CRABTREE GROUP INC.
ENGINEERING SMART GROWTH™

MEMO

To: Andi Ruggera

From: Tracy Vandaveer

CC: David Gardner, Cody Tusing, Joe Deluca

Date: December 2, 2021

Re: Gunnison Rising ; Phase 2 Drainage

Below are comments on the Gunnison Rising Phase 2 Drainage Report that you forwarded to us, followed by our response on how the comment was addressed in the revised submittal:

1. *"Please resubmit the drainage report and accompanying maps and ensure both items meet all requirements outlined in Sections 8.3.2 and 8.3.3 of the City of Gunnison Stormwater Management Manual (CGSMM)."*

   Attached.

2. *"It appears the drainage is designed for an interim phase of a larger overall development which is not discussed in the report. Please reference the Gunnison Rising Master Drainage Plan and discuss how this project adheres to the previous report. Provide analysis to show that the facilities proposed for Phase 2 can effectively convey and/or treat the additional stormwater runoff generated by future phases to the north and east, which will ultimately pass through this phase."*

   Text has been added within the report to address relationship with the overall PUD

3. *How will runoff from future development phases be treated for water quality since the proposed detention pond appears to only be sized for Phase 2?*

   Runoff treatment design form future phase of the development will be design when the specific phase is proposed for development. Due to the variability

4. *The design storms depths presented in Section 5 are less than the design storm depths provided in the CGSMM. Please revise calculations accordingly.*

   Design precipitation depths shown in tables 3-1 and 3-2 of the CGSMM are from the 1973 version of NOAA Atlas 14; and therefore 48 years out of date. Precipitation depths reported in the report are data available form NOAA for the project location; and therefor more accurate.

5. *Please provide floodplain discussion. The proposed detention pond appears to be located in a flood zone. How the pond can continue to function as planned if it becomes submerged during a 100-year event?*

   Construction of the roadways will prevent floodwaters from reaching this area.

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6. *Please provide street hydraulic capacity calculations to demonstrate that the allowable spread for each street classification within the site is met for both the minor and major events.*

   Street and Channel hydraulic calculation have been added to the appendix.

7. *Please explain how runoff for the developed condition can be less than existing condition? Have offsite contributory flows been considered in these calculations?*

   Runoff is being detained on-site to reduce peak flows.

8. *Please clarify how runoff from Block 1 is treated for stormwater quality prior to release from the site. Will the block have it's own detention to limit developed runoff to the historic rate? Or will the lot ultimately be graded to direct runoff to the proposed roadway(s) so the stormwater can be directed towards the proposed pond?*

   With this proposal, there is no changed to block 1 in the pre and post developed states, and therefore no change in runoff quality. The lot owner is expected to provide address water quality issues once the lot is sold and specific design plans for the intended improvements are available.

9. *Disagree with Section 7 that states potential pollutant sources cannot be identified and BMPs implemented. There is enough shown in the design plans to provide at minimum perimeter control, channel and culvert protection, vehicle tracking control, concrete washout, grading techniques (surface roughening), stabilized staging area, good housekeeping practices, and temporary or permanent seeding. Please provide discussion in the report and show control measures in the civil design drawings.*

   Potential BMP map has been added.

10. *The only hydraulic calculation provided other than the SSA analysis is a culvert profile which doesn't detail pipe characteristics, input parameters, etc. to verify that the profile shown represents the condition found on-site. When utilizing Hydraflow Express for culvert calculations please provide the full analysis report in the appendices and not just the graphical result.*

    The full Hydraflow Report has been added to the Appendix..

11. *Please provide capacity calculations when open channels are used for stormwater conveyance to ensure the proposed channel geometry is adequate, whether as an interim or final condition.*

    Capacity Calculations have been added to the Appendix

12. *Please provide calculations to support the allowable release rate and water surface elevations for the WQCV, minor and major events, freeboard, emergency spillway location, and stage storage calculations. The construction drawings will also be required to detail the pond grading, forebay and outlet structure.*

    As requested, WQCV calculations have been added per the UDFCD Drainage Criteria Manual; Volume 3.

13. *What condition are the culverts passing beneath Hwy 50 in? Have they been inspected recently?*

    The culverts are in satisfactory condition. The culverts are owned by CDOT and expected to be replaced by them at the end of their useful life.

14. *Suggest annotating map so the SSA analysis can be easily be correlated. i.e. Where are the SSA links and nodes found within the site?*

    Additional Nodes have been added to the map for the reviewers convenience.

15. *Last sentence of Section 2 appears to have the "easterly" and "westerly" words swapped. Please clarify.*

    Grammatical error has been corrected.

16. *Please cite the City of Gunnison Stormwater Management Manual since it contains the criteria to be met and many of the parameters which should be used when performing the drainage design.*

    The City of Gunnison Stormwater Management Manual has been referenced.

17. *Suggest transferring the SSA analysis results to a spreadsheet since the output tables are difficult to interpret when the program wraps text to the following line and headings no longer line up with results columns. Example:*

    Results have been reformatted.

18. *If SSA results are not transferred to a spreadsheet, please provide additional annotation so that links and nodes can be correlated to the design presented in the drainage map and civil drawings.*

    Results have been reformatted.

DECEMBER 2, 2021

Subdivision Drainage Report

Phase 2-Gunnison Rising Subdivision

GUNNISON, COLORADO

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Crabtree Group Inc.
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Contents

1 EXECUTIVE SUMMARY

Phase 2 of the Gunnison Rising Subdivision site was analyzed to determine the impact of the development to stormwater flows in the area. The proposed development was modeled using Autodesk Storm and Sanitary software and unit hydrograph techniques to quantify the increase stormwater flows and effect of mitigation measures incorporated into the subdivision design. The analysis showed historic stormwater flow rates from the site can be maintained with use of adequate detention facilities.

2 RELATIONSHIP WITH GUNNISON RISING PUD

The Gunnison Rising Planned Unit Development (PUD) consists of approximately 633 acres of land, located on the eastern sided of Gunnison Colorado. The PUD was originally approved in 2009, and has since seen several revisions, with the last being approved in 2021. Phase 1 of the PUD development was approved in 2021, with construction commencing in March of that year and currently ongoing.

Phase 2 of the PUD development, which is the subject of this report, consists of approximately 80 acres I the southeast portion of the overall PUD are. The applicant is seeking to subdivide this portion of the PUD in the spring of 2022, with construction to commence upon approval.

Approved with 2021 PUD amendment, is a Master Drainage Study the PUD area. The Mater Drainage Study, completed by CLC Associated Inc (CLC Associates, Inc., 2013), requires the that a site-specific drainage report be presented for City approval for each phase of the development.

3 LOCATION AND DESCRIPTION

Phase 2 of the Gunnison Rising Subdivision proposes to create 80 single-family, 6 multi-family, and 11 commercial lots on 51 acres within the Gunnison Rising PUD. The property is located adjacent to U.S. Highway 50, as shown in Figure 1 and is surrounded by vacant land, with U.S. Highway 50 being the southern boundary of the westerly portion of the property and bisecting the easterly portion.

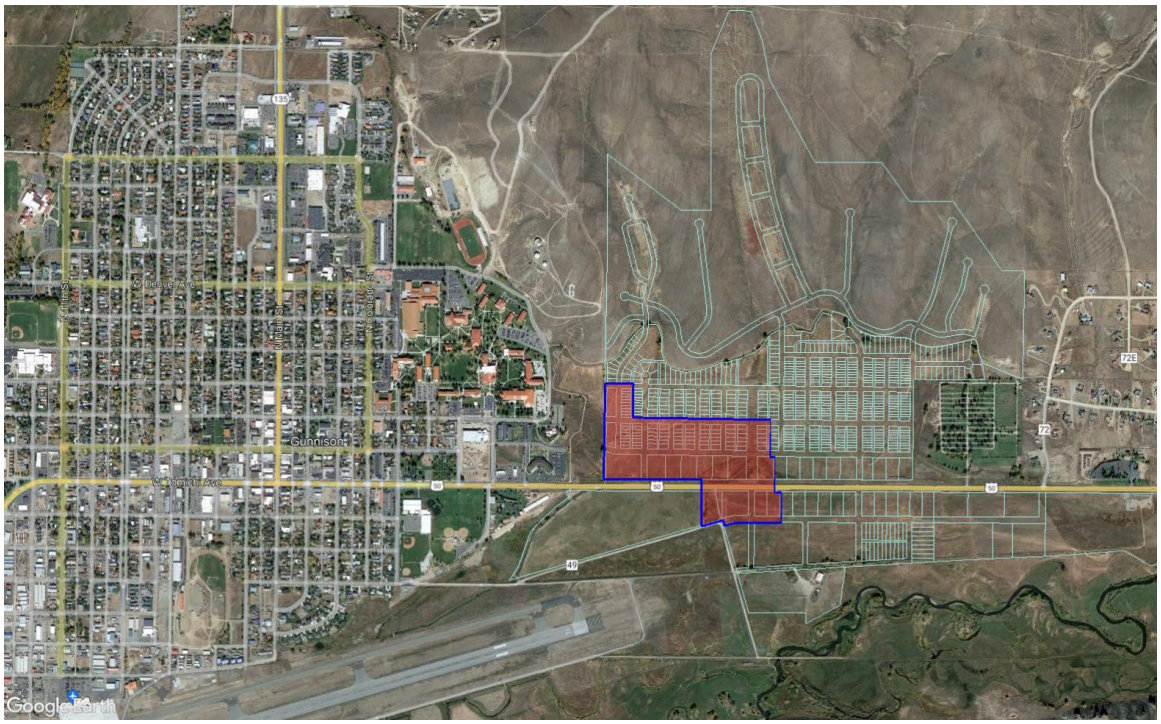

FIGURE 1 - VICINITY MAP

4 EXISTING CONDITIONS

Existing conditions of the subject property were ascertained from aerial photography, topographic surveys, and field reconnaissance of the subject parcel. The site is comprised of irrigated agricultural pastureland with relatively flat grades.

TOPOGRAPHY

The site consists of flat meadowland, gently sloping to the south. The majority of the site slopes less than 4% in a southerly direction, with areas on the northerly boundary exceeding 6%, as shown in Figure 2.

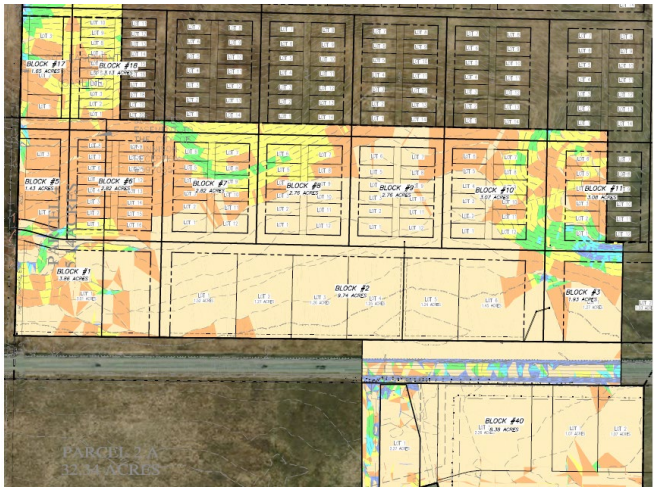

FIGURE 2 - SLOPES MAP

SLOPE TABLE				
#	MIN. SLOPE	MAX. SLOPE	COLOR	AREA (ACRES)
1	0%	2%		27.70
2	2%	4%		12.26
3	4%	6%		6.21
4	6%	8%		1.78
5	8%	10%		0.49
6	10%	5361%		1.10

VEGETATION

The site has historically been irrigated with vegetation consisting of relatively dense meadow grasses.

DRAINAGE PATTERNS

Existing drainage patterns on the site generally flow in a southerly direction to U.S. Highway 50, where flows are directed to existing culverts which convey flows to the south side of U.S Highway 50. Flows cross to the southern side of Highway 50 in the existing culverts, where they then flow in existing drainage ditches toward Tomichi Creek. To maintain flow paths to the existing culverts for this and future phases, a 25' drainage easement has been provided along the U.S. highway 50.

FLOODPLAINS

The project area is shown on FEMA map panel 08580C1266D. The FIRMette for the project area is included in Appendix F. Although a small portion of the FEMA mapped floodplain in included in the project area, the impact to the floodplain is considered de minimus.

IRRIGATION

Although the site is currently irrigated, Irrigation is expected to cease prior to commencement of the project. There is one downstream irrigation user of the Cemetery ditch who is expected to be supplied their decreed water via a pipe system, which does not impact the current application area. Future Phases of the development are expected to include an irrigation system for supplying lots with ditch water for landscape irrigation.

GROUNDWATER

Groundwater levels are currently being monitored and are expected to drop once irrigation of the parcel stops. Plat notes and CCR's will require engineered foundations and prohibit basements.

5 SOILS

Information for the on-site soils was obtained from the USDA Web Soil Survey (U.S. Department of Agriculture, n.d.). The soils consist primarily of Dewville Loam (DeB) with a smaller areas of Bosler Sandy Loam (BsB), and Irim Loam (IrA). The Dewville series of soils are assigned to Hydraulic Soils Group B, while

the Irim Series are assigned B/D. Group B Soils have a moderate infiltration rate, with a corresponding moderate potential to generate stormwater runoff. The site Soil information is shown in Figure 3. Soils Map and summarized in

Table 1 below, with the USDA Soils report included in Appendix A.

Saturated Hydraulic Soils Group Table				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BsB	Bosler sandy loam, 1 to 8 percent slopes	B	9.3	18.3%
DeB	Dewville loam, 1 to 5 percent slopes	B	35.4	69.3%
DeC	Dewville loam, 5 to 15 percent slopes	B	0.7	1.3%
IrA	Irim loam, 1 to 9 percent slopes	B/D	5.6	11.1%
Totals for Area of Interest			**51.0**	**100.0%**

TABLE 1 – HYDRAULIC SOILS GROUPS

Saturated Hydraulic Soils Group Table				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BsB	Bosler sandy loam, 1 to 8 percent slopes	B	9.3	18.3%
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Totals for Area of Interest			**51.0**	**100.0%**

6 DESIGN STORMS

Design storms for the analysis were modeled using a SCS Type II distribution, with cumulative precipitation amounts obtained from NOAA precipitation frequency estimates (National Weather Service, 2020) for the subject area. The precipitation amounts used to develop the storms are summarized in Table 2 below, with the NOAA report included in Appendix C.

TABLE 2 – DESIGN STORMS

	Design Storm				
	2yr-24hr	10yr-24hr	25yr-24hr	50yr-24hr	100yr-24hr
Cumulative Rainfall (in)	1.00	1.41	1.68	1.91	2.14

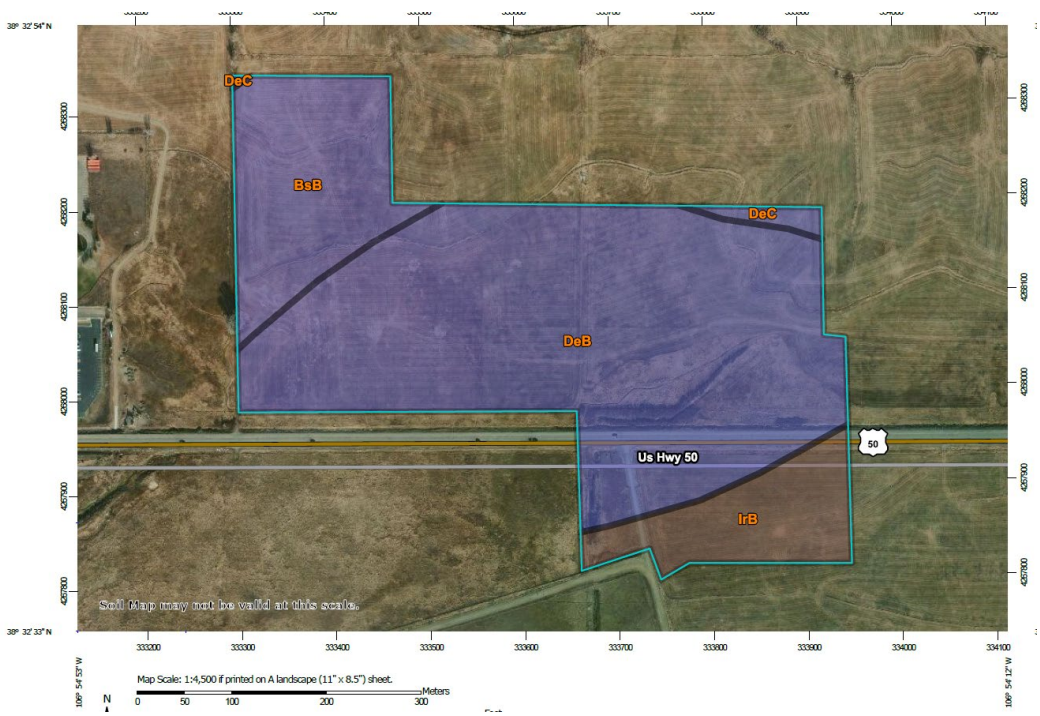


FIGURE 3 – SOILS MAP

7 RUNOFF ANALYSIS

The Analysis of the on-site stormwater flows was performed using Autodesk Storm and Sanitary Analysis software, with a Type II storm distribution. The site was analyzed in the pre-construction and buildout conditions to determine the impact of the development on stormwater flow in the area. Pre-Construction conditions were ascertained from aerial photography, topographic mapping, and field reconnaissance of the existing site.

For the predevelopment conditions, the existing drainage areas were analyzed using site topography and field observations to determine existing flow patterns. Two drainage areas were identified, being separated by a north-south ridge splitting the development site. Flows west of the ridge flow to the southern boundary, then westerly to an existing culvert under Highway 50. Flows east of the ridge flow to the southern boundary, then cross Highway 50 through an existing 30" culvert, where they are conveyed through existing drainage channels toward Tomichi Creek.

For the pre-development analysis, the drainage areas were assumed to have a runoff curve number of 79, which correlates to SCS published curve numbers for pasturelands on B rated soils. The pre-developed conditions were modeled in Autodesk Storm and Sanitary Analysis software to generate stormwater runoff rates for each of the design storms discussed in Section 6 above.

As lots develop, the amount of impervious area will increase, resulting in increased runoff rates. To mitigate the impact of this, a stormwater detention pond was incorporated into the subdivision design, with flows from the developed area being direct to the detention pond prior to discharge from the site.

For the post-development analysis of the stormwater generation, each block was assumed to have a runoff curve number corresponding with the intended use, as shown in Figure 4, with drainage paths determined from the construction plans for the proposed subdivision. The post-development conditions were modeled in Autodesk Storm and Sanitary Analysis software, using unit hydrograph techniques, to determine the expected stormwater runoff for each of the design storms.

Developed use	Runoff Curve No.
Street Right-of-Way	98
Commercial Blocks	92
MultiFamily Blocks	85
Residential Blocks	75
Landscape Areas	61

FIGURE 4 - RUNOFF CURVE NUMBERS

Comparison of the stormwater runoff rates for the design storms shows that the post-developed runoff rates will be reduced for the 2-, 10-, and 100-year design storms. However, there is a slight increase in runoff rates for the 25-year and 50-year design storms. The increase in flow rates modeled for the 25 and 50-year storms could be reduced with engineered outflow control. However, since these storms compromise a small fraction of rainfall events, and the pre and post difference in modeled flows is less than expected modeling errors, the reported difference is considered de minimus. A summary of the calculated runoff for each of the design storms is shown in Table 3 below, with the model results included in Appendix D.

TABLE 3 - RUNOFF SUMMARY

Design Point	Design Storms				
	2-yr 24-hr	10-yr 24-hr	25-yr 24-hr	50-yr 24-hr	100-yr 24-hr
Pre-Development					
West Outlet	0.60	3.30	5.80	8.30	11.00
East Outlet	1.20	6.40	11.70	16.80	22.30
Totals	1.80	9.70	17.50	25.10	33.30
Post-Development					
West Outlet	0.50	1.60	2.53	3.50	4.40
East Outlet	0.60	5.60	15.30	23.70	26.90
Totals	1.10	7.20	18.90	27.20	31.30
D Pre vs Post	**(0.70)**	**(2.50)**	**1.40**	**2.10**	**(2.00)**

8 STORMWATER CONVEYANCE

The majority of the stormwater flows on the site will be conveyed in the gutters of subdivision streets but there will be a storm drain and pipe to carry stormwater from College Avenue to the southern boundary.

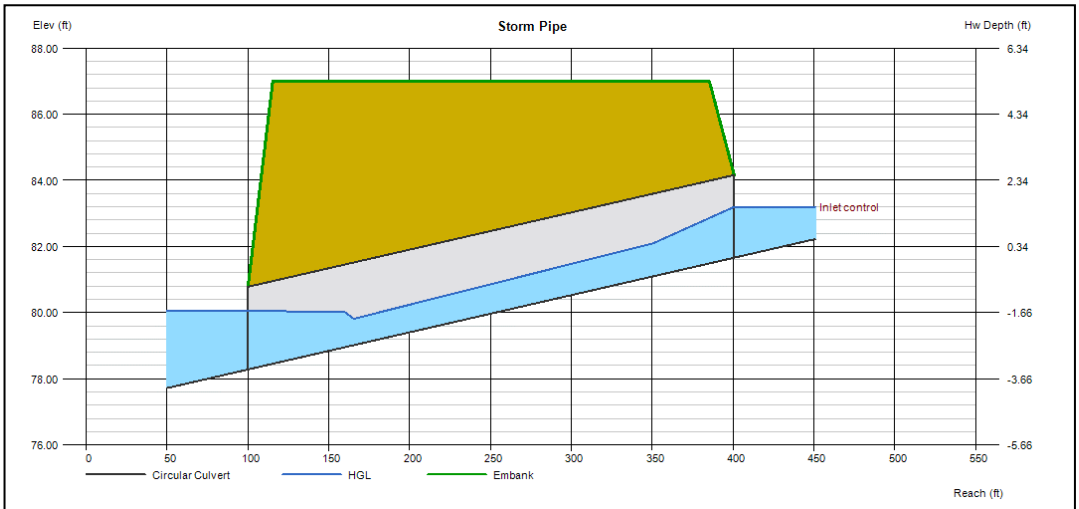


FIGURE 5 – STORM PIPE

Model results for the peak flow in the 100-year design storm show that the flows will be 47 cfs. Flow calculations have been included in Appendix E.

9 STORMWATER QUALITY

The City of Gunnison Stormwater Management Manual (City of Gunnison, 2012), requires that Water Quality Capture Volumes (WQCV) be calculated per the Urban Storm Drainage Criteria Manual (Urban Drainage and Flood Control District, 2010). Therefore, the calculations were completed assuming a BMP coefficient (α) of 1.0, corresponding with an extended detention basin, and an imperviousness (I) of 60%, as indicated by the Master Drainage Plan for Gunnison Rising (Urban Drainage and Flood Control District, 2010). Calculations are shown below:

The water quality capture volume was calculated using equation 3-1 as follows:

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

$= 1(0.90*0.6^3-1.19*0.6^2+0.78*0.6)$

= 0.23 in.

From this, the required storage volume was calculated using equation 3.2, as follows:

$$V = \frac{WQCV}{12}A \qquad \textbf{Equation 3-2}$$

= 0.23/12*80

= 1.56 ac.-ft.

10 CONCLUSION AND RECOMMENDATIONS

The development within the subdivision must be designed to mitigate stormwater impacts and convey offsite and on-site stormwater where applicable. The following recommendations will ensure that stormwater is safely conveyed through the site and the impacts to historic stormwater runoff rates are mitigated, in compliance with the Gunnison Stormwater Management Manual:

- Street designs should be graded per the project construction drawings dated October, 2021. Any changes to the proposed plans should be reviewed to determine potential impacts to the drainage design.
- A drainage easement should be provided for the storm pipe from college lane to the southern site boundary.
- A detention pond with a minimum storage capacity of 65,000 cubic feet should be incorporated into the design.

- Subdivision covenants should account for continuing maintenance of the detention pond.
- Site Plans for individual lots should require review for compliance with construction stormwater quality requirements.

11 WORKS CITED

City of Gunnison. (2012). *City of Gunnison Stormwater Management Manual.* Gunnison, Colorado.

CLC Associates, Inc. (2013). *Master Drainage Study for Gunnison Rising.* Greenwood Village, Colorado.

National Weather Service. (2020, August 24). *Precipitation Frequency Data Server*. Retrieved from Hydrometeorological Design Studies Center: https://hdsc.nws.noaa.gov

U.S. Department of Agriculture. (n.d.). *Web Soil Survey*. Retrieved August 21, 2020, from http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Urban Drainage and Flood Control District. (2010). *Urban Storm Drainage Criteria Manual: Volume 3.* Denver, Colorado: Urban Drainage and Flood Control District.

Appendix A

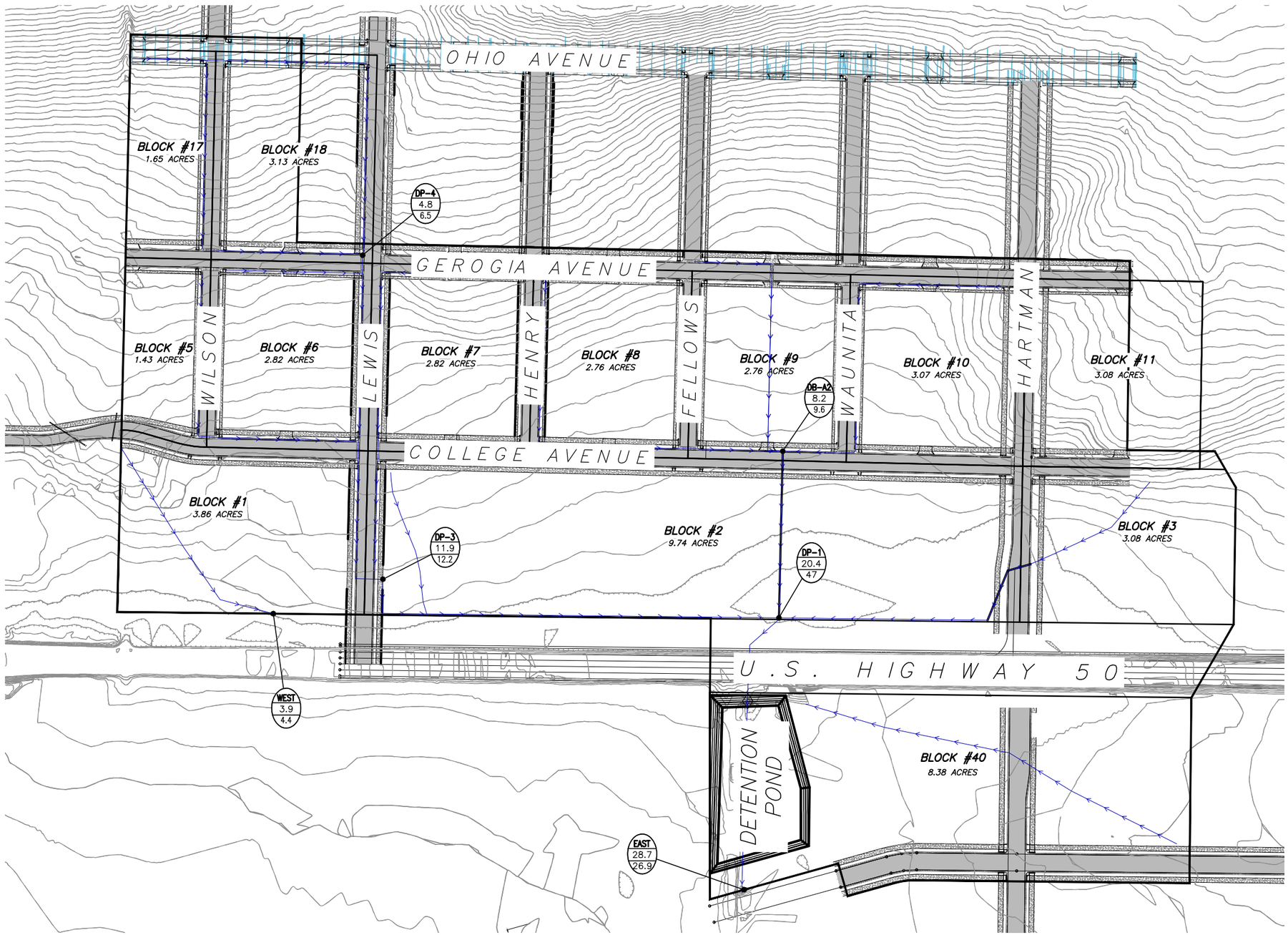
DRAINAGE MAP

GUNNISON RISING - PHASE 2

DRAINAGE MAP

GUNNISON, COLORADO

DECEMBER, 2021



GRAPHIC SCALE

60' 0 60' 120' 180'

(CONTOUR INTERVAL = 1 FOOT)

LEGEND

- INDEX CONTOUR
- INTERMEDIATE CONTOUR
- SUBDIVISION BOUNDARY
- ROAD RIGHT-OF-WAY LINE
- DRAINAGE FLOWPATH

A BASIN DESIGNATION
B COMPOSITE RUNOFF COEFFICIENT
C DRAINAGE BASIN AREA (ACRES)

D DESIGN POINT DESIGNATION
E DESIGN POINT TRIBUTARY AREA (ACRES)
F DESIGN POINT 100-YR FLOW RATE (CFS)

PREPARED BY:

CRABTREE GROUP INC.
ENGINEERING SMART GROWTH™

SHEET NO. 1 OF 1

GUNNISON RISING - PHASE 2 - DRAINAGE MAP

Appendix B

SOILS REPORT

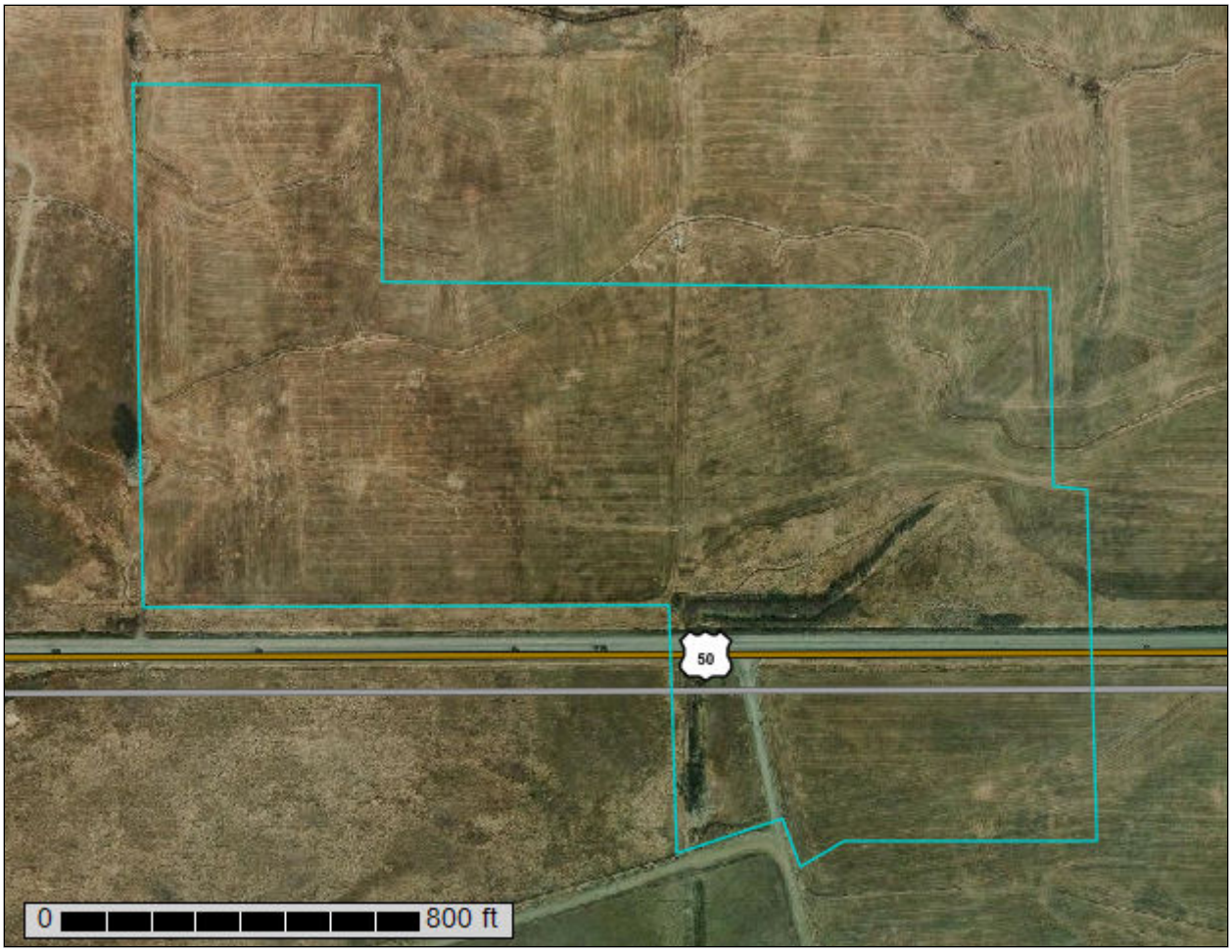
United States Department of Agriculture

Natural Resources Conservation Service

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

Custom Soil Resource Report for Gunnison Area, Colorado, Parts of Gunnison, Hinsdale, and Saguache Counties

Gunnison Rising-Phase 2



October 6, 2021

Preface

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

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

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

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

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

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

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

Contents

How Soil Surveys Are Made

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

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

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

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

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

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

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

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

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

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

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

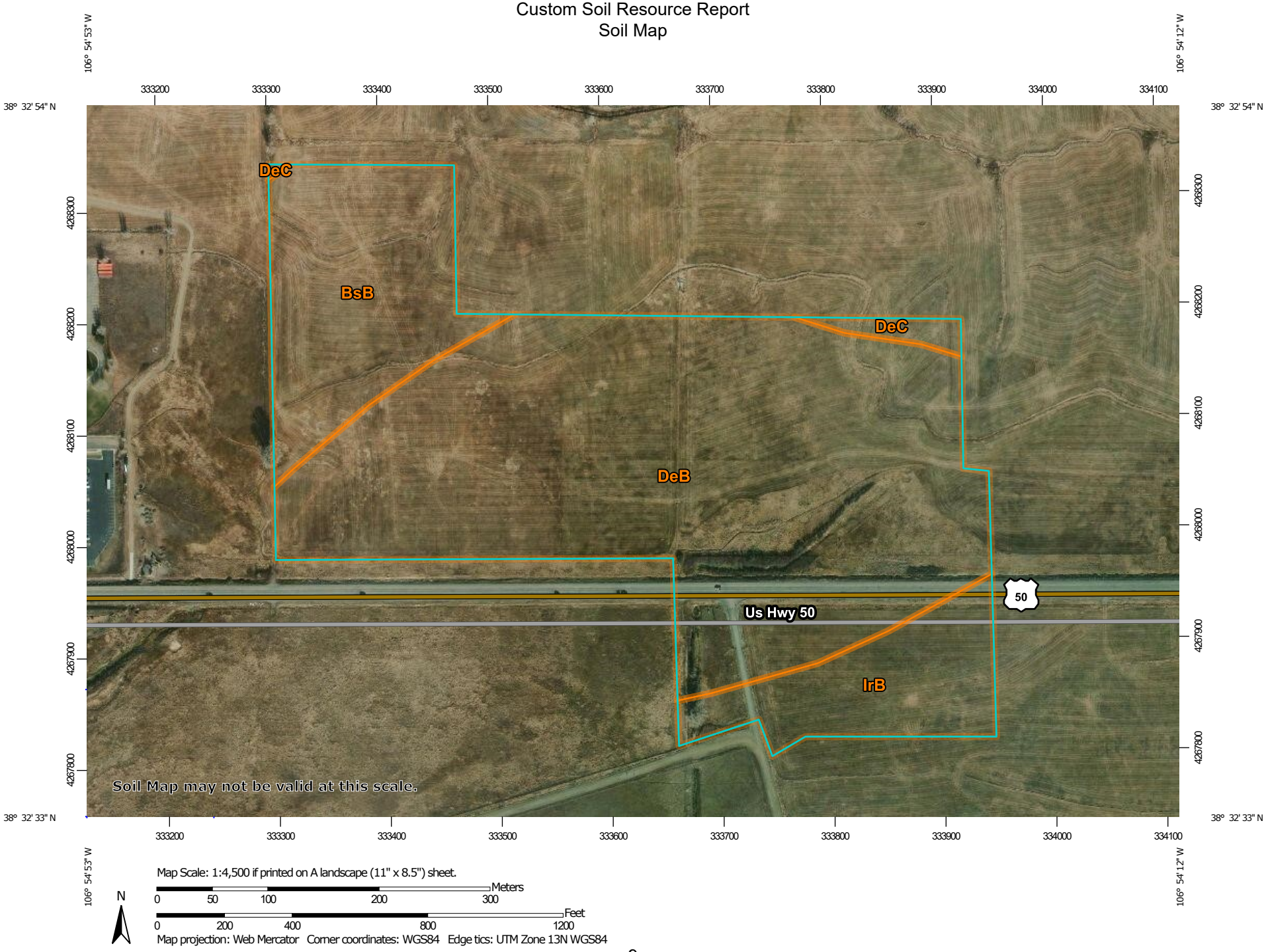
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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

Custom Soil Resource Report
Soil Map



Map Scale: 1:4,500 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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: Gunnison Area, Colorado, Parts of Gunnison, Hinsdale, and Saguache Counties
Survey Area Data: Version 14, Sep 2, 2021

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

Date(s) aerial images were photographed: Dec 31, 2009—Jun 17, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

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
BsB	Bosler sandy loam, 1 to 8 percent slopes	9.3	18.3%
DeB	Dewville loam, 1 to 5 percent slopes	35.4	69.3%
DeC	Dewville loam, 5 to 15 percent slopes	0.7	1.3%
IrB	Irim loam, 1 to 5 percent slopes	5.6	11.1%
Totals for Area of Interest		**51.0**	**100.0%**

Map Unit Descriptions

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

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

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

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate

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

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

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

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

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

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

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

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

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

Gunnison Area, Colorado, Parts of Gunnison, Hinsdale, and Saguache Counties

BsB—Bosler sandy loam, 1 to 8 percent slopes

Map Unit Setting

National map unit symbol: jqdm
Elevation: 7,800 to 8,500 feet
Frost-free period: 50 to 70 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Bosler

Setting

Landform: Stream terraces, alluvial fans, streams, drainageways
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed sandy and gravelly alluvium

Typical profile

H1 - 0 to 10 inches: sandy loam
H2 - 10 to 22 inches: sandy loam
H3 - 22 to 26 inches: very gravelly sandy clay loam
H4 - 26 to 32 inches: very gravelly sandy clay loam
H5 - 32 to 48 inches: very cobbly loamy sand
H6 - 48 to 72 inches: cobbly sand

Properties and qualities

Slope: 1 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Available water supply, 0 to 60 inches: Low (about 4.4 inches)

Interpretive groups

Land capability classification (irrigated): 6s
Land capability classification (nonirrigated): 6c
Hydrologic Soil Group: B
Ecological site: R048AY311CO - Mountain Outwash
Hydric soil rating: No

Minor Components

Curecanti

Percent of map unit:
Hydric soil rating: No

Fola

Percent of map unit:
Hydric soil rating: No

DeB—Dewville loam, 1 to 5 percent slopes

Map Unit Setting

National map unit symbol: jqdt
Elevation: 9,000 to 10,000 feet
Frost-free period: 50 to 70 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Dewville and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dewville

Setting

Landform: Fans, valleys, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed, rhyolite alluvium derived from tuff and/or mixed alluvium derived from rhyolite and/or mixed alluvium derived from sandstone

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
H1 - 1 to 10 inches: loam
H2 - 10 to 22 inches: sandy clay loam
H3 - 22 to 60 inches: sandy loam

Properties and qualities

Slope: 1 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 to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water supply, 0 to 60 inches: Moderate (about 7.6 inches)

Interpretive groups

Land capability classification (irrigated): 5c
Land capability classification (nonirrigated): 6c
Hydrologic Soil Group: B
Ecological site: R048AY311CO - Mountain Outwash
Hydric soil rating: No

Minor Components

Corpening

Percent of map unit:
Hydric soil rating: No

Hopkins

Percent of map unit:
Hydric soil rating: No

DeC—Dewville loam, 5 to 15 percent slopes

Map Unit Setting

National map unit symbol: jqdv
Elevation: 9,000 to 10,000 feet
Frost-free period: 50 to 70 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Dewville

Setting

Landform: Fans, valleys
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium derived from sandstone and/or mixed alluvium derived from rhyolite and/or mixed, rhyolite alluvium derived from tuff

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
H1 - 1 to 10 inches: loam
H2 - 10 to 22 inches: sandy clay loam
H3 - 22 to 60 inches: sandy loam

Properties and qualities

Slope: 5 to 15 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 to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 7.6 inches)

Interpretive groups
Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6c
Hydrologic Soil Group: B
Ecological site: R048AY311CO - Mountain Outwash
Hydric soil rating: No

Minor Components

Corpening
Percent of map unit:
Hydric soil rating: No

Hopkins
Percent of map unit:
Hydric soil rating: No

Rock outcrop
Percent of map unit:
Hydric soil rating: No

IrB—Irim loam, 1 to 5 percent slopes

Map Unit Setting
National map unit symbol: jqf8
Elevation: 7,800 to 8,500 feet
Frost-free period: 60 to 70 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Irim and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Irim

Setting
Landform: Streams, flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Recent, mixed origin alluvium

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
H1 - 2 to 11 inches: loam
H2 - 11 to 60 inches: very gravelly loam

Properties and qualities

Slope: 1 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: RareNone
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): 5w
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Ecological site: R048AA241CO - Mountain Meadow Gunnison Basin LRU
Hydric soil rating: Yes

Minor Components

Big blue

Percent of map unit: 5 percent
Landform: Depressions
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Gas creek

Percent of map unit: 5 percent
Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Soil Information for All Uses

Soil Properties and Qualities

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

Soil Physical Properties

Soil Physical Properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

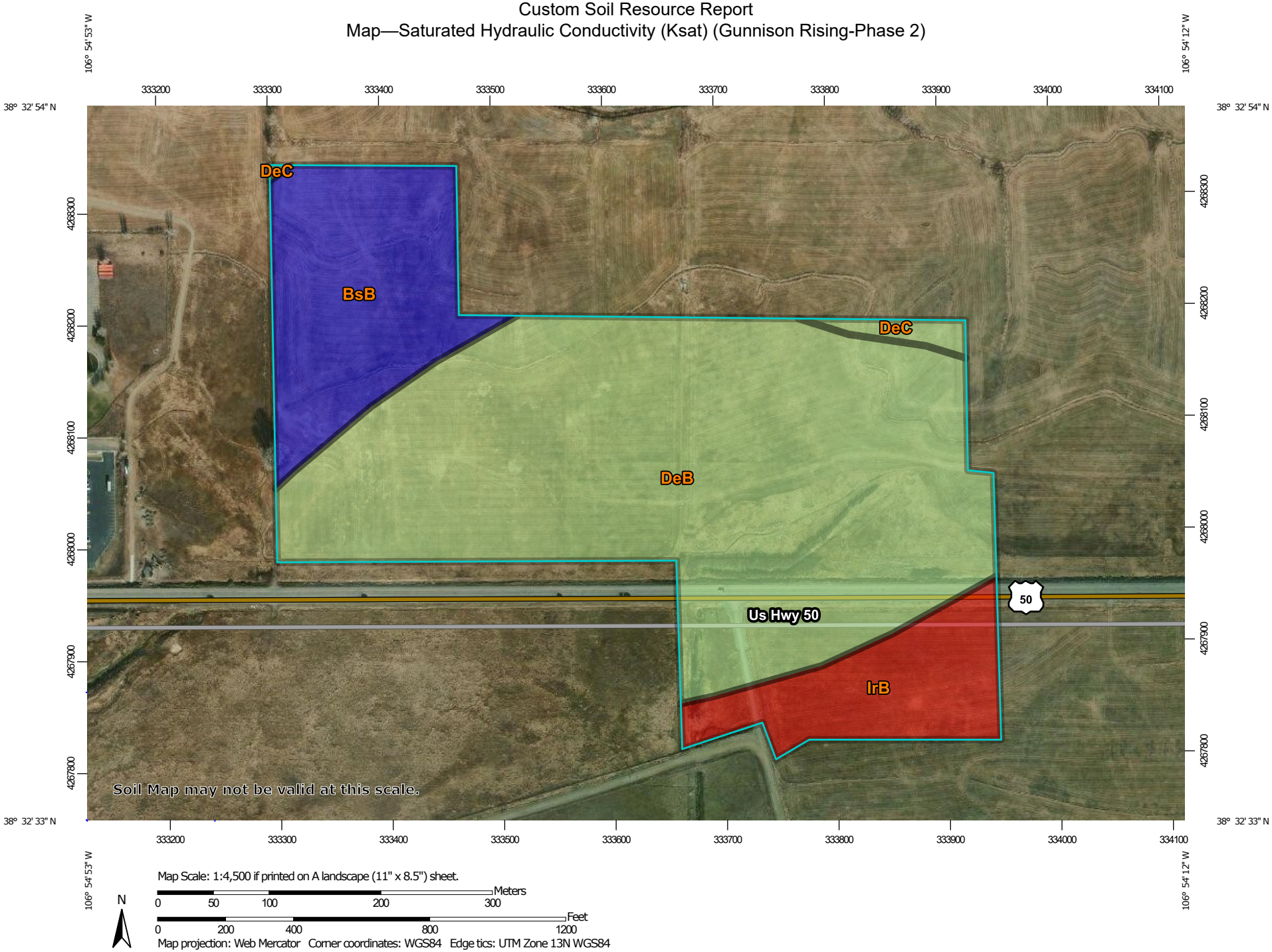
Saturated Hydraulic Conductivity (Ksat) (Gunnison Rising-Phase 2)

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

The numeric Ksat values have been grouped according to standard Ksat class limits.

Custom Soil Resource Report
Map—Saturated Hydraulic Conductivity (Ksat) (Gunnison Rising-Phase 2)



Map Scale: 1:4,500 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

<= 20.8718

> 20.8718 and <= 25.5763

> 25.5763 and <= 170.4360

Not rated or not available

Soil Rating Lines

<= 20.8718

> 20.8718 and <= 25.5763

> 25.5763 and <= 170.4360

Not rated or not available

Soil Rating Points

<= 20.8718

> 20.8718 and <= 25.5763

> 25.5763 and <= 170.4360

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Gunnison Area, Colorado, Parts of Gunnison, Hinsdale, and Saguache Counties
Survey Area Data: Version 14, Sep 2, 2021

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

Date(s) aerial images were photographed: Dec 31, 2009—Jun 17, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Saturated Hydraulic Conductivity (Ksat) (Gunnison Rising-Phase 2)

Map unit symbol	Map unit name	Rating (micrometers per second)	Acres in AOI	Percent of AOI
BsB	Bosler sandy loam, 1 to 8 percent slopes	170.4360	9.3	18.3%
DeB	Dewville loam, 1 to 5 percent slopes	25.5763	35.4	69.3%
DeC	Dewville loam, 5 to 15 percent slopes	25.5763	0.7	1.3%
IrB	Irim loam, 1 to 5 percent slopes	20.8718	5.6	11.1%
Totals for Area of Interest			**51.0**	**100.0%**

Rating Options—Saturated Hydraulic Conductivity (Ksat) (Gunnison Rising-Phase 2)

Units of Measure: micrometers per second

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Slowest

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): All Layers (Weighted Average)

Soil Qualities and Features

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

Hydrologic Soil Group (Gunnison Rising-Phase 2)

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

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

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

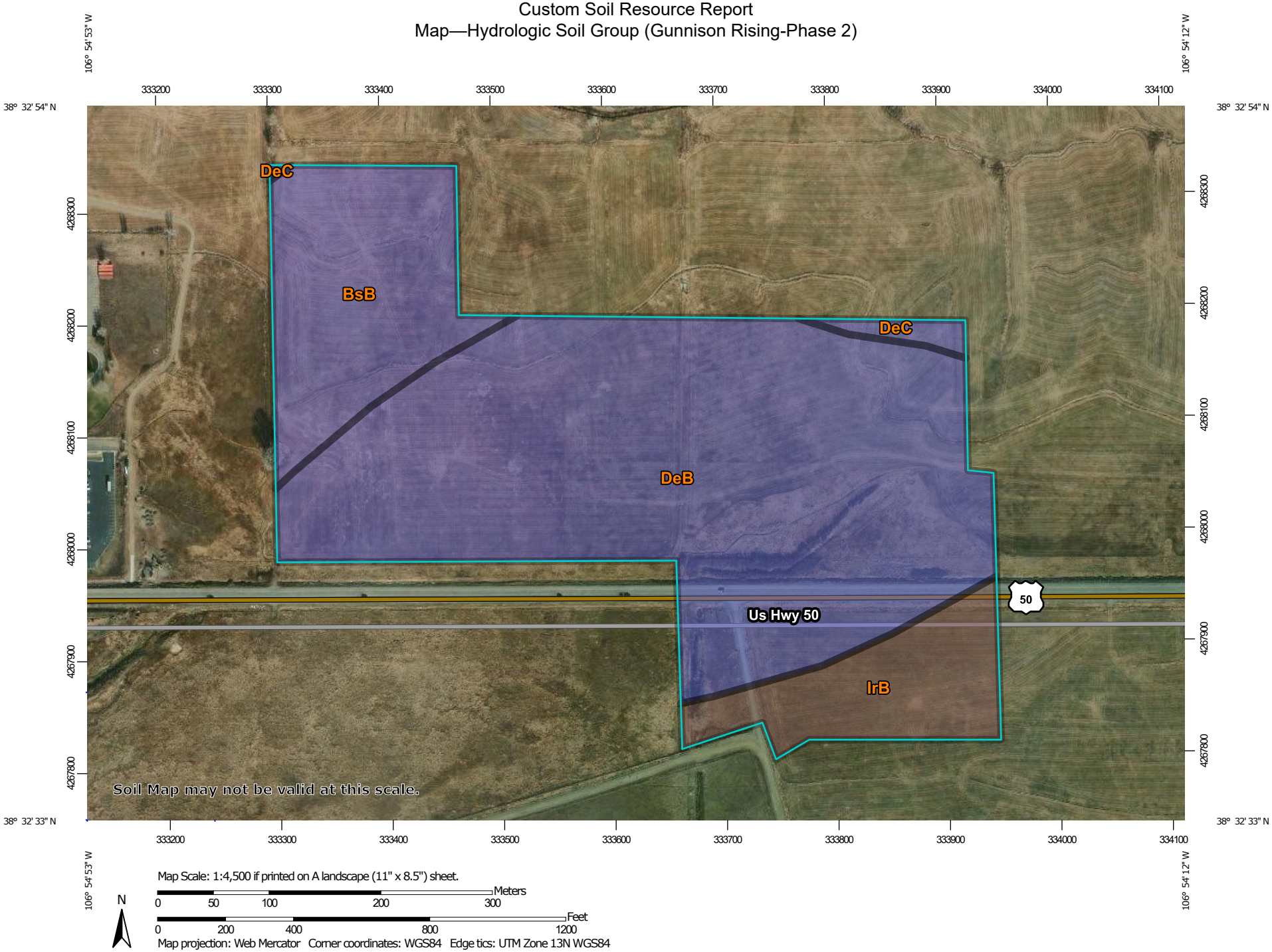
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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

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

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

Custom Soil Resource Report
Map—Hydrologic Soil Group (Gunnison Rising-Phase 2)



Map Scale: 1:4,500 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

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Rails

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US Routes

Major Roads

Local Roads

Background

Aerial Photography

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

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Date(s) aerial images were photographed: Dec 31, 2009—Jun 17, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydrologic Soil Group (Gunnison Rising-Phase 2)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BsB	Bosler sandy loam, 1 to 8 percent slopes	B	9.3	18.3%
DeB	Dewville loam, 1 to 5 percent slopes	B	35.4	69.3%
DeC	Dewville loam, 5 to 15 percent slopes	B	0.7	1.3%
IrB	Irim loam, 1 to 5 percent slopes	B/D	5.6	11.1%
Totals for Area of Interest			**51.0**	**100.0%**

Rating Options—Hydrologic Soil Group (Gunnison Rising-Phase 2)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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Appendix C

NOAA Precipitation Estimates

NOAA Atlas 14, Volume 8, Version 2
Location name: Gunnison, Colorado, USA*
Latitude: 38.543°, Longitude: -106.8967°
Elevation: m/ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.108** (0.091-0.127)	**0.142** (0.119-0.167)	**0.197** (0.165-0.233)	**0.242** (0.201-0.288)	**0.304** (0.239-0.377)	**0.351** (0.268-0.444)	**0.398** (0.290-0.519)	**0.446** (0.307-0.602)	**0.507** (0.332-0.711)	**0.554** (0.351-0.793)
10-min	**0.158** (0.133-0.186)	**0.208** (0.175-0.245)	**0.288** (0.241-0.341)	**0.355** (0.294-0.422)	**0.445** (0.350-0.552)	**0.515** (0.393-0.650)	**0.583** (0.425-0.760)	**0.652** (0.449-0.881)	**0.743** (0.486-1.04)	**0.811** (0.513-1.16)
15-min	**0.193** (0.162-0.227)	**0.254** (0.213-0.299)	**0.352** (0.294-0.416)	**0.433** (0.359-0.515)	**0.543** (0.427-0.673)	**0.627** (0.479-0.792)	**0.711** (0.518-0.927)	**0.796** (0.548-1.08)	**0.906** (0.592-1.27)	**0.989** (0.626-1.42)
30-min	**0.260** (0.219-0.306)	**0.344** (0.288-0.405)	**0.477** (0.399-0.564)	**0.585** (0.485-0.696)	**0.730** (0.573-0.900)	**0.838** (0.639-1.06)	**0.943** (0.687-1.23)	**1.05** (0.720-1.41)	**1.18** (0.771-1.65)	**1.28** (0.809-1.83)
60-min	**0.335** (0.282-0.394)	**0.425** (0.357-0.501)	**0.570** (0.476-0.673)	**0.687** (0.570-0.817)	**0.844** (0.663-1.04)	**0.962** (0.734-1.21)	**1.08** (0.785-1.40)	**1.19** (0.820-1.61)	**1.34** (0.874-1.87)	**1.45** (0.915-2.07)
2-hr	**0.410** (0.347-0.478)	**0.506** (0.429-0.592)	**0.662** (0.558-0.776)	**0.788** (0.659-0.930)	**0.959** (0.761-1.17)	**1.09** (0.838-1.36)	**1.21** (0.892-1.56)	**1.34** (0.930-1.79)	**1.50** (0.989-2.08)	**1.62** (1.03-2.29)
3-hr	**0.466** (0.397-0.541)	**0.556** (0.473-0.647)	**0.702** (0.595-0.820)	**0.823** (0.692-0.966)	**0.987** (0.790-1.20)	**1.11** (0.864-1.38)	**1.24** (0.917-1.59)	**1.36** (0.955-1.81)	**1.53** (1.02-2.11)	**1.65** (1.06-2.33)
6-hr	**0.578** (0.497-0.667)	**0.668** (0.573-0.770)	**0.815** (0.696-0.944)	**0.939** (0.796-1.09)	**1.11** (0.900-1.35)	**1.25** (0.979-1.54)	**1.38** (1.04-1.76)	**1.52** (1.08-2.01)	**1.71** (1.15-2.34)	**1.85** (1.21-2.59)
12-hr	**0.720** (0.624-0.823)	**0.823** (0.713-0.943)	**0.999** (0.861-1.15)	**1.15** (0.983-1.33)	**1.37** (1.12-1.65)	**1.54** (1.23-1.89)	**1.72** (1.31-2.18)	**1.91** (1.37-2.51)	**2.17** (1.48-2.95)	**2.37** (1.56-3.28)
24-hr	**0.875** (0.765-0.993)	**1.00** (0.874-1.14)	**1.22** (1.06-1.39)	**1.41** (1.22-1.61)	**1.68** (1.40-2.02)	**1.91** (1.53-2.33)	**2.14** (1.65-2.70)	**2.39** (1.74-3.12)	**2.73** (1.89-3.69)	**3.00** (2.01-4.13)
2-day	**1.04** (0.916-1.17)	**1.19** (1.05-1.34)	**1.44** (1.26-1.63)	**1.67** (1.45-1.89)	**1.99** (1.66-2.36)	**2.25** (1.82-2.72)	**2.52** (1.96-3.15)	**2.80** (2.07-3.63)	**3.20** (2.24-4.28)	**3.51** (2.38-4.78)
3-day	**1.15** (1.02-1.29)	**1.32** (1.17-1.48)	**1.59** (1.40-1.79)	**1.83** (1.60-2.07)	**2.17** (1.82-2.56)	**2.44** (1.99-2.93)	**2.72** (2.12-3.37)	**3.01** (2.23-3.87)	**3.41** (2.41-4.54)	**3.73** (2.54-5.05)
4-day	**1.25** (1.11-1.40)	**1.43** (1.27-1.59)	**1.71** (1.52-1.92)	**1.96** (1.72-2.21)	**2.31** (1.95-2.72)	**2.59** (2.12-3.10)	**2.87** (2.25-3.55)	**3.17** (2.36-4.05)	**3.57** (2.53-4.72)	**3.88** (2.66-5.23)
7-day	**1.49** (1.34-1.65)	**1.69** (1.51-1.87)	**2.01** (1.79-2.24)	**2.28** (2.02-2.55)	**2.65** (2.25-3.09)	**2.95** (2.43-3.49)	**3.24** (2.56-3.96)	**3.54** (2.66-4.49)	**3.94** (2.82-5.17)	**4.25** (2.95-5.69)
10-day	**1.69** (1.53-1.87)	**1.91** (1.71-2.11)	**2.25** (2.02-2.50)	**2.54** (2.26-2.83)	**2.94** (2.51-3.40)	**3.25** (2.69-3.82)	**3.55** (2.82-4.32)	**3.86** (2.92-4.86)	**4.28** (3.08-5.58)	**4.59** (3.20-6.11)
20-day	**2.27** (2.06-2.48)	**2.52** (2.29-2.76)	**2.93** (2.65-3.22)	**3.27** (2.94-3.62)	**3.73** (3.21-4.27)	**4.08** (3.42-4.76)	**4.43** (3.56-5.33)	**4.78** (3.65-5.96)	**5.24** (3.82-6.76)	**5.58** (3.95-7.37)
30-day	**2.75** (2.51-2.99)	**3.05** (2.79-3.33)	**3.54** (3.21-3.87)	**3.93** (3.55-4.32)	**4.46** (3.85-5.06)	**4.85** (4.08-5.61)	**5.23** (4.23-6.25)	**5.61** (4.31-6.94)	**6.10** (4.47-7.81)	**6.45** (4.59-8.47)
45-day	**3.38** (3.10-3.66)	**3.76** (3.45-4.08)	**4.36** (3.99-4.75)	**4.84** (4.39-5.29)	**5.46** (4.74-6.14)	**5.91** (5.00-6.79)	**6.33** (5.15-7.50)	**6.74** (5.21-8.27)	**7.24** (5.35-9.21)	**7.59** (5.45-9.91)
60-day	**3.93** (3.62-4.24)	**4.39** (4.04-4.74)	**5.11** (4.69-5.54)	**5.67** (5.16-6.18)	**6.38** (5.55-7.13)	**6.88** (5.84-7.85)	**7.34** (5.98-8.64)	**7.77** (6.02-9.47)	**8.27** (6.13-10.4)	**8.60** (6.21-11.2)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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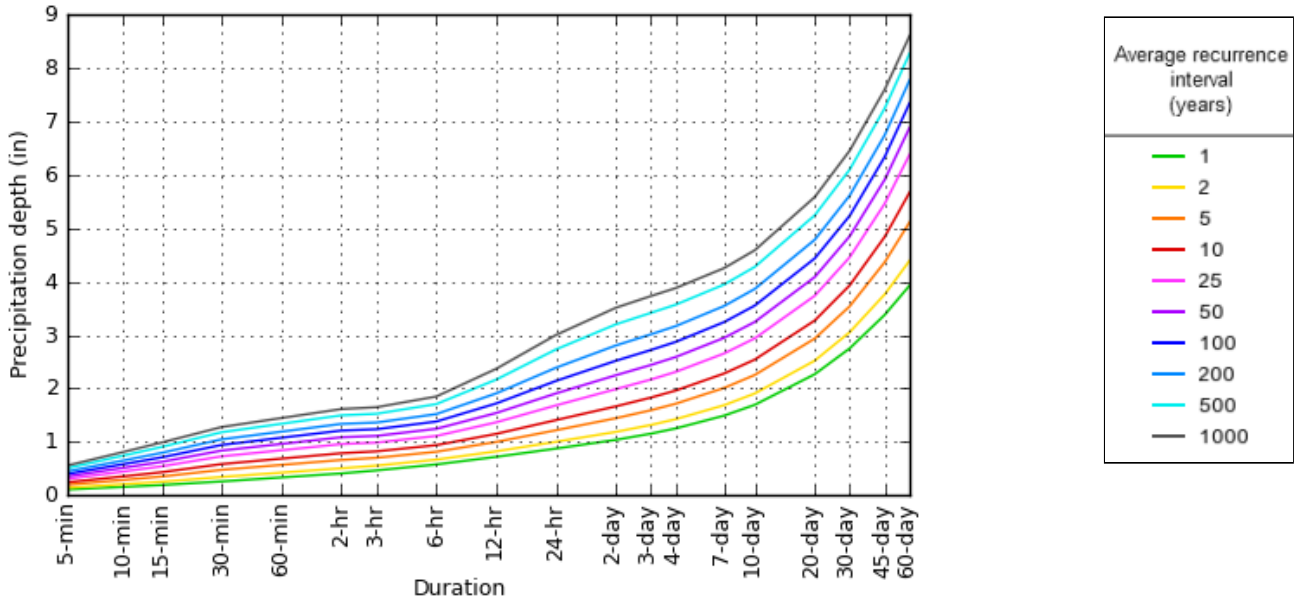
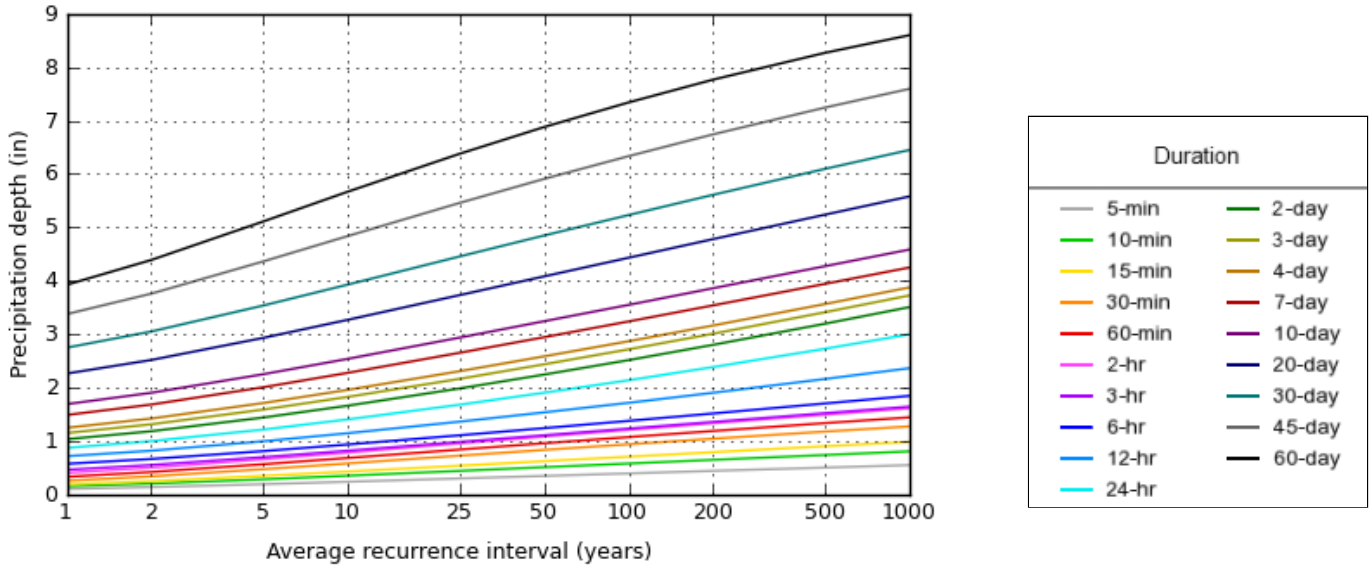
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 38.5430°, Longitude: -106.8967°





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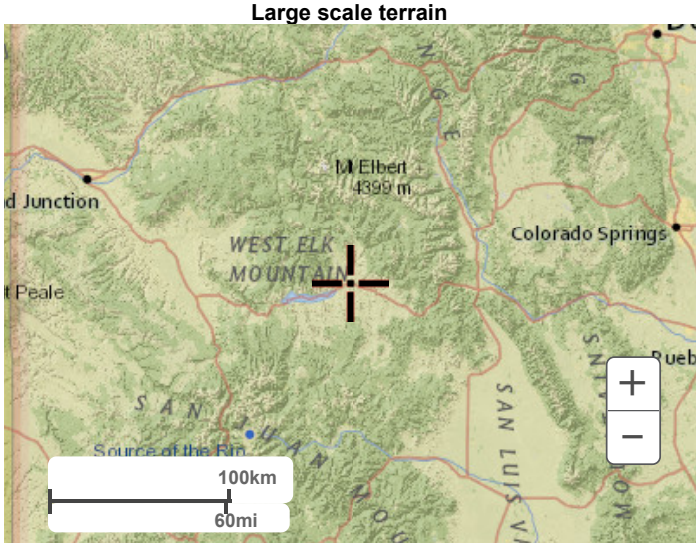
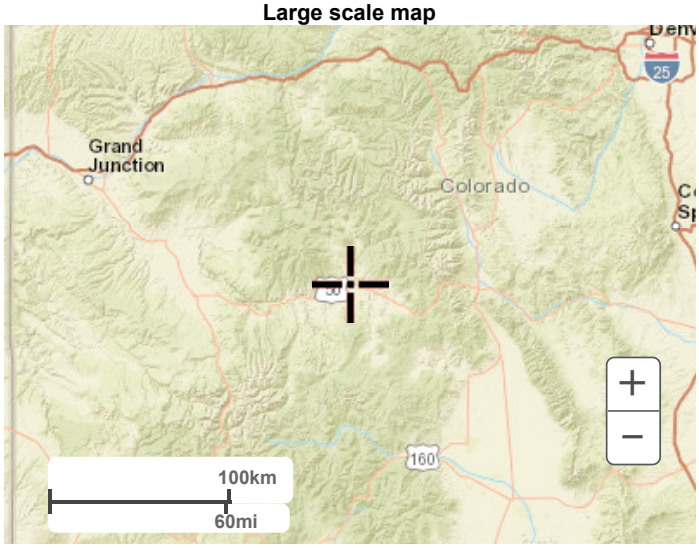
Maps & aerials

Small scale terrain

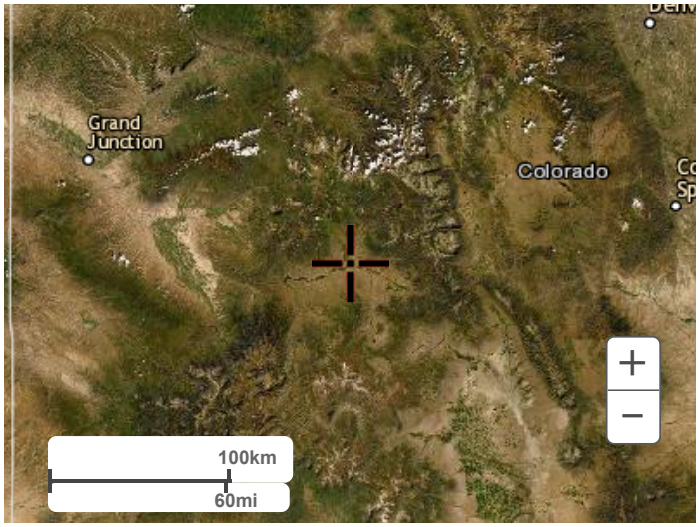
Large scale terrain



Large scale map



Large scale aerial



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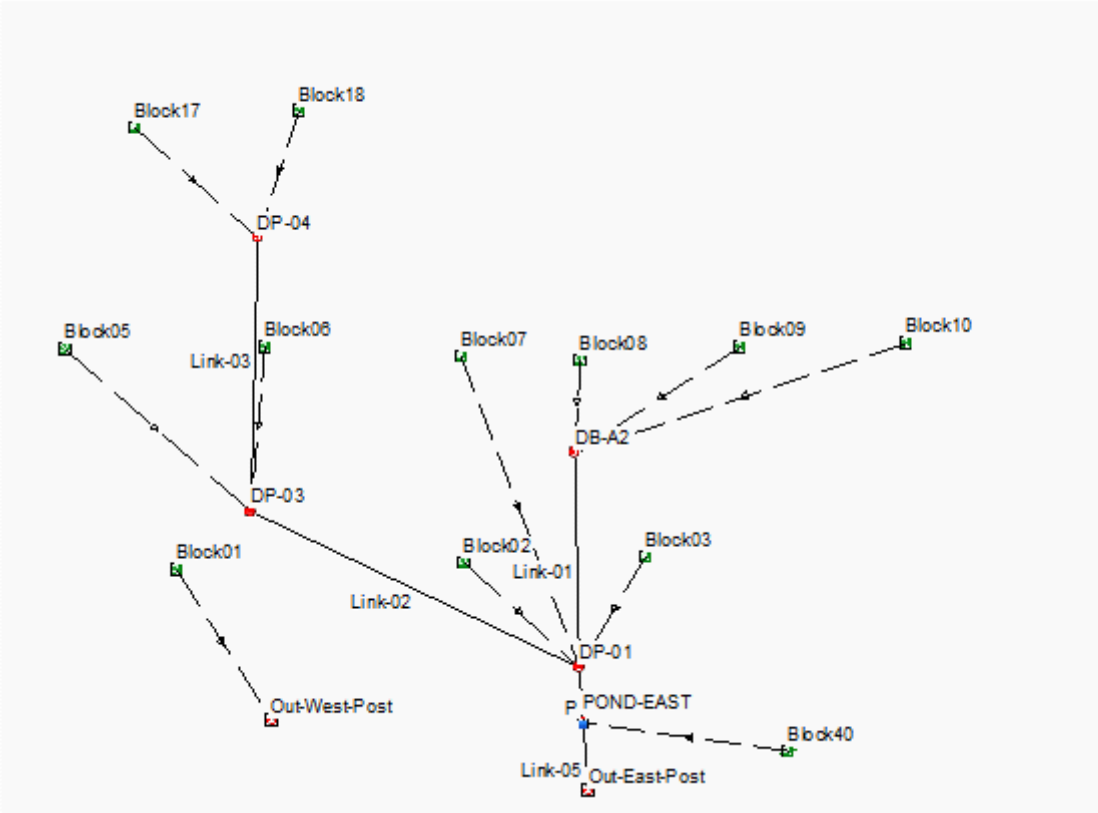
Appendix D

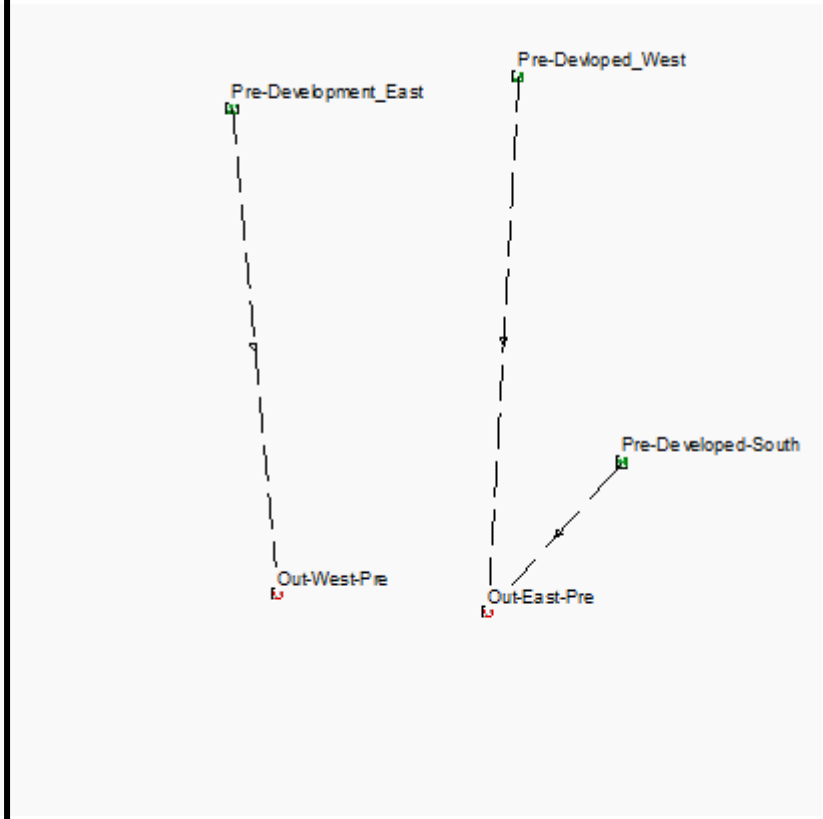
MODEL RESULTS

Drainage Schematic

Post Development



Pre Development



5-year Storm

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Autodesk® Storm and Sanitary Analysis 2016 - Version 13.0.94 (Build 0)
----------------------------------------------------------------------------------------

*******************
Project Description
*******************
File Name ................. 20020-Phase 2-Post.SPF


****************
Analysis Options
****************
Flow Units ................ cfs
Subbasin Hydrograph Method. SCS TR-55
Time of Concentration...... Kirpich
Link Routing Method ....... Kinematic Wave
Storage Node Exfiltration.. Constant rate, free surface area
Starting Date ............. OCT-04-2021 00:00:00
Ending Date ............... OCT-05-2021 00:00:00
Report Time Step .......... 00:05:00


*************
Element Count
*************
Number of rain gages ...... 1
Number of subbasins ....... 15
Number of nodes ........... 9
Number of links ........... 5


****************
Subbasin Summary
****************
Subbasin                 Total      Flow   Average    Raingage
                          Area    Length     Slope
ID                       acres        ft         %
-----------------------------------------------------------------
Block01                   3.86    475.00    1.7400    StormGage
Block02                   9.74   1071.00    1.1000    StormGage
Block03                   1.93    876.00    0.8000    StormGage
Block05                   1.43    500.00    3.0000    StormGage
Block06                   2.82    500.00    1.7000    StormGage
Block07                   2.82    500.00    1.5000    StormGage
Block08                   2.76    831.00    1.7000    StormGage
Block09                   2.76    507.00    1.3000    StormGage
Block10                   3.07    794.00    1.6000    StormGage
Block17                   1.65    698.00    2.6000    StormGage
Block18                   3.13    858.00    2.3000    StormGage
Block40                   8.38    500.00    0.5000    StormGage
Pre-Developed-South           8.38    801.00    0.5000    StormGage
Pre-Development_East          13.47   1208.00    2.7000    StormGage
Pre-Devloped_West          20.57   1204.00    1.2000    StormGage


************
Node Summary
************
Node                Element             Invert   Maximum    Ponded    External
ID                  Type             Elevation     Elev.      Area      Inflow
                                            ft        ft       ft²
-------------------------------------------------------------------------------
DB-A2               JUNCTION           7681.66   7686.09      0.00
DP-01               JUNCTION           7678.28   7685.00      0.00
DP-03               JUNCTION           7690.17   7690.67      0.00
DP-04               JUNCTION           7698.68   7699.28      0.00
```

Out-East-Post	OUTFALL	7678.23	7681.23	0.00
Out-East-Pre	OUTFALL	7678.28	7678.28	0.00
Out-West-Post	OUTFALL	7676.83	7676.83	0.00
Out-West-Pre	OUTFALL	7676.83	7676.83	0.00
POND-EAST	STORAGE	7676.00	7683.00	0.00

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
Link-01	DB-A2	DP-01	CONDUIT	300.7	1.1241	0.0120
Link-02	DP-03	DP-01	CHANNEL	450.0	2.6422	0.0150
Link-03	DP-04	DP-03	CHANNEL	375.0	2.2693	0.0150
Link-05	POND-EAST	Out-East-Post	CONDUIT	37.7	0.1856	0.0150
P	DP-01	POND-EAST	CONDUIT	45.4	5.0198	0.0150

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
Link-01	CIRCULAR	2.50	2.50	1	4.91	0.63	47.11
Link-02	IRREGULAR	0.50	12.50	1	3.16	0.24	19.68
Link-03	IRREGULAR	0.50	12.50	1	3.16	0.24	18.24
Link-05	CIRCULAR	3.00	3.00	2	7.07	0.75	24.90
P	CIRCULAR	2.50	2.50	1	4.91	0.63	79.65

****
Transect Summary
****

Transect 2' C&G
Area:

0.0002	0.0008	0.0017	0.0030	0.0047
0.0068	0.0093	0.0121	0.0154	0.0190
0.0229	0.0273	0.0320	0.0372	0.0427
0.0485	0.0548	0.0620	0.0709	0.0813
0.0933	0.1069	0.1221	0.1389	0.1573
0.1773	0.1988	0.2220	0.2467	0.2731
0.3010	0.3305	0.3616	0.3943	0.4286
0.4645	0.5020	0.5402	0.5785	0.6168
0.6551	0.6934	0.7317	0.7700	0.8083
0.8466	0.8850	0.9233	0.9617	1.0000

Hrad:

0.0193	0.0385	0.0578	0.0771	0.0963
0.1156	0.1348	0.1541	0.1734	0.1926
0.2119	0.2312	0.2504	0.2697	0.2890
0.3082	0.3275	0.3583	0.3797	0.3950

0.4065	0.4162	0.4249	0.4335	0.4422
0.4514	0.4611	0.4714	0.4822	0.4936
0.5054	0.5177	0.5305	0.5436	0.5571
0.5710	0.5851	0.6137	0.6433	0.6736
0.7047	0.7362	0.7683	0.8006	0.8333
0.8663	0.8994	0.9328	0.9663	1.0000

Width:

0.0096	0.0191	0.0287	0.0383	0.0479
0.0574	0.0670	0.0766	0.0861	0.0957
0.1053	0.1149	0.1244	0.1340	0.1436
0.1531	0.1627	0.2029	0.2430	0.2832
0.3234	0.3635	0.4037	0.4438	0.4840
0.5242	0.5643	0.6045	0.6446	0.6848
0.7250	0.7651	0.8053	0.8454	0.8856
0.9258	0.9659	0.9661	0.9662	0.9664
0.9666	0.9667	0.9669	0.9670	0.9672
0.9674	0.9675	0.9677	0.9678	1.0000

********** Runoff Quantity Continuity **********	Volume acre-ft	Depth inches
Total Precipitation	10.249	1.417
Surface Runoff	1.107	0.153
Continuity Error (%)	-0.001	

********** Flow Routing Continuity **********	Volume acre-ft	Volume Mgallons
External Inflow	0.000	0.000
External Outflow	2.053	0.669
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.713	0.232
Continuity Error (%)	0.001	

****
Composite Curve Number Computations Report
****

Subbasin Block01

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.66	B	98.00
Pasture, grassland, or range, Poor	3.20	B	79.00
Composite Area & Weighted CN	3.86		82.23

Subbasin Block02

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	1.75	B	98.00
Urban commercial, 85% imp	7.99	B	92.00
Composite Area & Weighted CN	9.74		93.08

Subbasin Block03

Soil/Surface Description	Area (acres)	Soil Group	CN

Paved parking & roofs	0.66	B	98.00
Urban commercial, 85% imp	1.27	B	92.00
Composite Area & Weighted CN	1.93		94.04

Subbasin Block05

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.49	B	98.00
1/8 acre lots, 65% impervious	0.94	B	85.00
Composite Area & Weighted CN	1.43		89.42

Subbasin Block06

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.96	B	98.00
1/4 acre lots, 38% impervious	1.86	B	75.00
Composite Area & Weighted CN	2.82		82.82

Subbasin Block07

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.96	B	98.00
1/4 acre lots, 38% impervious	1.86	B	75.00
Composite Area & Weighted CN	2.82		82.82

Subbasin Block08

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.94	B	98.00
1/4 acre lots, 38% impervious	1.82	B	75.00
Composite Area & Weighted CN	2.76		82.82

Subbasin Block09

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.94	B	98.00
1/4 acre lots, 38% impervious	1.82	B	75.00
Composite Area & Weighted CN	2.76		82.82

Subbasin Block10

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	1.11	B	98.00
1/4 acre lots, 38% impervious	1.84	B	75.00
> 75% grass cover, Good	0.12	B	61.00
Composite Area & Weighted CN	3.07		82.72

Subbasin Block17

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.51	B	98.00
1/8 acre lots, 65% impervious	1.14	B	85.00
Composite Area & Weighted CN	1.65		89.03

Subbasin Block18

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	1.03	B	98.00
1/4 acre lots, 38% impervious	2.10	B	75.00
Composite Area & Weighted CN	3.13		82.59

Subbasin Block40

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved parking & roofs	1.68	B	98.00
Urban commercial, 85% imp	6.70	B	92.00
Composite Area & Weighted CN	8.38		93.20

Subbasin Pre-Developed-South

Soil/Surface Description	Area (acres)	Soil Group	CN
Pasture, grassland, or range, Poor	8.38	B	79.00
Composite Area & Weighted CN	8.38		79.00

Subbasin Pre-Development_East

Soil/Surface Description	Area (acres)	Soil Group	CN
Pasture, grassland, or range, Poor	13.47	B	79.00
Composite Area & Weighted CN	13.47		79.00

Subbasin Pre-Devloped_West

Soil/Surface Description	Area (acres)	Soil Group	CN
Pasture, grassland, or range, Poor	20.57	B	79.00
Composite Area & Weighted CN	20.57		79.00

****
Kirpich Time of Concentration Computations Report
****

Tc = (0.0078 * (L^0.77) * (S^-0.385))

Where:

Tc = Time of Concentration (min)
L = Flow length (ft)
S = Slope (ft/ft)

```
-------------------
Subbasin Block01
-------------------

        Flow length (ft):                 475.00
        Slope (%):                          1.74
        Computed TOC (minutes):             4.27

-------------------
Subbasin Block02
-------------------

        Flow length (ft):                1071.00
        Slope (%):                          1.10
        Computed TOC (minutes):             9.53

-------------------
Subbasin Block03
-------------------

        Flow length (ft):                 876.00
        Slope (%):                          0.80
        Computed TOC (minutes):             9.23

-------------------
Subbasin Block05
-------------------

        Flow length (ft):                 500.00
        Slope (%):                          3.00
        Computed TOC (minutes):             3.60

-------------------
Subbasin Block06
-------------------

        Flow length (ft):                 500.00
        Slope (%):                          1.70
        Computed TOC (minutes):             4.48

-------------------
Subbasin Block07
-------------------

        Flow length (ft):                 500.00
        Slope (%):                          1.50
        Computed TOC (minutes):             4.70

-------------------
Subbasin Block08
-------------------

        Flow length (ft):                 831.00
        Slope (%):                          1.70
        Computed TOC (minutes):             6.63

-------------------
Subbasin Block09
-------------------

        Flow length (ft):                 507.00
        Slope (%):                          1.30
        Computed TOC (minutes):             5.02

-------------------
Subbasin Block10
```

```
-------------------

        Flow length (ft):                  794.00
        Slope (%):                           1.60
        Computed TOC (minutes):              6.55

-------------------
Subbasin Block17
-------------------

        Flow length (ft):                  698.00
        Slope (%):                           2.60
        Computed TOC (minutes):              4.92

-------------------
Subbasin Block18
-------------------

        Flow length (ft):                  858.00
        Slope (%):                           2.30
        Computed TOC (minutes):              6.05

-------------------
Subbasin Block40
-------------------

        Flow length (ft):                  500.00
        Slope (%):                           0.50
        Computed TOC (minutes):              7.18

-------------------------------
Subbasin Pre-Developed-South
-------------------------------

        Flow length (ft):                  801.00
        Slope (%):                           0.50
        Computed TOC (minutes):             10.32

--------------------------------
Subbasin Pre-Development_East
--------------------------------

        Flow length (ft):                 1208.00
        Slope (%):                           2.70
        Computed TOC (minutes):              7.40

-----------------------------
Subbasin Pre-Devloped_West
-----------------------------

        Flow length (ft):                 1204.00
        Slope (%):                           1.20
        Computed TOC (minutes):             10.08

***********************
Subbasin Runoff Summary
***********************
```

Subbasin ID	Total Precip in	Total Runoff in	Peak Runoff cfs	Weighted Curve Number	Time of Concentration days	hh:mm:ss
Block01	1.40	0.30	1.60	82.230	0	00:05:00
Block02	1.40	0.79	10.70	93.080	0	00:09:31
Block03	1.40	0.85	2.31	94.040	0	00:09:13
Block05	1.40	0.58	1.30	89.420	0	00:05:00

Block06	1.40	0.32	1.26	82.820	0	00:05:00
Block07	1.40	0.32	1.26	82.820	0	00:05:00
Block08	1.40	0.32	1.19	82.820	0	00:06:37
Block09	1.40	0.32	1.23	82.820	0	00:05:01
Block10	1.40	0.31	1.31	82.720	0	00:06:33
Block17	1.40	0.56	1.45	89.030	0	00:05:00
Block18	1.40	0.31	1.32	82.590	0	00:06:03
Block40	1.40	0.79	9.88	93.200	0	00:07:10
Pre-Developed-South	1.40	0.21	1.99	79.000	0	00:10:19
Pre-Development_East	1.40	0.21	3.51	79.000	0	00:07:24
Pre-Devloped_West	1.40	0.21	4.93	79.000	0	00:10:04

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
DB-A2	0.06	0.47	7682.13	0	12:04	0	0	0:00:00
DP-01	0.11	0.90	7679.18	0	12:04	0	0	0:00:00
DP-03	0.06	0.34	7690.51	0	12:02	0	0	0:00:00
DP-04	0.05	0.29	7698.97	0	12:00	0	0	0:00:00
Out-East-Post	0.15	0.67	7678.90	0	12:24	0	0	0:00:00
Out-East-Pre	0.00	0.00	7678.28	0	00:00	0	0	0:00:00
Out-West-Post	0.00	0.00	7676.83	0	00:00	0	0	0:00:00
Out-West-Pre	0.00	0.00	7676.83	0	00:00	0	0	0:00:00
POND-EAST	1.39	3.25	7679.25	0	12:24	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	hh:mm
DB-A2	JUNCTION	3.62	3.62	0	12:04	0.00		
DP-01	JUNCTION	13.75	22.26	0	12:04	0.00		
DP-03	JUNCTION	2.49	5.02	0	12:02	0.00		
DP-04	JUNCTION	2.62	2.62	0	12:00	0.00		
Out-East-Post	OUTFALL	0.00	5.37	0	12:24	0.00		
Out-East-Pre	OUTFALL	6.26	6.26	0	12:06	0.00		
Out-West-Post	OUTFALL	1.57	1.57	0	12:04	0.00		
Out-West-Pre	OUTFALL	3.21	3.21	0	12:06	0.00		
POND-EAST	STORAGE	9.34	31.43	0	12:04	0.00		

****
Storage Node Summary
****

Storage Node ID	Maximum Ponded	Maximum Ponded	Time of Max Ponded	Average Ponded	Average Ponded	Maximum Storage Node	Maximum Exfiltration	Time of Max. Exfiltration	Total Exfiltrated

	Volume 1000 ft³	Volume (%)	Volume days hh:mm	Volume 1000 ft³	Volume (%)	Outflow cfs	Rate cfm	Rate hh:mm:ss	Volume 1000 ft³
POND-EAST	38.950	46	0 12:24	16.634	20	5.36	0.00	0:00:00	0.000

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
Out-East-Post	49.79	1.22	5.37
Out-East-Pre	50.76	0.51	6.26
Out-West-Post	51.46	0.09	1.57
Out-West-Pre	50.76	0.24	3.21
System	50.69	2.06	11.05

****
Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow Occurrence days hh:mm	Maximum Velocity Attained ft/sec	Length Factor	Peak Flow during Analysis cfs	Design Flow Capacity cfs	Ratio of Maximum Flow /Design Flow	Ratio of Maximum Depth	Total Time minutes	Reported Condition
Link-01	CONDUIT	0 12:04	5.70	1.00	3.51	47.11	0.07	0.19	0	Calculated
Link-02	CHANNEL	0 12:04	4.41	1.00	5.00	19.68	0.25	0.67	0	Calculated
Link-03	CHANNEL	0 12:04	3.85	1.00	2.60	18.24	0.14	0.57	0	Calculated
Link-05	CONDUIT	0 12:24	2.30	1.00	5.37	49.80	0.11	0.22	0	Calculated
P	CONDUIT	0 12:04	13.90	1.00	22.23	79.65	0.28	0.36	0	Calculated

****
Highest Flow Instability Indexes
****
All links are stable.

WARNING 117 : Conduit outlet invert elevation defined for Conduit P is below downstream node invert elevation.
Assumed conduit outlet invert elevation equal to downstream node invert elevation.

```
Analysis began on:  Thu Dec 02 10:07:16 2021
Analysis ended on:  Thu Dec 02 10:07:17 2021
Total elapsed time: 00:00:01
```

10-year Storm

Autodesk® Storm and Sanitary Analysis 2016 - Version 13.0.94 (Build 0)

****
Project Description
****
File Name 20020-Phase 2-Post.SPF

****
Analysis Options
****
Flow Units ..... cfs
Subbasin Hydrograph Method. SCS TR-55
Time of Concentration..... Kirpich
Link Routing Method ..... Kinematic Wave
Storage Node Exfiltration.. Constant rate, free surface area
Starting Date OCT-04-2021 00:00:00
Ending Date OCT-05-2021 00:00:00
Report Time Step 00:05:00

****
Element Count
****
Number of rain gages 1
Number of subbasins 15
Number of nodes 9
Number of links 5

****
Subbasin Summary
****

Subbasin ID	Total Area acres	Flow Length ft	Average Slope %	Raingage
Block01	3.86	475.00	1.7400	StormGage
Block02	9.74	1071.00	1.1000	StormGage
Block03	1.93	876.00	0.8000	StormGage
Block05	1.43	500.00	3.0000	StormGage
Block06	2.82	500.00	1.7000	StormGage
Block07	2.82	500.00	1.5000	StormGage
Block08	2.76	831.00	1.7000	StormGage
Block09	2.76	507.00	1.3000	StormGage
Block10	3.07	794.00	1.6000	StormGage
Block17	1.65	698.00	2.6000	StormGage
Block18	3.13	858.00	2.3000	StormGage
Block40	8.38	500.00	0.5000	StormGage
Pre-Developed-South	8.38	801.00	0.5000	StormGage
Pre-Development_East	13.47	1208.00	2.7000	StormGage
Pre-Devloped_West	20.57	1204.00	1.2000	StormGage

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
DB-A2	JUNCTION	7681.66	7686.09	0.00	
DP-01	JUNCTION	7678.28	7685.00	0.00	
DP-03	JUNCTION	7690.17	7690.67	0.00	
DP-04	JUNCTION	7698.68	7699.28	0.00	

Out-East-Post	OUTFALL	7678.23	7681.23	0.00
Out-East-Pre	OUTFALL	7678.28	7678.28	0.00
Out-West-Post	OUTFALL	7676.83	7676.83	0.00
Out-West-Pre	OUTFALL	7676.83	7676.83	0.00
POND-EAST	STORAGE	7676.00	7683.00	0.00

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
Link-01	DB-A2	DP-01	CONDUIT	300.7	1.1241	0.0120
Link-02	DP-03	DP-01	CHANNEL	450.0	2.6422	0.0150
Link-03	DP-04	DP-03	CHANNEL	375.0	2.2693	0.0150
Link-05	POND-EAST	Out-East-Post	CONDUIT	37.7	0.1856	0.0150
P	DP-01	POND-EAST	CONDUIT	45.4	5.0198	0.0150

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
Link-01	CIRCULAR	2.50	2.50	1	4.91	0.63	47.11
Link-02	IRREGULAR	0.50	12.50	1	3.16	0.24	19.68
Link-03	IRREGULAR	0.50	12.50	1	3.16	0.24	18.24
Link-05	CIRCULAR	3.00	3.00	2	7.07	0.75	24.90
P	CIRCULAR	2.50	2.50	1	4.91	0.63	79.65

****
Transect Summary
****

Transect 2' C&G
Area:

0.0002	0.0008	0.0017	0.0030	0.0047
0.0068	0.0093	0.0121	0.0154	0.0190
0.0229	0.0273	0.0320	0.0372	0.0427
0.0485	0.0548	0.0620	0.0709	0.0813
0.0933	0.1069	0.1221	0.1389	0.1573
0.1773	0.1988	0.2220	0.2467	0.2731
0.3010	0.3305	0.3616	0.3943	0.4286
0.4645	0.5020	0.5402	0.5785	0.6168
0.6551	0.6934	0.7317	0.7700	0.8083
0.8466	0.8850	0.9233	0.9617	1.0000

Hrad:

0.0193	0.0385	0.0578	0.0771	0.0963
0.1156	0.1348	0.1541	0.1734	0.1926
0.2119	0.2312	0.2504	0.2697	0.2890
0.3082	0.3275	0.3583	0.3797	0.3950

0.4065	0.4162	0.4249	0.4335	0.4422
0.4514	0.4611	0.4714	0.4822	0.4936
0.5054	0.5177	0.5305	0.5436	0.5571
0.5710	0.5851	0.6137	0.6433	0.6736
0.7047	0.7362	0.7683	0.8006	0.8333
0.8663	0.8994	0.9328	0.9663	1.0000

Width:

0.0096	0.0191	0.0287	0.0383	0.0479
0.0574	0.0670	0.0766	0.0861	0.0957
0.1053	0.1149	0.1244	0.1340	0.1436
0.1531	0.1627	0.2029	0.2430	0.2832
0.3234	0.3635	0.4037	0.4438	0.4840
0.5242	0.5643	0.6045	0.6446	0.6848
0.7250	0.7651	0.8053	0.8454	0.8856
0.9258	0.9659	0.9661	0.9662	0.9664
0.9666	0.9667	0.9669	0.9670	0.9672
0.9674	0.9675	0.9677	0.9678	1.0000

********** Runoff Quantity Continuity **********	Volume acre-ft	Depth inches
Total Precipitation	10.321	1.427
Surface Runoff	1.123	0.155
Continuity Error (%)	-0.001	

********** Flow Routing Continuity **********	Volume acre-ft	Volume Mgallons
External Inflow	0.000	0.000
External Outflow	2.092	0.682
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.714	0.233
Continuity Error (%)	0.001	

****
Composite Curve Number Computations Report
****

Subbasin Block01

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.66	B	98.00
Pasture, grassland, or range, Poor	3.20	B	79.00
Composite Area & Weighted CN	3.86		82.23

Subbasin Block02

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	1.75	B	98.00
Urban commercial, 85% imp	7.99	B	92.00
Composite Area & Weighted CN	9.74		93.08

Subbasin Block03

Soil/Surface Description	Area (acres)	Soil Group	CN

Paved parking & roofs	0.66	B	98.00
Urban commercial, 85% imp	1.27	B	92.00
Composite Area & Weighted CN	1.93		94.04

Subbasin Block05

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.49	B	98.00
1/8 acre lots, 65% impervious	0.94	B	85.00
Composite Area & Weighted CN	1.43		89.42

Subbasin Block06

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.96	B	98.00
1/4 acre lots, 38% impervious	1.86	B	75.00
Composite Area & Weighted CN	2.82		82.82

Subbasin Block07

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.96	B	98.00
1/4 acre lots, 38% impervious	1.86	B	75.00
Composite Area & Weighted CN	2.82		82.82

Subbasin Block08

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.94	B	98.00
1/4 acre lots, 38% impervious	1.82	B	75.00
Composite Area & Weighted CN	2.76		82.82

Subbasin Block09

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.94	B	98.00
1/4 acre lots, 38% impervious	1.82	B	75.00
Composite Area & Weighted CN	2.76		82.82

Subbasin Block10

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	1.11	B	98.00
1/4 acre lots, 38% impervious	1.84	B	75.00
> 75% grass cover, Good	0.12	B	61.00
Composite Area & Weighted CN	3.07		82.72

Subbasin Block17

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.51	B	98.00
1/8 acre lots, 65% impervious	1.14	B	85.00
Composite Area & Weighted CN	1.65		89.03

Subbasin Block18

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	1.03	B	98.00
1/4 acre lots, 38% impervious	2.10	B	75.00
Composite Area & Weighted CN	3.13		82.59

Subbasin Block40

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved parking & roofs	1.68	B	98.00
Urban commercial, 85% imp	6.70	B	92.00
Composite Area & Weighted CN	8.38		93.20

Subbasin Pre-Developed-South

Soil/Surface Description	Area (acres)	Soil Group	CN
Pasture, grassland, or range, Poor	8.38	B	79.00
Composite Area & Weighted CN	8.38		79.00

Subbasin Pre-Development_East

Soil/Surface Description	Area (acres)	Soil Group	CN
Pasture, grassland, or range, Poor	13.47	B	79.00
Composite Area & Weighted CN	13.47		79.00

Subbasin Pre-Devloped_West

Soil/Surface Description	Area (acres)	Soil Group	CN
Pasture, grassland, or range, Poor	20.57	B	79.00
Composite Area & Weighted CN	20.57		79.00

****
Kirpich Time of Concentration Computations Report
****

Tc = (0.0078 * (L^0.77) * (S^-0.385))

Where:

Tc = Time of Concentration (min)
L = Flow length (ft)
S = Slope (ft/ft)

```
-------------------
Subbasin Block01
-------------------

        Flow length (ft):                 475.00
        Slope (%):                          1.74
        Computed TOC (minutes):             4.27

-------------------
Subbasin Block02
-------------------

        Flow length (ft):                1071.00
        Slope (%):                          1.10
        Computed TOC (minutes):             9.53

-------------------
Subbasin Block03
-------------------

        Flow length (ft):                 876.00
        Slope (%):                          0.80
        Computed TOC (minutes):             9.23

-------------------
Subbasin Block05
-------------------

        Flow length (ft):                 500.00
        Slope (%):                          3.00
        Computed TOC (minutes):             3.60

-------------------
Subbasin Block06
-------------------

        Flow length (ft):                 500.00
        Slope (%):                          1.70
        Computed TOC (minutes):             4.48

-------------------
Subbasin Block07
-------------------

        Flow length (ft):                 500.00
        Slope (%):                          1.50
        Computed TOC (minutes):             4.70

-------------------
Subbasin Block08
-------------------

        Flow length (ft):                 831.00
        Slope (%):                          1.70
        Computed TOC (minutes):             6.63

-------------------
Subbasin Block09
-------------------

        Flow length (ft):                 507.00
        Slope (%):                          1.30
        Computed TOC (minutes):             5.02

-------------------
Subbasin Block10
```

```
-------------------

        Flow length (ft):                  794.00
        Slope (%):                           1.60
        Computed TOC (minutes):              6.55

-------------------
Subbasin Block17
-------------------

        Flow length (ft):                  698.00
        Slope (%):                           2.60
        Computed TOC (minutes):              4.92

-------------------
Subbasin Block18
-------------------

        Flow length (ft):                  858.00
        Slope (%):                           2.30
        Computed TOC (minutes):              6.05

-------------------
Subbasin Block40
-------------------

        Flow length (ft):                  500.00
        Slope (%):                           0.50
        Computed TOC (minutes):              7.18

-------------------------------
Subbasin Pre-Developed-South
-------------------------------

        Flow length (ft):                  801.00
        Slope (%):                           0.50
        Computed TOC (minutes):             10.32

--------------------------------
Subbasin Pre-Development_East
--------------------------------

        Flow length (ft):                 1208.00
        Slope (%):                           2.70
        Computed TOC (minutes):              7.40

-----------------------------
Subbasin Pre-Devloped_West
-----------------------------

        Flow length (ft):                 1204.00
        Slope (%):                           1.20
        Computed TOC (minutes):             10.08

**********************
Subbasin Runoff Summary
**********************

-------------------------------------------------------------------------
Subbasin             Total     Total      Peak  Weighted           Time of
ID                  Precip    Runoff    Runoff     Curve     Concentration
                        in        in       cfs    Number    days  hh:mm:ss
-------------------------------------------------------------------------
Block01               1.41      0.30      1.63    82.230       0  00:05:00
Block02               1.41      0.79     10.81    93.080       0  00:09:31
Block03               1.41      0.86      2.33    94.040       0  00:09:13
Block05               1.41      0.58      1.31    89.420       0  00:05:00
```

Block06	1.41	0.32	1.29	82.820	0	00:05:00
Block07	1.41	0.32	1.29	82.820	0	00:05:00
Block08	1.41	0.32	1.21	82.820	0	00:06:37
Block09	1.41	0.32	1.26	82.820	0	00:05:01
Block10	1.41	0.32	1.33	82.720	0	00:06:33
Block17	1.41	0.56	1.47	89.030	0	00:05:00
Block18	1.41	0.32	1.35	82.590	0	00:06:03
Block40	1.41	0.80	9.99	93.200	0	00:07:10
Pre-Developed-South	1.41	0.22	2.05	79.000	0	00:10:19
Pre-Development_East	1.41	0.22	3.60	79.000	0	00:07:24
Pre-Devloped_West	1.41	0.22	5.05	79.000	0	00:10:04

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
DB-A2	0.06	0.47	7682.13	0	12:04	0	0	0:00:00
DP-01	0.11	0.91	7679.19	0	12:04	0	0	0:00:00
DP-03	0.06	0.34	7690.51	0	12:02	0	0	0:00:00
DP-04	0.05	0.29	7698.97	0	12:00	0	0	0:00:00
Out-East-Post	0.15	0.68	7678.91	0	12:24	0	0	0:00:00
Out-East-Pre	0.00	0.00	7678.28	0	00:00	0	0	0:00:00
Out-West-Post	0.00	0.00	7676.83	0	00:00	0	0	0:00:00
Out-West-Pre	0.00	0.00	7676.83	0	00:00	0	0	0:00:00
POND-EAST	1.39	3.27	7679.27	0	12:24	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	hh:mm
DB-A2	JUNCTION	3.69	3.69	0	12:04	0.00		
DP-01	JUNCTION	13.90	22.61	0	12:04	0.00		
DP-03	JUNCTION	2.54	5.12	0	12:02	0.00		
DP-04	JUNCTION	2.67	2.67	0	12:00	0.00		
Out-East-Post	OUTFALL	0.00	5.60	0	12:24	0.00		
Out-East-Pre	OUTFALL	6.43	6.43	0	12:06	0.00		
Out-West-Post	OUTFALL	1.60	1.60	0	12:04	0.00		
Out-West-Pre	OUTFALL	3.29	3.29	0	12:06	0.00		
POND-EAST	STORAGE	9.46	31.85	0	12:04	0.00		

****
Storage Node Summary
****

Storage Node ID	Maximum Ponded	Maximum Ponded	Time of Max Ponded	Average Ponded	Average Ponded	Maximum Storage Node	Maximum Exfiltration	Time of Max. Exfiltration	Total Exfiltrated

	Volume 1000 ft³	Volume (%)	Volume days hh:mm	Volume 1000 ft³	Volume (%)	Outflow cfs	Rate cfm	Rate hh:mm:ss	Volume 1000 ft³
POND-EAST	39.227	47	0 12:24	16.662	20	5.61	0.00	0:00:00	0.000

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
Out-East-Post	49.79	1.24	5.60
Out-East-Pre	50.76	0.52	6.43
Out-West-Post	51.46	0.10	1.60
Out-West-Pre	50.76	0.24	3.29
System	50.69	2.10	11.51

****
Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow Occurrence days hh:mm	Maximum Velocity Attained ft/sec	Length Factor	Peak Flow during Analysis cfs	Design Flow Capacity cfs	Ratio of Maximum Flow /Design Flow	Ratio of Maximum Depth	Total Time minutes	Reported Condition
Link-01	CONDUIT	0 12:04	5.68	1.00	3.62	47.11	0.08	0.19	0	Calculated
Link-02	CHANNEL	0 12:04	4.42	1.00	5.09	19.68	0.26	0.68	0	Calculated
Link-03	CHANNEL	0 12:04	3.87	1.00	2.65	18.24	0.15	0.57	0	Calculated
Link-05	CONDUIT	0 12:24	2.33	1.00	5.60	49.80	0.11	0.23	0	Calculated
P	CONDUIT	0 12:04	13.95	1.00	22.56	79.65	0.28	0.36	0	Calculated

****
Highest Flow Instability Indexes
****
Link Link-05 (2)

WARNING 117 : Conduit outlet invert elevation defined for Conduit P is below downstream node invert elevation.
Assumed conduit outlet invert elevation equal to downstream node invert elevation.

```
Analysis began on:  Thu Dec 02 10:04:16 2021
Analysis ended on:  Thu Dec 02 10:04:18 2021
Total elapsed time: 00:00:02
```

25-year Storm

Autodesk® Storm and Sanitary Analysis 2016 - Version 13.0.94 (Build 0)

****
Project Description
****
File Name 20020-Phase 2-Post.SPF

****
Analysis Options
****
Flow Units ..... cfs
Subbasin Hydrograph Method. SCS TR-55
Time of Concentration..... Kirpich
Link Routing Method ..... Kinematic Wave
Storage Node Exfiltration.. Constant rate, free surface area
Starting Date OCT-04-2021 00:00:00
Ending Date OCT-05-2021 00:00:00
Report Time Step 00:05:00

****
Element Count
****
Number of rain gages 1
Number of subbasins 15
Number of nodes 9
Number of links 5

****
Subbasin Summary
****

Subbasin ID	Total Area acres	Flow Length ft	Average Slope %	Raingage
Block01	3.86	475.00	1.7400	StormGage
Block02	9.74	1071.00	1.1000	StormGage
Block03	1.93	876.00	0.8000	StormGage
Block05	1.43	500.00	3.0000	StormGage
Block06	2.82	500.00	1.7000	StormGage
Block07	2.82	500.00	1.5000	StormGage
Block08	2.76	831.00	1.7000	StormGage
Block09	2.76	507.00	1.3000	StormGage
Block10	3.07	794.00	1.6000	StormGage
Block17	1.65	698.00	2.6000	StormGage
Block18	3.13	858.00	2.3000	StormGage
Block40	8.38	500.00	0.5000	StormGage
Pre-Developed-South	8.38	801.00	0.5000	StormGage
Pre-Development_East	13.47	1208.00	2.7000	StormGage
Pre-Devloped_West	20.57	1204.00	1.2000	StormGage

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
DB-A2	JUNCTION	7681.66	7686.09	0.00	
DP-01	JUNCTION	7678.28	7685.00	0.00	
DP-03	JUNCTION	7690.17	7690.67	0.00	
DP-04	JUNCTION	7698.68	7699.28	0.00	

Out-East-Post	OUTFALL	7678.23	7681.23	0.00
Out-East-Pre	OUTFALL	7678.28	7678.28	0.00
Out-West-Post	OUTFALL	7676.83	7676.83	0.00
Out-West-Pre	OUTFALL	7676.83	7676.83	0.00
POND-EAST	STORAGE	7676.00	7683.00	0.00

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
Link-01	DB-A2	DP-01	CONDUIT	300.7	1.1241	0.0120
Link-02	DP-03	DP-01	CHANNEL	450.0	2.6422	0.0150
Link-03	DP-04	DP-03	CHANNEL	375.0	2.2693	0.0150
Link-05	POND-EAST	Out-East-Post	CONDUIT	37.7	0.1856	0.0150
P	DP-01	POND-EAST	CONDUIT	45.4	5.0198	0.0150

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
Link-01	CIRCULAR	2.50	2.50	1	4.91	0.63	47.11
Link-02	IRREGULAR	0.50	12.50	1	3.16	0.24	19.68
Link-03	IRREGULAR	0.50	12.50	1	3.16	0.24	18.24
Link-05	CIRCULAR	3.00	3.00	2	7.07	0.75	24.90
P	CIRCULAR	2.50	2.50	1	4.91	0.63	79.65

****
Transect Summary
****

Transect 2' C&G
Area:

0.0002	0.0008	0.0017	0.0030	0.0047
0.0068	0.0093	0.0121	0.0154	0.0190
0.0229	0.0273	0.0320	0.0372	0.0427
0.0485	0.0548	0.0620	0.0709	0.0813
0.0933	0.1069	0.1221	0.1389	0.1573
0.1773	0.1988	0.2220	0.2467	0.2731
0.3010	0.3305	0.3616	0.3943	0.4286
0.4645	0.5020	0.5402	0.5785	0.6168
0.6551	0.6934	0.7317	0.7700	0.8083
0.8466	0.8850	0.9233	0.9617	1.0000

Hrad:

0.0193	0.0385	0.0578	0.0771	0.0963
0.1156	0.1348	0.1541	0.1734	0.1926
0.2119	0.2312	0.2504	0.2697	0.2890
0.3082	0.3275	0.3583	0.3797	0.3950

0.4065	0.4162	0.4249	0.4335	0.4422
0.4514	0.4611	0.4714	0.4822	0.4936
0.5054	0.5177	0.5305	0.5436	0.5571
0.5710	0.5851	0.6137	0.6433	0.6736
0.7047	0.7362	0.7683	0.8006	0.8333
0.8663	0.8994	0.9328	0.9663	1.0000

Width:

0.0096	0.0191	0.0287	0.0383	0.0479
0.0574	0.0670	0.0766	0.0861	0.0957
0.1053	0.1149	0.1244	0.1340	0.1436
0.1531	0.1627	0.2029	0.2430	0.2832
0.3234	0.3635	0.4037	0.4438	0.4840
0.5242	0.5643	0.6045	0.6446	0.6848
0.7250	0.7651	0.8053	0.8454	0.8856
0.9258	0.9659	0.9661	0.9662	0.9664
0.9666	0.9667	0.9669	0.9670	0.9672
0.9674	0.9675	0.9677	0.9678	1.0000

********** Runoff Quantity Continuity **********	Volume acre-ft	Depth inches
Total Precipitation	12.298	1.701
Surface Runoff	1.593	0.220
Continuity Error (%)	-0.001	

********** Flow Routing Continuity **********	Volume acre-ft	Volume Mgallons
External Inflow	0.000	0.000
External Outflow	3.257	1.061
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.724	0.236
Continuity Error (%)	0.001	

****
Composite Curve Number Computations Report
****

Subbasin Block01

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.66	B	98.00
Pasture, grassland, or range, Poor	3.20	B	79.00
Composite Area & Weighted CN	3.86		82.23

Subbasin Block02

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	1.75	B	98.00
Urban commercial, 85% imp	7.99	B	92.00
Composite Area & Weighted CN	9.74		93.08

Subbasin Block03

Soil/Surface Description	Area (acres)	Soil Group	CN

Paved parking & roofs	0.66	B	98.00
Urban commercial, 85% imp	1.27	B	92.00
Composite Area & Weighted CN	1.93		94.04

Subbasin Block05

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.49	B	98.00
1/8 acre lots, 65% impervious	0.94	B	85.00
Composite Area & Weighted CN	1.43		89.42

Subbasin Block06

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.96	B	98.00
1/4 acre lots, 38% impervious	1.86	B	75.00
Composite Area & Weighted CN	2.82		82.82

Subbasin Block07

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.96	B	98.00
1/4 acre lots, 38% impervious	1.86	B	75.00
Composite Area & Weighted CN	2.82		82.82

Subbasin Block08

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.94	B	98.00
1/4 acre lots, 38% impervious	1.82	B	75.00
Composite Area & Weighted CN	2.76		82.82

Subbasin Block09

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.94	B	98.00
1/4 acre lots, 38% impervious	1.82	B	75.00
Composite Area & Weighted CN	2.76		82.82

Subbasin Block10

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	1.11	B	98.00
1/4 acre lots, 38% impervious	1.84	B	75.00
> 75% grass cover, Good	0.12	B	61.00
Composite Area & Weighted CN	3.07		82.72

Subbasin Block17

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.51	B	98.00
1/8 acre lots, 65% impervious	1.14	B	85.00
Composite Area & Weighted CN	1.65		89.03

Subbasin Block18

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	1.03	B	98.00
1/4 acre lots, 38% impervious	2.10	B	75.00
Composite Area & Weighted CN	3.13		82.59

Subbasin Block40

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved parking & roofs	1.68	B	98.00
Urban commercial, 85% imp	6.70	B	92.00
Composite Area & Weighted CN	8.38		93.20

Subbasin Pre-Developed-South

Soil/Surface Description	Area (acres)	Soil Group	CN
Pasture, grassland, or range, Poor	8.38	B	79.00
Composite Area & Weighted CN	8.38		79.00

Subbasin Pre-Development_East

Soil/Surface Description	Area (acres)	Soil Group	CN
Pasture, grassland, or range, Poor	13.47	B	79.00
Composite Area & Weighted CN	13.47		79.00

Subbasin Pre-Devloped_West

Soil/Surface Description	Area (acres)	Soil Group	CN
Pasture, grassland, or range, Poor	20.57	B	79.00
Composite Area & Weighted CN	20.57		79.00

****
Kirpich Time of Concentration Computations Report
****

Tc = (0.0078 * (L^0.77) * (S^-0.385))

Where:

Tc = Time of Concentration (min)
L = Flow length (ft)
S = Slope (ft/ft)

```
-------------------
Subbasin Block01
-------------------

        Flow length (ft):                 475.00
        Slope (%):                          1.74
        Computed TOC (minutes):             4.27

-------------------
Subbasin Block02
-------------------

        Flow length (ft):                1071.00
        Slope (%):                          1.10
        Computed TOC (minutes):             9.53

-------------------
Subbasin Block03
-------------------

        Flow length (ft):                 876.00
        Slope (%):                          0.80
        Computed TOC (minutes):             9.23

-------------------
Subbasin Block05
-------------------

        Flow length (ft):                 500.00
        Slope (%):                          3.00
        Computed TOC (minutes):             3.60

-------------------
Subbasin Block06
-------------------

        Flow length (ft):                 500.00
        Slope (%):                          1.70
        Computed TOC (minutes):             4.48

-------------------
Subbasin Block07
-------------------

        Flow length (ft):                 500.00
        Slope (%):                          1.50
        Computed TOC (minutes):             4.70

-------------------
Subbasin Block08
-------------------

        Flow length (ft):                 831.00
        Slope (%):                          1.70
        Computed TOC (minutes):             6.63

-------------------
Subbasin Block09
-------------------

        Flow length (ft):                 507.00
        Slope (%):                          1.30
        Computed TOC (minutes):             5.02

-------------------
Subbasin Block10
```

```
-------------------

        Flow length (ft):                  794.00
        Slope (%):                           1.60
        Computed TOC (minutes):              6.55

-------------------
Subbasin Block17
-------------------

        Flow length (ft):                  698.00
        Slope (%):                           2.60
        Computed TOC (minutes):              4.92

-------------------
Subbasin Block18
-------------------

        Flow length (ft):                  858.00
        Slope (%):                           2.30
        Computed TOC (minutes):              6.05

-------------------
Subbasin Block40
-------------------

        Flow length (ft):                  500.00
        Slope (%):                           0.50
        Computed TOC (minutes):              7.18

-------------------------------
Subbasin Pre-Developed-South
-------------------------------

        Flow length (ft):                  801.00
        Slope (%):                           0.50
        Computed TOC (minutes):             10.32

--------------------------------
Subbasin Pre-Development_East
--------------------------------

        Flow length (ft):                 1208.00
        Slope (%):                           2.70
        Computed TOC (minutes):              7.40

-----------------------------
Subbasin Pre-Devloped_West
-----------------------------

        Flow length (ft):                 1204.00
        Slope (%):                           1.20
        Computed TOC (minutes):             10.08

***********************
Subbasin Runoff Summary
***********************
```

Subbasin ID	Total Precip in	Total Runoff in	Peak Runoff cfs	Weighted Curve Number	Time of Concentration days	hh:mm:ss
Block01	1.68	0.46	2.61	82.230	0	00:05:00
Block02	1.68	1.03	13.98	93.080	0	00:09:31
Block03	1.68	1.10	2.97	94.040	0	00:09:13
Block05	1.68	0.79	1.80	89.420	0	00:05:00

Block06	1.68	0.48	2.03	82.820	0	00:05:00
Block07	1.68	0.48	2.03	82.820	0	00:05:00
Block08	1.68	0.48	1.88	82.820	0	00:06:37
Block09	1.68	0.48	1.98	82.820	0	00:05:01
Block10	1.68	0.47	2.08	82.720	0	00:06:33
Block17	1.68	0.77	2.02	89.030	0	00:05:00
Block18	1.68	0.47	2.12	82.590	0	00:06:03
Block40	1.68	1.04	12.90	93.200	0	00:07:10
Pre-Developed-South	1.68	0.35	3.59	79.000	0	00:10:19
Pre-Development_East	1.68	0.35	6.16	79.000	0	00:07:24
Pre-Devloped_West	1.68	0.35	8.87	79.000	0	00:10:04

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
DB-A2	0.07	0.59	7682.25	0	12:04	0	0	0:00:00
DP-01	0.13	1.09	7679.37	0	12:04	0	0	0:00:00
DP-03	0.07	0.38	7690.55	0	12:02	0	0	0:00:00
DP-04	0.06	0.32	7699.00	0	12:00	0	0	0:00:00
Out-East-Post	0.18	1.14	7679.37	0	12:14	0	0	0:00:00
Out-East-Pre	0.00	0.00	7678.28	0	00:00	0	0	0:00:00
Out-West-Post	0.00	0.00	7676.83	0	00:00	0	0	0:00:00
Out-West-Pre	0.00	0.00	7676.83	0	00:00	0	0	0:00:00
POND-EAST	1.45	4.01	7680.01	0	12:14	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	hh:mm
DB-A2	JUNCTION	5.67	5.67	0	12:04	0.00		
DP-01	JUNCTION	18.20	31.31	0	12:04	0.00		
DP-03	JUNCTION	3.77	7.57	0	12:02	0.00		
DP-04	JUNCTION	3.99	3.99	0	12:00	0.00		
Out-East-Post	OUTFALL	0.00	15.33	0	12:14	0.00		
Out-East-Pre	OUTFALL	11.72	11.72	0	12:06	0.00		
Out-West-Post	OUTFALL	2.53	2.53	0	12:00	0.00		
Out-West-Pre	OUTFALL	5.84	5.84	0	12:04	0.00		
POND-EAST	STORAGE	12.26	43.25	0	12:04	0.00		

****
Storage Node Summary
****

Storage Node ID	Maximum Ponded	Maximum Ponded	Time of Max Ponded	Average Ponded	Average Ponded	Maximum Storage Node	Maximum Exfiltration	Time of Max. Exfiltration	Total Exfiltrated

```
                          Volume      Volume         Volume     Volume    Volume       Outflow
Rate          Rate       Volume
                         1000 ft³         (%)     days hh:mm   1000 ft³       (%)           cfs
cfm      hh:mm:ss     1000 ft³

-------------------------------------------------------------------------------------------------
-----------------------------------
  POND-EAST               48.085          57       0  12:14     17.410        21         15.38
0.00       0:00:00        0.000


  ************************
  Outfall Loading Summary
  ************************

  ------------------------------------------------
  Outfall Node ID        Flow   Average      Peak
                   Frequency      Flow    Inflow
                         (%)       cfs       cfs
  ------------------------------------------------
  Out-East-Post         50.07      1.90     15.33
  Out-East-Pre          51.46      0.81     11.72
  Out-West-Post         52.70      0.14      2.53
  Out-West-Pre          51.46      0.38      5.84
  ------------------------------------------------
  System                51.42      3.24     29.21


  *****************
  Link Flow Summary
  *****************


-------------------------------------------------------------------------------------------------
--------------------------------
  Link ID              Element       Time of   Maximum  Length   Peak Flow      Design  Ratio of
Ratio of       Total  Reported
                       Type        Peak Flow  Velocity  Factor      during        Flow   Maximum
Maximum        Time  Condition
                                  Occurrence  Attained            Analysis    Capacity   /Design
Flow  Surcharged
                                  days hh:mm    ft/sec                 cfs         cfs      Flow
Depth     minutes

-------------------------------------------------------------------------------------------------
--------------------------------
  Link-01              CONDUIT      0  12:02      6.50    1.00        5.68       47.11      0.12
0.23           0  Calculated
  Link-02              CHANNEL      0  12:04      4.62    1.00        7.50       19.68      0.38
0.75           0  Calculated
  Link-03              CHANNEL      0  12:02      3.99    1.00        3.94       18.24      0.22
0.64           0  Calculated
  Link-05              CONDUIT      0  12:14      3.10    1.00       15.33       49.80      0.31
0.38           0  Calculated
  P                    CONDUIT      0  12:04     15.24    1.00       31.31       79.65      0.39
0.44           0  Calculated


  *********************************
  Highest Flow Instability Indexes
  *********************************
  Link Link-05 (2)

  WARNING 117 : Conduit outlet invert elevation defined for Conduit P is below downstream node
invert elevation.
                Assumed conduit outlet invert elevation equal to downstream node invert
elevation.
```

```
Analysis began on:  Thu Dec 02 10:03:14 2021
Analysis ended on:  Thu Dec 02 10:03:16 2021
Total elapsed time: 00:00:02
```

50-year Storm

Autodesk® Storm and Sanitary Analysis 2016 - Version 13.0.94 (Build 0)

****
Project Description
****
File Name 20020-Phase 2-Post.SPF

****
Analysis Options
****
Flow Units ..... cfs
Subbasin Hydrograph Method. SCS TR-55
Time of Concentration..... Kirpich
Link Routing Method ..... Kinematic Wave
Storage Node Exfiltration.. Constant rate, free surface area
Starting Date OCT-04-2021 00:00:00
Ending Date OCT-05-2021 00:00:00
Report Time Step 00:05:00

****
Element Count
****
Number of rain gages 1
Number of subbasins 15
Number of nodes 9
Number of links 5

****
Subbasin Summary
****

Subbasin ID	Total Area acres	Flow Length ft	Average Slope %	Raingage
Block01	3.86	475.00	1.7400	StormGage
Block02	9.74	1071.00	1.1000	StormGage
Block03	1.93	876.00	0.8000	StormGage
Block05	1.43	500.00	3.0000	StormGage
Block06	2.82	500.00	1.7000	StormGage
Block07	2.82	500.00	1.5000	StormGage
Block08	2.76	831.00	1.7000	StormGage
Block09	2.76	507.00	1.3000	StormGage
Block10	3.07	794.00	1.6000	StormGage
Block17	1.65	698.00	2.6000	StormGage
Block18	3.13	858.00	2.3000	StormGage
Block40	8.38	500.00	0.5000	StormGage
Pre-Developed-South	8.38	801.00	0.5000	StormGage
Pre-Development_East	13.47	1208.00	2.7000	StormGage
Pre-Devloped_West	20.57	1204.00	1.2000	StormGage

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
DB-A2	JUNCTION	7681.66	7686.09	0.00	
DP-01	JUNCTION	7678.28	7685.00	0.00	
DP-03	JUNCTION	7690.17	7690.67	0.00	
DP-04	JUNCTION	7698.68	7699.28	0.00	

Out-East-Post	OUTFALL	7678.23	7681.23	0.00
Out-East-Pre	OUTFALL	7678.28	7678.28	0.00
Out-West-Post	OUTFALL	7676.83	7676.83	0.00
Out-West-Pre	OUTFALL	7676.83	7676.83	0.00
POND-EAST	STORAGE	7676.00	7683.00	0.00

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
Link-01	DB-A2	DP-01	CONDUIT	300.7	1.1241	0.0120
Link-02	DP-03	DP-01	CHANNEL	450.0	2.6422	0.0150
Link-03	DP-04	DP-03	CHANNEL	375.0	2.2693	0.0150
Link-05	POND-EAST	Out-East-Post	CONDUIT	37.7	0.1856	0.0150
P	DP-01	POND-EAST	CONDUIT	45.4	5.0198	0.0150

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
Link-01	CIRCULAR	2.50	2.50	1	4.91	0.63	47.11
Link-02	IRREGULAR	0.50	12.50	1	3.16	0.24	19.68
Link-03	IRREGULAR	0.50	12.50	1	3.16	0.24	18.24
Link-05	CIRCULAR	3.00	3.00	2	7.07	0.75	24.90
P	CIRCULAR	2.50	2.50	1	4.91	0.63	79.65

****
Transect Summary
****

Transect 2' C&G
Area:

0.0002	0.0008	0.0017	0.0030	0.0047
0.0068	0.0093	0.0121	0.0154	0.0190
0.0229	0.0273	0.0320	0.0372	0.0427
0.0485	0.0548	0.0620	0.0709	0.0813
0.0933	0.1069	0.1221	0.1389	0.1573
0.1773	0.1988	0.2220	0.2467	0.2731
0.3010	0.3305	0.3616	0.3943	0.4286
0.4645	0.5020	0.5402	0.5785	0.6168
0.6551	0.6934	0.7317	0.7700	0.8083
0.8466	0.8850	0.9233	0.9617	1.0000

Hrad:

0.0193	0.0385	0.0578	0.0771	0.0963
0.1156	0.1348	0.1541	0.1734	0.1926
0.2119	0.2312	0.2504	0.2697	0.2890
0.3082	0.3275	0.3583	0.3797	0.3950

0.4065	0.4162	0.4249	0.4335	0.4422
0.4514	0.4611	0.4714	0.4822	0.4936
0.5054	0.5177	0.5305	0.5436	0.5571
0.5710	0.5851	0.6137	0.6433	0.6736
0.7047	0.7362	0.7683	0.8006	0.8333
0.8663	0.8994	0.9328	0.9663	1.0000

Width:

0.0096	0.0191	0.0287	0.0383	0.0479
0.0574	0.0670	0.0766	0.0861	0.0957
0.1053	0.1149	0.1244	0.1340	0.1436
0.1531	0.1627	0.2029	0.2430	0.2832
0.3234	0.3635	0.4037	0.4438	0.4840
0.5242	0.5643	0.6045	0.6446	0.6848
0.7250	0.7651	0.8053	0.8454	0.8856
0.9258	0.9659	0.9661	0.9662	0.9664
0.9666	0.9667	0.9669	0.9670	0.9672
0.9674	0.9675	0.9677	0.9678	1.0000

********** Runoff Quantity Continuity **********	Volume acre-ft	Depth inches
Total Precipitation	13.982	1.934
Surface Runoff	2.030	0.281
Continuity Error (%)	-0.001	

********** Flow Routing Continuity **********	Volume acre-ft	Volume Mgallons
External Inflow	0.000	0.000
External Outflow	4.340	1.414
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.731	0.238
Continuity Error (%)	0.001	

****
Composite Curve Number Computations Report
****

Subbasin Block01

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.66	B	98.00
Pasture, grassland, or range, Poor	3.20	B	79.00
Composite Area & Weighted CN	3.86		82.23

Subbasin Block02

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	1.75	B	98.00
Urban commercial, 85% imp	7.99	B	92.00
Composite Area & Weighted CN	9.74		93.08

Subbasin Block03

Soil/Surface Description	Area (acres)	Soil Group	CN

Paved parking & roofs	0.66	B	98.00
Urban commercial, 85% imp	1.27	B	92.00
Composite Area & Weighted CN	1.93		94.04

Subbasin Block05

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.49	B	98.00
1/8 acre lots, 65% impervious	0.94	B	85.00
Composite Area & Weighted CN	1.43		89.42

Subbasin Block06

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.96	B	98.00
1/4 acre lots, 38% impervious	1.86	B	75.00
Composite Area & Weighted CN	2.82		82.82

Subbasin Block07

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.96	B	98.00
1/4 acre lots, 38% impervious	1.86	B	75.00
Composite Area & Weighted CN	2.82		82.82

Subbasin Block08

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.94	B	98.00
1/4 acre lots, 38% impervious	1.82	B	75.00
Composite Area & Weighted CN	2.76		82.82

Subbasin Block09

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.94	B	98.00
1/4 acre lots, 38% impervious	1.82	B	75.00
Composite Area & Weighted CN	2.76		82.82

Subbasin Block10

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	1.11	B	98.00
1/4 acre lots, 38% impervious	1.84	B	75.00
> 75% grass cover, Good	0.12	B	61.00
Composite Area & Weighted CN	3.07		82.72

Subbasin Block17

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.51	B	98.00
1/8 acre lots, 65% impervious	1.14	B	85.00
Composite Area & Weighted CN	1.65		89.03

Subbasin Block18

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	1.03	B	98.00
1/4 acre lots, 38% impervious	2.10	B	75.00
Composite Area & Weighted CN	3.13		82.59

Subbasin Block40

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved parking & roofs	1.68	B	98.00
Urban commercial, 85% imp	6.70	B	92.00
Composite Area & Weighted CN	8.38		93.20

Subbasin Pre-Developed-South

Soil/Surface Description	Area (acres)	Soil Group	CN
Pasture, grassland, or range, Poor	8.38	B	79.00
Composite Area & Weighted CN	8.38		79.00

Subbasin Pre-Development_East

Soil/Surface Description	Area (acres)	Soil Group	CN
Pasture, grassland, or range, Poor	13.47	B	79.00
Composite Area & Weighted CN	13.47		79.00

Subbasin Pre-Devloped_West

Soil/Surface Description	Area (acres)	Soil Group	CN
Pasture, grassland, or range, Poor	20.57	B	79.00
Composite Area & Weighted CN	20.57		79.00

****
Kirpich Time of Concentration Computations Report
****

Tc = (0.0078 * (L^0.77) * (S^-0.385))

Where:

Tc = Time of Concentration (min)
L = Flow length (ft)
S = Slope (ft/ft)

```
-------------------
Subbasin Block01
-------------------

        Flow length (ft):                 475.00
        Slope (%):                          1.74
        Computed TOC (minutes):             4.27

-------------------
Subbasin Block02
-------------------

        Flow length (ft):                1071.00
        Slope (%):                          1.10
        Computed TOC (minutes):             9.53

-------------------
Subbasin Block03
-------------------

        Flow length (ft):                 876.00
        Slope (%):                          0.80
        Computed TOC (minutes):             9.23

-------------------
Subbasin Block05
-------------------

        Flow length (ft):                 500.00
        Slope (%):                          3.00
        Computed TOC (minutes):             3.60

-------------------
Subbasin Block06
-------------------

        Flow length (ft):                 500.00
        Slope (%):                          1.70
        Computed TOC (minutes):             4.48

-------------------
Subbasin Block07
-------------------

        Flow length (ft):                 500.00
        Slope (%):                          1.50
        Computed TOC (minutes):             4.70

-------------------
Subbasin Block08
-------------------

        Flow length (ft):                 831.00
        Slope (%):                          1.70
        Computed TOC (minutes):             6.63

-------------------
Subbasin Block09
-------------------

        Flow length (ft):                 507.00
        Slope (%):                          1.30
        Computed TOC (minutes):             5.02

-------------------
Subbasin Block10
```

```
-------------------

        Flow length (ft):                  794.00
        Slope (%):                           1.60
        Computed TOC (minutes):              6.55

-------------------
Subbasin Block17
-------------------

        Flow length (ft):                  698.00
        Slope (%):                           2.60
        Computed TOC (minutes):              4.92

-------------------
Subbasin Block18
-------------------

        Flow length (ft):                  858.00
        Slope (%):                           2.30
        Computed TOC (minutes):              6.05

-------------------
Subbasin Block40
-------------------

        Flow length (ft):                  500.00
        Slope (%):                           0.50
        Computed TOC (minutes):              7.18

-------------------------------
Subbasin Pre-Developed-South
-------------------------------

        Flow length (ft):                  801.00
        Slope (%):                           0.50
        Computed TOC (minutes):             10.32

--------------------------------
Subbasin Pre-Development_East
--------------------------------

        Flow length (ft):                 1208.00
        Slope (%):                           2.70
        Computed TOC (minutes):              7.40

-----------------------------
Subbasin Pre-Devloped_West
-----------------------------

        Flow length (ft):                 1204.00
        Slope (%):                           1.20
        Computed TOC (minutes):             10.08

***********************
Subbasin Runoff Summary
***********************
```

Subbasin ID	Total Precip in	Total Runoff in	Peak Runoff cfs	Weighted Curve Number	Time of Concentration days	hh:mm:ss
Block01	1.91	0.60	3.53	82.230	0	00:05:00
Block02	1.91	1.24	16.71	93.080	0	00:09:31
Block03	1.91	1.32	3.53	94.040	0	00:09:13
Block05	1.91	0.98	2.23	89.420	0	00:05:00

Block06	1.91	0.63	2.71	82.820	0	00:05:00
Block07	1.91	0.63	2.71	82.820	0	00:05:00
Block08	1.91	0.63	2.52	82.820	0	00:06:37
Block09	1.91	0.63	2.65	82.820	0	00:05:01
Block10	1.91	0.62	2.79	82.720	0	00:06:33
Block17	1.91	0.96	2.51	89.030	0	00:05:00
Block18	1.91	0.62	2.85	82.590	0	00:06:03
Block40	1.91	1.25	15.41	93.200	0	00:07:10
Pre-Developed-South	1.91	0.47	5.08	79.000	0	00:10:19
Pre-Development_East	1.91	0.47	8.63	79.000	0	00:07:24
Pre-Devloped_West	1.91	0.47	12.56	79.000	0	00:10:04

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
DB-A2	0.08	0.67	7682.33	0	12:00	0	0	0:00:00
DP-01	0.14	1.24	7679.52	0	12:04	0	0	0:00:00
DP-03	0.08	0.41	7690.58	0	12:02	0	0	0:00:00
DP-04	0.07	0.35	7699.03	0	12:00	0	0	0:00:00
Out-East-Post	0.20	1.46	7679.69	0	12:12	0	0	0:00:00
Out-East-Pre	0.00	0.00	7678.28	0	00:00	0	0	0:00:00
Out-West-Post	0.00	0.00	7676.83	0	00:00	0	0	0:00:00
Out-West-Pre	0.00	0.00	7676.83	0	00:00	0	0	0:00:00
POND-EAST	1.50	4.65	7680.65	0	12:12	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	hh:mm
DB-A2	JUNCTION	7.51	7.51	0	12:00	0.00		
DP-01	JUNCTION	21.96	39.06	0	12:04	0.00		
DP-03	JUNCTION	4.88	9.80	0	12:02	0.00		
DP-04	JUNCTION	5.21	5.21	0	12:00	0.00		
Out-East-Post	OUTFALL	0.00	23.74	0	12:12	0.00		
Out-East-Pre	OUTFALL	16.81	16.81	0	12:06	0.00		
Out-West-Post	OUTFALL	3.46	3.46	0	12:00	0.00		
Out-West-Pre	OUTFALL	8.32	8.32	0	12:04	0.00		
POND-EAST	STORAGE	14.74	53.26	0	12:04	0.00		

****
Storage Node Summary
****

Storage Node ID	Maximum Ponded	Maximum Ponded	Time of Max Ponded	Average Ponded	Average Ponded	Maximum Storage Node	Maximum Exfiltration	Time of Max. Exfiltration	Total Exfiltrated

```
                          Volume      Volume         Volume     Volume    Volume       Outflow
Rate          Rate       Volume
                         1000 ft³         (%)     days hh:mm   1000 ft³       (%)           cfs
cfm      hh:mm:ss     1000 ft³

-------------------------------------------------------------------------------------------------
-----------------------------------
  POND-EAST               55.762          66       0  12:12     18.051        21         23.77
0.00       0:00:00        0.000


  ************************
  Outfall Loading Summary
  ************************

  ------------------------------------------------
  Outfall Node ID        Flow   Average      Peak
                   Frequency      Flow    Inflow
                         (%)       cfs       cfs
  ------------------------------------------------
  Out-East-Post         50.35      2.49     23.74
  Out-East-Pre          51.87      1.10     16.81
  Out-West-Post         54.23      0.18      3.46
  Out-West-Pre          51.87      0.51      8.32
  ------------------------------------------------
  System                52.08      4.28     45.75


  *****************
  Link Flow Summary
  *****************


-------------------------------------------------------------------------------------------------
--------------------------------
  Link ID              Element       Time of   Maximum  Length   Peak Flow      Design  Ratio of
Ratio of       Total  Reported
                       Type        Peak Flow  Velocity  Factor      during        Flow   Maximum
Maximum        Time  Condition
                                  Occurrence  Attained            Analysis    Capacity   /Design
Flow  Surcharged
                                  days hh:mm    ft/sec                 cfs         cfs      Flow
Depth     minutes

-------------------------------------------------------------------------------------------------
--------------------------------
  Link-01              CONDUIT      0  12:02      7.11    1.00        7.65       47.11      0.16
0.27           0  Calculated
  Link-02              CHANNEL      0  12:04      4.89    1.00        9.66       19.68      0.49
0.81           0  Calculated
  Link-03              CHANNEL      0  12:02      4.08    1.00        5.15       18.24      0.28
0.69           0  Calculated
  Link-05              CONDUIT      0  12:12      3.48    1.00       23.74       49.80      0.48
0.49           0  Calculated
  P                    CONDUIT      0  12:04     16.14    1.00       39.06       79.65      0.49
0.49           0  Calculated


  *********************************
  Highest Flow Instability Indexes
  *********************************
  Link Link-05 (3)

  WARNING 117 : Conduit outlet invert elevation defined for Conduit P is below downstream node
invert elevation.
                Assumed conduit outlet invert elevation equal to downstream node invert
elevation.
```

```
Analysis began on:  Thu Dec 02 09:55:59 2021
Analysis ended on:  Thu Dec 02 09:56:01 2021
Total elapsed time: 00:00:02
```

100-year Storm

```
Autodesk® Storm and Sanitary Analysis 2016 - Version 13.0.94 (Build 0)
----------------------------------------------------------------------------------------

*******************
Project Description
*******************
File Name ................. 20020-Phase 2-Post.SPF


****************
Analysis Options
****************
Flow Units ................ cfs
Subbasin Hydrograph Method. SCS TR-55
Time of Concentration...... Kirpich
Link Routing Method ....... Kinematic Wave
Storage Node Exfiltration.. Constant rate, free surface area
Starting Date ............. OCT-04-2021 00:00:00
Ending Date ............... OCT-05-2021 00:00:00
Report Time Step .......... 00:05:00


*************
Element Count
*************
Number of rain gages ...... 1
Number of subbasins ....... 15
Number of nodes ........... 9
Number of links ........... 5


****************
Subbasin Summary
****************
Subbasin                 Total      Flow   Average    Raingage
                          Area    Length     Slope
ID                       acres        ft         %
----------------------------------------------------------------
Block01                   3.86    475.00    1.7400    StormGage
Block02                   9.74   1071.00    1.1000    StormGage
Block03                   1.93    876.00    0.8000    StormGage
Block05                   1.43    500.00    3.0000    StormGage
Block06                   2.82    500.00    1.7000    StormGage
Block07                   2.82    500.00    1.5000    StormGage
Block08                   2.76    831.00    1.7000    StormGage
Block09                   2.76    507.00    1.3000    StormGage
Block10                   3.07    794.00    1.6000    StormGage
Block17                   1.65    698.00    2.6000    StormGage
Block18                   3.13    858.00    2.3000    StormGage
Block40                   8.38    500.00    0.5000    StormGage
Pre-Developed-South           8.38    801.00    0.5000    StormGage
Pre-Development_East          13.47   1208.00    2.7000    StormGage
Pre-Devloped_West          20.57   1204.00    1.2000    StormGage


************
Node Summary
************
Node                 Element             Invert   Maximum    Ponded    External
ID                   Type             Elevation     Elev.      Area      Inflow
                                             ft        ft       ft²
--------------------------------------------------------------------------------
DB-A2                JUNCTION           7681.66   7686.09      0.00
DP-01                JUNCTION           7678.28   7685.00      0.00
DP-03                JUNCTION           7690.17   7690.67      0.00
DP-04                JUNCTION           7698.68   7699.28      0.00
```

Out-East-Post	OUTFALL	7678.23	7681.23	0.00
Out-East-Pre	OUTFALL	7678.28	7678.28	0.00
Out-West-Post	OUTFALL	7676.83	7676.83	0.00
Out-West-Pre	OUTFALL	7676.83	7676.83	0.00
POND-EAST	STORAGE	7676.00	7683.00	0.00

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
Link-01	DB-A2	DP-01	CONDUIT	300.7	1.1241	0.0120
Link-02	DP-03	DP-01	CHANNEL	450.0	2.6422	0.0150
Link-03	DP-04	DP-03	CHANNEL	375.0	2.2693	0.0150
Link-05	POND-EAST	Out-East-Post	CONDUIT	37.7	0.1856	0.0150
P	DP-01	POND-EAST	CONDUIT	45.4	5.0198	0.0150

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
Link-01	CIRCULAR	2.50	2.50	1	4.91	0.63	47.11
Link-02	IRREGULAR	0.50	12.50	1	3.16	0.24	19.68
Link-03	IRREGULAR	0.50	12.50	1	3.16	0.24	18.24
Link-05	CIRCULAR	3.00	3.00	2	7.07	0.75	24.90
P	CIRCULAR	2.50	2.50	1	4.91	0.63	79.65

****
Transect Summary
****

Transect 2' C&G
Area:

0.0002	0.0008	0.0017	0.0030	0.0047
0.0068	0.0093	0.0121	0.0154	0.0190
0.0229	0.0273	0.0320	0.0372	0.0427
0.0485	0.0548	0.0620	0.0709	0.0813
0.0933	0.1069	0.1221	0.1389	0.1573
0.1773	0.1988	0.2220	0.2467	0.2731
0.3010	0.3305	0.3616	0.3943	0.4286
0.4645	0.5020	0.5402	0.5785	0.6168
0.6551	0.6934	0.7317	0.7700	0.8083
0.8466	0.8850	0.9233	0.9617	1.0000

Hrad:

0.0193	0.0385	0.0578	0.0771	0.0963
0.1156	0.1348	0.1541	0.1734	0.1926
0.2119	0.2312	0.2504	0.2697	0.2890
0.3082	0.3275	0.3583	0.3797	0.3950

0.4065	0.4162	0.4249	0.4335	0.4422
0.4514	0.4611	0.4714	0.4822	0.4936
0.5054	0.5177	0.5305	0.5436	0.5571
0.5710	0.5851	0.6137	0.6433	0.6736
0.7047	0.7362	0.7683	0.8006	0.8333
0.8663	0.8994	0.9328	0.9663	1.0000

Width:

0.0096	0.0191	0.0287	0.0383	0.0479
0.0574	0.0670	0.0766	0.0861	0.0957
0.1053	0.1149	0.1244	0.1340	0.1436
0.1531	0.1627	0.2029	0.2430	0.2832
0.3234	0.3635	0.4037	0.4438	0.4840
0.5242	0.5643	0.6045	0.6446	0.6848
0.7250	0.7651	0.8053	0.8454	0.8856
0.9258	0.9659	0.9661	0.9662	0.9664
0.9666	0.9667	0.9669	0.9670	0.9672
0.9674	0.9675	0.9677	0.9678	1.0000

********** Runoff Quantity Continuity **********	Volume acre-ft	Depth inches
Total Precipitation	15.666	2.166
Surface Runoff	2.491	0.345
Continuity Error (%)	-0.002	

********** Flow Routing Continuity **********	Volume acre-ft	Volume Mgallons
External Inflow	0.000	0.000
External Outflow	5.487	1.788
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.738	0.241
Continuity Error (%)	0.001	

****
Composite Curve Number Computations Report
****

Subbasin Block01

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.66	B	98.00
Pasture, grassland, or range, Poor	3.20	B	79.00
Composite Area & Weighted CN	3.86		82.23

Subbasin Block02

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	1.75	B	98.00
Urban commercial, 85% imp	7.99	B	92.00
Composite Area & Weighted CN	9.74		93.08

Subbasin Block03

Soil/Surface Description	Area (acres)	Soil Group	CN

Paved parking & roofs	0.66	B	98.00
Urban commercial, 85% imp	1.27	B	92.00
Composite Area & Weighted CN	1.93		94.04

Subbasin Block05

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.49	B	98.00
1/8 acre lots, 65% impervious	0.94	B	85.00
Composite Area & Weighted CN	1.43		89.42

Subbasin Block06

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.96	B	98.00
1/4 acre lots, 38% impervious	1.86	B	75.00
Composite Area & Weighted CN	2.82		82.82

Subbasin Block07

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.96	B	98.00
1/4 acre lots, 38% impervious	1.86	B	75.00
Composite Area & Weighted CN	2.82		82.82

Subbasin Block08

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.94	B	98.00
1/4 acre lots, 38% impervious	1.82	B	75.00
Composite Area & Weighted CN	2.76		82.82

Subbasin Block09

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.94	B	98.00
1/4 acre lots, 38% impervious	1.82	B	75.00
Composite Area & Weighted CN	2.76		82.82

Subbasin Block10

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	1.11	B	98.00
1/4 acre lots, 38% impervious	1.84	B	75.00
> 75% grass cover, Good	0.12	B	61.00
Composite Area & Weighted CN	3.07		82.72

Subbasin Block17

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	0.51	B	98.00
1/8 acre lots, 65% impervious	1.14	B	85.00
Composite Area & Weighted CN	1.65		89.03

Subbasin Block18

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved roads with curbs & sewers	1.03	B	98.00
1/4 acre lots, 38% impervious	2.10	B	75.00
Composite Area & Weighted CN	3.13		82.59

Subbasin Block40

Soil/Surface Description	Area (acres)	Soil Group	CN
Paved parking & roofs	1.68	B	98.00
Urban commercial, 85% imp	6.70	B	92.00
Composite Area & Weighted CN	8.38		93.20

Subbasin Pre-Developed-South

Soil/Surface Description	Area (acres)	Soil Group	CN
Pasture, grassland, or range, Poor	8.38	B	79.00
Composite Area & Weighted CN	8.38		79.00

Subbasin Pre-Development_East

Soil/Surface Description	Area (acres)	Soil Group	CN
Pasture, grassland, or range, Poor	13.47	B	79.00
Composite Area & Weighted CN	13.47		79.00

Subbasin Pre-Devloped_West

Soil/Surface Description	Area (acres)	Soil Group	CN
Pasture, grassland, or range, Poor	20.57	B	79.00
Composite Area & Weighted CN	20.57		79.00

****
Kirpich Time of Concentration Computations Report
****

Tc = (0.0078 * (L^0.77) * (S^-0.385))

Where:

Tc = Time of Concentration (min)
L = Flow length (ft)
S = Slope (ft/ft)

```
-------------------
Subbasin Block01
-------------------

        Flow length (ft):                 475.00
        Slope (%):                          1.74
        Computed TOC (minutes):             4.27

-------------------
Subbasin Block02
-------------------

        Flow length (ft):                1071.00
        Slope (%):                          1.10
        Computed TOC (minutes):             9.53

-------------------
Subbasin Block03
-------------------

        Flow length (ft):                 876.00
        Slope (%):                          0.80
        Computed TOC (minutes):             9.23

-------------------
Subbasin Block05
-------------------

        Flow length (ft):                 500.00
        Slope (%):                          3.00
        Computed TOC (minutes):             3.60

-------------------
Subbasin Block06
-------------------

        Flow length (ft):                 500.00
        Slope (%):                          1.70
        Computed TOC (minutes):             4.48

-------------------
Subbasin Block07
-------------------

        Flow length (ft):                 500.00
        Slope (%):                          1.50
        Computed TOC (minutes):             4.70

-------------------
Subbasin Block08
-------------------

        Flow length (ft):                 831.00
        Slope (%):                          1.70
        Computed TOC (minutes):             6.63

-------------------
Subbasin Block09
-------------------

        Flow length (ft):                 507.00
        Slope (%):                          1.30
        Computed TOC (minutes):             5.02

-------------------
Subbasin Block10
```

```
-------------------

        Flow length (ft):                  794.00
        Slope (%):                           1.60
        Computed TOC (minutes):              6.55

-------------------
Subbasin Block17
-------------------

        Flow length (ft):                  698.00
        Slope (%):                           2.60
        Computed TOC (minutes):              4.92

-------------------
Subbasin Block18
-------------------

        Flow length (ft):                  858.00
        Slope (%):                           2.30
        Computed TOC (minutes):              6.05

-------------------
Subbasin Block40
-------------------

        Flow length (ft):                  500.00
        Slope (%):                           0.50
        Computed TOC (minutes):              7.18

-------------------------------
Subbasin Pre-Developed-South
-------------------------------

        Flow length (ft):                  801.00
        Slope (%):                           0.50
        Computed TOC (minutes):             10.32

--------------------------------
Subbasin Pre-Development_East
--------------------------------

        Flow length (ft):                 1208.00
        Slope (%):                           2.70
        Computed TOC (minutes):              7.40

-----------------------------
Subbasin Pre-Devloped_West
-----------------------------

        Flow length (ft):                 1204.00
        Slope (%):                           1.20
        Computed TOC (minutes):             10.08

***********************
Subbasin Runoff Summary
***********************

-----------------------------------------------------------------------------
Subbasin             Total     Total      Peak  Weighted           Time of
ID                  Precip    Runoff    Runoff     Curve     Concentration
                        in        in       cfs    Number    days  hh:mm:ss
-----------------------------------------------------------------------------
Block01               2.14      0.75      4.51    82.230       0  00:05:00
Block02               2.14      1.45     19.47    93.080       0  00:09:31
Block03               2.14      1.53      4.08    94.040       0  00:09:13
Block05               2.14      1.17      2.66    89.420       0  00:05:00
```

Block06	2.14	0.78	3.45	82.820	0	00:05:00
Block07	2.14	0.78	3.45	82.820	0	00:05:00
Block08	2.14	0.78	3.19	82.820	0	00:06:37
Block09	2.14	0.78	3.36	82.820	0	00:05:01
Block10	2.14	0.78	3.54	82.720	0	00:06:33
Block17	2.14	1.15	3.01	89.030	0	00:05:00
Block18	2.14	0.77	3.63	82.590	0	00:06:03
Block40	2.14	1.46	17.93	93.200	0	00:07:10
Pre-Developed-South	2.14	0.61	6.71	79.000	0	00:10:19
Pre-Development_East	2.14	0.61	11.37	79.000	0	00:07:24
Pre-Devloped_West	2.14	0.61	16.55	79.000	0	00:10:04

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
DB-A2	0.08	0.77	7682.43	0	12:00	0	0	0:00:00
DP-01	0.16	1.38	7679.66	0	12:04	0	0	0:00:00
DP-03	0.09	0.43	7690.60	0	12:02	0	0	0:00:00
DP-04	0.07	0.37	7699.05	0	12:00	0	0	0:00:00
Out-East-Post	0.22	1.57	7679.80	0	12:22	0	0	0:00:00
Out-East-Pre	0.00	0.00	7678.28	0	00:00	0	0	0:00:00
Out-West-Post	0.00	0.00	7676.83	0	00:00	0	0	0:00:00
Out-West-Pre	0.00	0.00	7676.83	0	00:00	0	0	0:00:00
POND-EAST	1.57	5.46	7681.46	0	12:14	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	hh:mm
DB-A2	JUNCTION	9.61	9.61	0	12:00	0.00		
DP-01	JUNCTION	25.74	47.01	0	12:04	0.00		
DP-03	JUNCTION	6.05	12.15	0	12:02	0.00		
DP-04	JUNCTION	6.49	6.49	0	12:00	0.00		
Out-East-Post	OUTFALL	0.00	26.89	0	12:22	0.00		
Out-East-Pre	OUTFALL	22.27	22.27	0	12:06	0.00		
Out-West-Post	OUTFALL	4.44	4.44	0	12:00	0.00		
Out-West-Pre	OUTFALL	11.01	11.01	0	12:04	0.00		
POND-EAST	STORAGE	17.16	63.56	0	12:02	0.00		

****
Storage Node Summary
****

Storage Node ID	Maximum Ponded	Maximum Ponded	Time of Max Ponded	Average Ponded	Average Ponded	Maximum Storage Node	Maximum Exfiltration	Time of Max. Exfiltration	Total Exfiltrated

```
                          Volume      Volume         Volume     Volume    Volume       Outflow
Rate          Rate       Volume
                         1000 ft³         (%)     days hh:mm   1000 ft³       (%)           cfs
cfm      hh:mm:ss     1000 ft³

-------------------------------------------------------------------------------------------------
-----------------------------------
  POND-EAST               65.530          78       0  12:14     18.791        22         26.91
0.00       0:00:00        0.000


  ************************
  Outfall Loading Summary
  ************************

  ------------------------------------------------
  Outfall Node ID        Flow   Average      Peak
                   Frequency      Flow    Inflow
                         (%)       cfs       cfs
  ------------------------------------------------
  Out-East-Post         50.49      3.10     26.89
  Out-East-Pre          53.12      1.38     22.27
  Out-West-Post         55.89      0.22      4.44
  Out-West-Pre          53.12      0.64     11.01
  ------------------------------------------------
  System                53.16      5.35     61.96


  *****************
  Link Flow Summary
  *****************


-------------------------------------------------------------------------------------------------
--------------------------------
  Link ID              Element       Time of   Maximum  Length   Peak Flow      Design  Ratio of
Ratio of       Total  Reported
                        Type        Peak Flow  Velocity  Factor      during        Flow   Maximum
Maximum        Time  Condition
                                   Occurrence  Attained            Analysis    Capacity   /Design
Flow  Surcharged
                                   days hh:mm    ft/sec                 cfs         cfs      Flow
Depth     minutes

-------------------------------------------------------------------------------------------------
--------------------------------
  Link-01              CONDUIT      0  12:02      7.61    1.00        9.70       47.11      0.21
0.31           0  Calculated
  Link-02              CHANNEL      0  12:02      5.25    1.00       12.08       19.68      0.61
0.86           0  Calculated
  Link-03              CHANNEL      0  12:02      4.19    1.00        6.41       18.24      0.35
0.74           0  Calculated
  Link-05              CONDUIT      0  12:22      3.59    1.00       26.89       49.80      0.54
0.52           0  Calculated
  P                    CONDUIT      0  12:04     16.88    1.00       46.97       79.65      0.59
0.55           0  Calculated


  *********************************
  Highest Flow Instability Indexes
  *********************************
  Link P (3)
  Link Link-05 (1)

  WARNING 117 : Conduit outlet invert elevation defined for Conduit P is below downstream node
invert elevation.
                Assumed conduit outlet invert elevation equal to downstream node invert
```

elevation.

```
  Analysis began on:  Thu Dec 02 09:53:43 2021
  Analysis ended on:  Thu Dec 02 09:53:44 2021
  Total elapsed time: 00:00:01
```

Appendix E

CONVEYANCE CALCULATIONS

Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Nov 30 2021

Storm Pipe

Invert Elev Dn (ft)	=	78.28
Pipe Length (ft)	=	300.68
Slope (%)	=	1.00
Invert Elev Up (ft)	=	81.28
Rise (in)	=	30.0
Shape	=	Circular
Span (in)	=	30.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Culvert
Culvert Entrance	=	Smooth tapered inlet throat
Coeff. K,M,c,Y,k	=	0.534, 0.555, 0.0196, 0.9, 0.2

Embankment

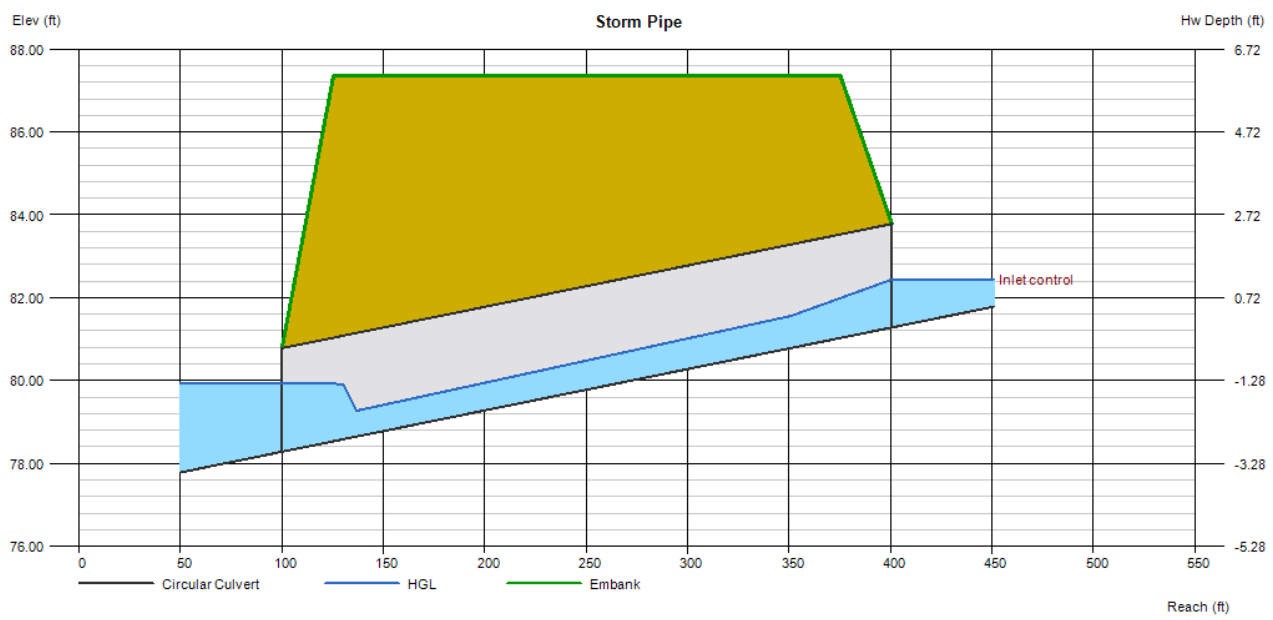
Top Elevation (ft)	=	87.35
Top Width (ft)	=	250.00
Crest Width (ft)	=	50.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	60.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

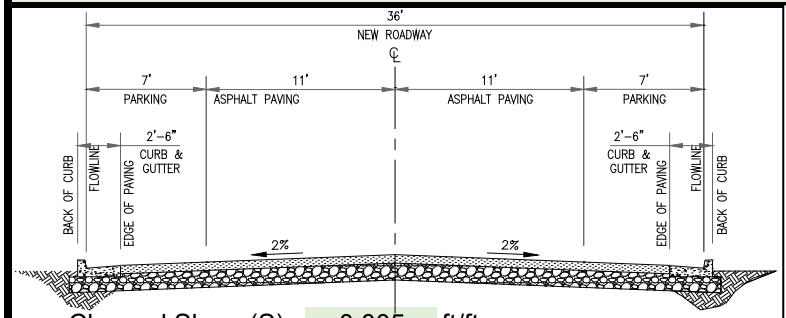
Qtotal (cfs)	=	6.00
Qpipe (cfs)	=	6.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	1.74
Veloc Up (ft/s)	=	4.36
HGL Dn (ft)	=	79.93
HGL Up (ft)	=	82.09
Hw Elev (ft)	=	82.44
Hw/D (ft)	=	0.46
Flow Regime	=	Inlet Control



Q Total (cfs)	Q Pipe (cfs)	Q Over (cfs)	Veloc Dn (ft/s)	Veloc Up (ft/s)	Depth Dn (in)	Depth Up (in)	HGL Dn (ft)	HGL Up (ft)	HGL Hw (ft)	HGL Hw/D
6	6	0	1.74	4.36	19.86	9.72	79.93	82.09	82.44	0.46
12	12	0	3.12	5.38	21.97	13.93	80.11	82.44	82.98	0.68
18	18	0	4.34	6.17	23.61	17.23	80.25	82.72	83.41	0.85
24	24	0	5.49	6.90	25.00	20.00	80.36	82.95	83.78	1.00
30	30	0	6.60	7.64	26.19	22.38	80.46	83.15	84.25	1.19
36	36	0	7.70	8.42	27.20	24.40	80.55	83.31	84.57	1.32
42	42	0	8.81	9.29	28.01	26.02	80.61	83.45	84.95	1.47
48	48	0	9.94	9.78	28.63	30.00	80.67	83.99	85.39	1.64
54	54	0	11.10	11.00	29.06	30.00	80.70	84.91	85.89	1.84
60	60	0	12.29	12.22	29.36	30.00	80.73	85.94	86.45	2.07

CRABTREE GROUP INC.
ENGINEERING SMART GROWTH™

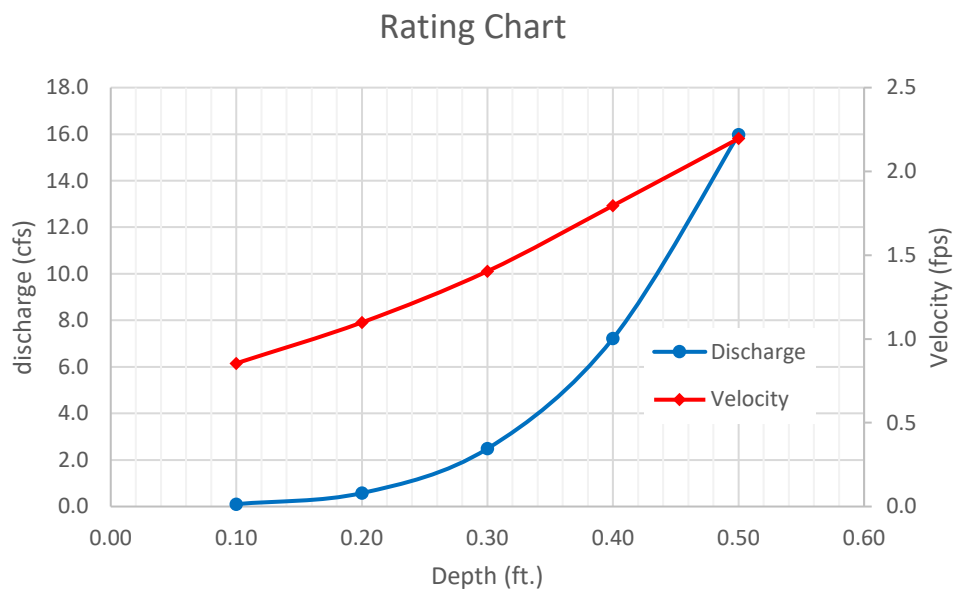
Project	Location	By	Date
Gunnison Rising - Phase 2	Gunnison Colorado	TLV	11/30/21
Description		**Checked**	**Date**
36' Roadway @ 0.5%			



Channel Slope (S)= 0.005 ft/ft

Manning's n= 0.016

Notes:



Depth (y)	Area (A)	Wetted Perimeter (P)	Hydraulic Radius (R)	Top Width (T)	Hydraulic Depth (D)	Section Factor (Z)	Discharge (Q)	Velocity (v)
	(ft^2)	(ft.)	$\frac{A}{P}$	(ft.)	$\frac{T}{P}$	$A(D)^{0.5}$	$\frac{1.49AR^{2/3}S^{1/2}}{n}$	Q/A
0.10	0.12	2.58	0.05	2.43	0.94	0.00	0.10	0.85
0.20	0.53	7.73	0.07	7.40	0.96	0.00	0.58	1.10
0.30	1.77	17.98	0.10	17.47	0.97	0.00	2.49	1.40
0.40	4.02	28.23	0.14	27.54	0.98	0.00	7.22	1.80
0.50	7.28	37.80	0.19	37.00	0.98	0.00	15.98	2.20

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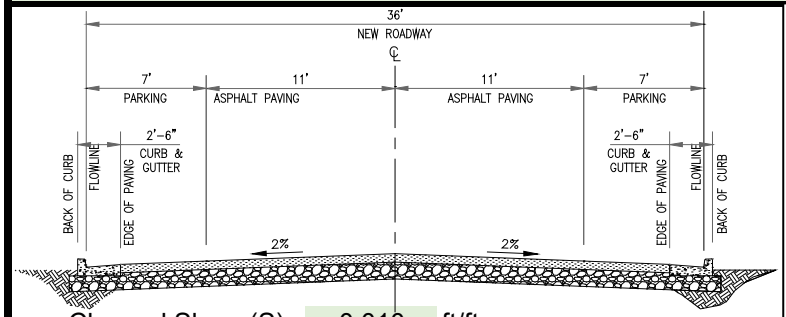
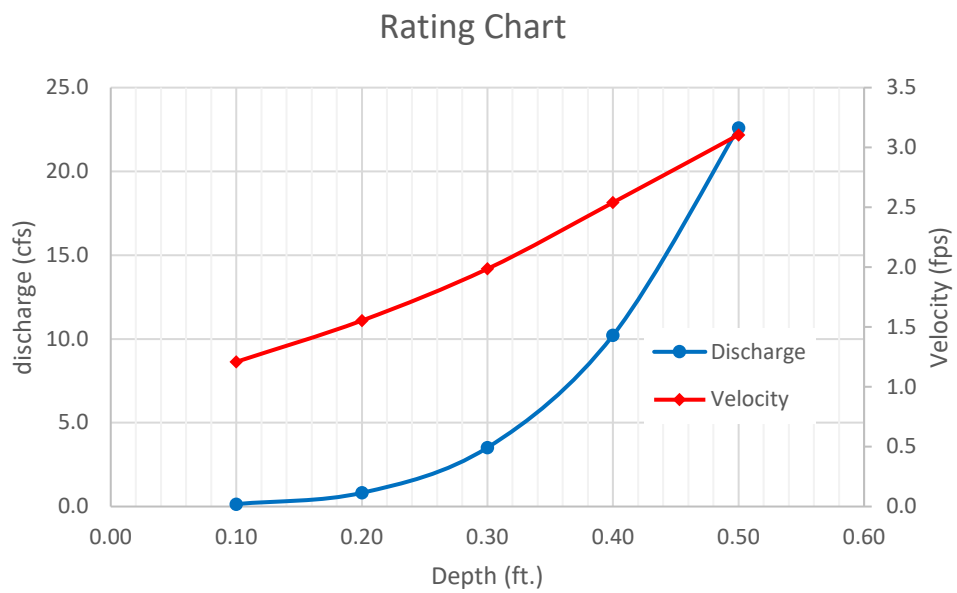
Project	Location	By	Date
Gunnison Rising - Phase 2	Gunnison Colorado	TLV	11/30/21
Description		**Checked**	**Date**
36' Roadway @ 1.0%			



Channel Slope (S)= 0.010 ft/ft

Manning's n= 0.016

Notes:



Depth (y)	Area (A)	Wetted Perimeter (P)	Hydraulic Radius (R)	Top Width (T)	Hydraulic Depth (D)	Section Factor (Z)	Discharge (Q)	Velocity (v)
	(ft^2)	(ft.)	$\frac{A}{P}$	(ft.)	$\frac{T}{P}$	$A(D)^{0.5}$	$\frac{1.49AR^{2/3}S^{1/2}}{n}$	Q/A
0.10	0.12	2.58	0.05	2.43	0.94	0.00	0.15	1.21
0.20	0.53	7.73	0.07	7.40	0.96	0.00	0.82	1.55
0.30	1.77	17.98	0.10	17.47	0.97	0.00	3.52	1.99
0.40	4.02	28.23	0.14	27.54	0.98	0.00	10.21	2.54
0.50	7.28	37.80	0.19	37.00	0.98	0.00	22.60	3.11

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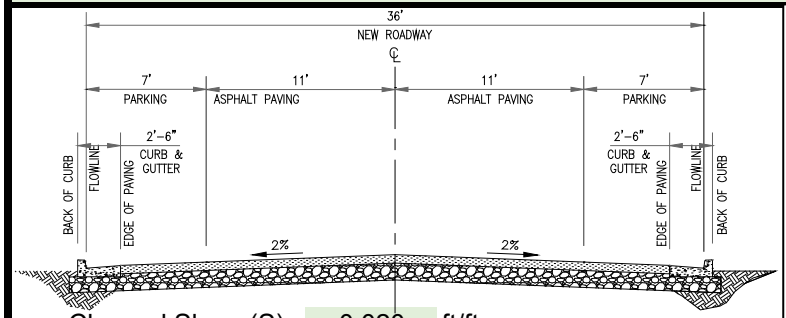
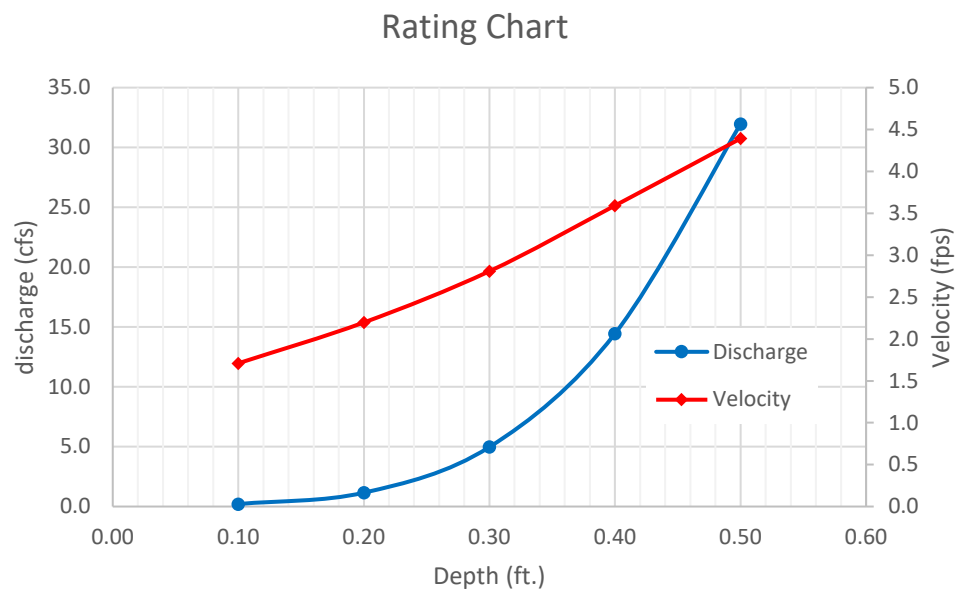
Project	Location	By	Date
Gunnison Rising - Phase 2	Gunnison Colorado	TLV	11/30/21
Description		**Checked**	**Date**
36' Roadway @ 2.0%			



Channel Slope (S)= 0.020 ft/ft

Manning's n= 0.016

Notes:



Depth (y)	Area (A)	Wetted Perimeter (P)	Hydraulic Radius (R)	Top Width (T)	Hydraulic Depth (D)	Section Factor (Z)	Discharge (Q)	Velocity (v)
	(ft^2)	$(ft.)$	$\frac{A}{P}$	$(ft.)$	$\frac{T}{P}$	$A(D)^{0.5}$	$\frac{1.49AR^{2/3}S^{1/2}}{n}$	Q/A
0.10	0.12	2.58	0.05	2.43	0.94	0.00	0.21	1.71
0.20	0.53	7.73	0.07	7.40	0.96	0.00	1.16	2.20
0.30	1.77	17.98	0.10	17.47	0.97	0.00	4.97	2.81
0.40	4.02	28.23	0.14	27.54	0.98	0.00	14.44	3.59
0.50	7.28	37.80	0.19	37.00	0.98	0.00	31.96	4.39

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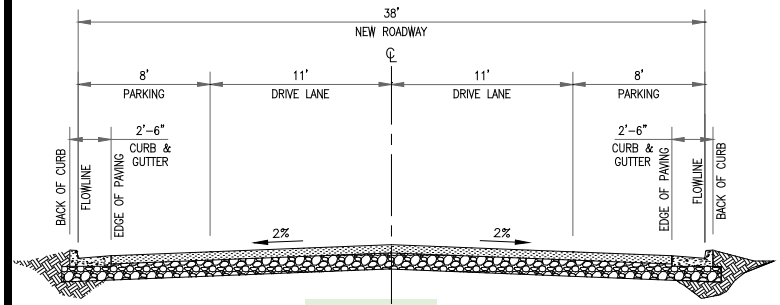
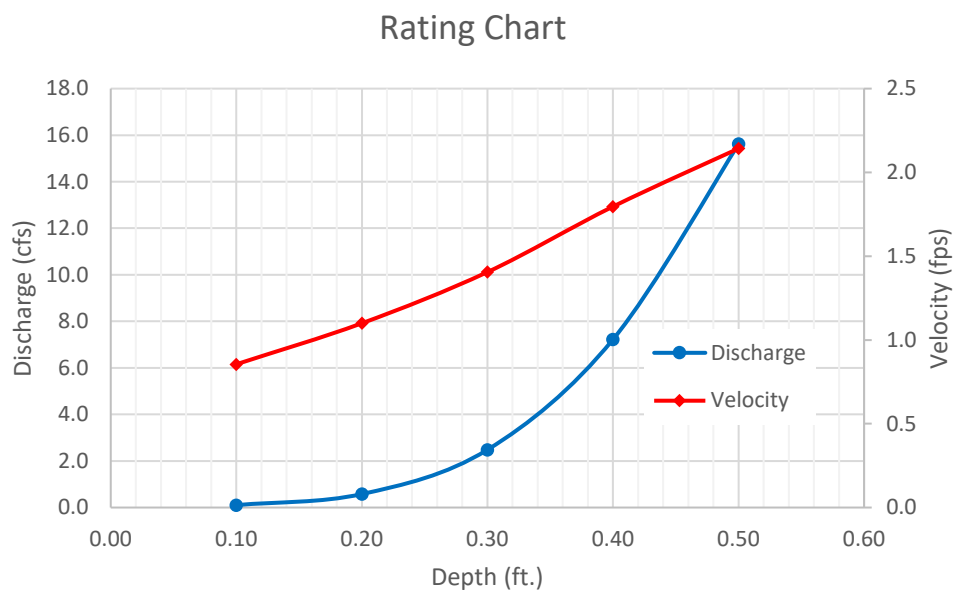
Project	Location	By	Date
Gunnison Rising - Phase 2	Gunnison Colorado	TLV	11/30/21
Description		**Checked**	**Date**
38' Roadway @ 0.5%			



Channel Slope (S)= 0.005 ft/ft

Manning's n= 0.016

Notes:



Depth (y)	Area (A)	Wetted Perimeter (P)	Hydraulic Radius (R)	Top Width (T)	Hydraulic Depth (D)	Section Factor (Z)	Discharge (Q)	Velocity (v)
	(ft^2)	$(ft.)$	$\frac{A}{P}$	$(ft.)$	$\frac{T}{P}$	$A(D)^{0.5}$	$\frac{1.49AR^{2/3}S^{1/2}}{n}$	Q/A
0.10	0.12	2.58	0.05	2.43	0.94	0.00	0.10	0.85
0.20	0.53	7.72	0.07	7.39	0.96	0.00	0.58	1.10
0.30	1.77	17.92	0.10	17.41	0.97	0.00	2.48	1.41
0.40	4.02	28.23	0.14	27.44	0.97	0.00	7.22	1.80
0.50	7.29	39.28	0.19	39.00	0.99	0.00	15.62	2.14

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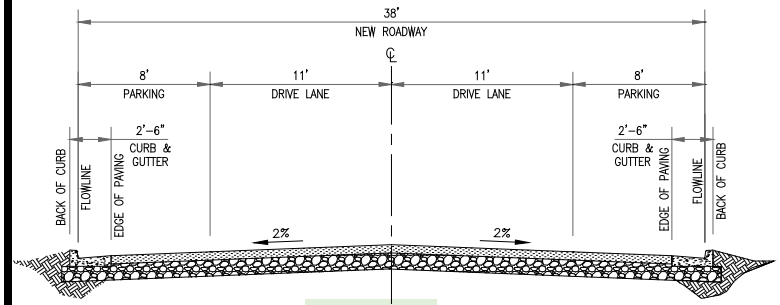
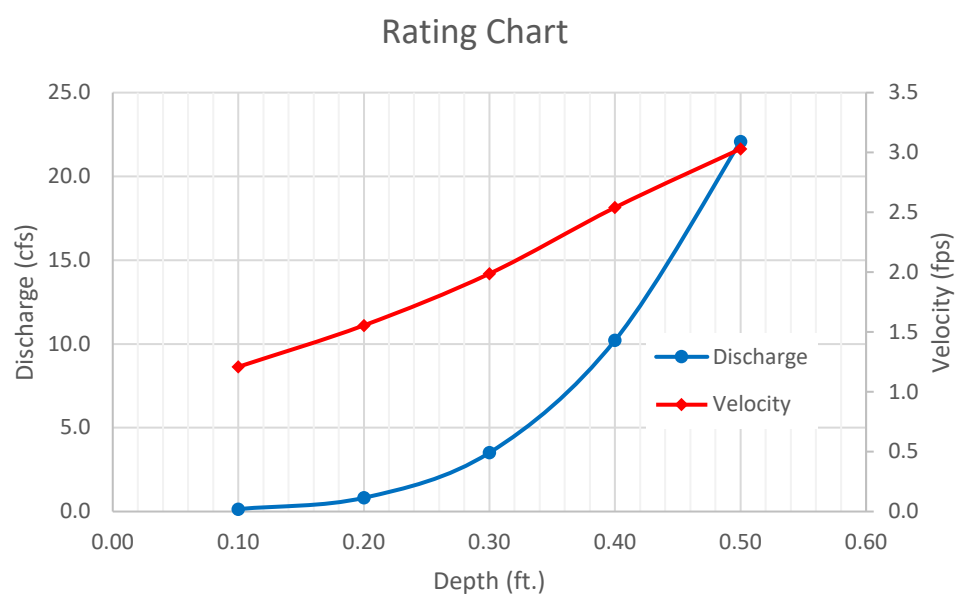
Project	Location	By	Date
Gunnison Rising - Phase 2	Gunnison Colorado	TLV	11/30/21
Description		**Checked**	**Date**
38' Roadway @ 1.0%			



Channel Slope (S)= 0.010 ft/ft

Manning's n= 0.016

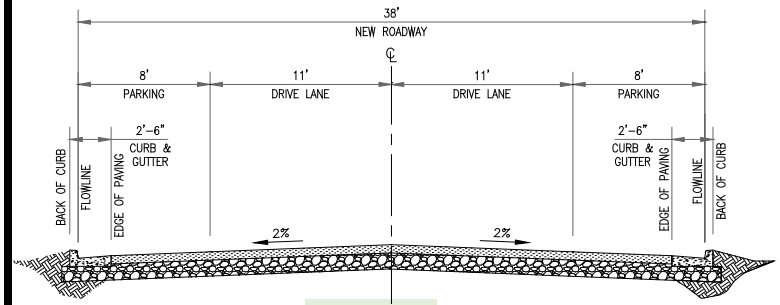
Notes:



Depth (y)	Area (A)	Wetted Perimeter (P)	Hydraulic Radius (R)	Top Width (T)	Hydraulic Depth (D)	Section Factor (Z)	Discharge (Q)	Velocity (v)
	(ft^2)	(ft.)	$\frac{A}{P}$	(ft.)	$\frac{T}{P}$	$A(D)^{0.5}$	$\frac{1.49AR^{2/3}S^{1/2}}{n}$	Q/A
0.10	0.12	2.58	0.05	2.43	0.94	0.00	0.15	1.21
0.20	0.53	7.72	0.07	7.39	0.96	0.00	0.82	1.56
0.30	1.77	17.92	0.10	17.41	0.97	0.00	3.51	1.99
0.40	4.02	28.23	0.14	27.44	0.97	0.00	10.21	2.54
0.50	7.29	39.28	0.19	39.00	0.99	0.00	22.09	3.03

CRABTREE GROUP INC.
ENGINEERING SMART GROWTH™

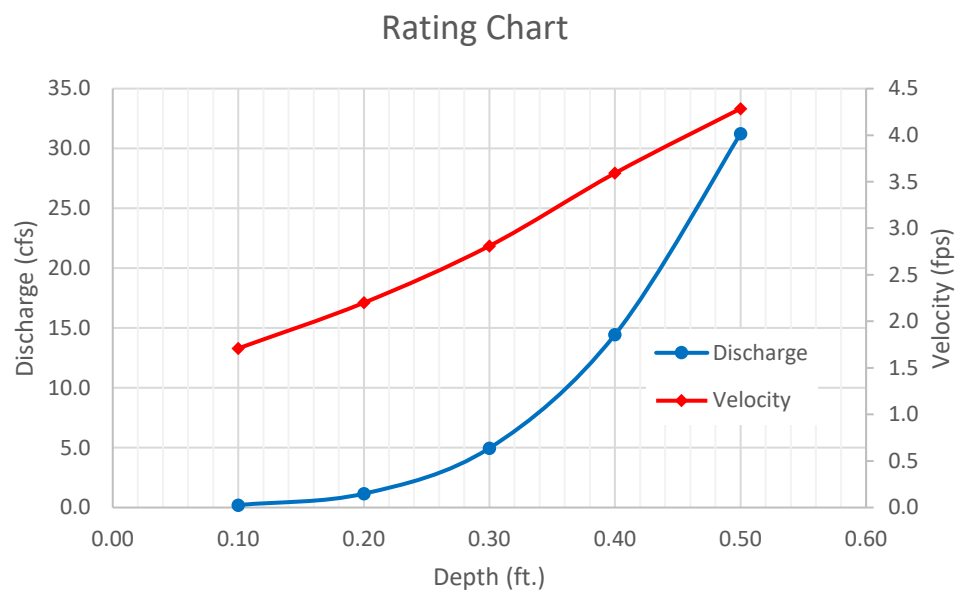
Project	Location	By	Date
Gunnison Rising - Phase 2	Gunnison Colorado	TLV	11/30/21
Description		**Checked**	**Date**
38' Roadway @ 2.0%			



Channel Slope (S)= 0.020 ft/ft

Manning's n= 0.016

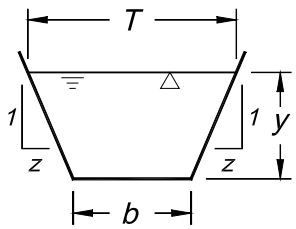
Notes:



Depth (y)	Area (A)	Wetted Perimeter (P)	Hydraulic Radius (R)	Top Width (T)	Hydraulic Depth (D)	Section Factor (Z)	Discharge (Q)	Velocity (v)
	(ft^2)	$(ft.)$	$\frac{A}{P}$	$(ft.)$	$\frac{T}{P}$	$A(D)^{0.5}$	$\frac{1.49AR^{2/3}S^{1/2}}{n}$	Q/A
0.10	0.12	2.58	0.05	2.43	0.94	0.00	0.21	1.71
0.20	0.53	7.72	0.07	7.39	0.96	0.00	1.16	2.20
0.30	1.77	17.92	0.10	17.41	0.97	0.00	4.96	2.81
0.40	4.02	28.23	0.14	27.44	0.97	0.00	14.44	3.59
0.50	7.29	39.28	0.19	39.00	0.99	0.00	31.23	4.28

CRABTREE GROUP INC.
ENGINEERING SMART GROWTH™

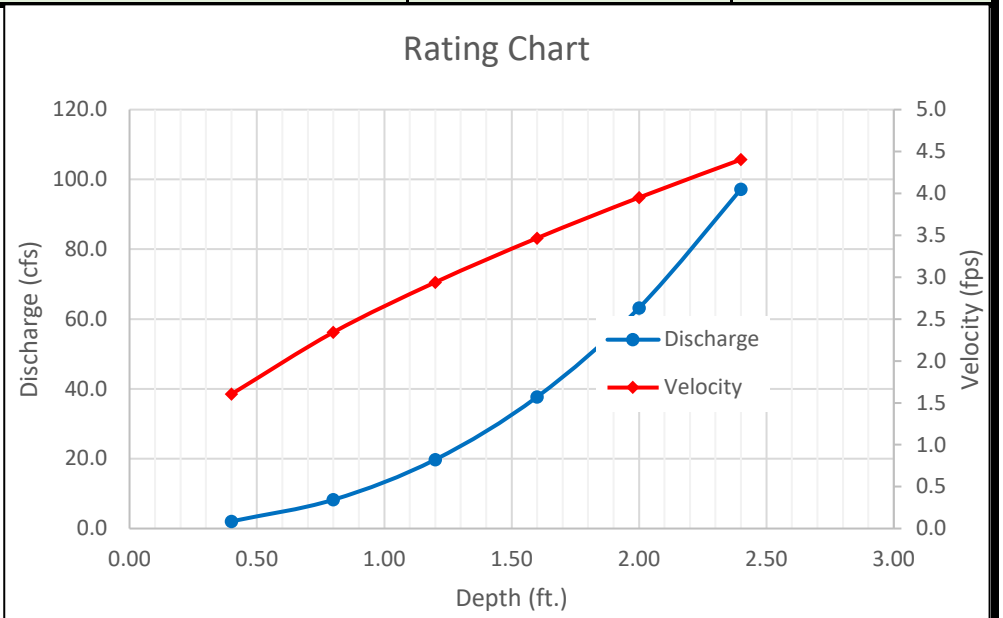
Project	Location	By	Date
Gunnison Rising - Phase 2	Gunnison Colorado	TLV	11/30/21
Description		**Checked**	**Date**
Channel @ 1.0%			



b= 2.0 ft
z= 3.0 ft

Channel Slope (S)= 0.010 ft/ft
Manning's n= 0.040

Notes:



Depth (y)	Area (A)	Wetted Perimeter (P)	Hydraulic Radius (R)	Top Width (T)	Hydraulic Depth (D)	Section Factor (Z)	Discharge (Q)	Velocity (v)
	$(b+zy)y$	$b+2y(1+z^2)^{1/2}$	$\frac{(b+zy)y}{b+2y(1+z^2)^{1/2}}$	$b+2zy$	$\frac{(b+zy)y}{b+2zy}$	$by^{1.5}$	$\frac{1.49AR^{2/3}S^{1/2}}{n}$	Q/A
0.40	1.28	4.53	0.28	4.40	0.29	0.51	2.05	1.60
0.80	3.52	7.06	0.50	6.80	0.52	1.43	8.24	2.34
1.20	6.72	9.59	0.70	9.20	0.73	2.63	19.75	2.94
1.60	10.88	12.12	0.90	11.60	0.94	4.05	37.72	3.47
2.00	16.00	14.65	1.09	14.00	1.14	5.66	63.21	3.95
2.40	22.08	17.18	1.29	16.40	1.35	7.44	97.23	4.40

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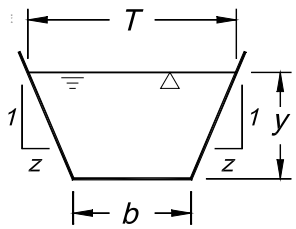
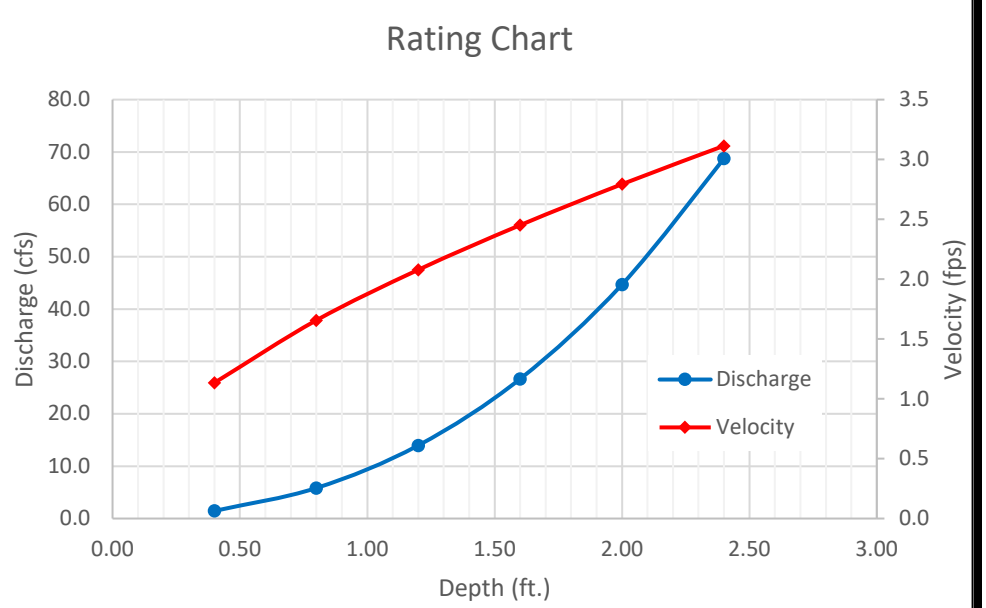
Project	Location	By	Date
Gunnison Rising - Phase 2	Gunnison Colorado	TLV	11/30/21
Description		**Checked**	**Date**
Channel @ 0.5%			



b= 2.0 ft
z= 3.0 ft

Channel Slope (S)= 0.005 ft/ft
Manning's n= 0.040

Notes:



Depth (y)	Area (A)	Wetted Perimeter (P)	Hydraulic Radius (R)	Top Width (T)	Hydraulic Depth (D)	Section Factor (Z)	Discharge (Q)	Velocity (v)
	$(b+zy)y$	$b+2y(1+z^2)^{1/2}$	$\frac{(b+zy)y}{b+2y(1+z^2)^{1/2}}$	$b+2zy$	$\frac{(b+zy)y}{b+2zy}$	$by^{1.5}$	$\frac{1.49AR^{2/3}S^{1/2}}{n}$	Q/A
0.40	1.28	4.53	0.28	4.40	0.29	0.51	1.45	1.13
0.80	3.52	7.06	0.50	6.80	0.52	1.43	5.83	1.66
1.20	6.72	9.59	0.70	9.20	0.73	2.63	13.96	2.08
1.60	10.88	12.12	0.90	11.60	0.94	4.05	26.67	2.45
2.00	16.00	14.65	1.09	14.00	1.14	5.66	44.70	2.79
2.40	22.08	17.18	1.29	16.40	1.35	7.44	68.75	3.11

Appendix F

FEMA FIRMette

National Flood Hazard Layer FIRMette

FEMA

106°54'52"W 38°32'56"N

106°54'15"W 38°32'28"N

Feet

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

1:6,000

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

Legend

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

SPECIAL FLOOD HAZARD AREAS

- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD

- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- B 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS

- Digital Data Available
- No Digital Data Available
- Unmapped

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 12/2/2021 at 5:53 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

Appendix G

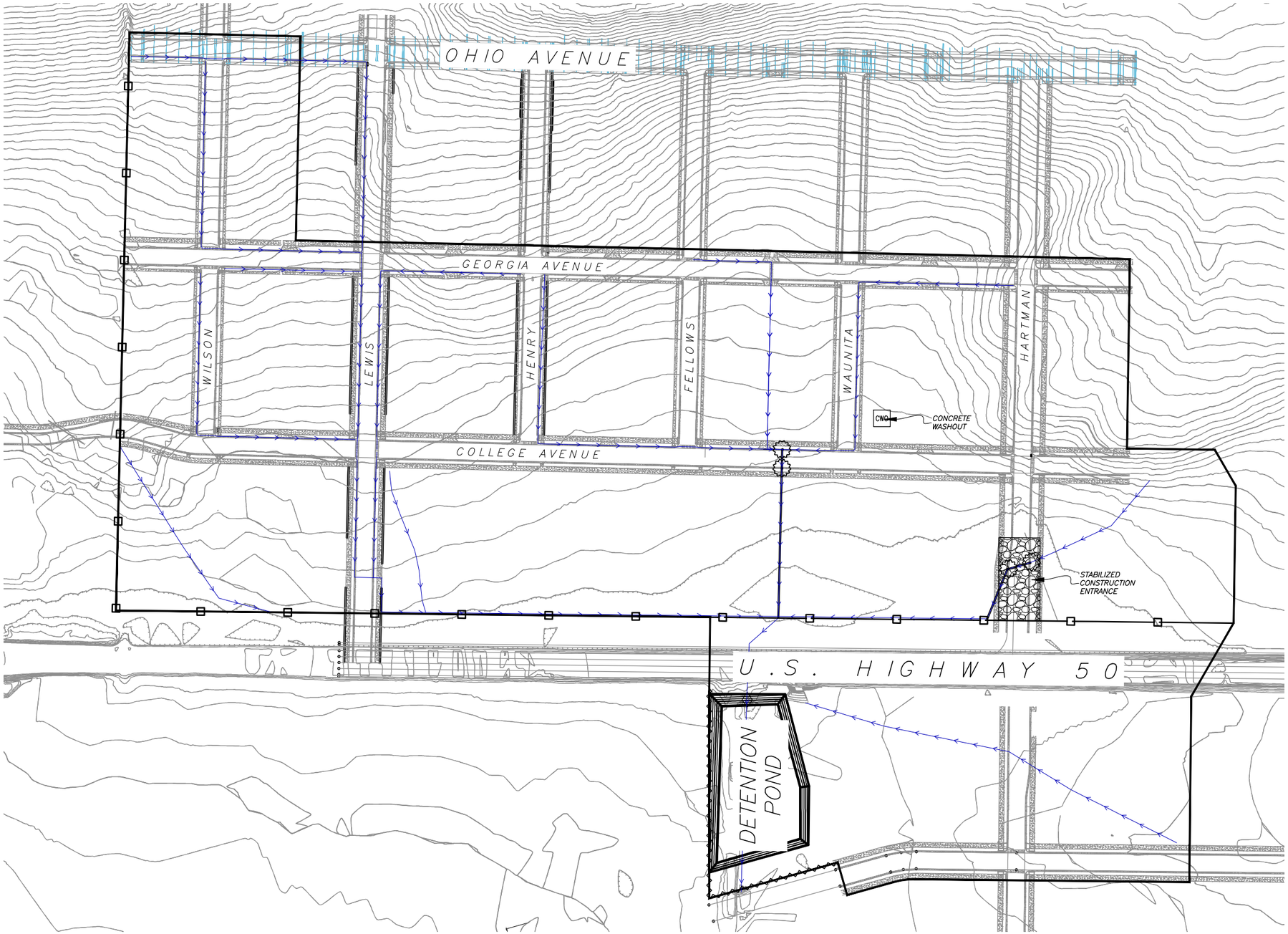
POTENTIAL BMP MAP

GUNNISON RISING - PHASE 2

POTENTIAL BMP PLAN

GUNNISON, COLORADO

DECEMBER, 2021



GRAPHIC SCALE

60' 0 60' 120' 180'

(CONTOUR INTERVAL = 1 FOOT)

LEGEND

- PROJECT BOUNDARY
- RIGHT-OF-WAY
- SILT FENCE
- STAW WATTLES
- FLOW DIRECTION
- CWO — CONCRETE WASHOUT
- INLET PROTECTION

GUNNISON RISING - PHASE 2 - DRAINAGE MAP

PREPARED BY:

CRABTREE GROUP INC.

ENGINEERING SMART GROWTH™

SHEET NO. 1 OF 1