	0.59	3.41	2.0											
	Existing	65.36	0.08					22.3	5.39	2.93	15.8											
	A	4.90	0.08	13.4	0.39	3.69	1.45															
	B	26.86	0.09	19.2	2.46	3.15	7.76															
	C	4.12	0.13	14.3	0.55	3.59	1.96															
	OS-A1 + A	7.35	0.08					16.2	0.59	3.41	2.0											
	Developed	65.25	0.09					22.3	5.57	2.93	16.3											

DCM:  $I = C1 * \ln(tc) + C2$   
 C1: 1.5  
 C1: 7.583

Job No.: **61170**  
 Project: **Boyd Subdivision**  
 Design Storm: **100-Year Storm (1% Probability)**  
 Jurisdiction: **DCM**

Date: **8/18/2022 9:00**  
 Calcs By: **TJW**  
 Checked By: \_\_\_\_\_

**Sub-Basin and Combined Flows** (Modified from Standard Form SF-2)

DP	Sub-Basin	Area (Acres)	C100	Direct Runoff				Combined Runoff				Streetflow			Pipe Flow				Travel Time			
				t <sub>c</sub> (min)	CA (Acres)	I100 (in/hr)	Q100 (cfs)	t <sub>c</sub> (min)	CA (Acres)	I100 (in/hr)	Q100 (cfs)	Slope (%)	Length (ft)	Q (cfs)	Q (cfs)	Slope (%)	Mnngs n	Length (ft)	D <sub>Pipe</sub> (in)	Length (ft)	V <sub>Disc</sub> (ft/s)	t <sub>t</sub> (min)
	OS-A1	2.45	0.35	12.8	0.86	6.31	5.41															
	OS-B1	4.34	0.38	15.8	1.65	5.78	9.54															
	OS-B2	26.81	0.35	17.6	9.38	5.50	51.64															
	EX-A	4.90	0.35	13.4	1.72	6.19	10.62															
	EX-B	26.86	0.35	19.2	9.45	5.29	49.96															
	EX-C	4.12	0.37	14.3	1.51	6.03	9.08															
OS-A1 + EX-A		7.35	0.35					16.2	2.57	5.72	14.7											
Existing		65.36	0.35					22.3	23.06	4.91	113.3											
	A	4.90	0.35	13.4	1.72	6.19	10.62															
	B	26.86	0.36	19.2	9.62	5.29	50.87															
	C	4.12	0.39	14.3	1.59	6.03	9.60															
OS-A1 + A		7.35	0.35					16.2	2.57	5.72	14.7											
Developed		65.25	0.35					22.3	23.15	4.91	113.8											

DCM:  $I = C1 * \ln(tc) + C2$   
 C1: 2.52  
 C2: 12.735

## Sub-Basin OS-A1 Runoff Calculations

Job No.: 61170  
 Project: Boyd Subdivision  
 Jurisdiction: DCM  
 Runoff Coefficient: Surface Type

Date: 8/18/2022 9:00  
 Calcs by: TJW  
 Checked by: \_\_\_\_\_  
 Soil Type: B  
 Urbanization: Urban

### Basin Land Use Characteristics

Surface	Area		Runoff Coefficient						% Imperv.
	(SF)	(Acres)	C2	C5	C10	C25	C50	C100	
Pasture/Meadow	106,657	2.45	0.02	0.08	0.15	0.25	0.3	0.35	0%
<b>Combined</b>	<b>106,657</b>	<b>2.45</b>	<b>0.02</b>	<b>0.08</b>	<b>0.15</b>	<b>0.25</b>	<b>0.30</b>	<b>0.35</b>	<b>0.0%</b>

### Basin Travel Time

	Shallow Channel Ground Cover		Short Pasture/Lawns			
	$L_{max,Overland}$		$S_0$	$v$	$t$	$t_{Alt}$
	L (ft)	$\Delta Z_0$ (ft)	(ft/ft)	(ft/s)	(min)	(min)
Total	656	50	-	-	-	-
Initial Time	100	15	0.150	-	7.5	13.6 DCM Eq. 6-8
Shallow Channel	556	35	0.063	1.8	5.3	- DCM Eq. 6-9
Channelized			0.000	0.0	0.0	- V-Ditch
				$t_c$	<b>12.8 min.</b>	

### Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
<b>Intensity (in/hr)</b>	3.00	3.76	4.38	5.01	5.64	6.31
<b>Runoff (cfs)</b>	0.1	<b>0.7</b>	1.6	3.1	4.1	<b>5.4</b>
<b>Release Rates (cfs/ac)</b>	-	-	-	-	-	-
<b>Allowed Release (cfs)</b>	0.1	<b>0.7</b>	1.6	3.1	4.1	<b>5.4</b>

DCM:  $I = C1 * \ln(tc) + C2$

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

### Notes

## Sub-Basin OS-B1 Runoff Calculations

Job No.: **61170**  
 Project: **Boyd Subdivision**  
 Jurisdiction: **DCM**  
 Runoff Coefficient: **Surface Type**

Date: **8/18/2022 9:00**  
 Calcs by: **TJW**  
 Checked by: \_\_\_\_\_  
 Soil Type: **B**  
 Urbanization: **Urban**

### Basin Land Use Characteristics

Surface	Area		Runoff Coefficient						% Imperv.
	(SF)	(Acres)	C2	C5	C10	C25	C50	C100	
5 Acre	189,239	4.34	0.06	0.1	0.2	0.29	0.34	0.38	7%
<b>Combined</b>	<b>189,239</b>	<b>4.34</b>	<b>0.06</b>	<b>0.10</b>	<b>0.20</b>	<b>0.29</b>	<b>0.34</b>	<b>0.38</b>	<b>7.0%</b>

### Basin Travel Time

	Shallow Channel Ground Cover		Short Pasture/Lawns			
	$L_{max,Overland}$	$\Delta Z_0$ (ft)	$S_0$ (ft/ft)	$v$ (ft/s)	$t$ (min)	$t_{Alt}$ (min)
Total	1,046	39	-	-	-	-
Initial Time	100	4	0.040	-	11.4	15.8 DCM Eq. 6-8
Shallow Channel	946	35	0.037	1.3	11.7	- DCM Eq. 6-9
Channelized			0.000	0.0	0.0	- V-Ditch
				$t_c$	<b>15.8 min.</b>	

### Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
<b>Intensity (in/hr)</b>	2.75	3.44	4.02	4.59	5.16	5.78
<b>Runoff (cfs)</b>	0.7	1.5	3.5	5.8	7.6	9.5
<b>Release Rates (cfs/ac)</b>	-	-	-	-	-	-
<b>Allowed Release (cfs)</b>	0.7	1.5	3.5	5.8	7.6	9.5

DCM:  $I = C1 * \ln(tc) + C2$

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

### Notes

## Sub-Basin OS-B2 Runoff Calculations

Job No.: 61170  
 Project: Boyd Subdivision  
 Jurisdiction: DCM  
 Runoff Coefficient: Surface Type

Date: 8/18/2022 9:00  
 Calcs by: TJW  
 Checked by: \_\_\_\_\_  
 Soil Type: B  
 Urbanization: Urban

### Basin Land Use Characteristics

Surface	Area		Runoff Coefficient						% Imperv.
	(SF)	(Acres)	C2	C5	C10	C25	C50	C100	
Pasture/Meadow	1,167,697	26.81	0.02	0.08	0.15	0.25	0.3	0.35	0%
<b>Combined</b>	<b>1,167,697</b>	<b>26.81</b>	<b>0.02</b>	<b>0.08</b>	<b>0.15</b>	<b>0.25</b>	<b>0.30</b>	<b>0.35</b>	<b>0.0%</b>

### Basin Travel Time

	Shallow Channel		Ground Cover		Short Pasture/Lawns		
	L <sub>max,Overland</sub> (ft)	ΔZ <sub>0</sub> (ft)	S <sub>0</sub> (ft/ft)	v (ft/s)	t (min)	t <sub>Alt</sub> (min)	
Total	1,373	71	-	-	-	-	
Initial Time	100	4	0.040	-	11.7	17.6	DCM Eq. 6-8
Shallow Channel	1,273	67	0.053	1.6	13.2	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				<b>t<sub>c</sub></b>	<b>17.6 min.</b>		

### Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
<b>Intensity (in/hr)</b>	2.62	3.28	3.83	4.37	4.92	5.50
<b>Runoff (cfs)</b>	1.4	7.0	15.4	29.3	39.6	51.6
<b>Release Rates (cfs/ac)</b>	-	-	-	-	-	-
<b>Allowed Release (cfs)</b>	1.4	7.0	15.4	29.3	39.6	51.6

DCM:  $I = C1 * \ln(tc) + C2$

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

### Notes

## Sub-Basin EX-A Runoff Calculations

Job No.: **61170**  
 Project: **Boyd Subdivision**  
 Jurisdiction: **DCM**  
 Runoff Coefficient: **Surface Type**

Date: **8/18/2022 9:00**  
 Calcs by: **TJW**  
 Checked by: \_\_\_\_\_  
 Soil Type: **B**  
 Urbanization: **Urban**

### Basin Land Use Characteristics

Surface	Area		Runoff Coefficient						% Imperv.
	(SF)	(Acres)	C2	C5	C10	C25	C50	C100	
Pasture/Meadow	213,513	4.90	0.02	0.08	0.15	0.25	0.3	0.35	0%
<b>Combined</b>	<b>213,513</b>	<b>4.90</b>	<b>0.02</b>	<b>0.08</b>	<b>0.15</b>	<b>0.25</b>	<b>0.30</b>	<b>0.35</b>	<b>0.0%</b>

213513

### Basin Travel Time

	Shallow Channel Ground Cover		Short Pasture/Lawns			
	$L_{max,Overland}$		$S_0$	$v$	$t$	$t_{Alt}$
	L (ft)	$\Delta Z_0$ (ft)	(ft/ft)	(ft/s)	(min)	(min)
Total	616	59	-	-	-	-
Initial Time	100	6	0.060	-	10.2	13.4 DCM Eq. 6-8
Shallow Channel	466	52	0.112	2.3	3.3	- DCM Eq. 6-9
Channelized	50	1	0.020	2.2	0.4	- Trap Ditch
				$t_c$	<b>13.4 min.</b>	

### Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
<b>Intensity (in/hr)</b>	2.94	3.69	4.30	4.92	5.53	6.19
<b>Runoff (cfs)</b>	0.3	1.4	3.2	6.0	8.1	10.6
<b>Release Rates (cfs/ac)</b>	-	-	-	-	-	-
<b>Allowed Release (cfs)</b>	0.3	1.4	3.2	6.0	8.1	10.6

DCM:  $I = C1 * \ln(tc) + C2$

C1      1.19      1.5      1.75      2      2.25      2.52  
 C2      6.035      7.583      8.847      10.111      11.375      12.735

### Notes

## Sub-Basin EX-B Runoff Calculations

Job No.: **61170**  
 Project: **Boyd Subdivision**  
 Jurisdiction: **DCM**  
 Runoff Coefficient: **Surface Type**

Date: **8/18/2022 9:00**  
 Calcs by: **TJW**  
 Checked by: \_\_\_\_\_  
 Soil Type: **B**  
 Urbanization: **Urban**

### Basin Land Use Characteristics

Surface	Area		Runoff Coefficient						% Imperv.
	(SF)	(Acres)	C2	C5	C10	C25	C50	C100	
Gravel	6,180	0.14	0.57	0.59	0.63	0.66	0.68	0.7	80%
Pasture/Meadow	1,163,992	26.72	0.02	0.08	0.15	0.25	0.3	0.35	0%
<b>Combined</b>	<b>1,170,172</b>	<b>26.86</b>	<b>0.02</b>	<b>0.08</b>	<b>0.15</b>	<b>0.25</b>	<b>0.30</b>	<b>0.35</b>	<b>0.4%</b>

1170172

### Basin Travel Time

	Shallow Channel Ground Cover		Short Pasture/Lawns			
	$L_{max,Overland}$	$\Delta Z_0$ (ft)	$S_0$ (ft/ft)	$v$ (ft/s)	$t$ (min)	$t_{Alt}$ (min)
Total	1,660	93	-	-	-	-
Initial Time	100	5	0.050	-	10.8	19.2 DCM Eq. 6-8
Shallow Channel	1,120	78	0.070	1.8	10.1	- DCM Eq. 6-9
Channelized	440	10	0.023	3.5	2.1	- Trap Ditch
				$t_c$	<b>19.2 min.</b>	

### Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
<b>Intensity (in/hr)</b>	2.52	3.15	3.67	4.20	4.72	5.29
<b>Runoff (cfs)</b>	1.5	7.0	15.1	28.4	38.3	50.0
<b>Release Rates (cfs/ac)</b>	-	-	-	-	-	-
<b>Allowed Release (cfs)</b>	1.5	7.0	15.1	28.4	38.3	50.0

DCM:  $I = C1 * \ln(tc) + C2$

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

### Notes

## Sub-Basin EX-C Runoff Calculations

Job No.: **61170**  
 Project: **Boyd Subdivision**  
 Jurisdiction: **DCM**  
 Runoff Coefficient: **Surface Type**

Date: **8/18/2022 9:00**  
 Calcs by: **TJW**  
 Checked by: \_\_\_\_\_  
 Soil Type: **B**  
 Urbanization: **Urban**

### Basin Land Use Characteristics

Surface	Area		Runoff Coefficient						% Imperv.
	(SF)	(Acres)	C2	C5	C10	C25	C50	C100	
Gravel	8,120	0.19	0.57	0.59	0.63	0.66	0.68	0.7	80%
Pasture/Meadow	171,130	3.93	0.02	0.08	0.15	0.25	0.3	0.35	0%
<b>Combined</b>	<b>179,250</b>	<b>4.12</b>	<b>0.04</b>	<b>0.10</b>	<b>0.17</b>	<b>0.27</b>	<b>0.32</b>	<b>0.37</b>	<b>3.6%</b>

179250

### Basin Travel Time

	Shallow Channel Ground Cover		Short Pasture/Lawns			
	$L_{max,Overland}$	$\Delta Z_0$ (ft)	$S_0$ (ft/ft)	$v$ (ft/s)	$t$ (min)	$t_{Alt}$ (min)
Total	772	63	-	-	-	-
Initial Time	100	5	0.050	-	10.6	14.3 DCM Eq. 6-8
Shallow Channel	672	58	0.086	2.1	5.4	- DCM Eq. 6-9
Channelized			0.000	0.0	0.0	- Trap Ditch
				$t_c$	<b>14.3 min.</b>	

### Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
<b>Intensity (in/hr)</b>	2.87	3.59	4.19	4.79	5.39	6.03
<b>Runoff (cfs)</b>	0.5	1.5	3.0	5.3	7.0	9.1
<b>Release Rates (cfs/ac)</b>	-	-	-	-	-	-
<b>Allowed Release (cfs)</b>	0.5	1.5	3.0	5.3	7.0	9.1

DCM:  $I = C1 * \ln(tc) + C2$

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

### Notes

## Sub-Basin A Runoff Calculations

Job No.: **61170** Date: **8/18/2022 9:00**  
 Project: **Boyd Subdivision** Calcs by: **TJW**  
 Checked by: \_\_\_\_\_  
 Jurisdiction: **DCM** Soil Type: **B**  
 Runoff Coefficient: **Surface Type** Urbanization: **Urban**

### Basin Land Use Characteristics

Surface	Area		Runoff Coefficient						% Imperv.
	(SF)	(Acres)	C2	C5	C10	C25	C50	C100	
Pasture/Meadow	213,513	4.90	0.02	0.08	0.15	0.25	0.3	0.35	0%
<b>Combined</b>	<b>213,513</b>	<b>4.90</b>	<b>0.02</b>	<b>0.08</b>	<b>0.15</b>	<b>0.25</b>	<b>0.30</b>	<b>0.35</b>	<b>0.0%</b>

213513

### Basin Travel Time

	Shallow Channel Ground Cover		Short Pasture/Lawns			
	$L_{max,Overland}$	$\Delta Z_0$ (ft)	$S_0$ (ft/ft)	$v$ (ft/s)	$t$ (min)	$t_{Alt}$ (min)
Total	616	59	-	-	-	-
Initial Time	100	6	0.060	-	10.2	13.4 DCM Eq. 6-8
Shallow Channel	466	52	0.112	2.3	3.3	- DCM Eq. 6-9
Channelized	50	1	0.020	2.2	0.4	- Trap Ditch
				$t_c$	<b>13.4 min.</b>	

### Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
<b>Intensity (in/hr)</b>	2.94	3.69	4.30	4.92	5.53	6.19
<b>Runoff (cfs)</b>	0.3	1.4	3.2	6.0	8.1	10.6
<b>Release Rates (cfs/ac)</b>	-	-	-	-	-	-
<b>Allowed Release (cfs)</b>	0.3	1.4	3.2	6.0	8.1	10.6

DCM:  $I = C1 * \ln(tc) + C2$

C1      1.19      1.5      1.75      2      2.25      2.52  
 C2      6.035      7.583      8.847      10.111      11.375      12.735

### Notes

## Sub-Basin EX-B Runoff Calculations

Job No.: **61170**  
 Project: **Boyd Subdivision**  
 Jurisdiction: **DCM**  
 Runoff Coefficient: **Surface Type**

Date: **8/18/2022 9:00**  
 Calcs by: **TJW**  
 Checked by: \_\_\_\_\_  
 Soil Type: **B**  
 Urbanization: **Urban**

### Basin Land Use Characteristics

Surface	Area		Runoff Coefficient						% Imperv.
	(SF)	(Acres)	C2	C5	C10	C25	C50	C100	
Gravel	6,180	0.14	0.57	0.59	0.63	0.66	0.68	0.7	80%
Gravel	4,800	0.11	0.57	0.59	0.63	0.66	0.68	0.7	80%
Roofs	10,000	0.23	0.71	0.73	0.75	0.78	0.8	0.81	90%
Paved	2,000	0.05	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	1,147,192	26.34	0.02	0.08	0.15	0.25	0.3	0.35	0%
<b>Combined</b>	<b>1,170,172</b>	<b>26.86</b>	<b>0.03</b>	<b>0.09</b>	<b>0.16</b>	<b>0.26</b>	<b>0.31</b>	<b>0.36</b>	<b>1.7%</b>

1170172

### Basin Travel Time

	Shallow Channel Ground Cover		Short Pasture/Lawns			
	$L_{max,Overland}$		$S_0$	$v$	$t$	$t_{Alt}$
	(ft)	$\Delta Z_0$ (ft)	(ft/ft)	(ft/s)	(min)	(min)
Total	1,660	93	-	-	-	-
Initial Time	100	5	0.050	-	10.7	19.2 DCM Eq. 6-8
Shallow Channel	1,120	78	0.070	1.8	10.1	- DCM Eq. 6-9
Channelized	440	10	0.023	3.5	2.1	- Trap Ditch
				$t_c$	<b>19.2 min.</b>	

### Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
<b>Intensity (in/hr)</b>	2.52	3.15	3.67	4.20	4.72	5.29
<b>Runoff (cfs)</b>	2.2	7.8	15.9	29.3	39.2	50.9
<b>Release Rates (cfs/ac)</b>	-	-	-	-	-	-
<b>Allowed Release (cfs)</b>	2.2	7.8	15.9	29.3	39.2	50.9

DCM:  $I = C1 * \ln(tc) + C2$

C1      1.19      1.5      1.75      2      2.25      2.52  
 C2      6.035      7.583      8.847      10.111      11.375      12.735

### Notes

## Sub-Basin EX-C Runoff Calculations

Job No.: **61170**  
 Project: **Boyd Subdivision**  
 Jurisdiction: **DCM**  
 Runoff Coefficient: **Surface Type**

Date: **8/18/2022 9:00**  
 Calcs by: **TJW**  
 Checked by: \_\_\_\_\_  
 Soil Type: **B**  
 Urbanization: **Urban**

### Basin Land Use Characteristics

Surface	Area		Runoff Coefficient						% Imperv.
	(SF)	(Acres)	C2	C5	C10	C25	C50	C100	
Gravel	8,120	0.19	0.57	0.59	0.63	0.66	0.68	0.7	80%
Gravel	2,400	0.06	0.57	0.59	0.63	0.66	0.68	0.7	80%
Roofs	5,000	0.11	0.71	0.73	0.75	0.78	0.8	0.81	90%
Paved	1,000	0.02	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	162,730	3.74	0.02	0.08	0.15	0.25	0.3	0.35	0%
<b>Combined</b>	<b>179,250</b>	<b>4.12</b>	<b>0.08</b>	<b>0.13</b>	<b>0.20</b>	<b>0.29</b>	<b>0.34</b>	<b>0.39</b>	<b>7.8%</b>

179250

### Basin Travel Time

	Shallow Channel Ground Cover		Short Pasture/Lawns			
	$L_{max,Overland}$		$S_0$	$v$	$t$	$t_{Alt}$
	L (ft)	$\Delta Z_0$ (ft)	(ft/ft)	(ft/s)	(min)	(min)
Total	772	63	-	-	-	-
Initial Time	100	5	0.050	-	10.3	14.3 DCM Eq. 6-8
Shallow Channel	672	58	0.086	2.1	5.4	- DCM Eq. 6-9
Channelized			0.000	0.0	0.0	- Trap Ditch
				$t_c$	<b>14.3 min.</b>	

### Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
<b>Intensity (in/hr)</b>	2.87	3.59	4.19	4.79	5.39	6.03
<b>Runoff (cfs)</b>	0.9	<b>2.0</b>	3.4	5.8	7.5	<b>9.6</b>
<b>Release Rates (cfs/ac)</b>	-	-	-	-	-	-
<b>Allowed Release (cfs)</b>	0.9	<b>2.0</b>	3.4	5.8	7.5	<b>9.6</b>

DCM:  $I = C1 * \ln(tc) + C2$

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

### Notes

## Combined Sub-Basin Runoff Calculations

Includes Basins OS-A1 EX-A

Job No.:	<b>61170</b>	Date:	<b>8/18/2022 9:00</b>
Project:	<b>Boyd Subdivision</b>	Calcs by:	<b>TJW</b>
Jurisdiction	<b>DCM</b>	Checked by:	
Runoff Coefficient	<b>Surface Type</b>	Soil Type	<b>B</b>
		Urbanization	<b>Urban</b>

### Basin Land Use Characteristics

Surface	Area		Runoff Coefficient						%
	(SF)	(Acres)	C2	C5	C10	C25	C50	C100	Imperv.
Pasture/Meadow	320,170	7.35	0.02	0.08	0.15	0.25	0.3	0.35	0%
<b>Combined</b>	<b>320,170</b>	<b>7.35</b>	<b>0.02</b>	<b>0.08</b>	<b>0.15</b>	<b>0.25</b>	<b>0.30</b>	<b>0.35</b>	<b>0.0%</b>

### Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. $\Delta Z_0$ (ft)	$Q_i$ (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	OS-A1	-	656	50	-	-	-	-	12.8
Channelized-1	Trap Ditch	3	410	30	5	2	2	2.0	3.4
Channelized-2									
Channelized-3									
Total			1,066	80					

3 = Natural, Winding, significant vegetation

$t_c$  (min) **16.2**

### Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas \_\_\_\_\_

$Q_{Minor}$  \_\_\_\_\_ (cfs) - 5-year Storm

$Q_{Major}$  \_\_\_\_\_ (cfs) - 100-year Storm

### Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
<b>Intensity (in/hr)</b>	2.72	3.41	3.97	4.54	5.11	5.72
<b>Site Runoff (cfs)</b>	0.40	<b>2.00</b>	4.38	8.35	11.27	<b>14.71</b>
<b>OffSite Runoff (cfs)</b>	-	<b>0.00</b>	-	-	-	<b>0.00</b>
<b>Release Rates (cfs/ac)</b>	-	-	-	-	-	-
<b>Allowed Release (cfs)</b>	-	<b>2.0</b>	-	-	-	<b>14.7</b>

DCM:  $I = C1 * \ln(tc) + C2$

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

### Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

## Combined Sub-Basin Runoff Calculations (Existing Site)

Includes Basins OS-A1 EX-A OS-B1 OS-B2 EX-B

Job No.:	<b>61170</b>	Date:	<b>8/18/2022 9:00</b>
Project:	<b>Boyd Subdivision</b>	Calcs by:	<b>TJW</b>
Jurisdiction	<b>DCM</b>	Checked by:	
Runoff Coefficient	<b>Surface Type</b>	Soil Type	<b>B</b>
		Urbanization	<b>Urban</b>

### Basin Land Use Characteristics

Surface	Area		Runoff Coefficient						% Imperv.
	(SF)	(Acres)	C2	C5	C10	C25	C50	C100	
Pasture/Meadow	2,651,859	60.88	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	6,180	0.14	0.57	0.59	0.63	0.66	0.68	0.7	80%
5 Acre	189,239	4.34	0.06	0.1	0.2	0.29	0.34	0.38	7%
<b>Combined</b>	<b>2,847,278</b>	<b>65.36</b>	<b>0.02</b>	<b>0.08</b>	<b>0.15</b>	<b>0.25</b>	<b>0.30</b>	<b>0.35</b>	<b>0.6%</b>

### Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ <sub>0</sub> (ft)	Q <sub>i</sub> (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	OS-A1	-	656	50	-	-	-	-	12.8
Channelized-1	Trap Ditch	3	410	30	5	2	2	2.0	3.4
Channelized-2	Trap Ditch	2	904	24	5	2	2	2.5	6.1
Channelized-3									
Total			1,970	104					

3 = Natural, Winding, significant vegetation  
 2 = Natural, Winding, minimal vegetation/shallow grass

**t<sub>c</sub> (min) 22.3**

### Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas \_\_\_\_\_

Q<sub>Minor</sub> \_\_\_\_\_ (cfs) - 5-year Storm

Q<sub>Major</sub> \_\_\_\_\_ (cfs) - 100-year Storm

### Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
<b>Intensity (in/hr)</b>	2.34	2.93	3.42	3.90	4.39	4.91
<b>Site Runoff (cfs)</b>	3.65	<b>15.77</b>	34.46	64.69	87.12	<b>113.30</b>
<b>OffSite Runoff (cfs)</b>	-	<b>0.00</b>	-	-	-	<b>0.00</b>
<b>Release Rates (cfs/ac)</b>	-	-	-	-	-	-
<b>Allowed Release (cfs)</b>	-	<b>15.8</b>	-	-	-	<b>113.3</b>

DCM: I = C1 \* ln(tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

### Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

## Combined Sub-Basin Runoff Calculations

Includes Basins OS-A1 A

Job No.:	<b>61170</b>	Date:	<b>8/18/2022 9:00</b>
Project:	<b>Boyd Subdivision</b>	Calcs by:	<b>TJW</b>
Jurisdiction	<b>DCM</b>	Checked by:	
Runoff Coefficient	<b>Surface Type</b>	Soil Type	<b>B</b>
		Urbanization	<b>Urban</b>

### Basin Land Use Characteristics

Surface	Area		Runoff Coefficient						%
	(SF)	(Acres)	C2	C5	C10	C25	C50	C100	Imperv.
Pasture/Meadow	320,170	7.35	0.02	0.08	0.15	0.25	0.3	0.35	0%
<b>Combined</b>	<b>320,170</b>	<b>7.35</b>	<b>0.02</b>	<b>0.08</b>	<b>0.15</b>	<b>0.25</b>	<b>0.30</b>	<b>0.35</b>	<b>0.0%</b>

### Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ <sub>0</sub> (ft)	Q <sub>i</sub> (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	OS-A1	-	656	50	-	-	-	-	12.8
Channelized-1	Trap Ditch	3	410	30	5	2	2	2.0	3.4
Channelized-2									
Channelized-3									
Total			1,066	80					

3 = Natural, Winding, significant vegetation

**t<sub>c</sub> (min) 16.2**

### Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q<sub>Minor</sub> (cfs) - 5-year Storm

Q<sub>Major</sub> (cfs) - 100-year Storm

### Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
<b>Intensity (in/hr)</b>	2.72	3.41	3.97	4.54	5.11	5.72
<b>Site Runoff (cfs)</b>	0.40	<b>2.00</b>	4.38	8.35	11.27	<b>14.71</b>
<b>OffSite Runoff (cfs)</b>	-	<b>0.00</b>	-	-	-	<b>0.00</b>
<b>Release Rates (cfs/ac)</b>	-	-	-	-	-	-
<b>Allowed Release (cfs)</b>	-	<b>2.0</b>	-	-	-	<b>14.7</b>

DCM: I = C1 \* ln(tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

### Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

## Combined Sub-Basin Runoff Calculations (Developed Site)

Includes Basins OS-A1 A OS-B1 OS-B2 B

Job No.:	<b>61170</b>	Date:	<b>8/18/2022 9:00</b>
Project:	<b>Boyd Subdivision</b>	Calcs by:	<b>TJW</b>
Jurisdiction	<b>DCM</b>	Checked by:	
Runoff Coefficient	<b>Surface Type</b>	Soil Type	<b>B</b>
		Urbanization	<b>Urban</b>

### Basin Land Use Characteristics

Surface	Area		Runoff Coefficient						% Imperv.
	(SF)	(Acres)	C2	C5	C10	C25	C50	C100	
Pasture/Meadow	2,635,059	60.49	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	6,180	0.14	0.57	0.59	0.63	0.66	0.68	0.7	80%
Paved	2,000	0.05	0.89	0.9	0.92	0.94	0.95	0.96	100%
Roofs	10,000	0.23	0.71	0.73	0.75	0.78	0.8	0.81	90%
5 Acre	189,239	4.34	0.06	0.1	0.2	0.29	0.34	0.38	7%
<b>Combined</b>	<b>2,842,478</b>	<b>65.25</b>	<b>0.03</b>	<b>0.09</b>	<b>0.16</b>	<b>0.26</b>	<b>0.31</b>	<b>0.35</b>	<b>1.0%</b>

### Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ <sub>0</sub> (ft)	Q <sub>i</sub> (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	OS-A1	-	656	50	-	-	-	-	12.8
Channelized-1	Trap Ditch	3	410	30	5	2	2	2.0	3.4
Channelized-2	Trap Ditch	2	904	24	5	2	2	2.5	6.1
Channelized-3									
Total			1,970	104					

3 = Natural, Winding, significant vegetation  
 2 = Natural, Winding, minimal vegetation/shallow grass

**t<sub>c</sub> (min) 22.3**

### Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas \_\_\_\_\_

Q<sub>Minor</sub> \_\_\_\_\_ (cfs) - 5-year Storm

Q<sub>Major</sub> \_\_\_\_\_ (cfs) - 100-year Storm

### Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
<b>Intensity (in/hr)</b>	2.34	2.93	3.42	3.90	4.39	4.91
<b>Site Runoff (cfs)</b>	4.11	<b>16.30</b>	35.00	65.18	87.61	<b>113.76</b>
<b>OffSite Runoff (cfs)</b>	-	<b>0.00</b>	-	-	-	<b>0.00</b>
<b>Release Rates (cfs/ac)</b>	-	-	-	-	-	-
<b>Allowed Release (cfs)</b>	-	<b>16.3</b>	-	-	-	<b>113.8</b>

DCM: I = C1 \* ln(tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

### Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

Boyd Subdivision  
 South Channel  
 M.V.E., Inc. March 2022

NRCS Curve Number Calculations

Basin	Basin Area (Sq Mi)	Basin Area (Ac)	Predominant Soil Type	Land Use (Type)	Land Use (Ac)	Land Use (CN)	Land Use (Type)	Land Use (Ac)	Land Use (CN)	Land Use (Type)	Land Use (Ac)	Land Use (CN)	Composite (CN)	Initial Abstraction (in)
OS-1	0.094	60.2	B	Pasture	60.2	66							66.0	0.52
OS-2	0.153	97.9	B	Pasture	97.9	66							66.0	0.52
OS-3	0.011	7.0	B	Pasture	7.0	66							66.0	0.52
OS-4	0.059	37.8	B	Pasture	37.8	66							66.0	0.52
OS-5	0.143	91.5	B	Pasture	51.5	66	RR5	40	67				66.4	0.51
B	0.091	58.2	B	Pasture	58.2	66							66.0	0.52
		352.6	Total AC.										Weighted Average CN = 66.1	

Boyd Subdivision  
 South Channel  
 M.V.E., Inc. March 2022

NRCS Curve Number Calculations (DEVELOPED)

<b>Basin</b>	<b>Basin Area (Sq Mi)</b>	<b>Basin Area (Ac)</b>	<b>Predominant Soil Type</b>	<b>Land Use (Type)</b>	<b>Land Use (Ac)</b>	<b>Land Use (CN)</b>	<b>Land Use (Type)</b>	<b>Land Use (Ac)</b>	<b>Land Use (CN)</b>	<b>Land Use (Type)</b>	<b>Land Use (Ac)</b>	<b>Land Use (CN)</b>	<b>Composite (CN)</b>	<b>Initial Abstraction (in)</b>
<b>OS-1</b>	0.094	60.2	B	Pasture	60.2	66							<b>66.0</b>	<b>0.52</b>
<b>OS-2</b>	0.153	97.9	B	Pasture	97.9	66							<b>66.0</b>	<b>0.52</b>
<b>OS-3</b>	0.011	7.0	B	Pasture	7.0	66							<b>66.0</b>	<b>0.52</b>
<b>OS-4</b>	0.059	37.8	B	Pasture	37.8	66							<b>66.0</b>	<b>0.52</b>
<b>OS-5</b>	0.143	91.5	B	Pasture	51.5	66 RR5		40	67				<b>66.4</b>	<b>0.51</b>
<b>B</b>	0.091	58.2	B	Pasture	27.2	66 RR5		31	67				<b>66.5</b>	<b>0.50</b>
		352.6	Total AC.										Weighted Average CN = 66.2	

Boyd Subdivision  
 South Channel  
 M.V.E., Inc. March 2022

Time of Concentration/Lag Time Calculations

Basin	Basin Area (Sq Mi)	Basin Area (Ac)	Overland Flow					Shallow Concentrated Flow				
			Manning's n	Length (ft)	P2 (in)	Slope (ft/ft)	Ti (hr)	Cover Type	Length (ft)	Slope (%)	V (fps)	Tsc (hr)
<b>OS-1</b>	0.094	60.2	0.130	300	2.1	0.117	<b>0.21</b>	Pasture	1050	7.1	1.9	<b>0.15</b>
<b>OS-2</b>	0.153	97.9	0.130	300	2.1	0.200	<b>0.17</b>	Pasture	785	8.9	2.1	<b>0.10</b>
<b>OS-3</b>	0.011	7.0	0.130	300	2.1	0.017	<b>0.46</b>	Pasture	370	9.5	2.2	<b>0.05</b>
<b>OS-4</b>	0.059	37.8	0.130	300	2.1	0.093	<b>0.23</b>	Pasture	1070	6.5	1.8	<b>0.17</b>
<b>OS-5</b>	0.143	91.5	0.130	300	2.1	0.026	<b>0.39</b>	Pasture	1380	1.9	1	<b>0.38</b>
<b>B</b>	0.091	58.2	0.130	300	2.1	0.060	<b>0.28</b>	Pasture	1380	5.8	1.7	<b>0.23</b>

Boyd Subdivision  
 South Channel  
 M.V.E., Inc. March 2022

Time of Concentration/Lag Time Calculations

Basin	Concentrated Flow											Total Time of Conc	Lag Time
	Length (ft)	Slope (%)	Manning's n	Bot Width (ft)	Est Flow (cfs)	Est d (ft)	Calc Q (cfs)	Calc A (ft)	Calc P (ft)	V (fps)	Tcf (hr)	Tc (hr)	(Min)
OS-1	1895	3.2	0.035	15	100	1.00	100	14.9	17.0	7.0	<b>0.08</b>	<b>0.44</b>	<b>16</b>
OS-2	1460	3.8	0.035	8	160	1.88	160	15.0	11.8	9.8	<b>0.04</b>	<b>0.32</b>	<b>11</b>
OS-3	450	4	0.035	2	15	1.50	15	3.0	5.0	6.1	<b>0.02</b>	<b>0.53</b>	<b>19</b>
OS-4	1185	4.6	0.035	15	65	0.72	65	10.8	16.4	6.9	<b>0.05</b>	<b>0.45</b>	<b>16</b>
OS-5	1250	2.2	0.035	15	100	1.10	100	16.5	17.2	6.1	<b>0.06</b>	<b>0.83</b>	<b>30</b>
B	750	2.0	0.035	5	95	2.51	95	12.6	10.0	7.0	<b>0.03</b>	<b>0.53</b>	<b>19</b>
											<b>227</b>	<b>3.8</b>	<b>136.2 composite</b>
											min	hr	

Project: Boyd Subdivision Simulation Run: 5yr Existing

Start of Run: 01Jan2000, 00:00

Basin Model: Boyd

End of Run: 02Jan2000, 00:00

Meteorologic Model: 5-yr

Compute Time: 08Apr2022, 16:10:00

Control Specifications: 24-hr

Show Elements: All Elements ▾

Volume Units:  IN  ACRE-FT

Sorting: Hydrologic ▾

Hydrologic Element	Drainage Area (MI <sup>2</sup> )	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Subbasin-OS2	0.153	34.8	01Jan2000, 12:07	0.41
Subbasin-OS1	0.094	16.7	01Jan2000, 12:12	0.40
Junction-1	0.247	49.4	01Jan2000, 12:08	0.41
Reach-1	0.247	48.8	01Jan2000, 12:11	0.40
Subbasin-OS4	0.059	10.5	01Jan2000, 12:12	0.40
Subbasin-OS3	0.011	1.7	01Jan2000, 12:16	0.40
Junction-2	0.317	60.8	01Jan2000, 12:12	0.40
Reach-2	0.317	60.7	01Jan2000, 12:15	0.40
Subbasin-OS5	0.143	17.2	01Jan2000, 12:29	0.41
Junction-3	0.460	73.1	01Jan2000, 12:16	0.41
Reach-3	0.460	73.0	01Jan2000, 12:18	0.41
Subbasin-B	0.091	14.3	01Jan2000, 12:16	0.40
Junction-4	0.551	87.0	01Jan2000, 12:18	0.41

Project: Boyd Subdivision Simulation Run: 5yr Developed

Start of Run: 01Jan2000, 00:00

Basin Model: Boyd - Developed

End of Run: 02Jan2000, 00:00

Meteorologic Model: 5-yr

Compute Time: 08Apr2022, 16:09:58

Control Specifications: 24-hr

Show Elements: All Elements ▾

Volume Units:  IN  ACRE-FT

Sorting: Hydrologic ▾

Hydrologic Element	Drainage Area (MI <sup>2</sup> )	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Subbasin-OS2	0.153	34.8	01Jan2000, 12:07	0.41
Subbasin-OS1	0.094	16.7	01Jan2000, 12:12	0.40
Junction-1	0.247	49.4	01Jan2000, 12:08	0.41
Reach-1	0.247	48.8	01Jan2000, 12:11	0.40
Subbasin-OS4	0.059	10.5	01Jan2000, 12:12	0.40
Subbasin-OS3	0.011	1.7	01Jan2000, 12:16	0.40
Junction-2	0.317	60.8	01Jan2000, 12:12	0.40
Reach-2	0.317	60.7	01Jan2000, 12:15	0.40
Subbasin-OS5	0.143	17.2	01Jan2000, 12:29	0.41
Junction-3	0.460	73.1	01Jan2000, 12:16	0.41
Reach-3	0.460	73.0	01Jan2000, 12:18	0.41
Subbasin-B	0.091	15.2	01Jan2000, 12:16	0.42
Junction-4	0.551	88.0	01Jan2000, 12:18	0.41



Project: Boyd Subdivision Simulation Run: 100yr Existing

Start of Run: 01Jan2000, 00:00

Basin Model: Boyd

End of Run: 02Jan2000, 00:00

Meteorologic Model: 100-yr

Compute Time: 08Apr2022, 16:09:53

Control Specifications: 24-hr

Show Elements: All Elements

Volume Units:  IN  ACRE-FT

Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI <sup>2</sup> )	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Subbasin-OS2	0.153	163.2	01Jan2000, 12:05	1.45
Subbasin-OS1	0.094	81.0	01Jan2000, 12:10	1.45
Junction-1	0.247	236.9	01Jan2000, 12:06	1.45
Reach-1	0.247	234.9	01Jan2000, 12:08	1.45
Subbasin-OS4	0.059	50.8	01Jan2000, 12:10	1.45
Subbasin-OS3	0.011	8.5	01Jan2000, 12:13	1.45
Junction-2	0.317	293.4	01Jan2000, 12:09	1.45
Reach-2	0.317	293.2	01Jan2000, 12:12	1.45
Subbasin-OS5	0.143	81.9	01Jan2000, 12:25	1.47
Junction-3	0.460	354.4	01Jan2000, 12:13	1.45
Reach-3	0.460	354.0	01Jan2000, 12:14	1.45
Subbasin-B	0.091	70.1	01Jan2000, 12:13	1.45
Junction-4	0.551	423.8	01Jan2000, 12:14	1.45

Project: Boyd Subdivision Simulation Run: 100yr Developed

Start of Run: 01Jan2000, 00:00

Basin Model: Boyd - Developed

End of Run: 02Jan2000, 00:00

Meteorologic Model: 100-yr

Compute Time: 08Apr2022, 16:09:52

Control Specifications: 24-hr

Show Elements: All Elements ▾

Volume Units:  IN  ACRE-FT

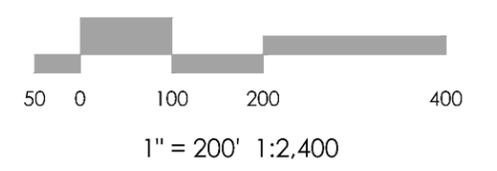
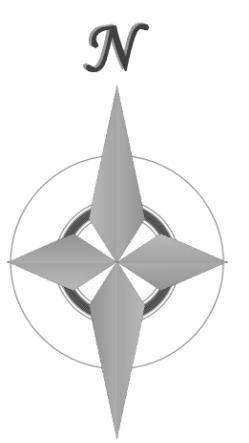
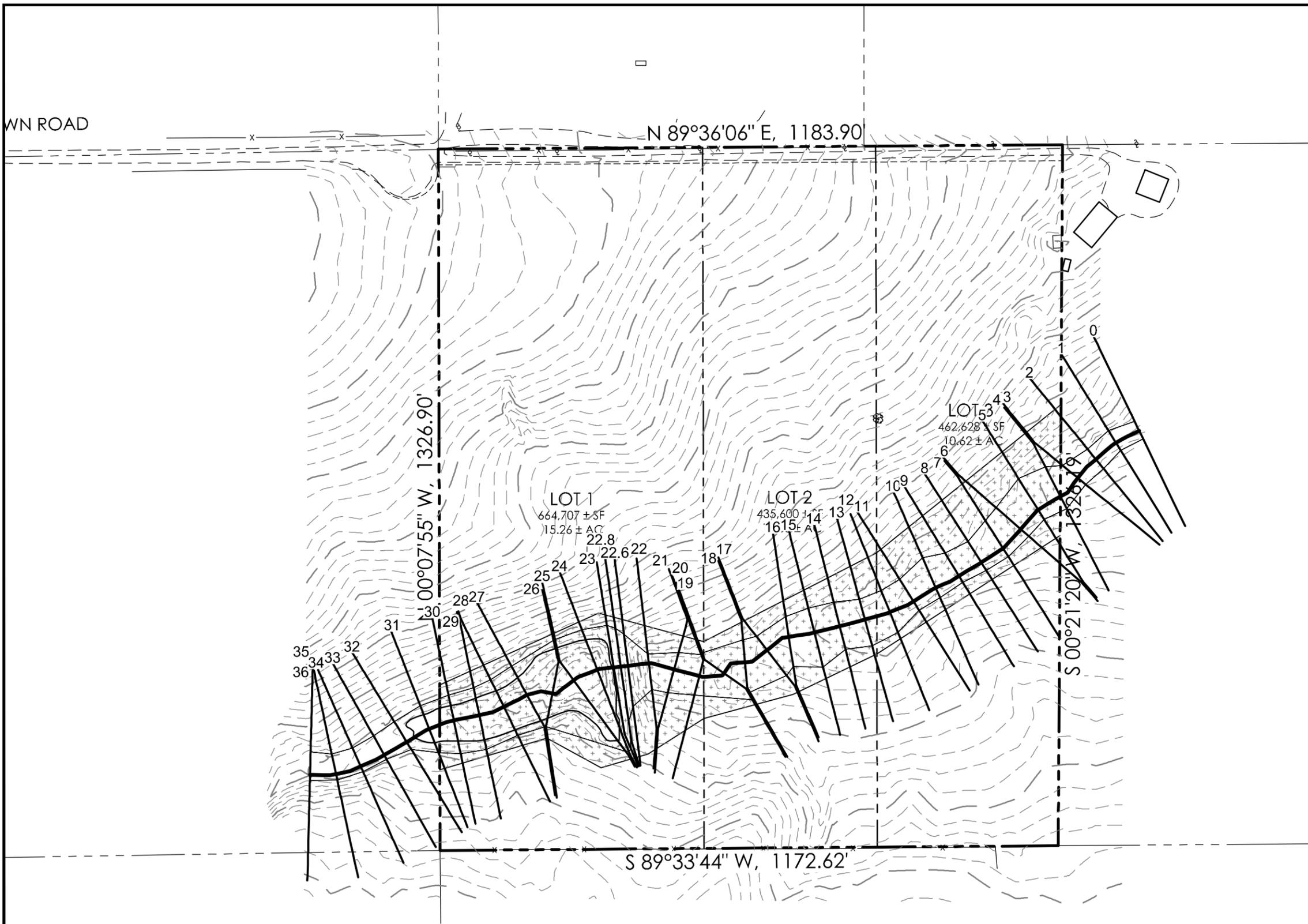
Sorting: Hydrologic ▾

Hydrologic Element	Drainage Area (MI <sup>2</sup> )	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Subbasin-OS2	0.153	163.2	01Jan2000, 12:05	1.45
Subbasin-OS1	0.094	81.0	01Jan2000, 12:10	1.45
Junction-1	0.247	236.9	01Jan2000, 12:06	1.45
Reach-1	0.247	234.9	01Jan2000, 12:08	1.45
Subbasin-OS4	0.059	50.8	01Jan2000, 12:10	1.45
Subbasin-OS3	0.011	8.5	01Jan2000, 12:13	1.45
Junction-2	0.317	293.4	01Jan2000, 12:09	1.45
Reach-2	0.317	293.2	01Jan2000, 12:12	1.45
Subbasin-OS5	0.143	81.9	01Jan2000, 12:25	1.47
Junction-3	0.460	354.4	01Jan2000, 12:13	1.45
Reach-3	0.460	353.9	01Jan2000, 12:14	1.45
Subbasin-B	0.091	72.1	01Jan2000, 12:13	1.48
Junction-4	0.551	425.8	01Jan2000, 12:14	1.46

## **11 Hydraulic Calculations**

- HEC-RAS Cross Section Map
- HEC-RAS Profile
- HEC-RAS Summary Table
- HEC-RAS Cross Sections
- HEC-RAS Detailed Report

WN ROAD



**FLOODPLAIN STATEMENT**

NO PORTION OF THE SUBJECT PROPERTY IS LOCATED WITHIN A FEMA DESIGNATED SPECIAL FLOOD HAZARD AREA (SFHA) AS INDICATED ON THE FLOOD INSURANCE RATE MAP (FIRM) FOR EL PASO COUNTY, COLORADO AND INCORPORATED AREAS - MAP NUMBER 08041C0305 G, EFFECTIVE DECEMBER 7, 2018.

 (719) 635-5736	<b>MONUMENT VALLEY ENGINEERS INC.</b> *** ENGINEERS *** SURVEYORS *** 1903 LELARAY ST., COLORADO SPRINGS, COLORADO 80909
	<b>HEC_RAS_CROSS_SECTIONS</b>

HEC-RAS HEC-RAS 5.0.7 March 2019  
U.S. Army Corps of Engineers  
Hydrologic Engineering Center  
609 Second Street  
Davis, California

```
X   X  XXXXXX   XXXX       XXXX       XX       XXXX
X   X X X      X  X      X  X      X X      X
X   X X      X      X  X      X  X      X  X      X
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X   X X      X      X  X      X  X      X  X      X
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PROJECT DATA

Project Title: HEC-RAS Model  
Project File : 61170-No Build Area.prj  
Run Date and Time: 8/17/2022 12:23:56 PM

Project in English units

Project Description:

CRS Info=<SpatialReference> <CoordinateSystem Code="2232"  
Unit="US\_survey\_Foot" AcadCode="C083-CF" /></SpatialReference>

PLAN DATA

Plan Title: Default Scenario  
Plan File : Z:\61170\Documents\Drainage\Calcs\Hydrology\61170-No Build Area.p01

Geometry Title: Default Geometry  
Geometry File : Z:\61170\Documents\Drainage\Calcs\Hydrology\61170-No Build Area.g01

Flow Title : Default Steady Flow  
Flow File : Z:\61170\Documents\Drainage\Calcs\Hydrology\61170-No Build Area.f01

Plan Description:

Default Scenario

Plan Summary Information:

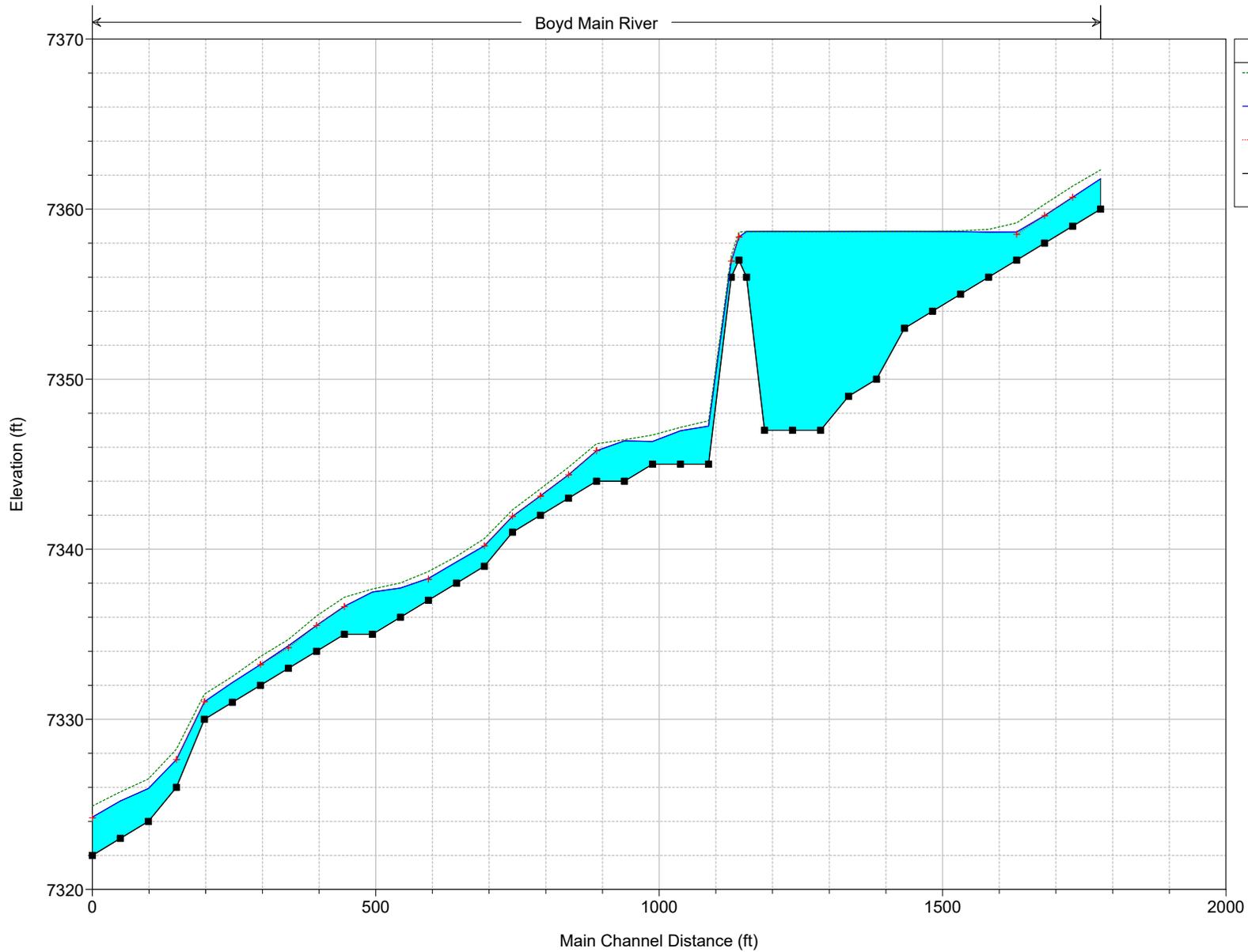
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Computational Information

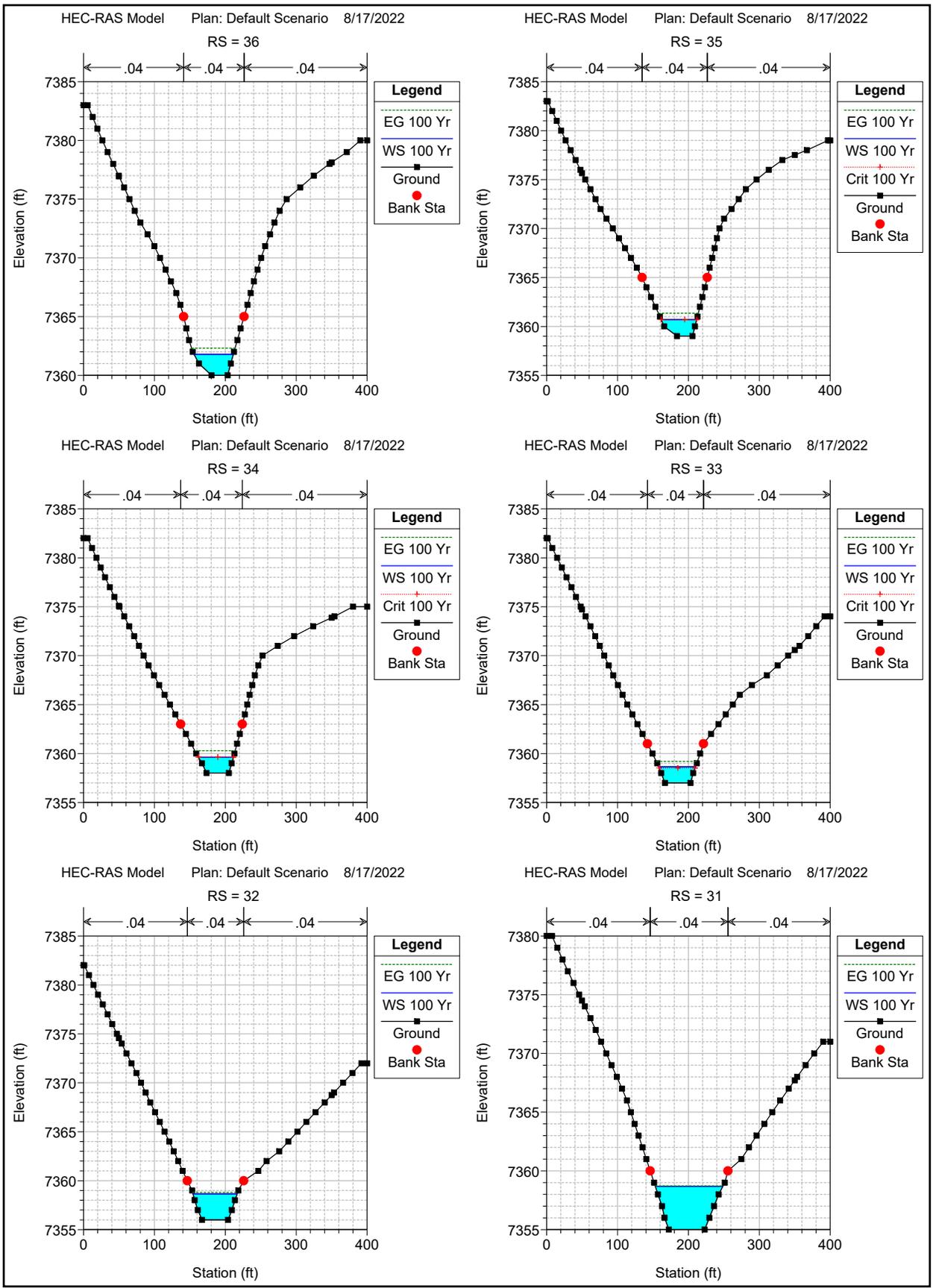
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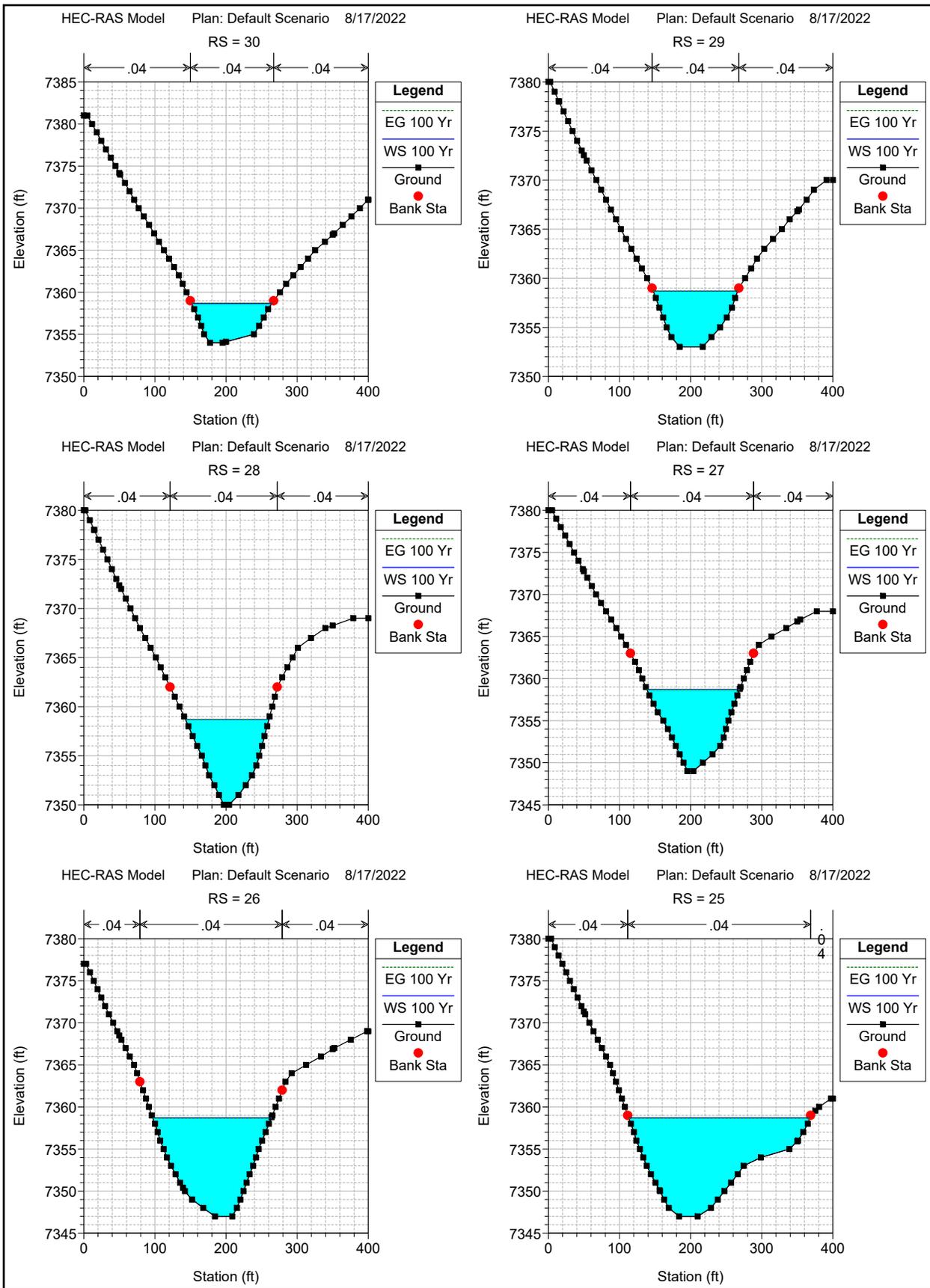
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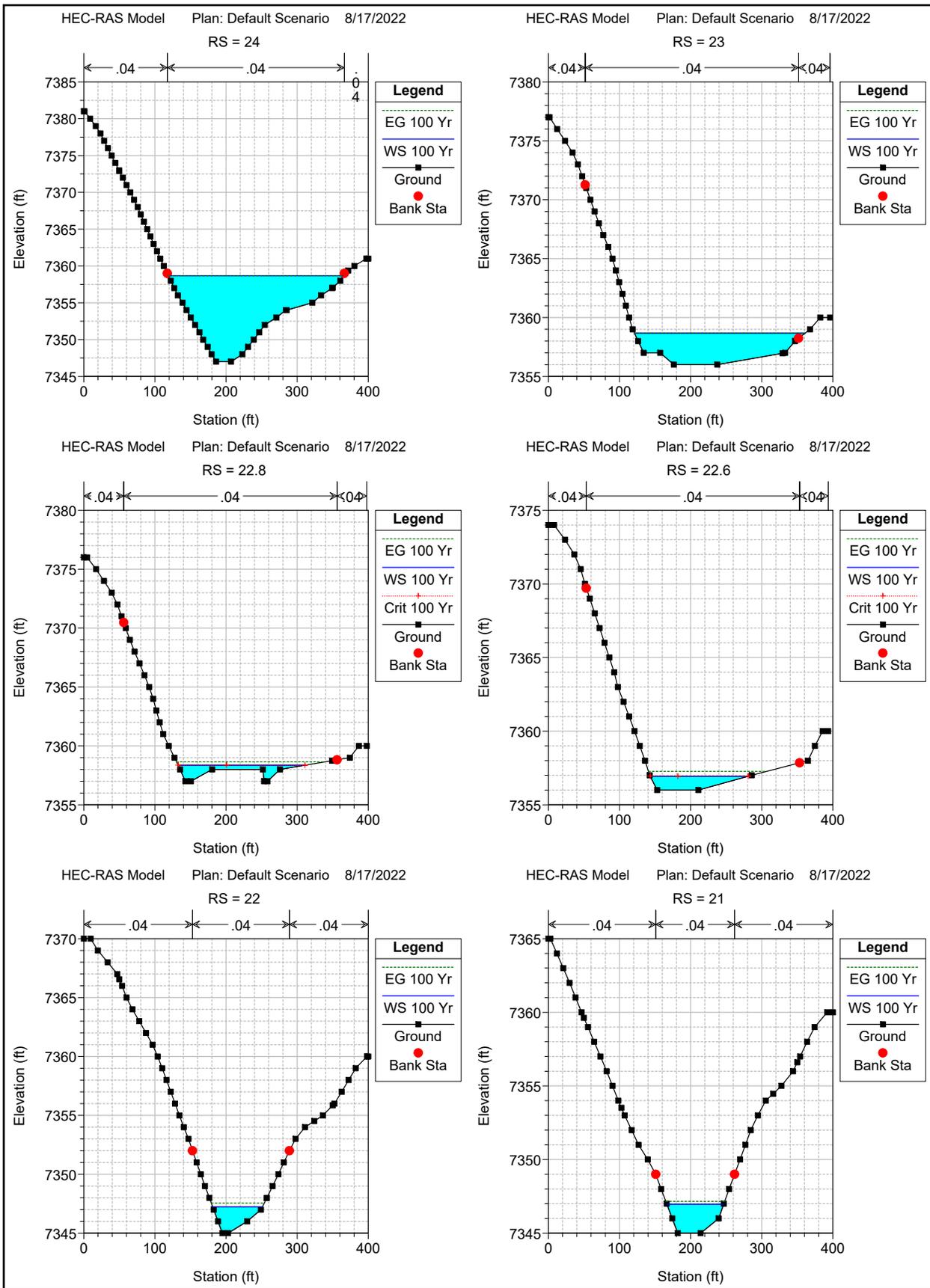
Boyd Main River

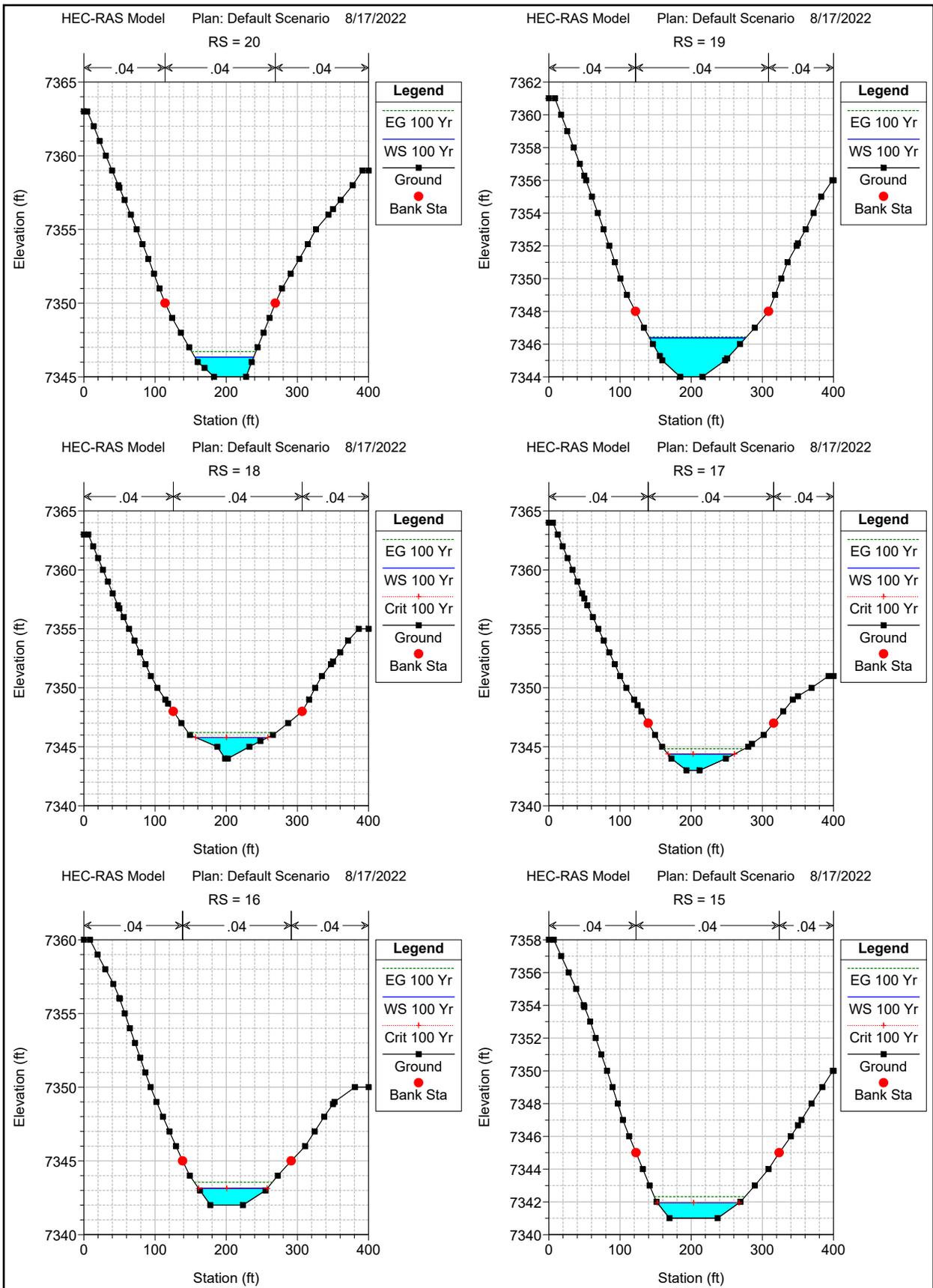


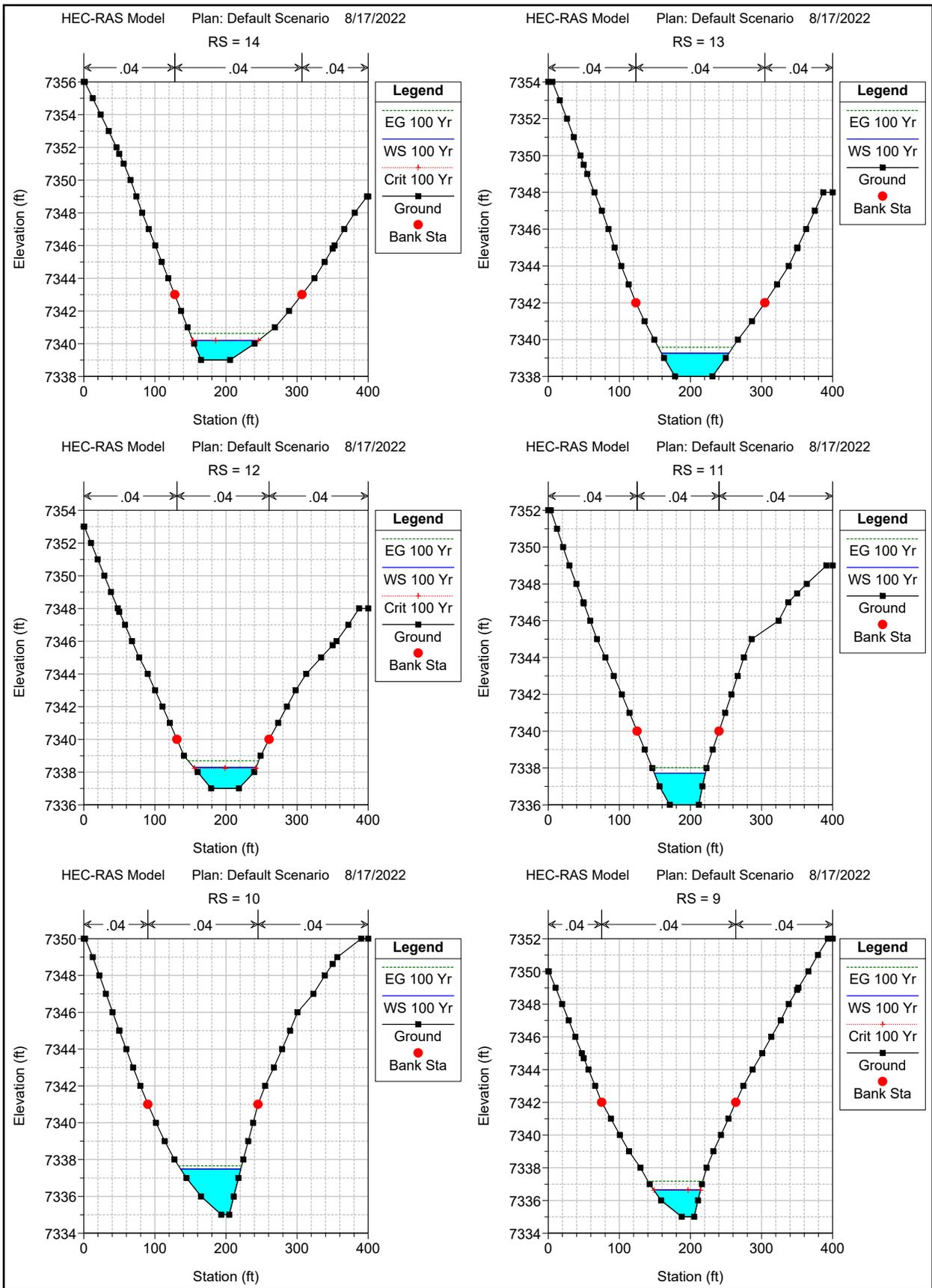
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WS 100 Yr	(Blue solid line)
Crit 100 Yr	(Red dotted line with '+' markers)
Ground	(Black solid line with square markers)

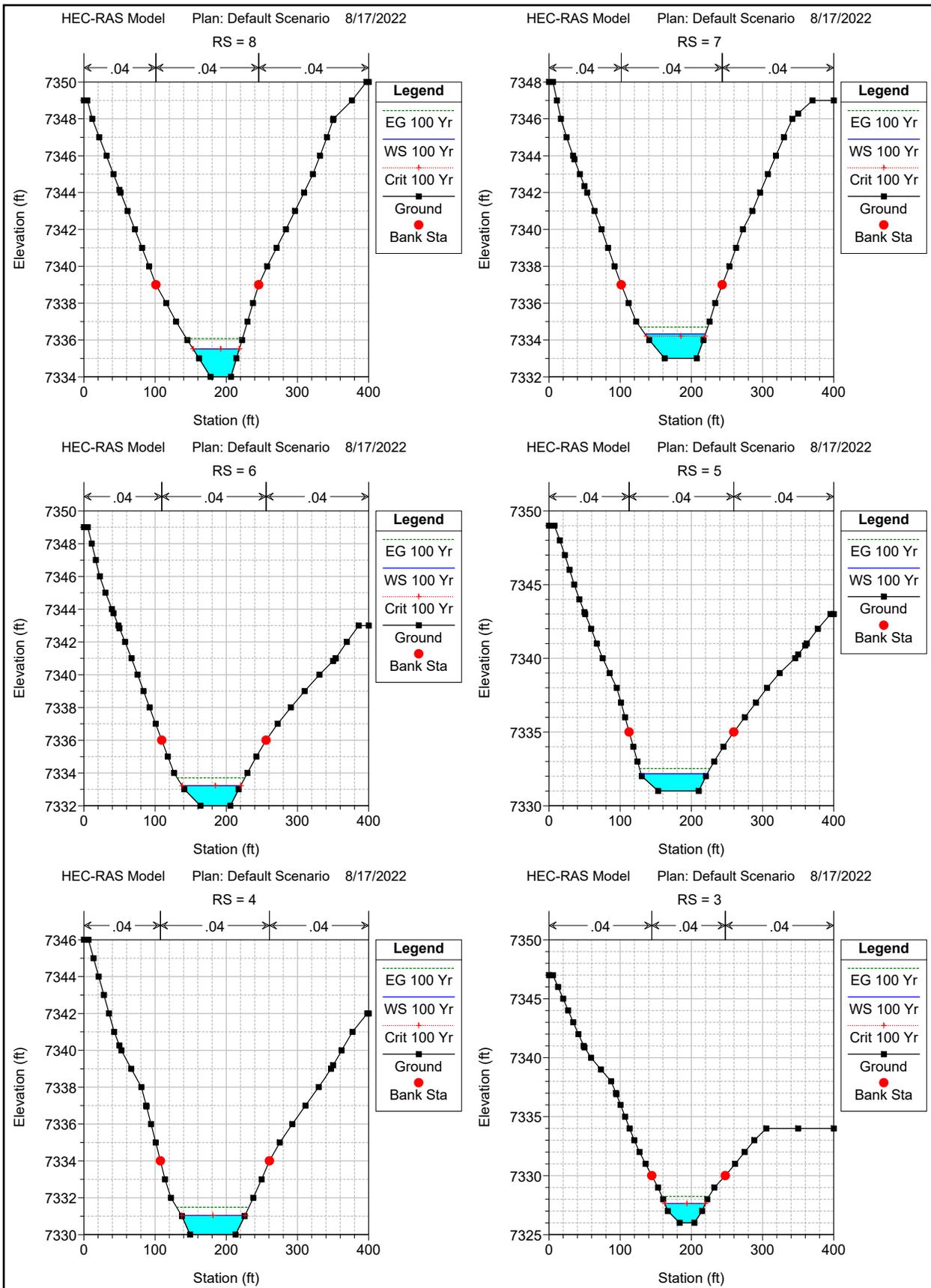


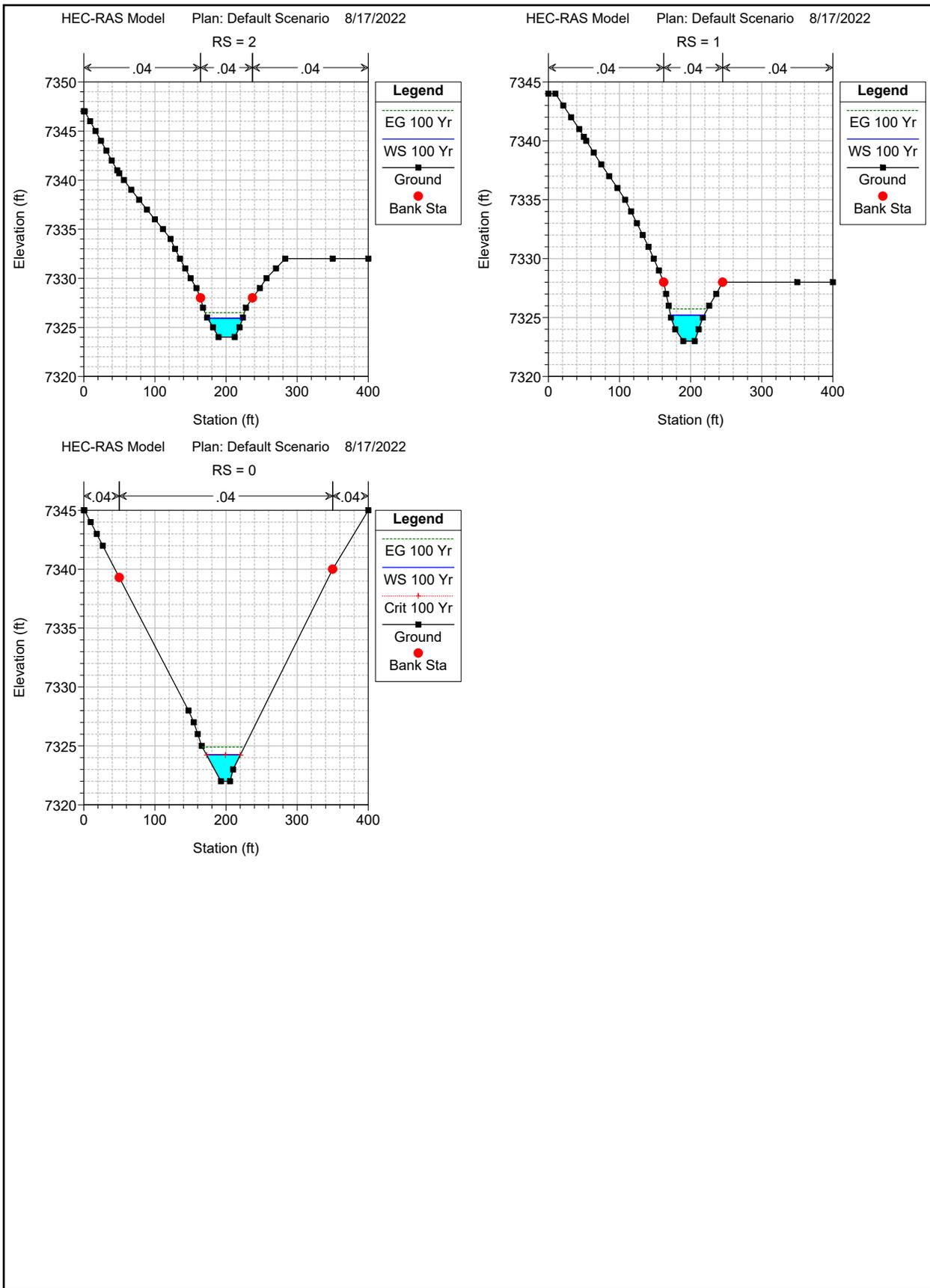












HEC-RAS Plan: Default Scenario River: Boyd Reach: Main River Profile: 100 Yr

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	Shear Chan (lb/sq ft)
Main River	36	100 Yr	425.80	7360.00	7361.79		7362.31	0.016972	5.81	73.28	55.43	0.89	1.39
Main River	35	100 Yr	425.80	7359.00	7360.70	7360.69	7361.36	0.021544	6.49	65.61	50.21	1.00	1.75
Main River	34	100 Yr	425.80	7358.00	7359.62	7359.62	7360.29	0.021703	6.55	65.00	49.32	1.01	1.77
Main River	33	100 Yr	425.80	7357.00	7358.65	7358.52	7359.19	0.016196	5.87	72.55	52.10	0.88	1.40
Main River	32	100 Yr	425.80	7356.00	7358.65		7358.81	0.002692	3.18	133.71	62.40	0.38	0.36
Main River	31	100 Yr	425.80	7355.00	7358.69		7358.73	0.000471	1.59	267.06	95.41	0.17	0.08
Main River	30	100 Yr	425.80	7354.00	7358.69		7358.71	0.000183	1.12	379.56	113.10	0.11	0.04
Main River	29	100 Yr	425.80	7353.00	7358.69		7358.70	0.000093	0.90	474.64	118.78	0.08	0.02
Main River	28	100 Yr	425.80	7350.00	7358.69		7358.69	0.000039	0.69	615.05	117.31	0.05	0.01
Main River	27	100 Yr	425.80	7349.00	7358.69		7358.69	0.000023	0.57	753.60	130.16	0.04	0.01
Main River	26	100 Yr	425.80	7347.00	7358.69		7358.69	0.000006	0.34	1269.67	166.69	0.02	0.00
Main River	25	100 Yr	425.80	7347.00	7358.69		7358.69	0.000003	0.24	1741.06	254.48	0.02	0.00
Main River	24	100 Yr	425.80	7347.00	7358.69		7358.69	0.000005	0.28	1516.68	245.66	0.02	0.00
Main River	23	100 Yr	425.80	7356.00	7358.68		7358.69	0.000212	0.88	483.85	240.00	0.11	0.03
Main River	22.8	100 Yr	425.80	7357.00	7358.36	7358.36	7358.65	0.029910	4.32	98.63	178.64	1.02	1.03
Main River	22.6	100 Yr	425.80	7356.00	7356.94	7356.94	7357.27	0.027023	4.65	91.64	138.01	1.01	1.12
Main River	22	100 Yr	425.80	7345.00	7347.24		7347.55	0.009797	4.49	94.86	70.08	0.68	0.83
Main River	21	100 Yr	425.80	7345.00	7346.96		7347.16	0.005500	3.58	118.83	79.89	0.52	0.51
Main River	20	100 Yr	425.80	7345.00	7346.34		7346.71	0.016248	4.90	86.97	82.61	0.84	1.07
Main River	19	100 Yr	425.80	7344.00	7346.38		7346.44	0.001557	1.99	213.88	135.03	0.28	0.15
Main River	18	100 Yr	425.80	7344.00	7345.79	7345.79	7346.21	0.025612	5.17	82.39	101.58	1.01	1.30
Main River	17	100 Yr	425.80	7343.00	7344.38	7344.38	7344.82	0.025340	5.32	79.98	93.56	1.02	1.35
Main River	16	100 Yr	425.80	7342.00	7343.15	7343.13	7343.56	0.023513	5.14	82.91	96.79	0.98	1.26
Main River	15	100 Yr	425.80	7341.00	7341.94	7341.94	7342.32	0.026422	4.97	85.73	114.87	1.01	1.23
Main River	14	100 Yr	425.80	7339.00	7340.20	7340.20	7340.63	0.024371	5.29	80.55	92.48	1.00	1.32
Main River	13	100 Yr	425.80	7338.00	7339.26		7339.58	0.015450	4.57	93.26	94.77	0.81	0.95
Main River	12	100 Yr	425.80	7337.00	7338.28	7338.23	7338.69	0.020524	5.13	82.99	87.59	0.93	1.21
Main River	11	100 Yr	425.80	7336.00	7337.72		7338.01	0.008995	4.33	98.23	71.75	0.65	0.77
Main River	10	100 Yr	425.80	7335.00	7337.48		7337.66	0.004873	3.38	126.10	84.61	0.49	0.45
Main River	9	100 Yr	425.80	7335.00	7336.65	7336.62	7337.18	0.021816	5.85	72.75	65.85	0.98	1.50
Main River	8	100 Yr	425.80	7334.00	7335.52	7335.52	7336.08	0.022966	5.97	71.30	65.12	1.01	1.57
Main River	7	100 Yr	425.80	7333.00	7334.33	7334.21	7334.70	0.016712	4.88	87.23	85.01	0.85	1.07
Main River	6	100 Yr	425.80	7332.00	7333.22	7333.22	7333.70	0.024506	5.55	76.75	82.27	1.01	1.43
Main River	5	100 Yr	425.80	7331.00	7332.16		7332.52	0.017899	4.81	88.57	93.01	0.87	1.06
Main River	4	100 Yr	425.80	7330.00	7331.04	7331.04	7331.49	0.024418	5.37	79.34	89.15	1.00	1.36
Main River	3	100 Yr	425.80	7326.00	7327.63	7327.63	7328.24	0.022541	6.26	68.01	57.01	1.01	1.67
Main River	2	100 Yr	425.80	7324.00	7325.93		7326.50	0.016649	6.04	70.44	49.45	0.89	1.47
Main River	1	100 Yr	425.80	7323.00	7325.20		7325.73	0.014056	5.85	72.74	47.13	0.83	1.34
Main River	0	100 Yr	425.80	7322.00	7324.25	7324.21	7324.90	0.019971	6.47	65.86	47.87	0.97	1.70

Critical depth computed only where necessary  
 Conveyance Calculation Method: At breaks in n values only  
 Friction Slope Method: Average Conveyance  
 Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: Default Steady Flow  
 Flow File : Z:\61170\Documents\Drainage\Calcs\Hydrology\61170-No Build Area.f01

Flow Data (cfs)

River	Reach	RS	100 Yr
Boyd	Main River	36	425.8

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Boyd	Main River	100 Yr	Normal S = 0.01996	Normal S = 0.01996

GEOMETRY DATA

Geometry Title: Default Geometry  
 Geometry File : Z:\61170\Documents\Drainage\Calcs\Hydrology\61170-No Build Area.g01

CROSS SECTION

RIVER: Boyd  
 REACH: Main River RS: 36

INPUT

Description:

Station Elevation Data num= 49

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7383	5.78	7383	12.72	7382	19.63	7381	26.52	7380
33.88	7379	41.8	7378	49.56	7377	50	7376.94	57.29	7376
64.85	7375	72.26	7374	80.25	7373	90.3	7372	99.87	7371
107.9	7370	115.67	7369	123.33	7368	130.78	7367	136.44	7366
141.17	7365	145.03	7364	148.69	7363	153.96	7362	162.75	7361
180.44	7360	203.12	7360	207.68	7361	212.24	7362	216.84	7363
221.56	7364	226.49	7365	231.4	7366	235.71	7367	240.43	7368
245.4	7369	250.34	7370	256.22	7371	262.93	7372	269.21	7373
276.59	7374	286.58	7375	305.68	7376	324.84	7377	346.9	7378
350	7378.13	371.32	7379	390.46	7380	400	7380		

Manning's n Values

num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	141.17	.04	226.49	.04

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	141.17	226.49		49.41	49.41	.1	.3

CROSS SECTION

RIVER: Boyd  
 REACH: Main River RS: 35

INPUT

Description:

Station	Elevation	Data	num=	50					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7383	1.53	7383	7.88	7382	14.21	7381	20.51	7380
26.76	7379	33.77	7378	40.87	7377	47.72	7376	50	7375.66
54.47	7375	61.74	7374	68.93	7373	76.1	7372	84.36	7371
93.24	7370	101.95	7369	110.56	7368	118.96	7367	127.1	7366
134.68	7365	140.65	7364	147.15	7363	153.45	7362	159.74	7361
165.64	7360	183.85	7359	205.64	7359	209.22	7360	212.76	7361
216.27	7362	219.73	7363	223.18	7364	226.61	7365	230.04	7366
233.47	7367	236.87	7368	240.24	7369	243.82	7370	250.31	7371
260.85	7372	271.05	7373	281.07	7374	296.19	7375	313.16	7376
332.43	7377	350	7377.51	367.18	7378	396.82	7379	400	7379

Manning's n	Values	num=	3
Sta	n Val	Sta	n Val
0	.04	134.68	.04
		226.61	.04

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	134.68	226.61		49.41	49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd  
 REACH: Main River RS: 34

INPUT

Description:

Station	Elevation	Data	num=	47					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7382	5.72	7382	11.92	7381	18.08	7380	24.2	7379
30.29	7378	36.96	7377	43.53	7376	50	7375.08	50.54	7375
57.52	7374	64.47	7373	71.37	7372	78.23	7371	84.75	7370
91.84	7369	99.3	7368	106.78	7367	114.31	7366	121.85	7365
129.4	7364	136.97	7363	144.47	7362	151.79	7361	158.94	7360
167.03	7359	173.51	7358	205.05	7358	208.93	7359	212.8	7360
216.63	7361	220.37	7362	223.93	7363	227.45	7364	230.94	7365
234.4	7366	237.83	7367	241.68	7368	246.61	7369	252.39	7370
274.07	7371	297.11	7372	324.01	7373	350	7373.87	353.98	7374
380.13	7375	400	7375						

Manning's n	Values	num=	3
Sta	n Val	Sta	n Val
0	.04	136.97	.04
		223.93	.04

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	136.97	223.93		49.41	49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd  
 REACH: Main River RS: 33



0	7380	7.6	7380	14.85	7379	22.22	7378	29.82	7377
37.79	7376	45.84	7375	50	7374.49	53.95	7374	61.81	7373
69.22	7372	76.66	7371	84.1	7370	91.53	7369	98.97	7368
106.39	7367	113.3	7366	118.69	7365	124.16	7364	129.64	7363
135.13	7362	140.6	7361	146.06	7360	151.53	7359	156.99	7358
162.59	7357	166.32	7356	172.38	7355	222.88	7355	229.49	7356
236.13	7357	242.79	7358	251.33	7359	255.76	7360	274.57	7361
285.36	7362	296.1	7363	306.97	7364	318.2	7365	329.35	7366
341.43	7367	350	7367.71	353.5	7368	365.35	7369	377.45	7370
390.24	7371	400	7371						

Manning's n Values	num=	3
Sta n Val	Sta n Val	Sta n Val
0 .04 146.06	.04	255.76 .04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
146.06	255.76	49.41	49.41	49.41	.1	.3	

CROSS SECTION

RIVER: Boyd  
REACH: Main River RS: 30

INPUT

Description:

Station Elevation Data	num=	51
Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev		
0 7381 5.07 7381 11.61 7380 18.12 7379 24.63 7378		
31.09 7377 37.82 7376 44.52 7375 50 7374.18 51.17 7374		
57.77 7373 64.31 7372 70.82 7371 77.3 7370 84.35 7369		
91.84 7368 98.81 7367 105.76 7366 112.72 7365 119.69 7364		
126.74 7363 133.67 7362 139.03 7361 144.37 7360 149.73 7359		
155.09 7358 160.39 7357 165.14 7356 169.15 7355 177.52 7354		
194.96 7354 200 7354.11 239.2 7355 246.48 7356 253.1 7357		
259.18 7358 266.93 7359 275.89 7360 284.65 7361 294.61 7362		
304.93 7363 315.21 7364 325.3 7365 339.08 7366 350 7366.84		
352.08 7367 364.2 7368 376.22 7369 388.33 7370 399.9 7371		
400 7371		

Manning's n Values	num=	3
Sta n Val	Sta n Val	Sta n Val
0 .04 149.73	.04	266.93 .04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
149.73	266.93	49.41	49.41	49.41	.1	.3	

CROSS SECTION

RIVER: Boyd  
REACH: Main River RS: 29

INPUT

Description:

Station Elevation Data	num=	51
Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev		
0 7380 2.5 7380 8.72 7379 14.65 7378.05 14.95 7378		
21.3 7377 27.64 7376 33.99 7375 40.34 7374 46.9 7373		
50 7372.55 53.78 7372 60.63 7371 67.46 7370 74.28 7369		
81.08 7368 87.89 7367 95.17 7366 101.82 7365 109.1 7364		

116.5	7363	123.88	7362	131.28	7361	138.78	7360	145.78	7359
150.89	7358	155.95	7357	161.25	7356	166.36	7355	172.85	7354
184.61	7353	216.92	7353	229.28	7354	241.52	7355	250.98	7356
258.18	7357	262.69	7358	267.76	7359	276.52	7360	285.02	7361
293.36	7362	303.52	7363	315.95	7364	328.26	7365	339.14	7366
350	7366.83	352.23	7367	363.15	7368	373.38	7369	391.17	7370
400	7370								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	145.78	.04	267.76	.04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

145.78	267.76	49.41	49.41	49.41	.1	.3
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CROSS SECTION

RIVER: Boyd  
REACH: Main River RS: 28

INPUT

Description:

Station Elevation Data num= 56

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7380	2.16	7380	8.38	7379	14.57	7378.01	14.62	7378
20.84	7377	27.06	7376	33.29	7375	39.55	7374	45.75	7373
50	7372.36	52.38	7372	59.02	7371	65.66	7370	72.25	7369
78.97	7368	86.5	7367	93.96	7366	101.32	7365	108.02	7364
114.54	7363	121.21	7362	127.88	7361	134.49	7360	141.04	7359
147.08	7358	152.92	7357	159.38	7356	165.75	7355	170.79	7354
176.04	7353	183.34	7352	190.05	7351	196.78	7350	204.26	7350
217.64	7351	227.82	7352	236.47	7353	242.67	7354	246.73	7355
250.51	7356	254.14	7357	257.76	7358	261.38	7359	265	7360
268.61	7361	272.09	7362	278.92	7363	286.22	7364	293.65	7365
300.93	7366	319.44	7367	339.78	7368	350	7368.26	378.85	7369
400	7369								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	121.21	.04	272.09	.04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

121.21	272.09	49.41	49.41	49.41	.1	.3
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CROSS SECTION

RIVER: Boyd  
REACH: Main River RS: 27

INPUT

Description:

Station Elevation Data num= 57

Sta	Elev								
0	7380	5.15	7380	11.11	7379	17.37	7378	23.66	7377
29.88	7376	36.03	7375	42.22	7374	48.42	7373	50	7372.75
54.63	7372	60.96	7371	67.07	7370	73.97	7369	81.15	7368
88.34	7367	95.48	7366	102.4	7365	109.05	7364	115.34	7363
121.7	7362	127.31	7361	132.05	7360	137.07	7359	141.99	7358
147.75	7357	153.8	7356	161.47	7355	167.95	7354	173.7	7353

179.06	7352	184.45	7351	189.94	7350	195.51	7349	204.06	7349
217.18	7350	230.76	7351	241.7	7352	246.42	7353	249.77	7354
253.27	7355	257.48	7356	261.67	7357	265.86	7358	269.12	7358.77
270.15	7359	274.66	7360	279.24	7361	283.83	7362	288.48	7363
296.03	7364	313.69	7365	334.44	7366	350	7366.79	354.06	7367
377.42	7368	400	7368						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	115.34	.04	288.48	.04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

115.34	288.48	49.41	49.41	49.41	.1	.3
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CROSS SECTION

RIVER: Boyd  
REACH: Main River RS: 26

INPUT

Description:

Station Elevation Data num= 61

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7377	3.25	7377	8.57	7376	13.9	7375	19.23	7374
24.57	7373	29.91	7372	35.36	7371	41.18	7370	47.01	7369
50	7368.49	52.86	7368	58.73	7367	64.63	7366	70.48	7365
74.82	7364	78.95	7363	83.23	7362	87.38	7361	91.41	7360
95.44	7359	100.09	7358	103.87	7357	107.37	7356	112.16	7355
116.95	7354	122.59	7353	128.97	7352	135.32	7351	139.4	7350.42
142.27	7350	152.1	7349	152.5	7349	167.77	7348	184.43	7347
208.74	7347	215.32	7348	220.08	7349	224.7	7350	228.99	7351
233.09	7352	237.98	7353	242.08	7354	245.86	7355	250.73	7356
255.59	7357	260.36	7358	264	7358.78	265.09	7359	269.68	7360
274.29	7361	278.88	7362	283.56	7363	292.22	7364	312.57	7365
333.48	7366	350	7366.87	352.43	7367	375.3	7368	398.31	7369
400	7369								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	78.95	.04	278.88	.04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

78.95	278.88	49.41	49.41	49.41	.1	.3
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CROSS SECTION

RIVER: Boyd  
REACH: Main River RS: 25

INPUT

Description:

Station Elevation Data num= 55

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7380	3.77	7380	9.08	7379	14.4	7378	19.73	7377
25.06	7376	30.39	7375	35.73	7374	41.07	7373	46.41	7372
50	7371.33	51.79	7371	57.59	7370	63.43	7369	69.28	7368
75.17	7367	81.07	7366	86.74	7365	90.79	7364	94.92	7363
99.19	7362	103.42	7361	107.46	7360	111.49	7359	116.03	7358
120.22	7357	123.7	7356	128.66	7355	133.41	7354	138.26	7353

144.26	7352	150.63	7351	156.2	7350.11	156.9	7350	162.63	7349
169.41	7348	183.75	7347	209.81	7347	228.43	7348	238.11	7349
247.49	7350	256.76	7351	266.2	7352	274.53	7353	298.84	7354
338.8	7355	350	7355.92	350.99	7356	358.34	7357	364.65	7358
368.62	7359	375.28	7359.55	380.78	7360	397.24	7361	400	7361

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	111.49	.04	368.62	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
111.49	368.62	49.41	49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd  
REACH: Main River RS: 24

INPUT

Description:

Station Elevation Data num= 56

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7381	1.03	7381	8.94	7380	16.83	7379	23.36	7378
28.55	7377	33.78	7376	39.02	7375	44.26	7374	49.5	7373
50	7372.9	54.76	7372	60.04	7371	65.37	7370	70.7	7369
75.77	7368	80.15	7367	84.62	7366	89.09	7365	93.62	7364
98.19	7363	102.8	7362	107.49	7361	112.39	7360	117.34	7359
122.3	7358	127.2	7357	132.24	7356	138.87	7355	144.32	7354
150.34	7353	156.45	7352	162.54	7351	167.63	7350	173.98	7349
179.69	7348	186.14	7347	207.01	7347	222.97	7348	231.06	7349
238.81	7350	246.72	7351	254.43	7352	270.83	7353	284.14	7354
285.23	7354	321.27	7355	333.65	7356	349.28	7357	350	7357.06
360.64	7358	366.31	7359	371.63	7359.38	380.42	7360	397.1	7361
400	7361								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	117.34	.04	366.31	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
117.34	366.31	31.7	31.7	31.7		.1	.3

CROSS SECTION

RIVER: Boyd  
REACH: Main River RS: 23

INPUT

Description:

Station Elevation Data num= 33

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7377	1.69	7377	12.41	7376	23.24	7375	34.08	7374
41.51	7373	47.36	7372	51.7	7371.26	53.24	7371	59.14	7370
65.05	7369	70.97	7368	77.22	7367	84.2	7366	90.07	7365
94.81	7364	99.49	7363	104.14	7362	108.81	7361	113.46	7360
118.48	7359	126.16	7358	133.95	7357	157.07	7357	176.46	7356
237.44	7356	329.21	7356.96	332.76	7357	346.71	7358	351.7	7358.24
367.84	7359	382.19	7360	395.91	7360				

Manning's n Values num= 3  
 Sta n Val Sta n Val Sta n Val  
 0 .04 51.7 .04 351.7 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 51.7 351.7 13.55 13.55 13.55 .1 .3

CROSS SECTION

RIVER: Boyd  
 REACH: Main River RS: 22.8

INPUT

Description:

Station Elevation Data num= 33  
 Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev  
 0 7376 4.65 7376 17.32 7375 28.34 7374 39.2 7373  
 47.22 7372 53.04 7371 56.14 7370.47 58.91 7370 64.86 7369  
 71.37 7368 78.4 7367 85.34 7366 92.02 7365 97.45 7364  
 102.08 7363 106.71 7362 111.66 7361 119.37 7360 127.49 7359  
 135.31 7358 142.78 7357 150.66 7357 180.44 7358 251.81 7358  
 253.41 7357 258.31 7357 275.84 7358 349.08 7358.75 356.14 7358.82  
 374.06 7359 386.78 7360 397.86 7360

Manning's n Values num= 3  
 Sta n Val Sta n Val Sta n Val  
 0 .04 56.14 .04 356.14 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 56.14 356.14 13.56 13.56 13.56 .1 .3

CROSS SECTION

RIVER: Boyd  
 REACH: Main River RS: 22.6

INPUT

Description:

Station Elevation Data num= 28  
 Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev  
 0 7374 8.08 7374 23.35 7373 36.55 7372 45.43 7371  
 51.35 7370 53.34 7369.71 58.21 7369 65.18 7368 72.07 7367  
 78.93 7366 85.76 7365 92.48 7364 97.69 7363 105.75 7362  
 113.49 7361 121.08 7360 128.49 7359 135.77 7358 142.43 7357  
 153.01 7356 210.9 7356 285.96 7357 353.34 7357.85 364.96 7358  
 374.68 7359 385.52 7360 393.49 7360

Manning's n Values num= 3  
 Sta n Val Sta n Val Sta n Val  
 0 .04 53.34 .04 353.34 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 53.34 353.34 40.01 40.01 40.01 .1 .3

CROSS SECTION

RIVER: Boyd  
 REACH: Main River RS: 22

INPUT

Description:

Station Elevation Data		num= 47							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7370	9.53	7370	19.77	7369	33.42	7368	47.04	7367
50	7366.56	53.71	7366	59.99	7365	68.35	7364	77.95	7363
87.51	7362	96.61	7361	103.85	7360	110.21	7359	116.22	7358
122.27	7357	128.26	7356	134.37	7355	140.48	7354	147.29	7353
152.78	7352	158.58	7351	164.49	7350	170.43	7349	176.47	7348
182.51	7347	188.61	7346	194.75	7345	202.92	7345	229.64	7346
249.15	7347	257.44	7348	265.57	7349	273.58	7350	281.23	7351
289.09	7352	297.69	7353	311.07	7354	324.15	7354.52	336.17	7355
350	7355.85	352.43	7356	362.43	7357	372.36	7358	382.3	7359
398.23	7360	400	7360						

Manning's n Values

num= 3	
Sta	n Val
0	.04
152.78	.04
289.09	.04

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	152.78	289.09		49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd

REACH: Main River RS: 21

INPUT

Description:

Station Elevation Data		num= 43							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7365	2.82	7365	11.82	7364	20.9	7363	29.8	7362
38.11	7361	46.78	7360	50	7359.63	55.54	7359	64.35	7358
73.18	7357	81.91	7356	90.11	7355	98.26	7354	102.73	7353.52
107.17	7353	117.05	7352	126.86	7351	139.74	7350	150.85	7349
158.5	7348	166.25	7347	174.08	7346	181.92	7345	214.04	7345
239.49	7346	246.68	7347	254.18	7348	261.82	7349	269.46	7350
277.07	7351	284.6	7352	294.49	7353	305.73	7354	316.05	7354.47
327.69	7355	344.07	7356	350	7356.6	354.01	7357	363.9	7358
374.4	7359	391.99	7360	400	7360				

Manning's n Values

num= 3	
Sta	n Val
0	.04
150.85	.04
261.82	.04

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	150.85	261.82		49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd

REACH: Main River RS: 20

INPUT

Description:

Station Elevation Data		num= 39							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7363	4.75	7363	13.71	7362	22.16	7361	30.89	7360

39.66	7359	48.46	7358	50	7357.83	57.3	7357	66.06	7356
74.26	7355	82.42	7354	90.48	7353	98.49	7352	106.4	7351
114.11	7350	124.02	7349	136.17	7348	147.98	7347	159.96	7346
169.48	7345.61	182.99	7345	228.01	7345	235.69	7346	243.98	7347
252.36	7348	260.74	7349	269.07	7350	278.32	7351	290.59	7352
302.74	7353	314.5	7354	326.07	7355	343.48	7356	350	7356.38
360.73	7357	377.76	7358	391.39	7359	400	7359		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	114.11	.04	269.07	.04

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	114.11	269.07		49.41	49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd  
 REACH: Main River RS: 19

INPUT

Description:

Station Elevation Data num= 37

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7361	8.5	7361	17.24	7360	26.01	7359	34.8	7358
43.63	7357	50	7356.28	52.44	7356	60.68	7355	68.83	7354
76.88	7353	84.88	7352	92.79	7351	100.53	7350	109.7	7349
121.82	7348	133.64	7347	146.15	7346	155.89	7345.27	159.32	7345
184.65	7344	215.82	7344	247.81	7345	250.37	7345.12	268.73	7346
289.25	7347	308.64	7348	317.97	7349	326.57	7350	335.39	7351
348.07	7352	350	7352.15	360.94	7353	371.92	7354	382.79	7355
398.37	7356	400	7356						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	121.82	.04	308.64	.04

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	121.82	308.64		49.41	49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd  
 REACH: Main River RS: 18

INPUT

Description:

Station Elevation Data num= 38

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7363	6.21	7363	13.12	7362	20.01	7361	26.88	7360
33.73	7359	40.56	7358	47.88	7357	50	7356.73	55.71	7356
63.45	7355	71.17	7354	78.88	7353	86.56	7352	94.07	7351
103.36	7350	114.38	7349	118.25	7348.66	125.64	7348	137.03	7347
148.92	7346	187.44	7345	198.29	7344	202.23	7344	232.52	7345
248.12	7345.48	265.61	7346	287.01	7347	306.68	7348	316.42	7349
325.01	7350	334.4	7351	347.22	7352	350	7352.22	360.07	7353
371.19	7354	386.24	7355	400	7355				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val				
0	.04	125.64	.04	306.68	.04				
Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	125.64	306.68		49.41	49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd  
 REACH: Main River      RS: 17

INPUT

Description:

Station	Elevation	Data	num=	37					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7364	5.65	7364	12.57	7363	19.48	7362	26.37	7361
33.25	7360	40.12	7359	46.97	7358	50	7357.58	54.1	7357
61.86	7356	69.58	7355	77.29	7354	85	7353	92.67	7352
100.19	7351	108.8	7350	119.83	7349	124.68	7348.53	129.93	7348
139.53	7347	149.23	7346	159.2	7345	172.27	7344	193.42	7343
211.8	7343	248.75	7344	280.3	7345	285.35	7345.24	301.9	7346
315.95	7347	329.25	7348	342.72	7349	350	7349.28	369.18	7350
392.89	7351	400	7351						

Manning's n	Values	num=	3						
Sta	n Val	Sta	n Val	Sta	n Val				
0	.04	139.53	.04	315.95	.04				
Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	139.53	315.95		49.41	49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd  
 REACH: Main River      RS: 16

INPUT

Description:

Station	Elevation	Data	num=	33					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7360	8.56	7360	19.04	7359	30.21	7358	41.41	7357
50	7356.04	50.35	7356	57.5	7355	64.71	7354	71.94	7353
79.19	7352	86.46	7351	93.76	7350	101.91	7349	111.04	7348
120.25	7347	129.49	7346	138.75	7345	148.71	7344	163.09	7343
177.69	7342	223.52	7342	255.22	7343	272.42	7344	291.29	7345
292.09	7345.04	310.95	7346	324.28	7347	337.65	7348	350	7348.86
352.09	7349	380.86	7350	400	7350				

Manning's n	Values	num=	3						
Sta	n Val	Sta	n Val	Sta	n Val				
0	.04	138.75	.04	291.29	.04				
Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	138.75	291.29		49.41	49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd

REACH: Main River RS: 15

INPUT

Description:

Station Elevation Data		num=		32	
Sta	Elev	Sta	Elev	Sta	Elev
0	7358	6.97	7358	17.44	7357
49.12	7354	50	7353.9	58.01	7353
81.66	7350	89.47	7349	96.78	7348
122.46	7345	132.02	7344	141.61	7343
237.13	7341	269.11	7342	289.5	7343
340.11	7346	350	7346.67	354.95	7347
398.95	7350	400	7350		

Manning's n Values		num=		3	
Sta	n Val	Sta	n Val	Sta	n Val
0	.04	122.46	.04	323.67	.04

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	122.46	323.67		49.41	49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd

REACH: Main River RS: 14

INPUT

Description:

Station Elevation Data		num=		33	
Sta	Elev	Sta	Elev	Sta	Elev
0	7356	1.34	7356	12.64	7355
46.04	7352	50	7351.61	56.13	7351
82.06	7348	91.22	7347	100.48	7346
128.04	7343	136.91	7342	145.84	7341
205.75	7339	239.97	7340	268.78	7341
324.51	7344	338.68	7345	350	7345.81
381.09	7348	398.32	7349	400	7349

Manning's n Values		num=		3	
Sta	n Val	Sta	n Val	Sta	n Val
0	.04	128.04	.04	306.8	.04

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	128.04	306.8		49.41	49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd

REACH: Main River RS: 13

INPUT

Description:

Station Elevation Data		num=		32	
Sta	Elev	Sta	Elev	Sta	Elev
0	7354	5.92	7354	16.3	7353
45.3	7350	50	7349.5	54.71	7349
84.7	7346	93.34	7345	102.71	7344
135.26	7341	149.08	7340	162.8	7339
249.59	7339	266.76	7340	286.53	7341

338.2	7344	350	7344.96	350.51	7345	362.71	7346	374.83	7347
386.84	7348	400	7348						

Manning's n Values		num=	3
Sta	n Val	Sta	n Val
0	.04	123.26	.04
		304.69	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
123.26	304.69	49.41	49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd  
 REACH: Main River      RS: 12

INPUT

Description:

Station Elevation Data		num=	33
Sta	Elev	Sta	Elev
0	7353	.72	7353
38.15	7349	47.98	7348
77.91	7345	90.02	7344
130.94	7340	140.91	7339
239.64	7338	248.74	7339
298.07	7343	312.92	7344
371.96	7347	387.34	7348
			400
			7348
			10.17
			7352
			19.57
			7351
			28.95
			7350
			50
			7347.8
			57.95
			7347
			67.92
			7346
			100.37
			7343
			110.66
			7342
			120.89
			7341
			160.06
			7338
			179.09
			7337
			218.06
			7337
			260.72
			7340
			273.31
			7341
			285.77
			7342
			333.76
			7345
			350
			7345.75
			355.42
			7346

Manning's n Values		num=	3
Sta	n Val	Sta	n Val
0	.04	130.94	.04
		260.72	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
130.94	260.72	49.41	49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd  
 REACH: Main River      RS: 11

INPUT

Description:

Station Elevation Data		num=	35
Sta	Elev	Sta	Elev
0	7352	3.5	7352
39.68	7348	49.44	7347
80.44	7344	92.19	7343
135.74	7339	146.45	7338
216.76	7337	222.62	7338
257.66	7342	266.44	7343
337.53	7347	350	7347.48
			363.43
			7348
			12.35
			7351
			21.02
			7350
			29.63
			7349
			50
			7346.94
			58.88
			7346
			68.56
			7345
			103.53
			7342
			114.26
			7341
			125.01
			7340
			156.49
			7337
			170.8
			7336
			211.65
			7336
			231.35
			7339
			240.16
			7340
			248.92
			7341
			275.23
			7344
			286.09
			7345
			323.9
			7346
			391.27
			7349
			400
			7349

Manning's n Values		num=	3
Sta	n Val	Sta	n Val
0	.04	125.01	.04
		240.16	.04

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
125.01	240.16	49.41	49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd  
 REACH: Main River RS: 10

INPUT

Description:

Station Elevation Data num= 36									
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7350	1.9	7350	12.64	7349	21.91	7348	31.2	7347
40.59	7346	50	7345.01	50.14	7345	59.74	7344	69.4	7343
79.59	7342	90.17	7341	101.47	7340	113.97	7339	127.53	7338
144.32	7337	164.92	7336	193.47	7335	204.44	7335	210.82	7336
217.53	7337	224.35	7338	231.28	7339	238.21	7340	245.08	7341
255.17	7342	267.27	7343	278.86	7344	290.05	7345	300.54	7346
322.93	7347	339.08	7348	350	7348.62	356.65	7349	390.28	7350
400	7350								

Manning's n Values num= 3					
Sta	n Val	Sta	n Val	Sta	n Val
0	.04	90.17	.04	245.08	.04

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	90.17	245.08		49.41	49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd  
 REACH: Main River RS: 9

INPUT

Description:

Station Elevation Data num= 38									
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7350	.76	7350	10.4	7349	19.6	7348	28.82	7347
38.03	7346	47.23	7345	50	7344.7	56.58	7344	65.93	7343
75.21	7342	88.16	7341	100.69	7340	113.53	7339	129.7	7338
142.54	7337	158.85	7336	187.67	7335	205.26	7335	210.58	7336
216.06	7337	222.76	7338	232.34	7339	242.81	7340	253.36	7341
263.86	7342	274.34	7343	287.39	7344	301.06	7345	313.72	7346
326.95	7347	338.13	7348	350	7348.87	351.79	7349	365.81	7350
379.2	7351	393.31	7352	400	7352				

Manning's n Values num= 3					
Sta	n Val	Sta	n Val	Sta	n Val
0	.04	75.21	.04	263.86	.04

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	75.21	263.86		49.41	49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd  
 REACH: Main River RS: 8

INPUT

Description:

Station Elevation Data num= 37									
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

0	7349	4.91	7349	11.7	7348	21.55	7347	31.84	7346
41.67	7345	50	7344.14	51.36	7344	61.42	7343	71.72	7342
81.78	7341	91.56	7340	101.12	7339	115.51	7338	129.54	7337
145.44	7336	161.61	7335	177.87	7334	206.51	7334	214.27	7335
222.04	7336	229.8	7337	237.53	7338	245.55	7339	257.39	7340
270.76	7341	283.69	7342	296.47	7343	309.17	7344	321.68	7345
331.69	7346	341.31	7347	350	7347.94	350.56	7348	376.55	7349
396.77	7350	400	7350						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	101.12	.04	245.55	.04

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	101.12	245.55		49.41	49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd  
REACH: Main River RS: 7

INPUT

Description:

Station Elevation Data num= 36

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7348	5.53	7348	11.2	7347	16.81	7346	24.77	7345
33.91	7344	35.75	7343.81	43.35	7343	50	7342.35	53.58	7342
63.95	7341	73.85	7340	82.9	7339	92.09	7338	101.59	7337
111.97	7336	122.5	7335	140.8	7334	162.44	7333	207.6	7333
216.91	7334	225.56	7335	233.58	7336	243.44	7337	253.51	7338
262.88	7339	272.35	7340	285.71	7341	296.54	7342	307.54	7343
318.72	7344	330.02	7345	341.89	7346	350	7346.29	370.03	7347
400	7347								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	101.59	.04	243.44	.04

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	101.59	243.44		49.41	49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd  
REACH: Main River RS: 6

INPUT

Description:

Station Elevation Data num= 36

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7349	5.37	7349	11.07	7348	16.74	7347	22.37	7346
30.25	7345	39.38	7344	41.63	7343.75	48.49	7343	50	7342.84
57.8	7342	66.94	7341	75.32	7340	83.8	7339	92.29	7338
100.82	7337	109.37	7336	117.96	7335	126.62	7334	141.04	7333
163.61	7332	205.67	7332	217.45	7333	229.59	7334	242.24	7335
255.92	7336	272.19	7337	290.77	7338	310.13	7339	330.83	7340
350	7340.84	353.45	7340.99	353.73	7341	369.28	7342	386.02	7343
400	7343								

Manning's n Values num= 3  
 Sta n Val Sta n Val Sta n Val  
 0 .04 109.37 .04 255.92 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 109.37 255.92 49.41 49.41 49.41 .1 .3

CROSS SECTION

RIVER: Boyd  
 REACH: Main River RS: 5

INPUT

Description:

Station Elevation Data num= 37  

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7349	7.75	7349	15.29	7348	22.26	7347	28.98	7346
35.56	7345	42.78	7344	50	7343.12	51	7343	59.27	7342
67.14	7341	75.46	7340	85.27	7339	95.15	7338	101.14	7337
106.84	7336	112.58	7335	118.37	7334	124.31	7333	130.36	7332
153.19	7331	210.35	7331	220.48	7332	232.18	7333	245.11	7334
259.61	7335	275.13	7336	290.78	7337	306.33	7338	324.01	7339
345.71	7340	350	7340.26	359.94	7340.87	362.09	7341	377.7	7342
395.54	7343	400	7343						

Manning's n Values num= 3  
 Sta n Val Sta n Val Sta n Val  
 0 .04 112.58 .04 259.61 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 112.58 259.61 49.41 49.41 49.41 .1 .3

CROSS SECTION

RIVER: Boyd  
 REACH: Main River RS: 4

INPUT

Description:

Station Elevation Data num= 35  

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7346	6.42	7346	13.64	7345	20.84	7344	28.06	7343
35.3	7342	42.56	7341	50	7340.26	52.61	7340	66.43	7339
80.66	7338	87.64	7337	87.98	7336.95	94.25	7336	100.89	7335
107.53	7334	113.82	7333	122.34	7332	137.69	7331	149.14	7330
212.95	7330	225.8	7331	237.84	7332	249.58	7333	260.71	7334
275.23	7335	292.8	7336	311.2	7337	329.83	7338	347.11	7339
350	7339.19	361.97	7340	377.3	7341	398.06	7342	400	7342

Manning's n Values num= 3  
 Sta n Val Sta n Val Sta n Val  
 0 .04 107.53 .04 260.71 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 107.53 260.71 49.41 49.41 49.41 .1 .3

CROSS SECTION

RIVER: Boyd  
 REACH: Main River RS: 3

INPUT

Description:

Station Elevation Data num= 36									
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7347	5.49	7347	12.67	7346	19.87	7345	27.04	7344
34.21	7343	41.42	7342	48.76	7341	50	7340.88	59.2	7340
72.99	7339	87.22	7338	94.12	7337	94.71	7336.91	100.51	7336
106.91	7335	113.31	7334	119.74	7333	127.09	7332	135.72	7331
144.43	7330	153.17	7329	160.28	7328	166.79	7327	183.38	7326
204.22	7326	215.14	7327	222.29	7328	232.25	7329	247.75	7330
261.42	7331	274.82	7332	288.37	7333	305.28	7334	350	7334
400	7334								

Manning's n Values num= 3					
Sta	n Val	Sta	n Val	Sta	n Val
0	.04	144.43	.04	247.75	.04

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	144.43	247.75		49.41	49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd  
 REACH: Main River RS: 2

INPUT

Description:

Station Elevation Data num= 37									
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7347	1.21	7347	8.93	7346	16.66	7345	24.14	7344
31.66	7343	39.26	7342	47.1	7341	50	7340.69	56.41	7340
66.86	7339	77.69	7338	88.71	7337	99.87	7336	111.21	7335
121.94	7334	128.33	7333	135.15	7332	142.55	7331	150.11	7330
158.29	7329	164.14	7328	167.43	7327	173.43	7326	181.73	7325
189.43	7324	212.21	7324	219	7325	223.77	7326	228.04	7327
237.17	7328	247.55	7329	256.73	7330	270.14	7331	283.24	7332
350	7332	400	7332						

Manning's n Values num= 3					
Sta	n Val	Sta	n Val	Sta	n Val
0	.04	164.14	.04	237.17	.04

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	164.14	237.17		49.41	49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd  
 REACH: Main River RS: 1

INPUT

Description:

Station Elevation Data num= 32									
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7344	9.68	7344	20.88	7343	32.07	7342	43.42	7341
50	7340.33	53.28	7340	63.75	7339	74.39	7338	85.61	7337

97.09	7336	107.81	7335	116.32	7334	124.52	7333	132.74	7332
140.67	7331	147.99	7330	155.27	7329	162.14	7328	165.44	7327
169.23	7326	172.39	7325	178.23	7324	189.58	7323	205.75	7323
211.31	7324	217.04	7325	226.18	7326	236.09	7327	245.08	7328
350	7328	400	7328						

Manning's n Values

num=		3	
Sta	n Val	Sta	n Val
0	.04	162.14	.04

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	162.14	245.08		49.41	49.41	49.41		.1	.3

CROSS SECTION

RIVER: Boyd  
 REACH: Main River      RS: 0

INPUT

Description:

Station Elevation Data		num=		15					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	7345	.88	7345	9.52	7344	18.15	7343	26.63	7342
50	7339.29	147.21	7328	154.59	7327	160.1	7326	165.62	7325
192.75	7322	205.48	7322	209.96	7323	350	7340	400	7345

Manning's n Values

num=		3			
Sta	n Val	Sta	n Val		
0	.04	50	.04	350	.04

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	50	350		0	0	0		.1	.3

SUMMARY OF MANNING'S N VALUES

River: Boyd

Reach	River Sta.	n1	n2	n3
Main River	36	.04	.04	.04
Main River	35	.04	.04	.04
Main River	34	.04	.04	.04
Main River	33	.04	.04	.04
Main River	32	.04	.04	.04
Main River	31	.04	.04	.04
Main River	30	.04	.04	.04
Main River	29	.04	.04	.04
Main River	28	.04	.04	.04
Main River	27	.04	.04	.04
Main River	26	.04	.04	.04
Main River	25	.04	.04	.04
Main River	24	.04	.04	.04
Main River	23	.04	.04	.04
Main River	22.8	.04	.04	.04
Main River	22.6	.04	.04	.04
Main River	22	.04	.04	.04
Main River	21	.04	.04	.04
Main River	20	.04	.04	.04

Main River	19	.04	.04	.04
Main River	18	.04	.04	.04
Main River	17	.04	.04	.04
Main River	16	.04	.04	.04
Main River	15	.04	.04	.04
Main River	14	.04	.04	.04
Main River	13	.04	.04	.04
Main River	12	.04	.04	.04
Main River	11	.04	.04	.04
Main River	10	.04	.04	.04
Main River	9	.04	.04	.04
Main River	8	.04	.04	.04
Main River	7	.04	.04	.04
Main River	6	.04	.04	.04
Main River	5	.04	.04	.04
Main River	4	.04	.04	.04
Main River	3	.04	.04	.04
Main River	2	.04	.04	.04
Main River	1	.04	.04	.04
Main River	0	.04	.04	.04

SUMMARY OF REACH LENGTHS

River: Boyd

Reach	River Sta.	Left	Channel	Right
Main River	36	49.41	49.41	49.41
Main River	35	49.41	49.41	49.41
Main River	34	49.41	49.41	49.41
Main River	33	49.41	49.41	49.41
Main River	32	49.41	49.41	49.41
Main River	31	49.41	49.41	49.41
Main River	30	49.41	49.41	49.41
Main River	29	49.41	49.41	49.41
Main River	28	49.41	49.41	49.41
Main River	27	49.41	49.41	49.41
Main River	26	49.41	49.41	49.41
Main River	25	49.41	49.41	49.41
Main River	24	31.7	31.7	31.7
Main River	23	13.55	13.55	13.55
Main River	22.8	13.56	13.56	13.56
Main River	22.6	40.01	40.01	40.01
Main River	22	49.41	49.41	49.41
Main River	21	49.41	49.41	49.41
Main River	20	49.41	49.41	49.41
Main River	19	49.41	49.41	49.41
Main River	18	49.41	49.41	49.41
Main River	17	49.41	49.41	49.41
Main River	16	49.41	49.41	49.41
Main River	15	49.41	49.41	49.41
Main River	14	49.41	49.41	49.41
Main River	13	49.41	49.41	49.41
Main River	12	49.41	49.41	49.41
Main River	11	49.41	49.41	49.41
Main River	10	49.41	49.41	49.41
Main River	9	49.41	49.41	49.41
Main River	8	49.41	49.41	49.41

Main River	7	49.41	49.41	49.41
Main River	6	49.41	49.41	49.41
Main River	5	49.41	49.41	49.41
Main River	4	49.41	49.41	49.41
Main River	3	49.41	49.41	49.41
Main River	2	49.41	49.41	49.41
Main River	1	49.41	49.41	49.41
Main River	0	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS

River: Boyd

Reach	River Sta.	Contr.	Expan.
Main River	36	.1	.3
Main River	35	.1	.3
Main River	34	.1	.3
Main River	33	.1	.3
Main River	32	.1	.3
Main River	31	.1	.3
Main River	30	.1	.3
Main River	29	.1	.3
Main River	28	.1	.3
Main River	27	.1	.3
Main River	26	.1	.3
Main River	25	.1	.3
Main River	24	.1	.3
Main River	23	.1	.3
Main River	22.8	.1	.3
Main River	22.6	.1	.3
Main River	22	.1	.3
Main River	21	.1	.3
Main River	20	.1	.3
Main River	19	.1	.3
Main River	18	.1	.3
Main River	17	.1	.3
Main River	16	.1	.3
Main River	15	.1	.3
Main River	14	.1	.3
Main River	13	.1	.3
Main River	12	.1	.3
Main River	11	.1	.3
Main River	10	.1	.3
Main River	9	.1	.3
Main River	8	.1	.3
Main River	7	.1	.3
Main River	6	.1	.3
Main River	5	.1	.3
Main River	4	.1	.3
Main River	3	.1	.3
Main River	2	.1	.3
Main River	1	.1	.3
Main River	0	.1	.3

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Ch1
Main River	36	100 Yr	425.80	7360.00	7361.79		7362.31	0.016972	5.81	73.28	55.43	0.89
Main River	35	100 Yr	425.80	7359.00	7360.70	7360.69	7361.36	0.021544	6.49	65.61	50.21	1.00
Main River	34	100 Yr	425.80	7358.00	7359.62	7359.62	7360.29	0.021703	6.55	65.00	49.32	1.01
Main River	33	100 Yr	425.80	7357.00	7358.65	7358.52	7359.19	0.016196	5.87	72.55	52.10	0.88
Main River	32	100 Yr	425.80	7356.00	7358.65		7358.81	0.002692	3.18	133.71	62.40	0.38
Main River	31	100 Yr	425.80	7355.00	7358.69		7358.73	0.000471	1.59	267.06	95.41	0.17
Main River	30	100 Yr	425.80	7354.00	7358.69		7358.71	0.000183	1.12	379.56	113.10	0.11
Main River	29	100 Yr	425.80	7353.00	7358.69		7358.70	0.000093	0.90	474.64	118.78	0.08
Main River	28	100 Yr	425.80	7350.00	7358.69		7358.69	0.000039	0.69	615.05	117.31	0.05
Main River	27	100 Yr	425.80	7349.00	7358.69		7358.69	0.000023	0.57	753.60	130.16	0.04
Main River	26	100 Yr	425.80	7347.00	7358.69		7358.69	0.000006	0.34	1269.67	166.69	0.02
Main River	25	100 Yr	425.80	7347.00	7358.69		7358.69	0.000003	0.24	1741.06	254.48	0.02
Main River	24	100 Yr	425.80	7347.00	7358.69		7358.69	0.000005	0.28	1516.68	245.66	0.02
Main River	23	100 Yr	425.80	7356.00	7358.68		7358.69	0.000212	0.88	483.85	240.00	0.11
Main River	22.8	100 Yr	425.80	7357.00	7358.36	7358.36	7358.65	0.029910	4.32	98.63	178.64	1.02
Main River	22.6	100 Yr	425.80	7356.00	7356.94	7356.94	7357.27	0.027023	4.65	91.64	138.01	1.01
Main River	22	100 Yr	425.80	7345.00	7347.24		7347.55	0.009797	4.49	94.86	70.08	0.68
Main River	21	100 Yr	425.80	7345.00	7346.96		7347.16	0.005500	3.58	118.83	79.89	0.52
Main River	20	100 Yr	425.80	7345.00	7346.34		7346.71	0.016248	4.90	86.97	82.61	0.84
Main River	19	100 Yr	425.80	7344.00	7346.38		7346.44	0.001557	1.99	213.88	135.03	0.28
Main River	18	100 Yr	425.80	7344.00	7345.79	7345.79	7346.21	0.025612	5.17	82.39	101.58	1.01
Main River	17	100 Yr	425.80	7343.00	7344.38	7344.38	7344.82	0.025340	5.32	79.98	93.56	1.02
Main River	16	100 Yr	425.80	7342.00	7343.15	7343.13	7343.56	0.023513	5.14	82.91	96.79	0.98
Main River	15	100 Yr	425.80	7341.00	7341.94	7341.94	7342.32	0.026422	4.97	85.73	114.87	1.01
Main River	14	100 Yr	425.80	7339.00	7340.20	7340.20	7340.63	0.024371	5.29	80.55	92.48	1.00
Main River	13	100 Yr	425.80	7338.00	7339.26		7339.58	0.015450	4.57	93.26	94.77	0.81
Main River	12	100 Yr	425.80	7337.00	7338.28	7338.23	7338.69	0.020524	5.13	82.99	87.59	0.93
Main River	11	100 Yr	425.80	7336.00	7337.72		7338.01	0.008995	4.33	98.23	71.75	0.65
Main River	10	100 Yr	425.80	7335.00	7337.48		7337.66	0.004873	3.38	126.10	84.61	0.49
Main River	9	100 Yr	425.80	7335.00	7336.65	7336.62	7337.18	0.021816	5.85	72.75	65.85	0.98
Main River	8	100 Yr	425.80	7334.00	7335.52	7335.52	7336.08	0.022966	5.97	71.30	65.12	1.01
Main River	7	100 Yr	425.80	7333.00	7334.33	7334.21	7334.70	0.016712	4.88	87.23	85.01	0.85
Main River	6	100 Yr	425.80	7332.00	7333.22	7333.22	7333.70	0.024506	5.55	76.75	82.27	1.01
Main River	5	100 Yr	425.80	7331.00	7332.16		7332.52	0.017899	4.81	88.57	93.01	0.87
Main River	4	100 Yr	425.80	7330.00	7331.04	7331.04	7331.49	0.024418	5.37	79.34	89.15	1.00
Main River	3	100 Yr	425.80	7326.00	7327.63	7327.63	7328.24	0.022541	6.26	68.01	57.01	1.01
Main River	2	100 Yr	425.80	7324.00	7325.93		7326.50	0.016649	6.04	70.44	49.45	0.89
Main River	1	100 Yr	425.80	7323.00	7325.20		7325.73	0.014056	5.85	72.74	47.13	0.83
Main River	0	100 Yr	425.80	7322.00	7324.25	7324.21	7324.90	0.019971	6.47	65.86	47.87	0.97

**Table 2. Permissible Shear and Velocity for Selected Lining Materials<sup>1</sup>**

Boundary Category	Boundary Type	Permissible Shear Stress (lb/sq ft)	Permissible Velocity (ft/sec)	Citation(s)
<u>Soils</u>	Fine colloidal sand	0.02 - 0.03	1.5	A
	Sandy loam (noncolloidal)	0.03 - 0.04	1.75	A
	Alluvial silt (noncolloidal)	0.045 - 0.05	2	A
	Silty loam (noncolloidal)	0.045 - 0.05	1.75 – 2.25	A
	Firm loam	0.075	2.5	A
	Fine gravels	0.075	2.5	A
	Stiff clay	0.26	3 – 4.5	A, F
	Alluvial silt (colloidal)	0.26	3.75	A
	Graded loam to cobbles	0.38	3.75	A
	Graded silts to cobbles	0.43	4	A
	Shales and hardpan	0.67	6	A
<u>Gravel/Cobble</u>	1-in.	0.33	2.5 – 5	A
	2-in.	0.67	3 – 6	A
	6-in.	2.0	4 – 7.5	A
	12-in.	4.0	5.5 – 12	A
<u>Vegetation</u>	Class A turf	3.7	6 – 8	E, N
	Class B turf	2.1	4 - 7	E, N
	Class C turf	1.0	3.5	E, N
	Long native grasses	1.2 – 1.7	4 – 6	G, H, L, N
	Short native and bunch grass	0.7 - 0.95	3 – 4	G, H, L, N
<u>Temporary Degradable RECPS</u>	Reed plantings	0.1-0.6	N/A	E, N
	Hardwood tree plantings	0.41-2.5	N/A	E, N
	Jute net	0.45	1 – 2.5	E, H, M
	Straw with net	1.5 – 1.65	1 – 3	E, H, M
	Coconut fiber with net	2.25	3 – 4	E, M
<u>Non-Degradable RECPS</u>	Fiberglass roving	2.00	2.5 – 7	E, H, M
	Unvegetated	3.00	5 – 7	E, G, M
	Partially established	4.0-6.0	7.5 – 15	E, G, M
	Fully vegetated	8.00	8 – 21	F, L, M
<u>Riprap</u>	6 – in. d <sub>50</sub>	2.5	5 – 10	H
	9 – in. d <sub>50</sub>	3.8	7 – 11	H
	12 – in. d <sub>50</sub>	5.1	10 – 13	H
	18 – in. d <sub>50</sub>	7.6	12 – 16	H
	24 – in. d <sub>50</sub>	10.1	14 – 18	E
	<u>Soil Bioengineering</u>	Wattles	0.2 – 1.0	3
Reed fascine		0.6-1.25	5	E
Coir roll		3 - 5	8	E, M, N
Vegetated coir mat		4 - 8	9.5	E, M, N
Live brush mattress (initial)		0.4 – 4.1	4	B, E, I
Live brush mattress (grown)		3.90-8.2	12	B, C, E, I, N
Brush layering (initial/grown)		0.4 – 6.25	12	E, I, N
Live fascine		1.25-3.10	6 – 8	C, E, I, J
Live willow stakes		2.10-3.10	3 – 10	E, N, O
<u>Hard Surfacing</u>		Gabions	10	14 – 19
	Concrete	12.5	>18	H

<sup>1</sup> Ranges of values generally reflect multiple sources of data or different testing conditions.

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USACE TR EL 97-8

**12 Report Maps**

Off-Site Basin Map for HEC-HMS Calculations

Existing Condition Hydraulic Analysis Map (Map Pocket)

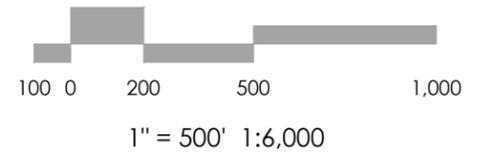
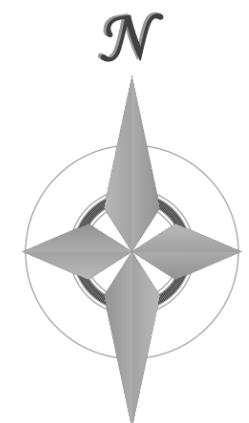
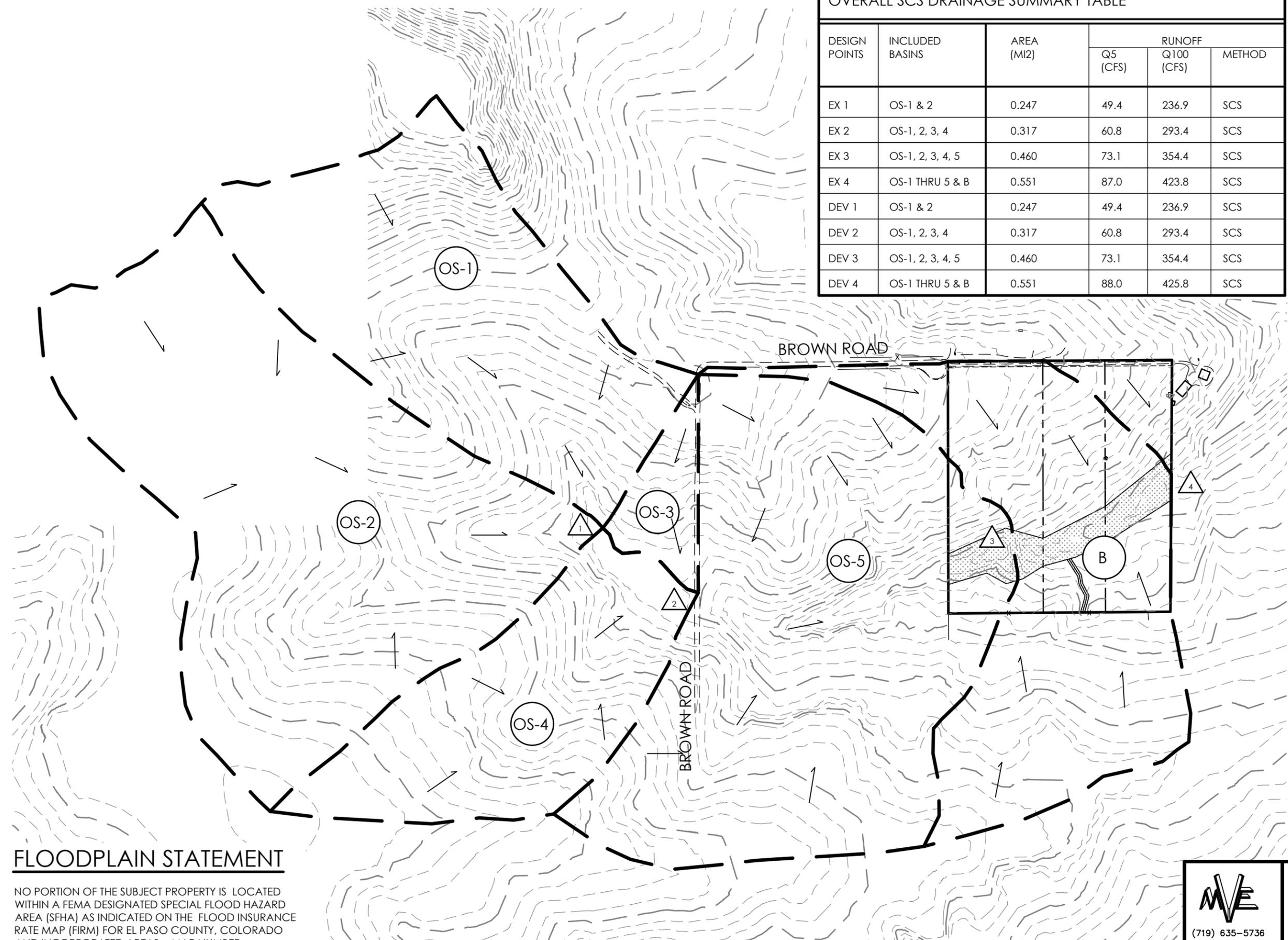
Proposed Condition Hydraulic Analysis Map (Map Pocket)

OVERALL SCS DRAINAGE SUMMARY TABLE

DESIGN POINTS	INCLUDED BASINS	AREA (MI <sup>2</sup> )	RUNOFF		
			Q5 (CFS)	Q100 (CFS)	METHOD
EX 1	OS-1 & 2	0.247	49.4	236.9	SCS
EX 2	OS-1, 2, 3, 4	0.317	60.8	293.4	SCS
EX 3	OS-1, 2, 3, 4, 5	0.460	73.1	354.4	SCS
EX 4	OS-1 THRU 5 & B	0.551	87.0	423.8	SCS
DEV 1	OS-1 & 2	0.247	49.4	236.9	SCS
DEV 2	OS-1, 2, 3, 4	0.317	60.8	293.4	SCS
DEV 3	OS-1, 2, 3, 4, 5	0.460	73.1	354.4	SCS
DEV 4	OS-1 THRU 5 & B	0.551	88.0	425.8	SCS

LEGEND

-  PROPERTY LINE
-  EASEMENT LINE
-  LOT LINE
-  5985 INDEX CONTOUR
-  84 INTERMEDIATE CONTOUR
-  BASIN BOUNDARY
-  GENERAL FLOW/DIRECTION
-  OS-1 BASIN LABEL
-  1 DESIGN POINT



**FLOODPLAIN STATEMENT**

NO PORTION OF THE SUBJECT PROPERTY IS LOCATED WITHIN A FEMA DESIGNATED SPECIAL FLOOD HAZARD AREA (SFHA) AS INDICATED ON THE FLOOD INSURANCE RATE MAP (FIRM) FOR EL PASO COUNTY, COLORADO AND INCORPORATED AREAS - MAP NUMBER 08041C0305 G, EFFECTIVE DECEMBER 7, 2018.

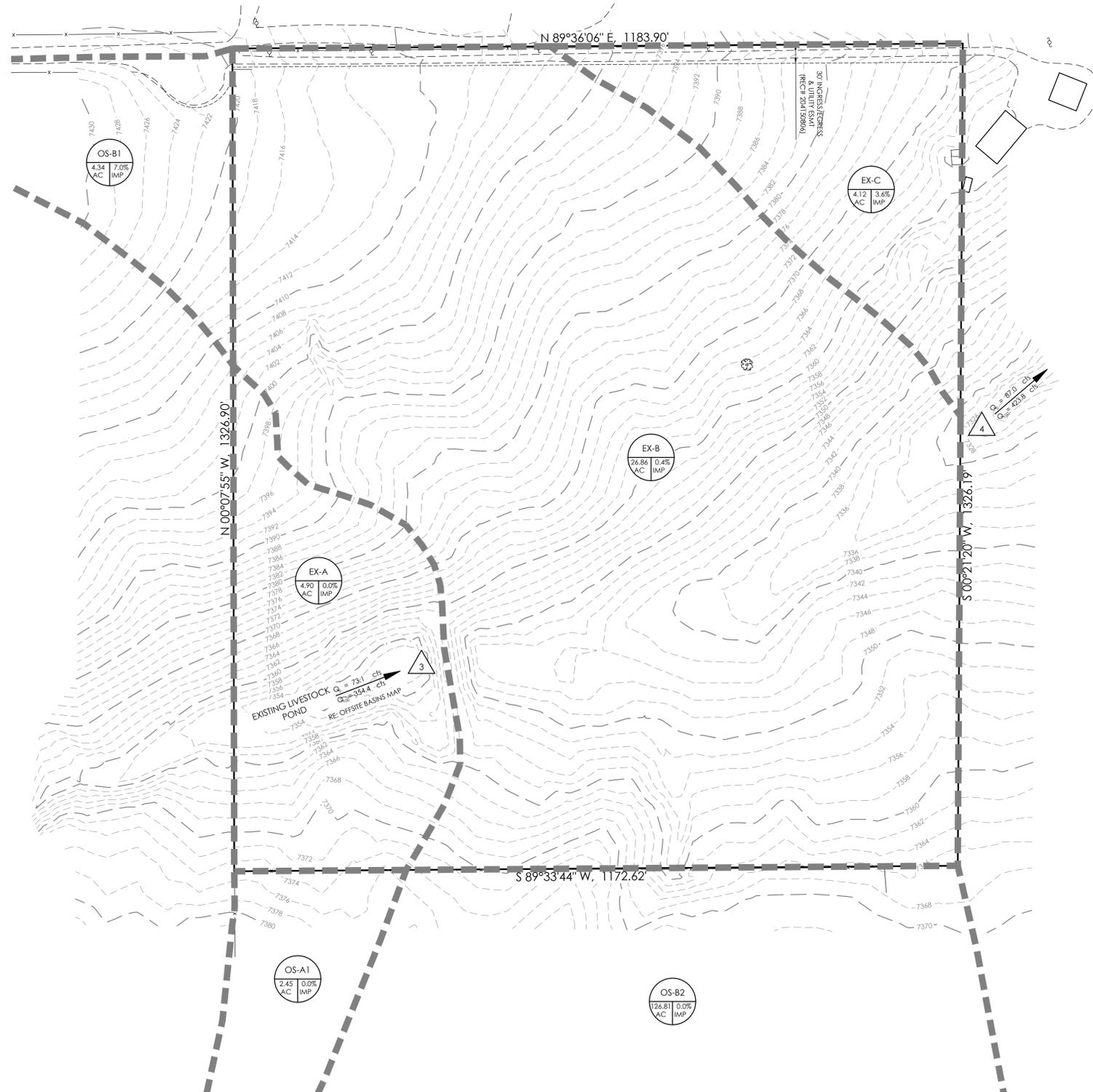


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1903 LELARAY ST., COLORADO SPRINGS, COLORADO 80909

OFF-SITE\_BASIN\_MAP



**LEGEND**

- PROPERTY LINE
- EASEMENT LINE
- LOT LINE

**EXISTING**

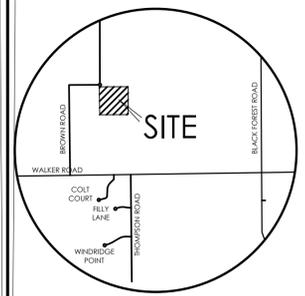
- INDEX CONTOUR
- INTERMEDIATE CONTOUR

**PROPOSED**

- INDEX CONTOUR
- INTERMEDIATE CONTOUR

- BASIN BOUNDARY
- GENERAL FLOW/DIRECTION
- SLOPE DIRECTION AND GRADE

$Q_5 = 19.0$  CFS  
 $Q_{100} = 60.0$  CFS  
 1.5%  
 A1  
 1.2 AC  
 0.0% IMP  
 DESIGN POINT



**VICINITY MAP**  
NOT TO SCALE

BENCHMARK

1" = 100' 1:1,200

**EXISTING DRAINAGE SUMMARY TABLE**

DESIGN POINTS	INCLUDED BASINS	AREA (AC)	Tc (MIN.)	RUNOFF		METHOD
				Q5 (CFS)	Q100 (CFS)	
	OS-A1	2.45	12.8	0.7	5.4	RATIONAL
	OS-B1	4.34	15.8	1.5	9.5	RATIONAL
	OS-B2	26.81	17.6	7.0	51.6	RATIONAL
	EX-A	4.90	13.4	1.4	10.6	RATIONAL
	EX-B	26.86	19.2	7.0	50.0	RATIONAL
	EX-C	4.12	14.3	1.5	9.1	RATIONAL
3		0.46 MI2		73.1	354.4	HEC-HMS
4		0.55 MI2		87.0	423.8	HEC-HMS

**FLOODPLAIN STATEMENT**

NO PORTION OF THE SUBJECT PROPERTY IS LOCATED WITHIN A FEMA DESIGNATED SPECIAL FLOOD HAZARD AREA (SFHA) AS INDICATED ON THE FLOOD INSURANCE RATE MAPS (FIRM) FOR EL PASO COUNTY, COLORADO AND INCORPORATED AREAS - MAP NUMBERS 08041C0305 G, EFFECTIVE DECEMBER 7, 2018.

NOTE: SEE BASIN MAP FOR OFFSITE BASIN DETAILS

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ENGINEERS / SURVEYORS

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REVISIONS

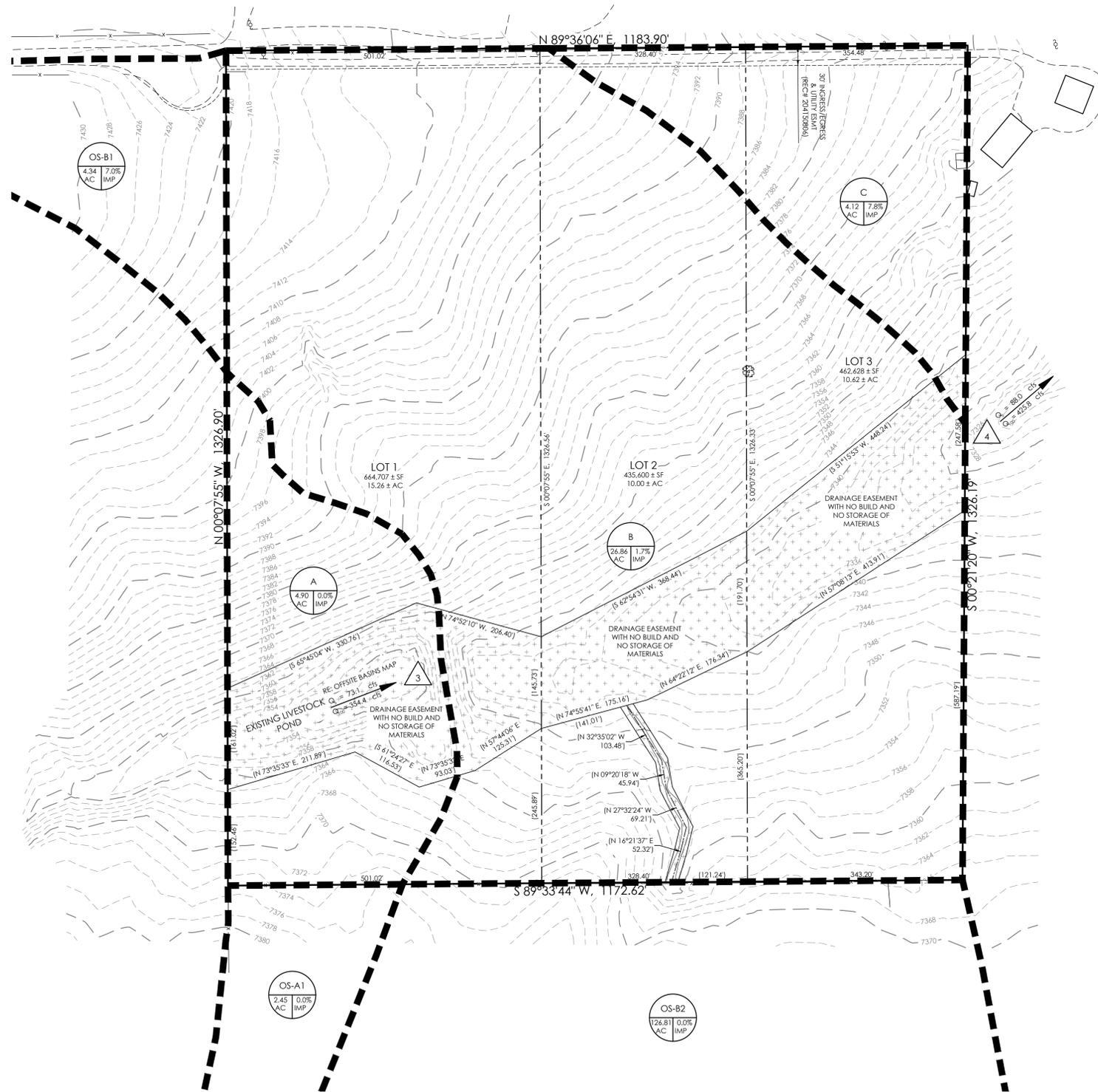
DESIGNED BY \_\_\_\_\_  
 DRAWN BY \_\_\_\_\_  
 CHECKED BY \_\_\_\_\_  
 AS-BUILTS BY \_\_\_\_\_  
 CHECKED BY \_\_\_\_\_

**18735 BROWN ROAD**

**EXISTING DRAINAGE MAP**

MVE PROJECT **61170**  
 MVE DRAWING **EX-DRN**

**AUGUST 18, 2022**  
**SHEET 1 OF 1**



**LEGEND**

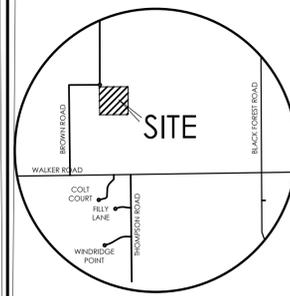
- PROPERTY LINE
- EASEMENT LINE
- LOT LINE

**EXISTING**

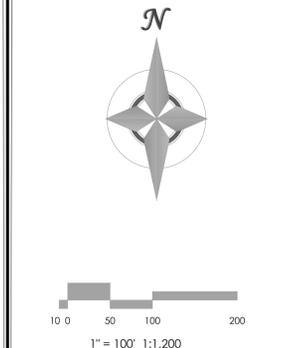
- INDEX CONTOUR
- INTERMEDIATE CONTOUR

**PROPOSED**

- INDEX CONTOUR
- INTERMEDIATE CONTOUR
- BASIN BOUNDARY
- GENERAL FLOW/DIRECTION
- SLOPE DIRECTION AND GRADE
- BASIN LABEL  
AREA IN ACRES  
PERCENT IMPERVIOUS
- DESIGN POINT



**VICINITY MAP**  
NOT TO SCALE



**DEVELOPED DRAINAGE SUMMARY TABLE**

DESIGN POINTS	INCLUDED BASINS	AREA (AC)	Tc (MIN.)	RUNOFF		METHOD
				Q5 (CFS)	Q100 (CFS)	
	OS-A1	2.45	12.8	0.7	5.4	RATIONAL
	OS-B1	4.34	15.8	1.5	9.5	RATIONAL
	OS-B2	26.81	17.6	7.0	51.6	RATIONAL
	A	4.90	13.4	1.4	10.6	RATIONAL
	B	26.86	19.2	7.8	50.9	RATIONAL
	C	4.12	14.3	2.0	9.6	RATIONAL
3		0.46 MI2		73.1	354.4	SCS
4		0.55 MI2		88.0	425.8	SCS

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NOTE: SEE BASIN MAP FOR OFFSITE BASIN DETAILS

**MVE, INC.**  
ENGINEERS & SURVEYORS

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DESIGNED BY  
DRAWN BY  
CHECKED BY  
AS-BUILT BY  
CHECKED BY

**18735 BROWN ROAD**

**DEVELOPED DRAINAGE MAP**

MVE PROJECT **61170**  
MVE DRAWING **PP-DRN**

**AUGUST 18, 2022**  
**SHEET 1 OF 1**