FINAL DRAINAGE REPORT

PPR 234

Schubert Ranch Sand Resource Pit

Ellicott Sand and Gravel

May 23, 2023
Revised January 31, 2024
Revised March 13, 2024

Prepared by:

Environment, Inc.

Regulatory Permits Management, Inc.

EME Solutions, Inc.

Signature Page

Design Engineer's Statement:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

John L. Jankousky, PE #30491, EME Solutions, Inc. March 13, 2024
Date

Owner/Developer's Statement:

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

4/10/2024

George Schubert, Manager
Schubert Ranch LLC.
1555S. Baggett Road
Calhan, CO 80808-7808

El Paso County:

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

County Engineer / ECM Administrator Date

Conditions:

Contents

Attachments

Appendix A

The Table of Contents for Appendix A is at the start of the appendix.

1. Introduction

This Final Drainage Report meets the El Paso County requirements. Please note that the Proposed Project is a sand and gravel mine, not a commercial development or a subdivision:

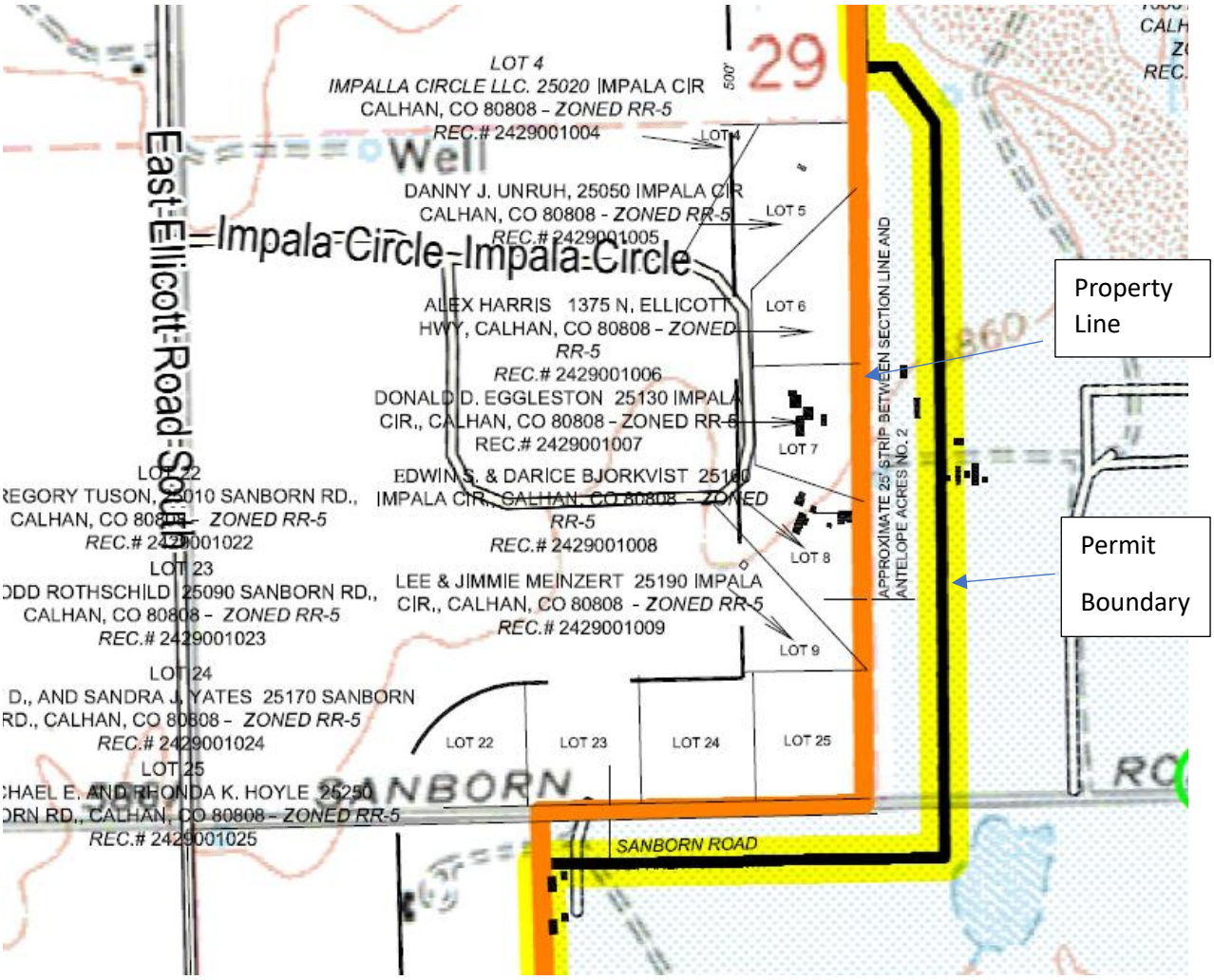
- No structures, residential or commercial development or associated infrastructures are proposed.
- We provided a Landscape Plan, Grading and Erosion Control Plan and a Reclamation Plan which show the interim and final configuration of the site once mining and site reclamation are complete. No additional drainage controls will be installed other than those which are in the above-referenced documents.
- We have provided a Grading and Erosion Control Plan Checklist with associated maps. These documents show the engineering designs for ditches, and berms which will be removed during site reclamation.
- All post mining drainage will be internal to Stage I. The runoff into Stage I will infiltrate into the floor of the reclaimed mine pit.
- No drainage will be mined through or receive additional stormwater runoff from reclaimed Stage I.

2. General Location:

1. **City and County, and local streets within and adjacent to the subdivision:**
   - Response to comment:
     - ✓ This is a mineral extraction operation and not a subdivision. The nearest municipality is Ellicott, Colorado. It is not adjacent to the proposed mineral extraction operation and lies to the north of the proposed operation.
     - ✓ The adjacent roads are Sanborn, and Baggett Roads, both rural dirt roads.
     - ✓ The proposed operation is in eastern El Paso County, about 1.65 miles south of Colorado State Highway 94 and about 1.5 miles east of Ellicott Highway.
2. **Township. Range, Section, ¼ section:**

   Parts of the SW1/4NE1/4, SW1/4SE1/4 & NW1/4SE1/4, SECTION 29, T-14-S, R-62-W, 6TH PM, El Paso County, Colorado, Containing 66.1 acres, more or less.

3. **Major drainage ways and existing facilities:**
   - The major drainageways are Black Squirrel Creek and Big Springs Creek, both ephemeral drainages. Stage I is not involving Big Springs Creek. Stage I borders Black Squirrel Creek to the east. It will not negatively impact Black Squirrel Creek.
   - There are no existing facilities.
4. **Names of surrounding platted developments:**
   - The only development we are aware of in the immediate vicinity is Antelope Acres No.2, zoned RR-5, west of Stage I.



3. Description of Property:

1. **Area in acres:**
   - Stage I, 66.1 acres, more or less.

2. **Ground cover, (type of trees, shrubs, vegetation):**
   - A mix of rangeland grasses, forbs, and shrubs.

3. **General topography:**
   - Gently rolling topography with incised ephemeral drainages.

4. General soil conditions:

- The attached portion of the soils map shows the soil units in Stage I, map unit 95 (Truckton loamy sand 1, to 9% slopes), map unit 78 (Sampson loam, 0 to 3 % slopes), and map unit 28 (Ellicott loamy coarse sand, 0 to 5% slopes).
- Map Unit Description:
  - ✓ Map Unit 28:

    "The Ellicott component makes up 85 percent of the map unit (*on the entire permit area*). The slopes are 0 to 5 percent. This component is on stream terraces, flood plains. The parent material consists of sandy alluvium…The natural drainage class is somewhat excessively drained. Water movement in the most restrictive layer is high…This soil is frequently flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches…" (NRCS, Web Soil Survey, National Cooperative Soil Survey, 3/27/2018)

  - ✓ Properties and Qualities:

    "Runoff Class: very low

    Ksat: 5.95 to 19.98 in/hr.

    Available Water Storage in Profile: About 4.1 inches

    (NRCS, Web Soil Survey, National Cooperative Soil Survey, 3/27/2018)

  - ✓ Map Unit 78:

    "The Sampson component makes up 90 percent of the map unit (*on the entire permit area*). Slopes are 0 to 3 percent. This component is on alluvial fans, terraces, depressions. The parent material consists of alluvium…The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high…This soil is not flooded. It is not ponded. There is no water saturation within a depth of 72 inches…" (NRCS, Web Soil Survey, National Cooperative Soil Survey, 3/27/2018)

  - ✓ Properties and Qualities:

    Runoff Class: Low

    Ksat: 0.60 to 2.00 in/hr.

    Available Water Storage in Profile: About 9.2 inches

    (NRCS, Web Soil Survey, National Cooperative Soil Survey, 3/27/2018)

  - ✓ Map Unit 95:

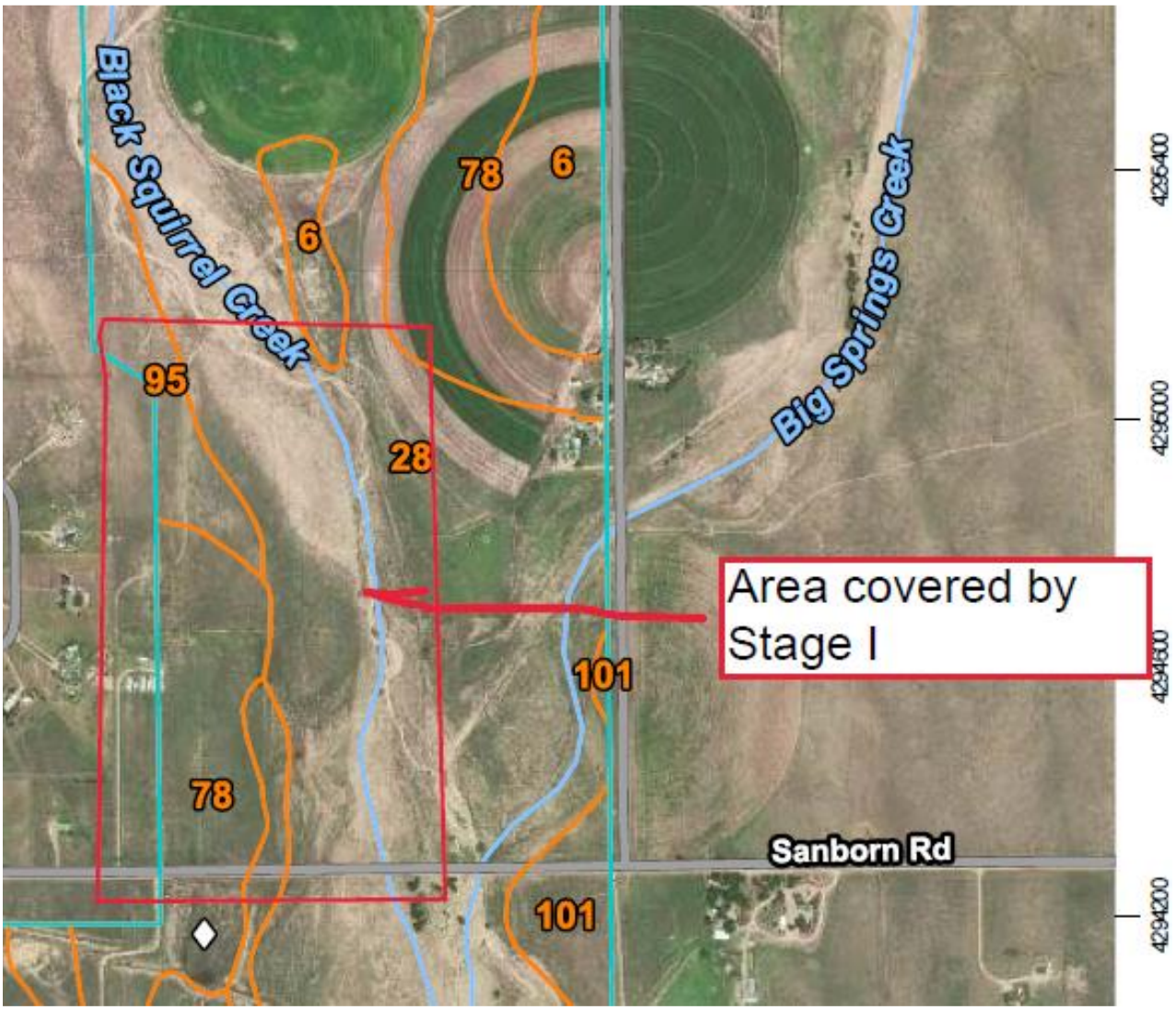
"The Truckton component makes up 85 percent of the map unit (*on the entire permit area*). Slopes are 1 to 9 percent. This component is on flats, uplands, hills. The parent material consists of arkosic alluvium derived from sedimentary rock and/or arkosic residuum weathered from sedimentary rock…The natural drainage class is well drained. Water movement in the restrictive layer is high…This soil is not flooded. It is not ponded…"

✓ Properties and Qualities:

Runoff Class: Low

Ksat: 1.98 to 6.00 in/hr.

(NRCS, Web Soil Survey, National Cooperative Soil Survey, 3/27/2018)



From NRCS, Web Soil Survey, National Cooperative Soil Survey, 3/27/2018.

5. **Major drainageways:**
   - Black Squirrel Creek
   - Big Springs Creek, and does not flow into Stage I.
   - Both ephemeral drainages
6. **Irrigation facilities:**
   - No irrigation facilities in Stage I

7. **Utilities and other encumbrances:**
   - At the south end of Stage I, between the permit boundary and Sanborn Road, within the Sanborn Road right-of -way are an overhead power line, and buried telephone/communications lines. (Please see the Ellicott Sand and Gravel LLC – Site Development Plan Stage I of 6 – Grading and Erosion Control Plans, Sheet 2.)

4. Major Basin Descriptions:

1. **Reference should be made to major drainageway planning studies, such as drainage basin planning studies, flood hazard delineation reports, and flood insurance studies and maps if available:**

The Project Site is in the major drainage basin of Upper Black Squirrel Creek (Colorado Department of Natural Resources 2024). The Project Site is in subbasins Ellicott Consolidated Drainage Basin, Ellicott Drainage Basin and Lower Big Springs Creek Drainage Basin (El Paso County Planning Department 1989). No drainage basin planning studies were provided or discovered for any of these basins.

There is a Flood Insurance Rate Map (FIRM) for the Project Area. See the first bullet point below. The flood plain is this vicinity ranges in width from about 3,500 feet to about 1,800 feet. Part of the Proposed Project is in flood zone designation type Zone AE.

The following references were available:

- Flood Insurance Rate Map (FIRM), Attachment 1. FIRM 0841C0840G and 08041C0830G, effective on 12/7/2018.
- Schubert Ranch Sand Resource Floodplain Modeling Technical Memorandum for Black Squirrel Creek, El Paso County, Colorado, EME Solutions, Inc., J.L. Jankousky. P.E., 02/25/2020.
- Groundwater Quality, Age, and Susceptibility and Vulnerability to Nitrate Contamination with Linkages to Land Use and Groundwater Flow, Upper Black Squirrel Creek Basin, Colorado, 2013, Scientific Investigations Report 2016-5020,

USDA, USGS, TP Wellman and MG Rupert, 2016. (Sourced for "Major Basin Description)

2. **A floodplain statement shall be provided indicating whether any portion of the development is in a designated floodplain as delineated on the current FEMA mapping:**
   - Part of the Proposed Project is in flood zone designation type Zone AE. See FIRM 0841C0840G and 08041C0830G, effective on 12/7/2018 (FEMA 2018).
   - The Proposed Project will consist of cutting material from the flood plain, not filling in the flood plain.
   - No residential or commercial developments are planned. The project consists of a sand and gravel mine. There will be no structures associated with mining activities. There will be a portable scale and a portable scale house. Mining will occur within the designated floodplain. There will be no rise in water surface elevation due to the mining activities.
   - A Flood Plain Development Permit for the entire project is presented as Attachment 2. The Flood Plain Development Permit was originally issued on February 25, 2020 and was re-issued on January 18, 2024.

3. **Major basin drainage characteristics:**

   Geology (Note: the following information is derived from the USGS Scientific Investigations Report 2016-5020 as noted above. (Pages 5, and 17) Please refer to that report for listed author citations for the following information.

   - "Consolidated geologic deposits of the Upper Black Squirrel Creek Basin in ascending stratigraphic order include the Cretaceous Pierre Shale. Fox Hills Sandstone, Laramie, and Arapahoe Formations, Cretaceous and Tertiary Denver Formation, and the Dawson Arkose, all of which are important aquifers (Buckles and Watts, 1988)."
   - "Unconsolidated alluvium and aeolian deposits of Quaternary age overlie the slightly dipping sedimentary rocks of Tertiary and Cretaceous age in the Upper Black Squirrel Creek Basin (Banta, 1989). The unconsolidated Quaternary deposits are the primary source of groundwater pumped by irrigation, municipal, and domestic wells in the study area. They consist of modern flood-plain alluvium and Piney Creek alluvium along stream channels; reworked aeolian deposits of sand, silt, and loess; and older valley-fill alluvium. Flood-plain alluvium along stream channels consists of less than 4.5 m of poorly sorted clay, silt, sand, and gravel. The Piney Creek alluvium of Holocene age ranges in thickness up to 4.5 m and consists of clayey and sandy silt and silty sand. In some areas, the Piney Creek alluvium overlies aeolian deposits and, in the other areas, overlies valley-fill alluvium. The aeolian deposits of Holocene age range in thickness up to 12 m and consist of fine to very coarse grained sand (Soister,

1968). The valley-fill alluvium of Pleistocene age ranges in thickness up to about 60 m and consists of sand and gravel. The consolidated water-bearing sandstones, and conglomerates, which intersect the unconsolidated Quaternary deposits and overlie the Pierre Shale."

"The geologic deposits are generally elongate in shape, often following creek drainages, and trend in a north-south to northwest-southeast direction."

"Classifications were defined as: (1) modern flood plain or Piney Creek deposits, (2) aeolian deposits, or (3) intermediate to late alluvium Louviers Alluvium, Slocum Alluvium, or Rocky Flats Alluvium)."

"Modern flood plain or Piney Creek deposits were deposited mainly along the stream channels and near the northwest aquifer boundary. "

"As a general overview, major soil orders overlying the primary aquifer are alfisols, aridisols, entisols, and mollisols (fig. 9). The main soil order is a mollisol, which form a semiarid to semihumid areas, typically under a grassland cover, and are characterized by a thick, dark surface horizon with organic materials derived from plant roots (Soil Survey Staff, 1999). The second most abundant soil is an entisol, which has no diagnostic horizons and is generally unaltered parent material, such as unconsolidated sediment or rock. Remaining soils (aridisols and alfisols) are minor in spatial distribution and occur mainly to the south and in small, isolated areas to the north.

"Areas with highest soil porosity are concentrated in the central part of the study area and to a lesser degree along stream channels to the northwest. Soil clay content is an important factor controlling infiltration, commonly ranging from a few percent to more than 20 percent by weight (fig. 12). Soils can possess greater porosity because of greater clay content, but also have lower permeability to water movement under saturated conditions. Areas with moderate to high clay content are typically located in the central part of the study area, while areas with the highest clay components are usually located within 1 km of stream channels. The soil is classified as generally well drained to excessively drained (fig. 13), although wetlands are present in small, isolated areas. The majority of excessively drained soils reside in the southern part of the study area with somewhat excessively drained soils trending along a northwest-southeast direction, mainly near stream channels to the west."

Hydrology

- "Black Squirrel Creek is ephemeral and a tributary to Chico Creek located south of the study area. Chico Creek is tributary to the Arkansas River (fig.1). Streambeds are composed primarily of sand, which allows for rapid infiltration of water. Dry conditions persist during most times of the year. Focused runoff generally infiltrates into the sandy streambeds and directly recharges the primary aquifer. Occasionally, after intense precipitation, the available water exceeds infiltration capacity and

surface water is discharged from the study area. Infiltration of precipitation and surface water is the main source of recharge to the groundwater and represents about 93 percent of total recharge (Watts, 1995).

For the Stage I Project, there will be approximately zero flow from the project area. At the southern edge of the Project Area, there is a 20-foot apron north of Sanborn Road. All of the drainage basin north of this 20-foot apron will flow into the pit and infiltrate. Under the existing conditions, there is the potential for some flow from the Project Area to Black Squirrel Creek (calculated at less than 100 cubic feet per second [cfs] for the 100-year, 24-hour storm). The Proposed Project will result in reduced flows from the Project Area.

4. **Identification of all nearby irrigation facilities and other obstructions which could influence or be influenced by local drainage.**
   - There are no nearby irrigation facilities.
   - The only obstruction we are aware of is Sanborn Road immediately to the south of Stage I.

5. Sub-Basin Descriptions:

1. **Discussion of historic drainage pattern of the property in question:**

One historic ephemeral drainage, Black Squirrel Creek, runs along the northeast and east sides of Stage I. There are no other significant drainages, other than sheet flow within Stage I.

2. **Discussion of offsite drainage flow patterns and their impact on the development:**

Offsite drainage patterns will not impact the project.

On the western side of Stage I, the offsite basin OFF-1 may have flows that flow to the western edge of Stage I. See Sheet 3. During construction, Stage I will have a sight berm to minimize visual impact from project activities. This berm is not intended to re-direct the offsite flows from Basin OFF-1. There will be a break in this berm approximately every 300 feet. The berm will be about 3,000 feet in length, so there will be 8 to 10 breaks in the berm. Flows from Basin OFF-1 will continue into the pit, just as they now flow from Basin OFF-1 into the proposed project area. After completion of the project, the sight berm will be removed. The flows from Basin OFF-1 are calculated at 45.9 cfs for the 5-year storm and 169.3 cfs for the 100-year storm. It is believed that these calculations, using runoff coefficients for Soil Hydrologic Group A, significantly overestimate the flows. The soils in this area include loamy coarse sands and sandy loams and runoff classes are very low to low.

Observations in the project area and vicinity lead to the conclusion that under most storm conditions, there is very little runoff.

On the eastern side of Stage I, Black Squirrel Creek is an ephemeral drainage located to the east and north. Under almost all conditions, Black Squirrel Creek will stay in its banks. For the 100-year flood, Black Squirrel Creek leaves its bank and will encroach upon the project area. Armoring will be placed in order to minimize erosion during the 100-year event. The mine pit will temporarily flood, but will drain within a few days.

6. Drainage Design Criteria

1. **Reference all criteria master plans, and technical information used for report preparation and design; any deviation from such material must be discussed and justified:**
   - Please see "Major Basin Descriptions" Item 1 above for a list of such items. We supplied the information as reported and did our best to not deviate from what was presented in the documents.

2. **Discussion of previous drainage studies (i.e., PDR, drainage basin planning studies, master plans, flood insurance studies) for the site in question that influence or are influenced by the drainage design and how the studies affect drainage design for the site:**

There are no previous drainage studies for the site. A Floodplain Modeling Technical Memorandum was prepared in 2020 (EME 2020) and a floodplain permit has been issued by the County.

7. Four Step Process:

1. **Runoff reduction proposed:**

   Topsoil stockpiles will be stabilized (seeded) per the commitments made in our approved Colorado Mined Land Reclamation Division (CMLRD) permit application.

   Silt fence is included as a potential Control Measure on the Grading and Erosion Control Plan. The actual placement of silt fence will be determined in the field and the Stormwater Management Plan (SWMP) will be updated as necessary to show actual placement.

   Stormwater runoff in the Project Area will flow into the active and reclaimed Stage I pit. The runoff will then infiltrate into the floor of the Stage I pit.

Upon completion of Stage I mining, the slopes will be graded to 3H:1V or less, topsoil replaced, the area seeded, then mulch applied per our approved Colorado Mined Land Reclamation Division (CMLRD) permit application.

When reclamation is completed, Stage I will slope into the mined area. Stormwater runoff will flow into the active and reclaimed Stage I pit. The runoff will then infiltrate into the floor of the Stage I pit. It is expected that under almost all conditions, this runoff will infiltrate into the ground. Colorado Division of Water Resources guidelines state that 97 percent of the water runoff from a rainfall event that is equal to or less than a five-year storm should infiltrate within 72 hours of the end the rainfall event. For events greater than the five-year storm, the pit should be able to infiltrate at least 99 percent of the water within 120 hours of the end the rainfall event (Colorado Division of Water Resources 2016). For the vast majority of conditions, no water rights are needed to retain and infiltrate the runoff because open water will not be maintained in the pit past the allowable time frames.

Under certain rare conditions, there may be open water in the pit for a period longer than 72 or 120 hours. To discuss water rights for captured water, we met with the Upper Black Squirrel Creek (UBSC) Groundwater Commission board and presented the plan and explained the concern about capturing the excess flow. The consensus of the Board was that the presence of the pit would increase the ground water capture, allowing for more recharge and due to the nature of the sand would soak in fast enough to present little problem. The UBSC Groundwater Commission's board felt that if the channel can be preserved, the capturing of the water and soaking in of said water (recharge) would be a benefit to the basin. One idea was that this would be a fairly short time and that Mr. Schubert (the landowner) had enough water to provide evaporative losses for that period. This may be done by not pumping from his well until the captured water has soaked into the ground and show that the volume of the water lost to evaporation would be accounted for as if it were actually pumped from the ground. They also thought because of the unknowns that it would be impractical to try to plan for such an event until it happens. The Upper Black Squirrel drainage board asked Ellicott Sand & Gravel LLC to stay at least 10 feet above the ground water table. The mining plan has been revised to show this separation as they suggested. Ellicott Sand & Gravel LLC has committed to obtaining any necessary well permits and a replacement water plan for exposed ground water if needed.

At the present time, there are no culverts across Sanborn Road. Flows at Black Squirrel Creek cross Sanborn Road at a low water crossing. The low water crossing is an unimproved ford. This Proposed Project will result in a small decrease in flows at Black Squirrel Creek (the Proposed Project area is small compared to the entire basin area). Leaving the status quo at the ford is an acceptable solution.

For the existing condition, at the Project Area (west of Black Squirrel Creek), there may be small flows that either pool on the north side of Sanborn Road or small flows that cross Sanborn Road. These flows will be greatly reduced after the Proposed Project is

implemented. Almost all of these flows will go to the pit. No culverts are proposed or needed at Sanborn Road at the Project Area.

2. Stabilization of drainage ways proposed/discussed:

Black Squirrel Creek (an ephemeral drainage) runs along the east side of Stage I. Following is the proposed bank protection plan from the approved CMLRD permit application.

To be able to do this we needed to know if the U.S. Army Corps of Engineers had jurisdiction for Black Squirrel Creek. Steve O'Brian of Environment, Inc. met with Tony Martinez with the U.S. Army Corps of Engineers on June 20, 2019 to determine want jurisdiction they had along this stretch of the creek within the boundary I put on the maps. Basically, Mr. Martinez said the Ordinary High Water (OHW) line was the area that is scoured and has little or no vegetation from the past normal water flow events. Map Exhibit C has been revised to show the OHW line defined by Mr. Martinez. This means that for most of the permit area construction along the banks is outside Corps jurisdiction and can be built without a 404 permit.

The Mining Plan and Reclamation Plan Maps have been revised to show the revised setback and the approximate location of the armoring areas and the OHW line as mapped by the Corps of Engineers. A detailed Bank Protection Plan is supplied with this response and explains how the armoring will be done and has a typical cross section showing how the armoring will be placed. The height will vary but along each side, the bottom of the armoring will be 5 feet below the creek bed on the outside and 3 feet below the creek bed on the inside. The material to be used will be broken concrete rubble that meets the definition of Inert Material. Sufficient material will be stockpiled on the site to do up to 500 feet at a time. This amounts to approximately 2500 cubic yards of inert material rubble. This material will be stored in the setback area so it runs parallel to the drainage as shown on the Mining Plan Map. As mining progresses, armoring will be done when mining gets within 350 feet of the outside bank it will be armored as well as a couple of hundred feet in front of the area to be stripped and mined. When the inner slopes are being shaped that area will then be armored. We believe that in combination with the increased setbacks and bank armoring the channel can be kept in its present location. Please see Map set PPR234-ESG GEC for details.

Calculations for the riprap sizing are shown in Appendix A.

3. Proposed Stormwater Quality Capture Volume (WQCV) proposed:

The Stage I Project is not required to provide Stormwater Quality Capture Volume (WQCV). The requirements for post-construction stormwater management, including WQCV, are presented in the Engineering Criteria Manual (El Paso County Colorado

2020) in Appendix I.7.1. The Stage I project meets the conditions required for an exclusion from these requirements as outlined in Appendix I.7.1.B.6, "Non-Residential and Non-Commercial Infiltration Conditions." "This exclusion applies to applicable development sites for which post-development surface conditions do not result in concentrated stormwater flow during the 80th percentile stormwater runoff event. In addition, post-development surface conditions must not be projected to result in a surface water discharge from the 80th percentile stormwater runoff events." (El Paso County Colorado 2020). See Appendix A for the calculations related to the 80th percentile stormwater runoff events. Stormwater runoff will be captured in the Stage I pit and infiltrate into the floor of the pit.

4. **Identify Best Management Practices (BMP's) to be used to control industrial and commercial pollutants:**
   - Please see Map set PPR234-ESG GEC for details.
   - We have a Stormwater Management Plan.
   - We have an SPCC Plan.
   - The excavated and reclaimed pit will be able to hold up to 2010 acre-feet of runoff, if fully excavated. This amount is greater than the storage necessary for WQCV and detention.

8. Hydrologic Criteria:

1. **Identify design rainfall:**

The design rainfall was defined using NOAA Atlas 14, Volume 8, Version 2.

2. **Identify runoff calculation method:**

The Rational Method was used to calculate runoff.

3. **Identify design storm recurrence intervals:**

The Site was evaluated for the 5-year and 100-year rainfall events for conveyance of runoff.

4. **Identify detention discharge and storage calculation method:**

The site will be a mine pit. The size of the mine pit is adequate to retain the entire volume of stormwater runoff. The retained runoff will soak into the subsurface quickly because of the high infiltration rates of the soils and subsurface materials.

5. Note ECM Appendix I Full Spectrum Detention (FSD) requirement:

This provision is not applicable. The site once reclaimed and during mining will function as a retention basin receiving regulated stormwater runoff. The floor of the pit will allow for infiltration of regulated stormwater into the substrate. There will be no designed or constructed outlet structure. This "retention basin" is not considered a Post-Construction Control measure because the Stage I site is excluded from needing WQCV treatment (Exclusion F on the PBMP Applicability form) and detention (because there is no increase in flows from the pre-development to post-development conditions).

9. Drainage Facility Design – General Concept:

1. **Discussion of compliance with offsite runoff considerations:**
   - All regulated Stormwater runoff will be captured by the Stage I pit during active mining, and through site reclamation.
   - No drainage facilities are proposed for Stage I.

2. **Discussion of anticipated and proposed drainage patterns:**
   - We do not anticipate or propose any significant change to drainage patterns. Once Stage I begins, it will intercept precipitation which falls on the affected area and ends up on the floor of the Stage I pit. It will then infiltrate into the highly pervious pit floor and enter the ground water system.

3. **Discussion of the content of tables, charts, figures, plates of drawings presented in the report:**

The following are presented in the Attachments:

- FIRM
- Floodplain Development Permit

The following tables, charts, and figures are presented in Appendix A:

- Table 1. Areas, Lengths, and Elevation Changes from Site Map
- Table 2. Percent Impervious Calculations and Rational Method "C" Calculations
- Table 3. Time of Concentration
- Chart 1. NOAA Atlas Data and Rainfall Intensity
- Table 4. Rational Method Procedure -- 5-year Design Storm
- Table 5. Rational Method Procedure -- 100-year Design Storm
- Table 6. Required Cross-Sectional Areas for Channel Flow
- Table 7. Riprap Calculations
- Table 8. Retention Basin Calculations

Flows for Basin 1 (the Stage I project area) were calculated for the existing conditions and proposed conditions for the 5-year design storm and the 100-year design storm. Flows for the offsite basin, Basin OFF-1, were calculated for the same storms for the proposed conditions (no change from the existing conditions). For Basin 1, existing conditions, the 5-year flow is 8.1 cubic feet per second (cfs) and the 100-year flow is 63.2 cfs. For Basin 1, proposed conditions, the 5-year flow is 12.9 cfs and the 100-year flow is 95.8 cfs. For Basin OFF-1, existing and proposed conditions, the 5-year flow is 45.9 cfs and the 100-year flow is 169.3 cfs.

Note that the flows for the Basin 1, the proposed condition, are greater than the flows for Basin Existing 1, the existing condition. The existing condition in Basin Existing 1 has a fairly

uniform 1% slope. The proposed condition in Basin 1 has a slope of 20% on the pit walls and a slope of about 1% on the pit floor. Because of the slope of the pit walls, Basin 1 has a shorter time of concentration than Basin Existing 1 (16.1 minutes versus 44.7 minutes, respectively). See Table 1 and Table 3. The Rational Formula is Q = C x i x A, where Q is the flow in cfs, i is rainfall intensity in inches per hour, and A is the area in acres. The intensity, i, in the Rational Formula is the rainfall intensity for the time of concentration. Therefore, Basin 1, with a shorter time of concentration, has greater expected flows than Basin Existing 1. See Rainfall Intensity Curve, page A-11, Table 4, page A-12, and Table 5, page A-13. Please note that these flows are in the pit only. The flows will not leave the pit and cannot impact any offsite areas.

The flows in Basin 1 for the proposed conditions were evaluated for channel flow in a shallow swale (50:1 side slopes). For the 5-year storm, the swale will have a flow depth of 0.28 feet and a flow top width of 34.0 feet. For the 100-year storm, the swale will have a flow depth of 0.65 feet and a flow top width of 71.0 feet.

Riprap was sized for Black Squirrel Creek at the Stage I project area. The model results from a HEC-RAS model were used to provide the depth of flow and slope of the channel during the 100-year storm flow (EME Solutions 2020). The riprap size was calculated using allowable shear stress calculations. The calculations indicate that at most locations, riprap with a d50 of 6 inches is adequate. At one location, a riprap with d50 of 12 inches is required. To be conservative, and also because concrete materials are proposed as riprap, EME recommends that a d50 of 12 inches is used for the entire length of channel along Stage I.

The Stage I pit will act as a retention pond for Basin 1 and Basin OFF-1. The site once reclaimed and during mining will function as a retention basin receiving stormwater runoff. The floor of the pit will allow for infiltration of regulated stormwater into the substrate. There will be no designed or constructed outlet structure. This “retention basin” is not considered a Post-Construction Control measure because the Stage I site is excluded from needing WQCV treatment (Exclusion F on the PBMP Applicability form) and detention (because there is no increase in flows from the pre-development to post-development conditions).

10. Drainage Facility Design – Specific Details:

1. **Presentation of existing and proposed hydrologic conditions including approximate flow rates entering and exiting the subdivision with all necessary calculations:**
   - This is not a subdivision or commercial development.
   - Given the mining plan, any stormwater runoff which enters the site will infiltrate into the highly permeable pit floor.
   - Flow rates before and after the project implementation will be identical. No increase in impervious area is planned.

2. **Presentation of approach to accommodate drainage impacts on existing or proposed improvements and facilities:**
   - We will not significantly impact existing drainages which are ephemeral in nature.
   - No existing facilities exist.

3. **Presentation of proposed facilities with regard to alignment, material, and structure type:**
   - No such facilities are planned.

4. **Discussion of drainage impact of site constraints such as streets, utilities, existing and proposed structures:**
   - The only structures will be portable, such as a scale and scale house, and crusher and screen.
   - No new streets are planned. We plan on using the existing ranch road.
   - The only utility is a stub line to the scale and scale house.
   - Therefore, we do not anticipate any impacts to or from drainages.
   - At the present time, there are no culverts across Sanborn Road. Flows at Black Squirrel Creek cross Sanborn Road at a low water crossing. The low water crossing is an unimproved ford. This Proposed Project will result in a small decrease in flows at Black Squirrel Creek (the Proposed Project area is small compared to the entire basin area). Leaving the status quo at the ford is an acceptable solution.
   - For the existing condition, at the Project Area (west of Black Squirrel Creek), there may be small flows that either pool on the north side of Sanborn Road or small flows that cross Sanborn Road. These flows will be greatly reduced after the Proposed Project is implemented. Almost all of these flows will go to the pit. No culverts are proposed or needed at Sanborn Road at the Project Area.

5. **Environmental features and issues shall be if applicable:**
   - We know of no environmental features or issues which would be applicable.

6. **Discussion of maintenance access and aspects of the design:**
   - Maintenance access will be via the existing ranch road(s). These existing roads are of native material and will not be significantly upgraded.

7. **Discussion and analysis of existing and proposed downstream derange facilities and their ability to convey developed runoff from the proposed development:**

- Since all regulated stormwater runoff will be retained in the Stage I pit during its infiltration into the substrate, no downstream drainage facilities should be negatively impacted.

8. **Presentation of detention storage and outlet design (including reservoir routings) when applicable. Note that the Engineering Criteria Manual Appendix I requires Full Spectrum Detention.**
   - There will be retention storage within the Stage I pit. The outlet will be through the bottom of the sandy/gravelly pit floor. This "retention basin" is not considered a Post-Construction Control measure because the Stage I site is excluded from needing WQCV treatment (Exclusion F on the PBMP Applicability form) and detention (because there is no increase in flows from the pre-development to post-development conditions).

9. **Presentation of all hydrologic calculations including hydraulic grade line computations as appropriate. Recommended use of Mile High Flood District (MHFD/UDFCD) spreadsheets and calculations to properly meet this requirement, however other commonly used software may (*be*) acceptable.**

See the calculations presented in Appendix A.

10. **Presentation of an accurate, complete current estimate of cost of proposed facilities:**
    - No facilities are proposed.
    - The cost of the reclaimed pit (which will act as a temporary detention pond) is the approved CDRMS reclamation bond.

11. **Presentation of all drainage basin fees and bridge fees for the property in question as applicable.**
    - We know of no drainage basin fees or bridge fees for the property in question.

11. Other Government Agency Requirements:

1. **Federal Emergency Management Agency (FEMA):**
   - Our FEMA Permit is attached.

2. **Army Corps of Engineers (COE):**
   - No Corp of Engineers requirements since no Waters of the US or wetlands will be impacted.

3. **Colorado State Engineer:**
   - No well permit is needed since no ground water will be exposed.
   - No tributary ground water will be impacted.
   - From the Div. of Water Resources, 12/1/2021:

The applicant should be required to identify the specific water rights that will provide the water purchased from Tim Kunau Drilling, and provide evidence that those rights may be used for plant processing and dust control purposes at the site. In addition, if potable water is purchased from a potable water provider the applicant should be required to demonstrate that the potable water was purchased from a legal source that is permitted/decreed for domestic use.

4. **Colorado Water Conservation Board (CWCB):**
   - As of the date of this document, no CWCB comments were provided.
5. **Others:**
   - CDOT 12/14/2021:

Traffic:

The Traffic Impact Study for Ellicott Sand and Gravel dated October 12, 2021 and supporting documentation has been reviewed by a CDOT Traffic Engineer. Their comments follow:

- A CDOT Access Permit will be required for this development. As part of the access permit the Applicant will be required the following improvements at SH94 & Baggett:
- The Permittee will be required to make improvements to the corner radii on the southwest and southwest corners to accommodate turning tractor trailers onto and off of Baggett and SH94. This work will include, but is not limited to, grading, paving of Baggett for a distance of 50' minimum or the furthest right-of-way line south of SH94, relocation of signage as necessary, and any other improvements as determined by the Engineer. The radii shall be designed per Section 4.6 of the State Highway Access Code.
- The current response letter to CDOT does not indicate acknowledgement of the comments dated June 24, 2021 above. Letter should be revised to reflect comments.

Access

- Section 2.6(3) of the State Highway Access Code, states that if the proposed vehicle volumes increase by 20 percent or more or property improvements are occurring an updated access permit will be required for the intersection of SH94 and Baggett Rd according to the haul route.
- A State Highway Application has not been made with CDOT to date.
- Please contact Arthur Gonzales with CDOT for Access Permitting Processes. Contact information is below.

Hydraulics:

- Hydraulic study was not reviewed at this time but will be required as part of the access permitting process.

Environmental:

- No comments

Additionally,

- On-premise and off-premise signing shall comply with the current Colorado Outdoor Advertising Act, sections 43-1-401 to 421, C.R.S., and all rules and regulations pertaining to outdoor advertising. Please contact Mr. Todd Ausbun at (719) 696-1403 for any questions regarding advertising devices.
- Any utility work within the state highway right of way will require a utility permit from the CDOT. Information for obtaining a utility permit can also be obtained by contacting Mr. Ausbun.

Please contact me in Pueblo at Arthur.gonzales@state.co.us or (719) 546-5732 with any questions (email is best).

Sincerely,

AG

Arthur Gonzales
CDOT R2 - Access Manager

- CDPW, 11/29/2021:

After reviewing the maps and documents for the proposed expansion, Colorado Parks and Wildlife (CPW) does not foresee significant impacts to wildlife, wildlife habitat, or aquatic resources. The proposed area of mineral development is characterized by short grass prairie. Native short grass prairies are highly valued for their ability to support obligate species. In El Paso County, native short grass prairies are critical habitat for Swift Fox and Pronghorn. It would be very important that any disturbed soil in this area be replanted in native grasses as soon as possible to minimize loss of top soil and the introduction of invasive noxious weeds. We would recommend using NRCS seeding guidelines for reclamation of any ground disturbance.

CPW recommends there be minimal impact to the stream bed, both during construction and after, and the stream bed should be handled as a stream crossing whether or not water is present at the time of construction. Minimizing impact to these streams is a priority for CPW and avoidance is best whenever possible. Erosion and sediment control precautions should be in place to avoid deposition into water ways. Destruction of riparian vegetation and truck/heavy machinery stream crossings should be avoided.

CPW further recommends crossing riparian corridors and streams at a perpendicular angle, in order to reduce impacts to natural resources, as well as spanning the corridors with structures located outside the riparian and stream zone. CPW recommends avoiding treed areas of cottonwood and willow, as these areas provide bird and wildlife habitat. During construction, stream crossing by construction vehicles should be avoided. CPW requests that any new service roads that are proposed for construction in conjunction with the project avoid crossing creeks or stream beds to avoid impacts to wildlife and habitat. If any new access or maintenance roads will be constructed that cross stream habitat, CPW would like to be consulted on best management practices and options for construction to minimize impacts.

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CPW would recommend identifying and avoiding all maternal swift fox den sites. Swift fox live here year-round, breed, during December, and raise their young into the next fall. Any disturbance or destruction of dens while pups are den dependent should be avoided. It is recommended that swift fox surveys include daylight searches for den areas and nighttime spotlight searches. CPW recommends no human encroachment, surface disturbance, or construction activity within 0.25-mile of an active den site from **March 15 through June 15.** Swift fox is a species of state and federal concern that lives in and around the proposed area.

Also of importance of revegetation of disturbed soils and the control of noxious weed species through the development of a noxious weed management plan prior to initiating construction activities. The Colorado Weed Management Association provides the booklet "Noxious Weeds of Colorado" that provides information on identification and management of noxious weeds in Colorado. CPW prefers that native vegetation be retained on site during the operational lifespan of the project, both as habitat for wildlife and to ensure successful reclamation of the project area. Proper reclamation, from a wildlife perspective, involves not only stabilizing the soil and establishing ground cover, but also fostering plant communities with a diversity of species and plant types- grasses, woody plants, and broadleaf forbs, which will fully serve the nutritional needs of wildlife.

Once again, we appreciate being given the opportunity to comment on the Ellicott Sand and Gravel Special Use. Please feel free to contact our office at 719-227-5250 should you have any questions or require additional information.

Sincerely,

Cody Wigner
Area Wildlife Manager

- EPC Public Health, 7/8/2020:

Ellicott Sand and Gravel, AL-20-14

Please accept the following comments from El Paso County Public Health for the Special Use request referenced above:

- **Process water (material processing and dust control) for the commercial operation was not included in the submittal. The source of process water must be reviewed prior to approval.**

- **The source of potable water is undecided. It will either be provided by an individual private well or purchased locally. The potable water system may be subject to Colorado Department of Public Health and Environment (CDPHE) rules and regulations for Public Water Systems if the operation serves water to 25 or more employees for six or more months per year. The potable water source requires review for approval.**

- **Wastewater service for the project is proposed to be by portable toilets. Per the El Paso County Public Health, Onsite Wastewater Treatment System (OWTS) Regulations, portable toilets are allowed for temporary use only. If the portable trailer/office building is moved as site entrance locations change, then the use of portable toilets is acceptable. If the trailer/office stays at a fixed site, then an OWTS is required and must be designed by a Colorado Registered Professional Engineer.**

- **The CDPHE, Air Pollution Control Division (APCD), will require an Air Pollutant Emissions Notice (APEN) as noted in the "Draft Air Quality Management Plan" submitted for review. All aspects of the APEN must be complied with including dust control, emissions from equipment, and odor control and response.**

- **The operation must comply with all environmental water quality rules and regulations, including, but not limited to, a Spill Prevention Control and Countermeasure (SPCC) plan. Water quality Water quality detention basins, if any, must have mosquito control responsibilities included as a part of the design and maintenance plan to help control mosquito breeding habitat and minimize the potential for West Nile Virus.**

Mike McCarthy
El Paso County Public Health
719.575.8602
mikemccarthy@elpasoco.com
08July2020

- Colorado Geological Survey, about 7/29/32022:

Colorado Geological Survey understands the applicant, Ellicott Sand and Gravel LLC, proposes a sand and gravel extraction operation on approximately 733 acres with physical address 1550/1555 S. Baggett Rd., Calhan (38.8, -104.355).

The site is not undermined, and no geologic hazards are known or suspected to be present that would preclude the proposed sand and gravel extraction operation.

The Colorado Division of Reclamation, Mining, and Safety (DRMS) approved mining permit M-2018-063 Schubert Ranch Sand Resource on 11/6/2019, but the permit has not yet been issued (pending reclamation bond.) The only condition of DRMS permit approval was, "Conditions of Approval: No mining is allowed within 200 feet of any structure until the required geotechnical stability exhibit is submitted via a technical revision … and approved by the DRMS."

Provided the pit is operated and reclaimed in accordance with mining and reclamation plans approved by DRMS, CGS has no objection to approval of AL2014.

Jill Carlson, engineering geologist
(303) 384-2643 / carlson@mines.edu

12. References

City of Colorado Springs Colorado 2021. City of Colorado Springs Drainage Criteria Manual. May 2014. Revised January 2021. Accessed on January 23, 2024 at https://coloradosprings.gov/document/dcmvolume1revjan2021.pdf.

Colorado Department of Natural Resources 2024. Colorado's Decision Support Services Map Viewer, accessed on January 9, 2024 at https://maps.dnrgis.state.co.us/dwr/Index.html?viewer=mapviewer.

Colorado Division of Water Resources 2016. Administrative Statement Regarding the Management of Storm Water Detention Facilities and Post-Wildland Fire Facilities in Colorado. February 11, 2016.

El Paso County Colorado 2018. El Paso County Colorado Drainage Criteria Manual. Version October 31, 2018. Accessed on January 22, 2024 at https://library.municode.com/co/el_paso_county/codes/drainage_criteria_manual?nodeId=DRCRMAVO1ELPACO.

El Paso County Colorado 2020. El Paso County Colorado Engineering Criteria Manual. Version October 14, 2020. Accessed on January 18, 2024 at https://library.municode.com/co/el_paso_county/codes/engineering_criteria_manual_?nodeId=ENCRMA_APXISTQUPOPR_I.7PONSSTMA.

El Paso County Planning Department 1989. *Ellicott Valley Comprehensive Plan*. March 1989.

EME Solutions 2020. *Schubert Ranch Sand Resource Floodplain Modeling Technical Memorandum for Black Squirrel Creek, El Paso County, Colorado*, EME Solutions, Inc., J.L. Jankousky. P.E., 02/25/2020.

FEMA 2018. Flood Insurance Rate Map (FIRM). FIRM 0841C0840G and 08041C0830G, effective on 12/7/2018.

FHWA 2005. *Hydraulic Engineering Circular No. 11, Design of Riprap Revetment.* U.S. Department of Transportation Federal Highway Administration. Publication No. FHWA-IP-89-016. March 1989.

FHWA 1989. *Hydraulic Engineering Circular No. 15, Third Edition. Design of Roadside Channels with Flexible Linings.* U.S. Department of Transportation Federal Highway Administration. Publication No. FHWA-NHI-05-114. September 2005.

13. Drawings

Drawing Contents, two maps/plans are required, existing conditions & the proposed plans:

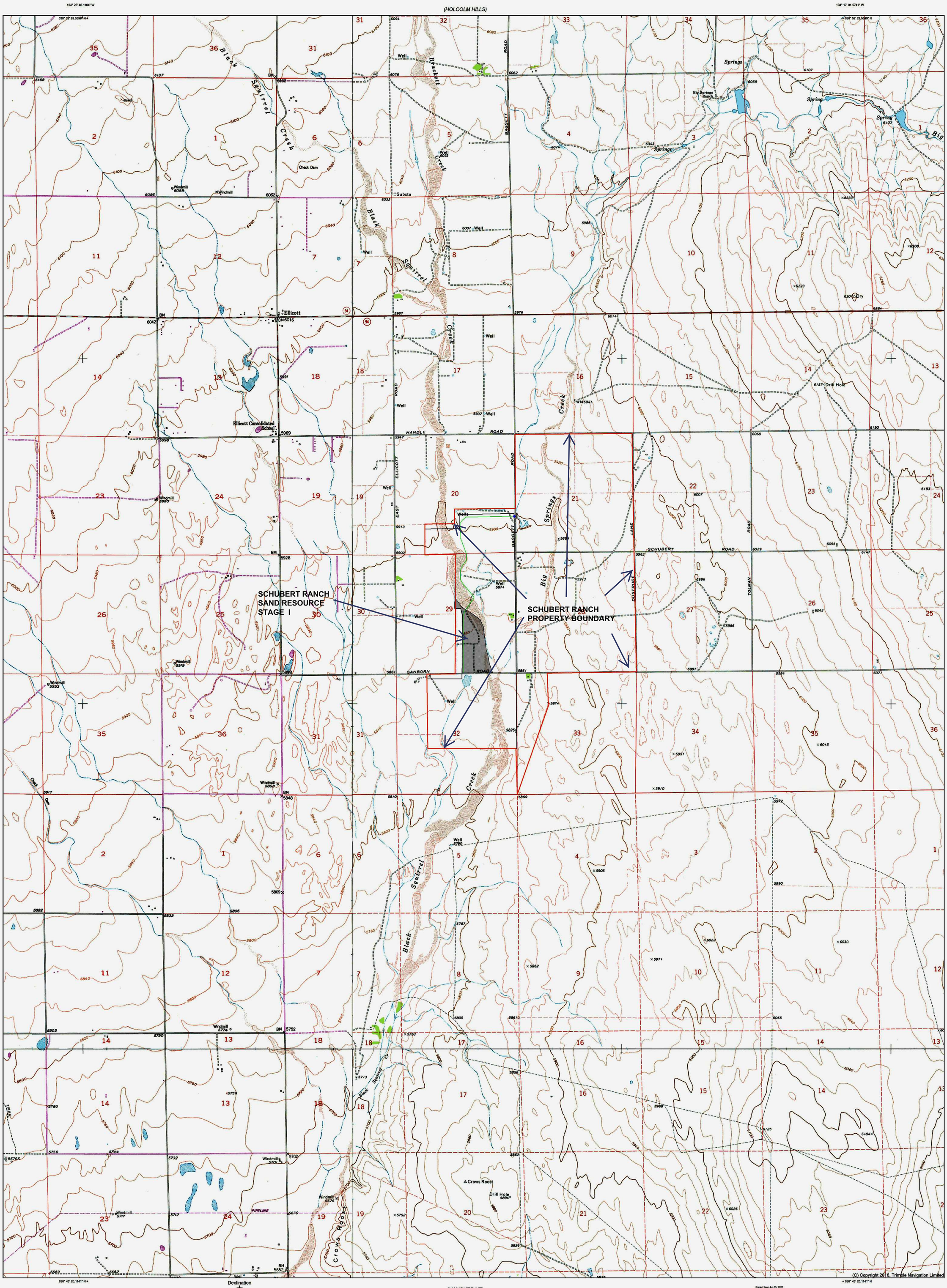
1. **General Location Map: A Map shall be provided in sufficient detail to identify drainage flows entering and leaving the development and general drainage patterns. The map should be at a scale of 1" = 50' to 1" – 2000'. The map shall identify any major construction (i.e., development, irrigation ditches, existing detention facilities, culverts, storm sewers, etc.) that shall influence or be influenced by the subdivision.**

2. **Drainage Plan: Map(s) of the proposed development at a scale of 1" = 20' to 1" – 200' shall be included to identify existing condition on or adjacent to the site in question. It shall include a minimum of:**
   - **Existing and proposed contours at 2 feet maximum intervals. For subdivisions involving rural lots greater than 1.0 acre, the maximum interval may be 5 feet where approved. In terrain greater than 10% the intervals should be 10-foot intervals.**
   - **Property lines and existing or proposed easements with purpose noted.**
   - **All streets.**
     - Only existing ranch roads will be used.
   - **Existing drainage facilities and structures, including irrigation ditches, roadside ditches, drainageways, gutters and culverts, all indicating flow direction. All pertinent information such as material, size, shape, and locations shall also be included.**
   - **Proposed type of street sections (i.e., vertical or ramp curb and gutters, roadside ditch, gutter flow and/or cross pans).**
     - No proposed streets or other such structures or facilities are planned.
   - **Proposed storm sewers and open drainageways, including inlets, manholes, culverts, and other appurtenances.**
     - No storm sewers or other similar structures are planned.
   - **Proposed outfalls point for runoff from the development area and facilities to convey flows to the final outfall point without damage to downstream properties.**
     - There will be no designated outfall points or associated damage since all regulated stormwater runoff will be internal to the operation and will infiltrate into the pit floor.
   - **Routing and summary of initial and major flow rates at various design points for all storm runoff associated with the property.**
   - **Path(s) chosen for computation of time of concentration.**
   - **Details of and design for computations for detention storage facilities including outlet.**

- **Locations and elevations of all defined 100-year floodplains affecting the property.**
- **Location of all existing and proposed utilities affected by or affecting the drainage design.**

Ellicott Sand and Gravel LLC
Schubert Ranch Sand Resource
Drainage Plan - Stage I
General Location Map

BIG SPRINGS RANCH QUADRANGLE
COLORADO
TOPOGRAPHIC SERIES



Declination
GN MN
GN 0° 24' E
MN 7° 39' E

0 1 2 3 Miles

0 1000 2000 3000 4000 5000 Yards

0 1 2 3 4 Kilometers

CONTOUR INTERVAL 20 FT
[BASE MAP VERTICAL DATUM]

Produced by MyTopo Terrain Navigator
Topography based on USGS 1:24,000 Maps

North American 1983 Datum (NAD83)
[Projection] Projection

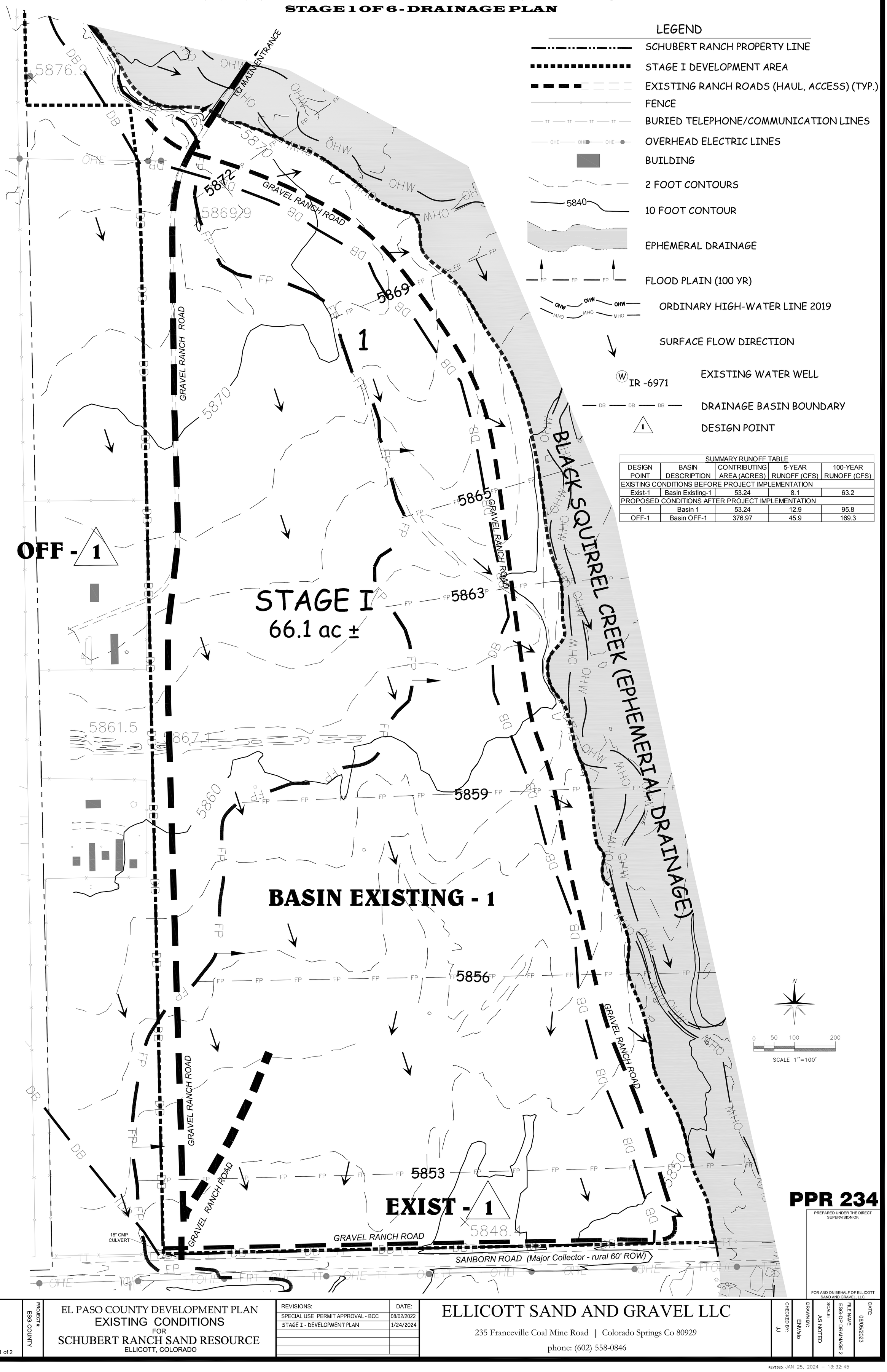
To place on the predicted North American 1927 move the projection lines 1M S and 45M W

BIG SPRINGS RANCH, CO
JAN 1, 1973

ELLICOTT SAND AND GRAVEL LLC - SITE DEVELOPMENT PLAN

Parts of the SW¼NE¼ , SW¼SE¼ & NW¼SE¼, Section 29, T-14-S, R-62-W, 6th P.M., El Paso County, Colorado. - Containing 66.1 acres more or less.

STAGE 1 OF 6 - DRAINAGE PLAN



LEGEND

- SCHUBERT RANCH PROPERTY LINE
- STAGE I DEVELOPMENT AREA
- EXISTING RANCH ROADS (HAUL, ACCESS) (TYP.)
- FENCE
- BURIED TELEPHONE/COMMUNICATION LINES
- OVERHEAD ELECTRIC LINES
- BUILDING
- 2 FOOT CONTOURS
- 5840 — 10 FOOT CONTOUR
- EPHEMERAL DRAINAGE
- FLOOD PLAIN (100 YR)
- ORDINARY HIGH-WATER LINE 2019
- SURFACE FLOW DIRECTION
- (W) IR -6971 — EXISTING WATER WELL
- DRAINAGE BASIN BOUNDARY
- 1 — DESIGN POINT

SUMMARY RUNOFF TABLE

DESIGN POINT	BASIN DESCRIPTION	CONTRIBUTING AREA (ACRES)	5-YEAR RUNOFF (CFS)	100-YEAR RUNOFF (CFS)
EXISTING CONDITIONS BEFORE PROJECT IMPLEMENTATION				
Exist-1	Basin Existing-1	53.24	8.1	63.2
PROPOSED CONDITIONS AFTER PROJECT IMPLEMENTATION				
1	Basin 1	53.24	12.9	95.8
OFF-1	Basin OFF-1	376.97	45.9	169.3

PPR 234

PREPARED UNDER THE DIRECT SUPERVISION OF:

FOR AND ON BEHALF OF ELLICOTT SAND AND GRAVEL, LLC.

1

SHEET 1 of 2

PROJECT #: ESG-COUNTY

EL PASO COUNTY DEVELOPMENT PLAN
EXISTING CONDITIONS
FOR
SCHUBERT RANCH SAND RESOURCE
ELLICOTT, COLORADO

REVISIONS:	DATE:
SPECIAL USE PERMIT APPROVAL - BCC	08/02/2022
STAGE I - DEVELOPMENT PLAN	1/24/2024

ELLICOTT SAND AND GRAVEL LLC
235 Franceville Coal Mine Road | Colorado Springs Co 80929
phone: (602) 558-0846

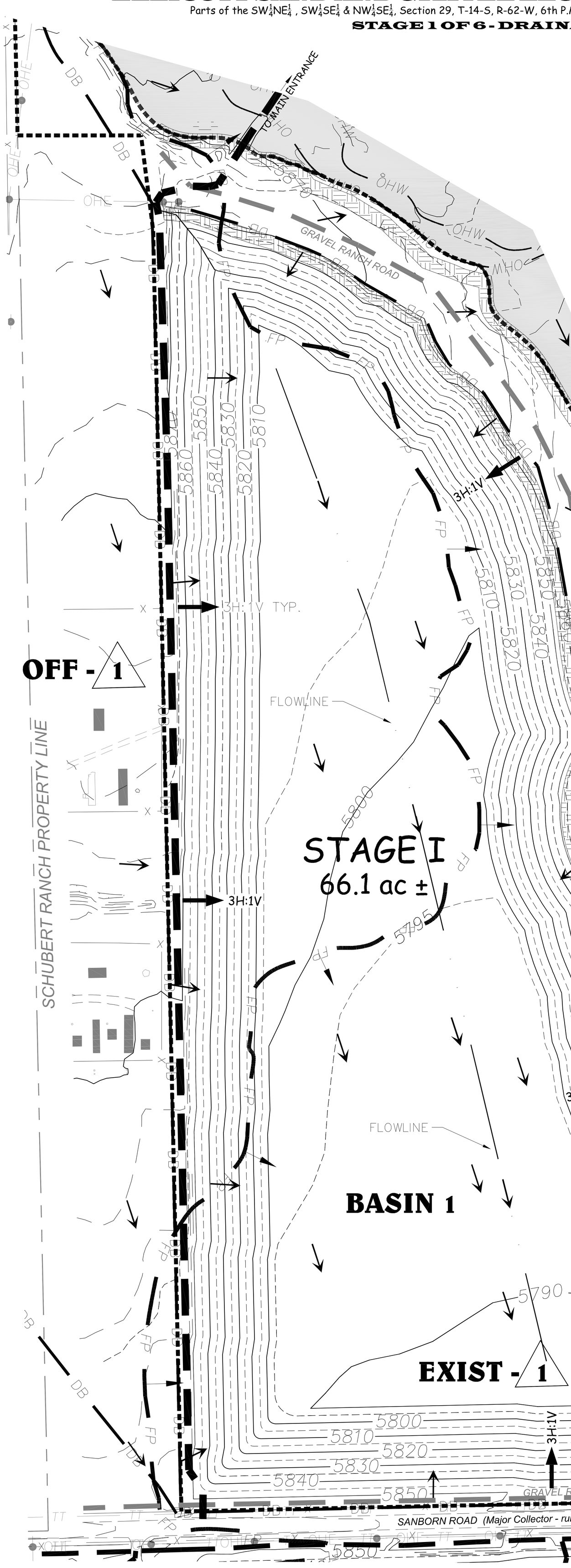
CHECKED BY: JJ
DRAWN BY: ENV/slo
SCALE: AS NOTED
FILE NAME: ESG-DP DRAINAGE 2
DATE: 06/05/2023

REVISED: JAN 25, 2024 – 13:32:45

ELLICOTT SAND AND GRAVEL LLC - SITE DEVELOPMENT PLAN

Parts of the $SW\frac{1}{4}NE\frac{1}{4}$, $SW\frac{1}{4}SE\frac{1}{4}$ & $NW\frac{1}{4}SE\frac{1}{4}$, Section 29, T-14-S, R-62-W, 6th P.M., El Paso County, Colorado. - Containing 66.1 acres more or less.

STAGE 1 OF 6 - DRAINAGE REPORT



LEGEND

- SCHUBERT RANCH PROPERTY LINE
- STAGE I DEVELOPMENT AREA
- RANCH ROADS (TYP.)
- FENCE
- BURIED TELEPHONE/COMMUNICATION LINES
- OVERHEAD ELECTRIC LINES
- BUILDING
- 2 FOOT CONTOURS
- 5 FOOT CONTOURS
- 5840 TOPO CONTOUR
- EPHEMERAL DRAINAGE
- FP FLOOD PLAIN (100 YR)
- OHW / MHO ORDINARY HIGH-WATER LINE 2019
- BANK ARMORING
- FLOW DIRECTION
- DB DRAINAGE BASIN BOUNDARY
- 1 DESIGN POINT

RETENTION BASIN IN BASIN 1

Basin Designation	Runoff Volume, WQCV (acre-feet)	Runoff Volume, 5-year storm (acre-feet)	Runoff Volume, 100-year storm (acre-feet)	Volume of Available Storage (acre-feet)
Basin 1	0.054	0.041	3.362	2,010
Basin OFF-1	1.521	1.613	27.863	2,010
Sum of Both Basins	1.575	1.654	31.225	2,010

SUMMARY RUNOFF TABLE

DESIGN POINT	BASIN DESCRIPTION	CONTRIBUTING AREA (ACRES)	5-YEAR RUNOFF (CFS)	100-YEAR RUNOFF (CFS)
EXISTING CONDITIONS BEFORE PROJECT IMPLEMENTATION				
Exist-1	Basin Existing-1	53.24	8.1	63.2
PROPOSED CONDITIONS AFTER PROJECT IMPLEMENTATION				
1	Basin 1	53.24	12.9	95.8
OFF-1	Basin OFF-1	376.97	45.9	169.3

N

0 50 100 200

SCALE 1"=100'

PPR 234

PREPARED UNDER THE DIRECT SUPERVISION OF:

FOR AND ON BEHALF OF ELLICOTT SAND AND GRAVEL, LLC.

2

SHEET 2 of 2

PROJECT #: ESG-COUNTY

EL PASO COUNTY DEVELOPMENT PLAN
PROPOSED CONDITIONS
FOR
SCHUBERT RANCH SAND RESOURCE
ELLICOTT, COLORADO

REVISIONS:	DATE:
SPECIAL USE PERMIT APPROVAL - BCC	08-02-2022
STAGE I - DEVELOPMENT PLAN	01/24/2024

ELLICOTT SAND AND GRAVEL LLC
235 Franceville Coal Mine Road | Colorado Springs Co 80929
phone: (602) 558-0846

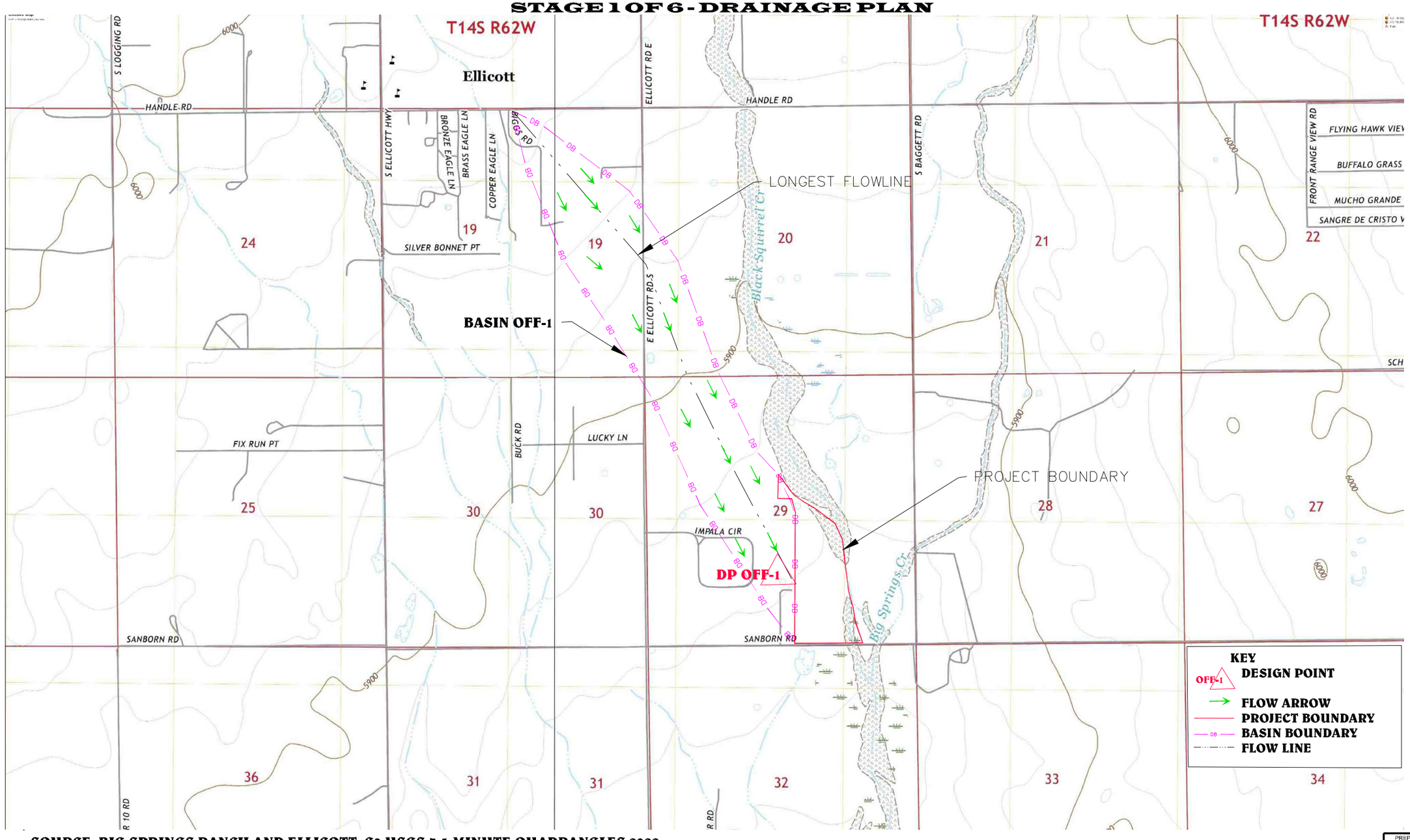
CHECKED BY: JJ
DRAWN BY: ENV/slo
SCALE: AS NOTED
FILE NAME: ESG-DP DRAINAGE 2
DATE: 06/22/2023

REVISED: JAN 25, 2024 - 13:41:22

ELLICOTT SAND AND GRAVEL LLC - SITE DEVELOPMENT PLAN

Parts of the SW¼NE¼ , SW¼SE¼ & NW¼SE¼, Section 29, T-14-S, R-62-W, 6th P.M., El Paso County, Colorado. - Containing 66.1 acres more or less.

STAGE 1 OF 6 - DRAINAGE PLAN



SOURCE: BIG SPRINGS RANCH AND ELLICOTT, Co USGS 7.5-MINUTE QUADRANGLES 2022
SCALE = 1" = 2,000' AT 11X17

PREPARED BY: EME SOLUTIONS, INC, JOHN JANKOUSKY, 15248 W. ELLSWORTH DR, GOLDEN, CO 80401 303-905-3635

PPR 234

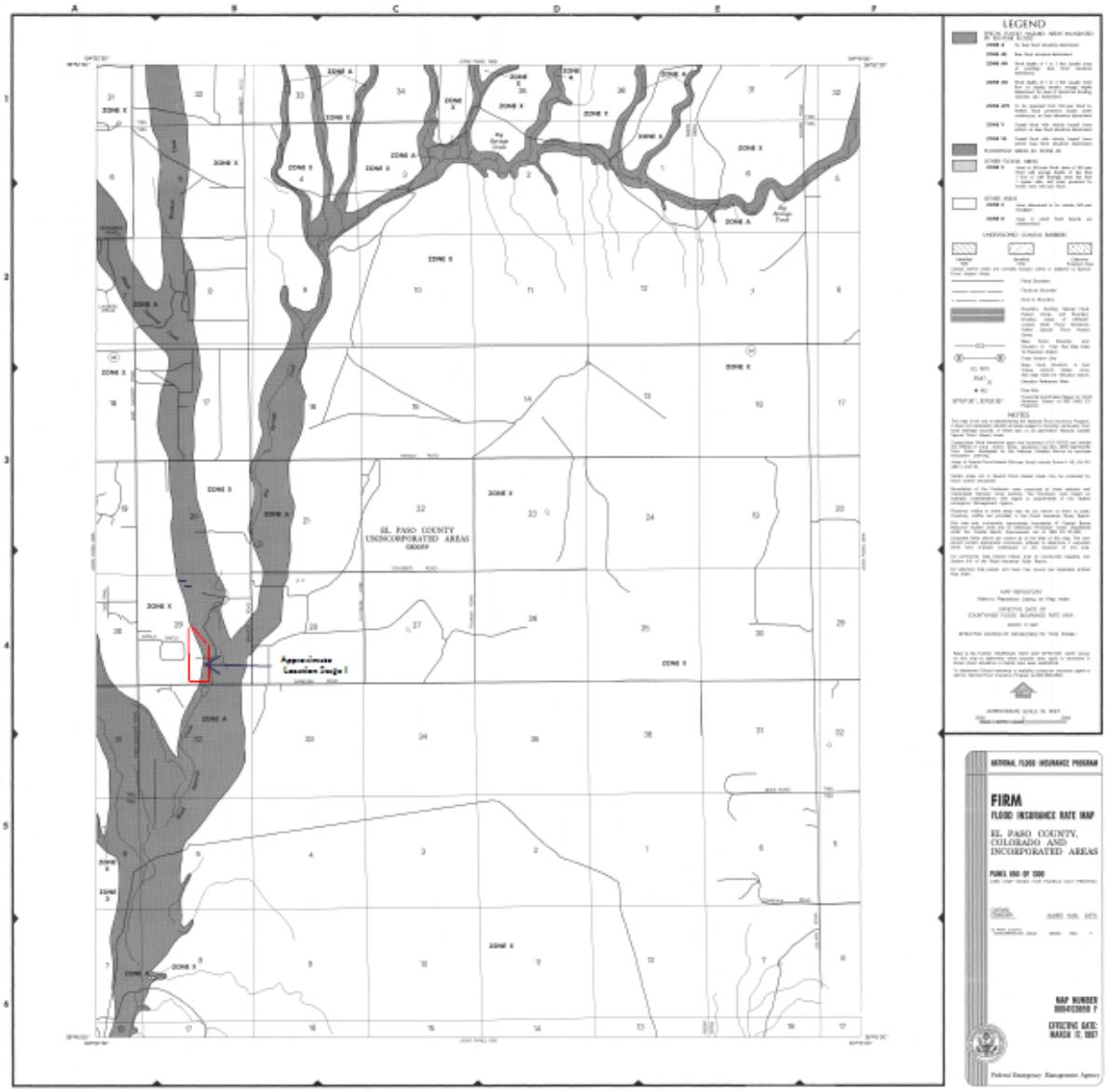
3 SHEET 3 of 3	PROJECT #: ESG-DRAINAGE PLAN	EL PASO COUNTY DEVELOPMENT PLAN **OFFSITE BASIN** FOR SCHUBERT RANCH SAND RESOURCE ELLICOTT, COLORADO	REVISIONS: / DATE: SPECIAL USE PERMIT APPROVAL - BCC 08/02/2022	ELLICOTT SAND AND GRAVEL LLC 235 Franceville Coal Mine Road | Colorado Springs Co 80929 phone: (602) 558-0846	CHECKED BY: JJ / DRAWN BY: EN//slo / SCALE: AS NOTED / FILE NAME: ESG-DP DRAINAGE 3 / DATE: 01/24/2024	PREPARED UNDER THE DIRECT SUPERVISION OF: FOR AND ON BEHALF OF ELLICOTT SAND AND GRAVEL, LLC.

REVISED: JAN 25, 2024 - 12:45:50

Attachments

Attachment 1:

FEMA Flood Insurance Rate Map (FIRM):



Attachment 2:

Flood Plain Development Permit:

Pikes Peak Regional Building Department

Permit # 20017 **FLOOD PLAIN DEVELOPMENT PERMIT** **Date 18-Jan-2024**

Owner Information

Name: SCHUBERT RANCHES, INC. **Phone:**

Address: 1555 S. BAGGETT ROAD
CALHAN, CO 80808
Attention: GEORGE SCHUBERT

Project Location

Address: ELLICOTT SAND & GRAVEL

,

Location/Directions: Ellicott Sand & Gravel

Contractor/Engineer: Ellicott Sand & Gravel, Christine Wilson Phone: (719) 568-3164

Project Description

Single Family Residential:	[ ]	Addition/Remodel (<50%):	[ ]
Multi-Family Residential:	[ ]	Rehabilitation	[ ]
Manufactured Home:	[ ]	Subst. (>50 Appraisal) Imprv:	[ ]
Non-Residential	[X]	Fill	[ ]
New Construction	[ ]	Bridge/Culvert	[ ]
Watercourse Modification:	[ ]	Levee:	[ ]

Project Cost: $0.00 Structure Market Value: $0.00
Creek: black squirrel
Description of work: ELLICOTT SAND & GRAVEL
sand mine The mine permit area is 733.7 acres, with a maximum of 561.7 acres disturbed by the mining operation over the life of the mine.
No-Rise attached

Flood Hazard Data

Location: Flood Fringe
Base (1%) Flood Elevation: varies
Lowest Floor Elevation:
Floodproofing Level:
Source Document: 08041C0830G, 08041C0840G

Permit Action

Permit Granted (Y/N): Yes Variance Granted (Y/N): No
Action Comments: contractor is permit owner : Ellicott Sand & Gravel,
No-Rise attached
reissued good through 1/18/2025

Compliance Section

Elevation Certificate: N Date:

LOMA: N Date: CLOMR: N Date: LOMR: N Date:

Site Inspection:
Preliminary Required: N Date:
Final Required: Y Date:

For Inspection Requests call: Keith 327-2898

Compliance Comments: No-Rise attached

Regional Floodplain Division: Date 18-Jan-2024

NOTE: This permit expires twelve (12) months from the date it is issued.

APPENDIX A

APPENDIX A

TABLE OF CONTENTS

Table 1. Areas, Lengths, and Elevation Changes from Site Map
Schubert Ranch Sand Resource Pit Phase I
Final Drainage Report

Calculated by: John Jankousky Revision: 1/31/2024

Design Point Number	Basin Designation	Area (ft^2)	Area (acres)	Area (mi^2)	Flow Length, L (ft)	Flow Length, L (mi)	Length of Overland Flow, L(OL) (ft)	Length of Concentrated Flow, L(P) (ft)	Top Elevation (ft)	Bottom Elevation (ft)	Change in elevation, H (ft)	Overall Slope, S = H/L (ft/ft)	Overland Flow Top Elevation (ft)	Overland Flow Bottom Elevation (ft)	Overland Change in elevation, H (ft)	Overland Flow Slope, S = H/L (ft/ft)	Concentrated Flow Top Elevation (ft)	Concentrated Flow Bottom Elevation (ft)	Concentrated Change in elevation, H (f	Concentrated Flow Slope, S = H/L (ft/ft)
EXISTING CONDITIONS																				
1	Existing 1	2,319,035	53.24	0.0832	2,529	0.48	500	2029	5874.0	5848.0	26.0	0.0103	5874.0	5869.0	5.0	0.0100	5869.0	5848.0	21.0	0.0103
	Basin OFF-1 is the same for Existing and Proposed Conditions. See the calculation below																			
PROPOSED CONDITIONS																				
1	Basin 1	2,319,035	53.24	0.0832	2,529	0.48	320	2209	5874.0	5790.0	84.0	0.0332	5874.0	5810.0	64.0	0.2000	5810.0	5790.0	20.0	0.0091
OFF-1	Basin OFF-1	16,420,861	376.97	0.5890	11,159	2.11	2000	9159	5965.0	5870.0	95.0	0.0085	5965.0	5948.0	17.0	0.0085	5948.0	5870.0	78.0	0.0085

The Site is evaluated as one basin. Basin 1 flows to the pit. There is a portion of the Site along the eastern edge that currently drains directly to Black Squirrel Creek. See the site plan. This drainage pattern will not change. Water quality at this location will be protected by the installation of silt fence as needed.

Note: If no large slope difference between overland flow area and concentrated flow area, use overall slope value only.
Source: Site AutoCAD drawings

Table 2. Percent Impervious Calculations and Rational Method "C" Calculations
Schubert Ranch Sand Resource Pit Phase I
Final Drainage Report

Calculated by: John Jankousky Revision: 1/31/2024

Soil Hydrologic Group A

Land Use	% Imp.	C2	C5	C10	C100
Greenbelt, Agriculture	2	0.03	0.09	0.17	0.36
Residential, One Acre	20	0.12	0.20	0.27	0.44
Railroad Yard Area	40	0.23	0.30	0.36	0.50
Street, Gravel	80	0.57	0.59	0.63	0.70
Light Industrial	80	0.57	0.59	0.63	0.70
Building/Roof Area	90	0.73	0.75	0.77	0.81
Pavement Area	100	0.84	0.86	0.87	0.89

Source: City of Colorado Springs Drainage Criteria Manual. May 2014. Revised January 2021. Volume 1. Table 6-6.

Design Point	Basin Designation	Total Area (ft^2)	Total Area (acres)	Greenbelt, Agriculture (ft^2)	Residential, One Acre (ft^2)	Railroad Yard Area (ft^2)	Street, Gravel (ft^2)	Light Industrial Area (ft^2)	Building/Roof Area (ft^2)	Pavement Area (ft^2)	Combined % Impervious	Combined C2	Combined C5	Combined C10	Combined C100
EXISTING CONDITIONS (HISTORIC, PRIOR TO DEVELOPMENT)															
1	Existing 1	2,319,035	53.24	2,319,035							2.00	0.03	0.09	0.17	0.36
	Basin OFF-1 is the same for Existing and Proposed Conditions. See the calculation below														
PROPOSED CONDITIONS AFTER PROJECT IMPLEMENTATION															
1	Basin 1	2,319,035	53.24	2,319,035					0	0	2.00	0.03	0.09	0.17	0.36
OFF-1	Basin OFF-1	16,420,861	376.97	10,664,806	5,601,043		155,012				8.88	0.07	0.13	0.21	0.39

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

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

3.2 Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_t) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

Table 3. Time of Concentration
Schubert Ranch Sand Resource Pit Phase I
Final Drainage Report

Calculated by: John Jankousky Revision: 1/31/2024

	Sub-Basin Data			Initial Overland Time (t_o)			Travel Time (t_t)					$t_c = t_i + t_t$	tc Check (urbanized)		Final t_c	Remarks
Number	Designation	Area, Ac	C5	Overland Flow Length, Ft.	Slope, %	t_o, min*	Concentrated Flow Length, Ft.	Slope, %	K Conveyance Factor	Velocity, FPS **	t_t, min	Comp. t_c, min	Total Length, Ft.	t_c = (L/180) +10, min	Final t_c, min	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)		(9)	(10)	(11)	(12)	(13)	(14)	
EXISTING CONDITIONS (HISTORIC, PRIOR TO DEVELOPMENT)																
1	Existing 1	53.24	0.09	500	1.00	41.3	2029	1.03	10.00	10.2	3.3	44.7	2529	24.1	44.7	
	Basin OFF-1 is the same for Existing and Proposed Conditions. See the calculation below															
PROPOSED CONDITIONS AFTER PHASE I IMPLEMENTATION																
1	Basin 1	53.24	0.09	320	20.00	12.2	2209	0.91	10.00	9.5	3.9	16.1	2529	24.1	16.1	
OFF-1	Basin OFF-1	376.97	0.13	2000	0.85	83.8	9159	0.85	10.00	9.2	16.5	100.3	11159	72.0	100.3	

* Calculated using formula: $t_i = (0.395 * (1.1 - C5) * L^{0.5}) / (S^{0.333})$ (Urban Drainage Manual, Equation 6-3)

Where:

t_i = overland (initial) flow time (minutes)

C_5 = runoff coefficient for 5-year frequency (from Table 6-4)

L_i = length of overland flow (ft)

S_o = average slope along the overland flow path (ft/ft).

** For travel time velocity, channelized flow time equation 6-4: tt = Lt /60Vt

NOAA Atlas 14, Volume 8, Version 2
Location name: Calhan, Colorado, USA*
Latitude: 38.797°, Longitude: -104.3569°
Elevation: 5851 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

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	**0.243** (0.194-0.307)	**0.297** (0.238-0.377)	**0.392** (0.312-0.498)	**0.476** (0.378-0.607)	**0.601** (0.464-0.798)	**0.703** (0.529-0.942)	**0.811** (0.591-1.11)	**0.926** (0.648-1.30)	**1.09** (0.732-1.56)	**1.22** (0.796-1.76)
10-min	**0.355** (0.284-0.450)	**0.435** (0.348-0.551)	**0.574** (0.458-0.729)	**0.697** (0.553-0.889)	**0.879** (0.679-1.17)	**1.03** (0.775-1.38)	**1.19** (0.865-1.63)	**1.36** (0.949-1.90)	**1.59** (1.07-2.28)	**1.78** (1.16-2.58)
15-min	**0.433** (0.347-0.549)	**0.530** (0.424-0.672)	**0.700** (0.558-0.889)	**0.850** (0.674-1.08)	**1.07** (0.829-1.42)	**1.26** (0.945-1.68)	**1.45** (1.06-1.98)	**1.65** (1.16-2.32)	**1.94** (1.31-2.79)	**2.17** (1.42-3.14)
30-min	**0.656** (0.525-0.831)	**0.801** (0.640-1.02)	**1.05** (0.840-1.34)	**1.28** (1.01-1.63)	**1.61** (1.24-2.14)	**1.88** (1.42-2.53)	**2.17** (1.58-2.98)	**2.48** (1.74-3.48)	**2.92** (1.96-4.18)	**3.26** (2.13-4.72)
60-min	**0.834** (0.668-1.06)	**1.03** (0.825-1.31)	**1.37** (1.09-1.74)	**1.67** (1.33-2.13)	**2.11** (1.63-2.81)	**2.47** (1.86-3.32)	**2.85** (2.08-3.90)	**3.26** (2.28-4.56)	**3.82** (2.57-5.47)	**4.26** (2.79-6.16)
2-hr	**1.01** (0.815-1.27)	**1.26** (1.02-1.59)	**1.69** (1.36-2.14)	**2.07** (1.65-2.62)	**2.62** (2.03-3.45)	**3.06** (2.32-4.08)	**3.53** (2.59-4.80)	**4.03** (2.83-5.60)	**4.72** (3.19-6.71)	**5.26** (3.47-7.56)
3-hr	**1.08** (0.870-1.35)	**1.35** (1.09-1.70)	**1.83** (1.47-2.30)	**2.24** (1.79-2.83)	**2.84** (2.21-3.73)	**3.33** (2.53-4.41)	**3.84** (2.82-5.19)	**4.37** (3.08-6.05)	**5.11** (3.48-7.24)	**5.70** (3.77-8.15)
6-hr	**1.24** (1.00-1.54)	**1.48** (1.20-1.85)	**1.92** (1.56-2.40)	**2.33** (1.87-2.92)	**2.93** (2.31-3.85)	**3.45** (2.64-4.56)	**4.00** (2.96-5.40)	**4.59** (3.27-6.34)	**5.44** (3.74-7.69)	**6.12** (4.08-8.70)
12-hr	**1.35** (1.10-1.67)	**1.59** (1.30-1.97)	**2.02** (1.64-2.51)	**2.42** (1.96-3.02)	**3.04** (2.41-3.96)	**3.56** (2.75-4.68)	**4.12** (3.08-5.53)	**4.73** (3.40-6.50)	**5.60** (3.88-7.87)	**6.31** (4.24-8.91)
24-hr	**1.44** (1.18-1.77)	**1.69** (1.39-2.08)	**2.14** (1.75-2.64)	**2.56** (2.08-3.17)	**3.20** (2.56-4.15)	**3.75** (2.91-4.90)	**4.34** (3.26-5.78)	**4.98** (3.60-6.79)	**5.90** (4.11-8.23)	**6.65** (4.50-9.32)
2-day	**1.60** (1.32-1.96)	**1.85** (1.52-2.26)	**2.30** (1.89-2.82)	**2.73** (2.23-3.36)	**3.39** (2.73-4.37)	**3.96** (3.10-5.14)	**4.58** (3.47-6.07)	**5.26** (3.83-7.13)	**6.23** (4.38-8.64)	**7.03** (4.80-9.79)
3-day	**1.74** (1.44-2.12)	**2.03** (1.68-2.47)	**2.54** (2.10-3.10)	**3.02** (2.47-3.69)	**3.73** (3.00-4.77)	**4.33** (3.40-5.59)	**4.98** (3.78-6.56)	**5.68** (4.15-7.65)	**6.68** (4.71-9.21)	**7.49** (5.13-10.4)
4-day	**1.88** (1.56-2.28)	**2.20** (1.82-2.67)	**2.76** (2.28-3.36)	**3.27** (2.69-3.99)	**4.02** (3.24-5.12)	**4.66** (3.66-5.98)	**5.33** (4.05-6.98)	**6.05** (4.43-8.12)	**7.07** (5.00-9.71)	**7.89** (5.42-10.9)
7-day	**2.26** (1.89-2.73)	**2.62** (2.18-3.16)	**3.25** (2.70-3.93)	**3.81** (3.15-4.63)	**4.64** (3.75-5.86)	**5.33** (4.20-6.79)	**6.05** (4.63-7.88)	**6.83** (5.03-9.10)	**7.92** (5.63-10.8)	**8.80** (6.09-12.1)
10-day	**2.57** (2.15-3.09)	**2.97** (2.48-3.58)	**3.66** (3.05-4.42)	**4.28** (3.54-5.17)	**5.17** (4.18-6.50)	**5.91** (4.67-7.49)	**6.68** (5.12-8.66)	**7.51** (5.54-9.96)	**8.66** (6.17-11.8)	**9.57** (6.65-13.1)
20-day	**3.33** (2.80-3.97)	**3.90** (3.28-4.66)	**4.85** (4.06-5.81)	**5.65** (4.71-6.79)	**6.77** (5.48-8.38)	**7.66** (6.07-9.59)	**8.55** (6.58-10.9)	**9.47** (7.02-12.4)	**10.7** (7.68-14.4)	**11.7** (8.17-15.9)
30-day	**3.98** (3.36-4.73)	**4.68** (3.94-5.56)	**5.81** (4.88-6.92)	**6.74** (5.63-8.06)	**8.01** (6.48-9.83)	**8.98** (7.13-11.2)	**9.94** (7.67-12.6)	**10.9** (8.12-14.2)	**12.2** (8.76-16.3)	**13.1** (9.24-17.8)
45-day	**4.88** (4.13-5.78)	**5.69** (4.81-6.74)	**6.98** (5.88-8.29)	**8.02** (6.73-9.56)	**9.42** (7.64-11.5)	**10.5** (8.32-12.9)	**11.5** (8.86-14.5)	**12.5** (9.30-16.1)	**13.7** (9.90-18.2)	**14.7** (10.4-19.8)
60-day	**5.72** (4.84-6.75)	**6.58** (5.57-7.77)	**7.95** (6.72-9.42)	**9.05** (7.60-10.8)	**10.5** (8.52-12.7)	**11.6** (9.22-14.2)	**12.6** (9.75-15.8)	**13.6** (10.2-17.5)	**14.8** (10.7-19.6)	**15.7** (11.2-21.2)

[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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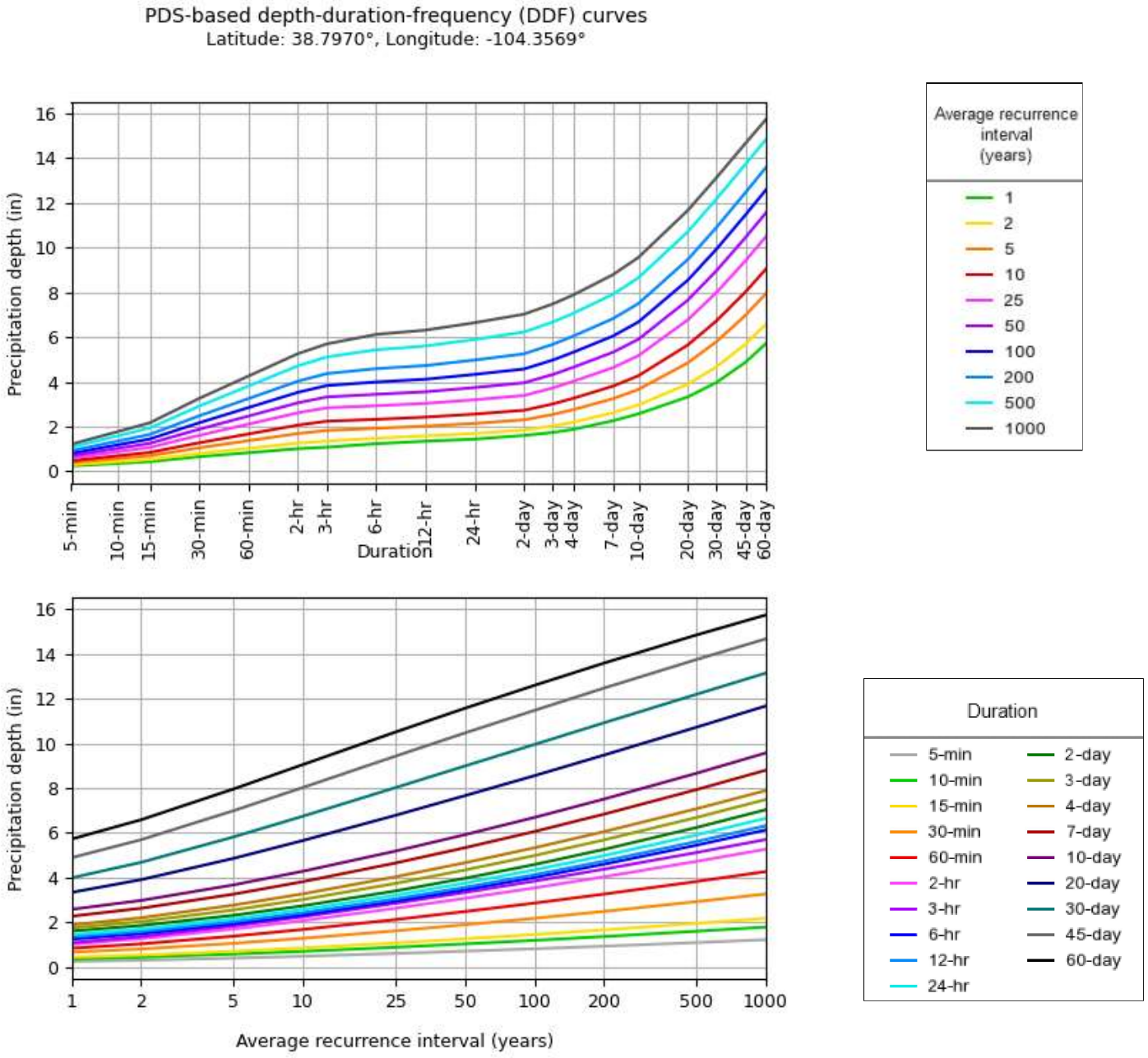
PF graphical



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Created (GMT): Mon Jun 12 21:09:11 2023

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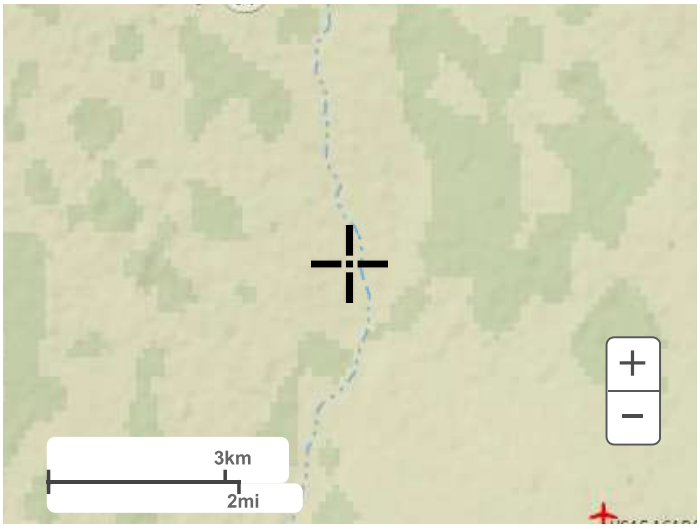
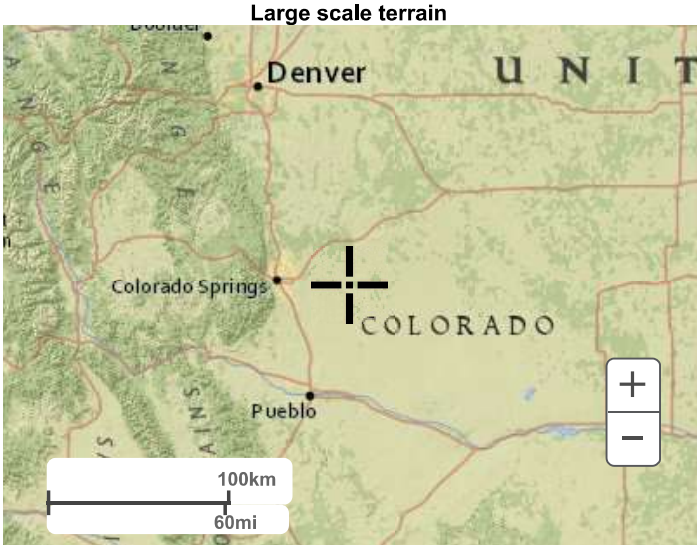
Maps & aerials

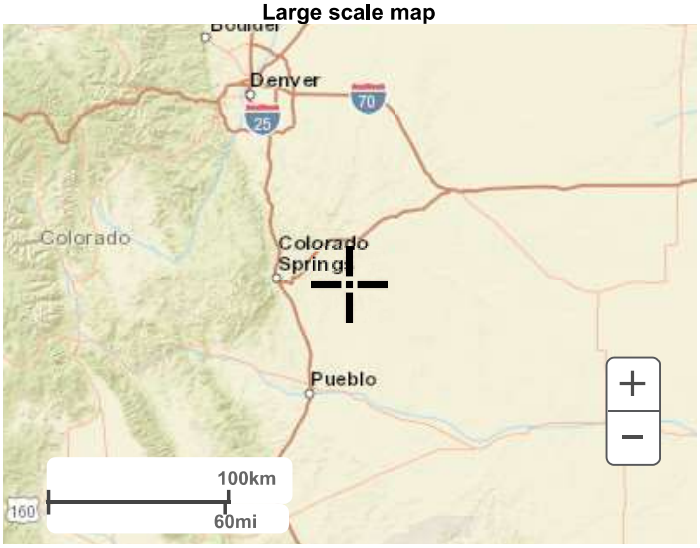
Small scale terrain



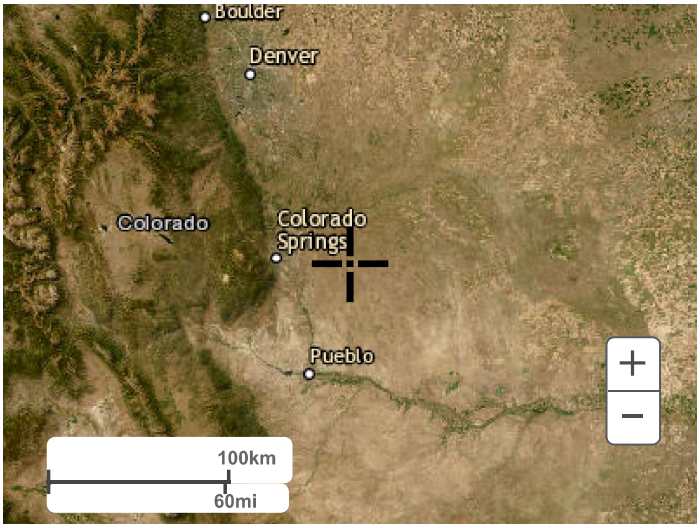
Large scale terrain



Large scale map



Large scale aerial



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National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Rainfall Amounts and Rainfall Intensity from NOAA Atlas

Ellicott Sand Phase 1

Latitude	Longitude
38.79701	-104.356873

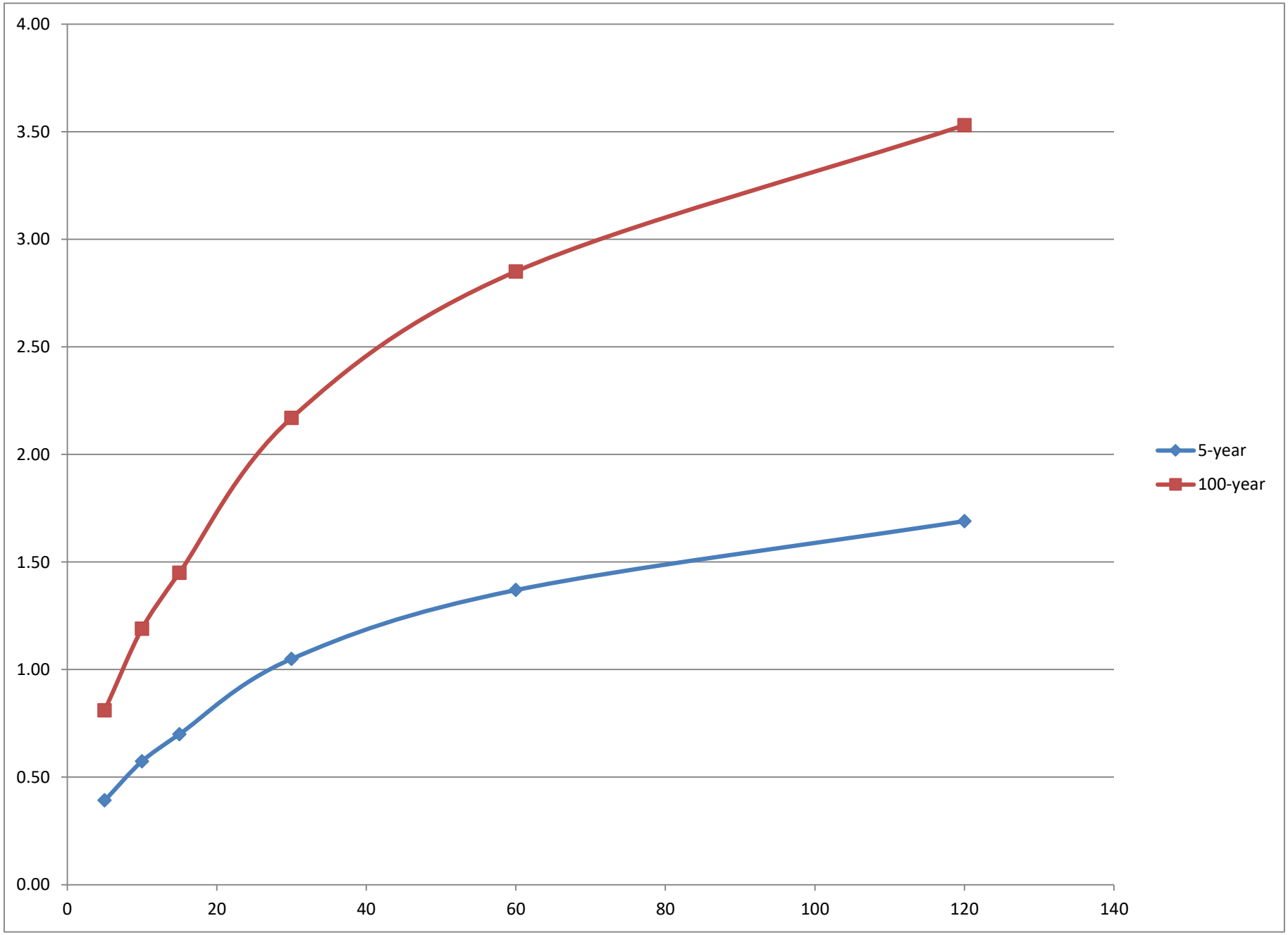
Rainfall From NOAA Atlas

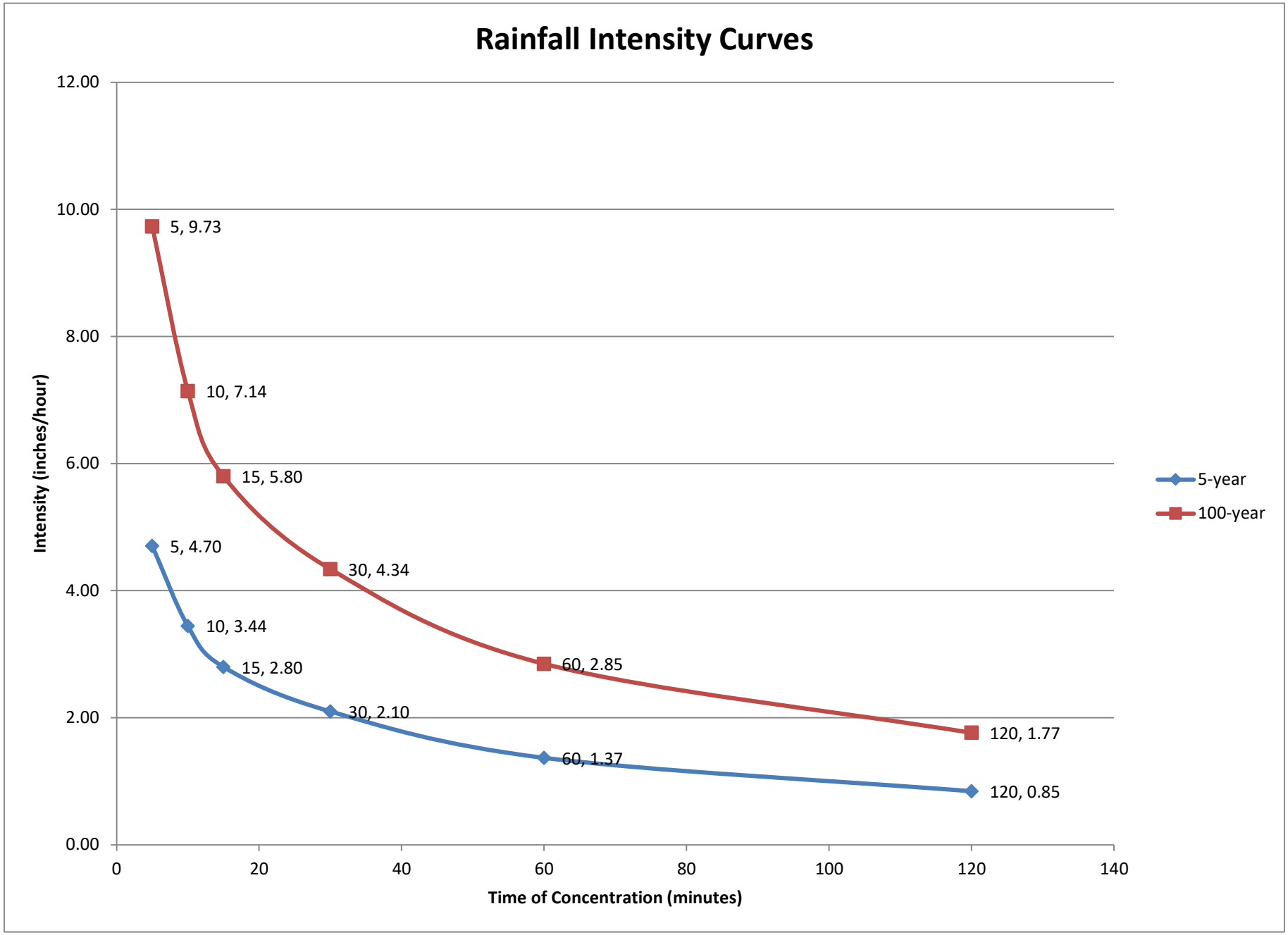
	One-hour Rainfall (inches)	Duration (minutes)					
		5	10	15	30	60	120
2-year							
5-year	1.37	0.39	0.57	0.70	1.05	1.37	1.69
10-year							
50-year							
100-year	2.85	0.81	1.19	1.45	2.17	2.85	3.53

Rainfall Amount		
Minutes	5-year	100-year
5	0.39	0.81
10	0.57	1.19
15	0.70	1.45
30	1.05	2.17
60	1.37	2.85
120	1.69	3.53

Rainfall Intensity (inches/hour)		
Minutes	5-year	100-year
5	4.70	9.73
10	3.44	7.14
15	2.80	5.80
30	2.10	4.34
60	1.37	2.85
120	0.85	1.77

Rainfall Amounts (inches)




Rainfall Intensity Curves
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Intensity (inches/hour)
0
20
40
60
80
100
120
140
Time of Concentration (minutes)
5, 9.73
10, 7.14
15, 5.80
30, 4.34
60, 2.85
120, 1.77
5, 4.70
10, 3.44
15, 2.80
30, 2.10
60, 1.37
120, 0.85
5-year
100-year

Standard Form SF-2
Table 4. Rational Method Procedure -- 5-year Design Storm
Schubert Ranch Sand Resource Pit Phase I
Calculated by: John Jankousky Revision: 1/31/2024
DESIGN STORM: 5-YR
PROPOSED FLOWS

Street		Design Point	DIRECT RUNOFF							TOTAL RUNOFF				SWALE		PIPE			TRAVEL TIME			REMARKS
			Area Designation	Area (ac)	Runoff Coeff., C	tc (min)	C*A (AC)	Intensity, I (in/hr)	Q (cfs)	t_c (min)	sum(C*A) (AC)	Intensity, I (in/hr)	Q (cfs)	Slope (%)	Swale Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	t_t (min)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
HISTORIC CONDITIONS (PRE-DEVELOPMENT)																						
1		1	Existing 1	53.24	0.09	44.7	4.79	1.70	8.1													
PROPOSED CONDITIONS AFTER PROJECT IMPLEMENTATION																						
1		1	Basin 1	53.24	0.09	16.1	4.79	2.70	12.9													
2		OFF-1	Basin OFF-1	376.97	0.13	100.3	49.9	0.92	45.9													

Standard Form SF-2
Table 5. Rational Method Procedure -- 100-year Design Storm
Schubert Ranch Sand Resource Pit Phase I
Calculated by: John Jankousky Revision: 1/31/2024
DESIGN STORM: 100-YR
PROPOSED FLOWS

Street		Design Point	DIRECT RUNOFF							TOTAL RUNOFF				SWALE		PIPE			TRAVEL TIME			REMARKS
			Area Designation	Area (ac)	Runoff Coeff., C	tc (min)	C*A (AC)	Intensity, I (in/hr)	Q (cfs)	t_c (min)	sum(C*A) (AC)	Intensity, I (in/hr)	Q (cfs)	Slope (%)	Swale Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	t_t (min)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
HISTORIC CONDITIONS (PRE-DEVELOPMENT)																						
1		1	Existing 1	53.24	0.36	44.7	19.2	3.30	63.2													
PROPOSED CONDITIONS AFTER PROJECT IMPLEMENTATION																						
1		1	Basin 1	53.24	0.36	16.1	19.2	5.00	95.8													
2		OFF-1	Basin OFF-1	376.97	0.39	100.3	147	1.15	169.3													

Table 6. Required Cross-Sectional Areas for Channel Flow
Schubert Ranch Sand Resource Pit Phase I

Designer: John Jankousky
Revision: 1/31/2024

Description	Shallow channel flow, Basin 1	Shallow channel flow, Basin 1
Flows Collected in Channel	Basin 1	Basin 1
Length of Channel (ft)	2209	2209
Change in Elevation (ft)	20.00	20.00
Slope, S (ft/ft)	0.0091	0.0091
Roughness Factor, n (dimension-less), for sandy swale	0.0180	0.0180
FLOW IN SMALL CHANNEL WEST OF BUILDING IN BASIN 1		
Design Storm	5 year, 24 hour	100 year, 24 hour
Required Peak Flow (cfs)	12.94	95.83
Manning Formula Peak Flow (cfs)	**13.24**	**98.31**
Left Side Slope factor, Z (Z:1)	50.00	50.00
Right Side Slope factor, Z (Z:1)	50.00	50.00
Cross-sectional Area, A (ft^2)	5.6	25.0
Wetted Perimeter, P (ft)	34.0	71.0
Hydraulic Radius, R (ft^2/ft)	0.16	0.35
Slope, S (ft/ft)	0.009	0.009
Flow Depth, Y (ft)	0.28	0.65
Top Width, T (ft), without freeboard	34.0	71.0
Bottom Width, W (ft)	6	6
Flow Velocity, V (fps)	2.4	3.9
Hydraulic Mean Depth, D	0.16	0.35
Froude Number, F	1.03	1.17
Subcritical/Supercritical	Supercritical	Supercritical

Source for Manning's n: Chow, 1959. 4. Excavated or Dredged Channels, a. Earth, straight, and uniform, 1. clean, recently completed

Note: this is flow in a large mine pit, no freeboard needed

Total depth (ft) =	**0.28**	**0.65**
Top Width, T (ft)	**34.00**	**71.00**

Equations:
Slope, S = Change in Elevation / Length of Channel
Area, $A = Z \times Y^2 + Y \times W$
Wetted Perimeter, $P = 2 \times Y \times (1 + Z^2)^{0.5} + W$
Hydraulic Radius, R = A / P
Top Width, $T = 2 \times Z \times Y + W$
Flow, $Q = (1.49 \times A \times R^{0.667} \times S^{0.5}) / n$
Flow Velocity, V = Q / A
Bottom Width, W = initial assumption
Height, Y = trial and error input
Hydraulic Mean Depth, D = A / T
Froude Number, $F = V / (g \times D)^{0.5}$
where: g = gravity acceleration = 32.2 ft/sec^2

Show

Manning's n Values

Reference tables for Manning's n values for Channels, Closed Conduits Flowing Partially Full, and Corrugated Metal Pipes.

Manning's n for Channels (Chow, 1959).

Type of Channel and Description	Minimum	Normal	Maximum
Natural streams - minor streams (top width at floodstage < 100 ft)			
1. Main Channels			
a. clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
b. same as above, but more stones and weeds	0.030	0.035	0.040
c. clean, winding, some pools and shoals	0.033	0.040	0.045
d. same as above, but some weeds and stones	0.035	0.045	0.050
e. same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
f. same as "d" with more stones	0.045	0.050	0.060
g. sluggish reaches, weedy, deep pools	0.050	0.070	0.080
h. very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075	0.100	0.150
2. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages			
a. bottom: gravels, cobbles, and few boulders	0.030	0.040	0.050
b. bottom: cobbles with large boulders	0.040	0.050	0.070
3. Floodplains			
a. Pasture, no brush			
1.short grass	0.025	0.030	0.035
2. high grass	0.030	0.035	0.050
b. Cultivated areas			
1. no crop	0.020	0.030	0.040
2. mature row crops	0.025	0.035	0.045
3. mature field crops	0.030	0.040	0.050
c. Brush			
1. scattered brush, heavy weeds	0.035	0.050	0.070
2. light brush and trees, in winter	0.035	0.050	0.060
3. light brush and trees, in summer	0.040	0.060	0.080
4. medium to dense brush, in winter	0.045	0.070	0.110
5. medium to dense brush, in summer	0.070	0.100	0.160
d. Trees			
1. dense willows, summer, straight	0.110	0.150	0.200

2. cleared land with tree stumps, no sprouts	0.030	0.040	0.050
3. same as above, but with heavy growth of sprouts	0.050	0.060	0.080
4. heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	0.080	0.100	0.120
5. same as 4. with flood stage reaching branches	0.100	0.120	0.160
4. Excavated or Dredged Channels			
a. Earth, straight, and uniform			
1. clean, recently completed	0.016	0.018	0.020
2. clean, after weathering	0.018	0.022	0.025
3. gravel, uniform section, clean	0.022	0.025	0.030
4. with short grass, few weeds	0.022	0.027	0.033
b. Earth winding and sluggish			
1. no vegetation	0.023	0.025	0.030
2. grass, some weeds	0.025	0.030	0.033
3. dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
4. earth bottom and rubble sides	0.028	0.030	0.035
5. stony bottom and weedy banks	0.025	0.035	0.040
6. cobble bottom and clean sides	0.030	0.040	0.050
c. Dragline-excavated or dredged			
1. no vegetation	0.025	0.028	0.033
2. light brush on banks	0.035	0.050	0.060
d. Rock cuts			
1. smooth and uniform	0.025	0.035	0.040
2. jagged and irregular	0.035	0.040	0.050
e. Channels not maintained, weeds and brush uncut			
1. dense weeds, high as flow depth	0.050	0.080	0.120
2. clean bottom, brush on sides	0.040	0.050	0.080
3. same as above, highest stage of flow	0.045	0.070	0.110
4. dense brush, high stage	0.080	0.100	0.140
5. Lined or Constructed Channels			
a. Cement			
1. neat surface	0.010	0.011	0.013
2. mortar	0.011	0.013	0.015
b. Wood			
1. planed, untreated	0.010	0.012	0.014
2. planed, creosoted	0.011	0.012	0.015
3. unplaned	0.011	0.013	0.015
4. plank with battens	0.012	0.015	0.018
5. lined with roofing paper	0.010	0.014	0.017
c. Concrete			
1. trowel finish	0.011	0.013	0.015

2. float finish	0.013	0.015	0.016
3. finished, with gravel on bottom	0.015	0.017	0.020
4. unfinished	0.014	0.017	0.020
5. gunite, good section	0.016	0.019	0.023
6. gunite, wavy section	0.018	0.022	0.025
7. on good excavated rock	0.017	0.020	
8. on irregular excavated rock	0.022	0.027	
d. Concrete bottom float finish with sides of:			
1. dressed stone in mortar	0.015	0.017	0.020
2. random stone in mortar	0.017	0.020	0.024
3. cement rubble masonry, plastered	0.016	0.020	0.024
4. cement rubble masonry	0.020	0.025	0.030
5. dry rubble or riprap	0.020	0.030	0.035
e. Gravel bottom with sides of:			
1. formed concrete	0.017	0.020	0.025
2. random stone mortar	0.020	0.023	0.026
3. dry rubble or riprap	0.023	0.033	0.036
f. Brick			
1. glazed	0.011	0.013	0.015
2. in cement mortar	0.012	0.015	0.018
g. Masonry			
1. cemented rubble	0.017	0.025	0.030
2. dry rubble	0.023	0.032	0.035
h. Dressed ashlar/stone paving	0.013	0.015	0.017
i. Asphalt			
1. smooth	0.013	0.013	
2. rough	0.016	0.016	
j. Vegetal lining	0.030		0.500

Manning's n for Closed Conduits Flowing Partly Full (Chow, 1959).

Type of Conduit and Description	Minimum	Normal	Maximum
1. Brass, smooth:	0.009	0.010	0.013
2. Steel:			
Lockbar and welded	0.010	0.012	0.014
Riveted and spiral	0.013	0.016	0.017
3. Cast Iron:			
Coated	0.010	0.013	0.014
Uncoated	0.011	0.014	0.016
4. Wrought Iron:			
Black	0.012	0.014	0.015
Galvanized	0.013	0.016	0.017
5. Corrugated Metal:			
Subdrain	0.017	0.019	0.021
Stormdrain	0.021	0.024	0.030
6. Cement:			

Neat Surface	0.010	0.011	0.013
Mortar	0.011	0.013	0.015
7. Concrete:			
Culvert, straight and free of debris	0.010	0.011	0.013
Culvert with bends, connections, and some debris	0.011	0.013	0.014
Finished	0.011	0.012	0.014
Sewer with manholes, inlet, etc., straight	0.013	0.015	0.017
Unfinished, steel form	0.012	0.013	0.014
Unfinished, smooth wood form	0.012	0.014	0.016
Unfinished, rough wood form	0.015	0.017	0.020
8. Wood:			
Stave	0.010	0.012	0.014
Laminated, treated	0.015	0.017	0.020
9. Clay:			
Common drainage tile	0.011	0.013	0.017
Vitrified sewer	0.011	0.014	0.017
Vitrified sewer with manholes, inlet, etc.	0.013	0.015	0.017
Vitrified Subdrain with open joint	0.014	0.016	0.018
10. Brickwork:			
Glazed	0.011	0.013	0.015
Lined with cement mortar	0.012	0.015	0.017
Sanitary sewers coated with sewage slime with bends and connections	0.012	0.013	0.016
Paved invert, sewer, smooth bottom	0.016	0.019	0.020
Rubble masonry, cemented	0.018	0.025	0.030

Manning's n for Corrugated Metal Pipe (AISI, 1980).

Type of Pipe, Diameter and Corrugation Dimension	n
1. Annular 2.67 x 1/2 inch (all diameters)	0.024
2. Helical 1.50 x 1/4 inch	
8" diameter	0.012
10" diameter	0.014
3. Helical 2.67 x 1/2 inch	
12" diameter	0.011
18" diameter	0.014
24" diameter	0.016
36" diameter	0.019
48" diameter	0.020
60" diameter	0.021
4. Annular 3x1 inch (all diameters)	0.027
5. Helical 3x1 inch	
48" diameter	0.023
54" diameter	0.023
60" diameter	0.024
66" diameter	0.025
72" diameter	0.026
78" diameter and larger	0.027
6. Corrugations 6x2 inches	
60" diameter	0.033
72" diameter	0.032
120" diameter	0.030
180" diameter	0.028

FishXing Version 3.0 Beta, 2006

Table 7. Riprap Calculations For Black Squirrel Creek at Stage I Project

Riprap calculations for Black Squirrel Creek at Stage I area.
From HEC-RAS model results, find the following information:
d = maximum depth of flow (m)
S = slope of channel (m/m)

Source of flow depth and slope is *Schubert Ranch Sand Resource Floodplain Modeling Technical Memorandum for Black Squirrel Creek*, El Paso County, Colorado, EME Solutions, Inc., J.L. Jankousky. P.E., 02/25/2020.

Cross Sections at Stage 1 (from North to South)	Water Surface Elevation (ft)	Channel Bottom Elevation at Bank (ft)	d = maximum depth of flow (ft)	d = maximum depth of flow (m)	S = slope of channel (m/m)	Maximum Shear Stress (N/m^2) =	Allowable Shear Stress > Max Shear Stress?	Required Riprap d50
29058	5872.79	5868.37	4.42	1.347	0.00285	37.666	Yes, okay	d50 = 6 inches OK
28752	5871.19	5865.79	5.40	1.646	0.005756	92.939	Yes, okay	d50 = 6 inches OK
28260	5868.61	5862.97	5.64	1.719	0.005269	88.857	Yes, okay	d50 = 6 inches OK
27887	5866.36	5860.27	6.09	1.856	0.004533	82.544	Yes, okay	d50 = 6 inches OK
27503	5863.4	5856.14	7.26	2.213	0.004448	96.557	Yes, okay	d50 = 6 inches OK
26962	5859.43	5852.51	6.92	2.109	0.006873	142.212	Yes, okay	d50 = 12 inches OK
26498	5856.28	5850.24	6.04	1.841	0.004885	88.224	Yes, okay	d50 = 6 inches OK
25826	5853.25	5848.74	4.51	1.375	0.004533	61.129	Yes, okay	d50 = 6 inches OK

Convert Feet to Meters, Divide by: 3.28084

	For riprap d50 = 0.3 m = 12 inches	For riprap d50 = 0.15 m = 6 inches
Shear Stress		
Allowable Shear Stress (N/m^2)	227	113
Maximum Shear Stress (N/m^2) = Tau(depth) = gamma x d x S		
Where		
gamma = unit mass of water (N/m^3)	9810	
d = maximum depth of flow (m)	See table above	
S = slope of channel (m/m)	See table above	
Calculate Maximum Shear Stress (N/m^2) =	See table above	
Allowable Shear Stress > Max Shear Stress?	Check whether Allowable Shear Stress is greater than Maximum Shear Stress	

Riprap Shear Stress Reference: US Department of Transportation, Federal Highway Administration Publication FHWA-NHI-05-114, Sept. 2005

Schubert Ranch Sand Resource
Floodplain Modeling
Technical Memorandum
For
Black Squirrel Creek

El Paso County, Colorado

Prepared For:
Perry Hastings
Ellicott Sand and Gravel

Prepared By:
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John L. Jankousky, P.E.
Phone: 303-279-1707

February 25, 2020

Plan: Plan 02 BlackSquirrelCrk US to LBS RS: 29665 Profile: 100yr

E.G. Elev (ft)	5877.35	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.71	Wt. n-Val.	0.040	0.030	
W.S. Elev (ft)	5876.64	Reach Len. (ft)	284.00	326.80	348.43
Crit W.S. (ft)	5876.64	Flow Area (sq ft)	2618.72	1052.63	
E.G. Slope (ft/ft)	0.015151	Area (sq ft)	95122.95	1052.63	
Q Total (cfs)	23714.00	Flow (cfs)	15120.40	8593.60	
Top Width (ft)	2506.68	Top Width (ft)	1828.74	677.94	
Vel Total (ft/s)	6.46	Avg. Vel. (ft/s)	5.77	8.16	
Max Chl Dpth (ft)	61.64	Hydr. Depth (ft)	1.43	1.55	
Conv. Total (cfs)	192654.8	Conv. (cfs)	122839.6	69815.2	
Length Wtd. (ft)	304.98	Wetted Per. (ft)	1845.52	679.31	
Min Ch El (ft)	5872.00	Shear (lb/sq ft)	1.34	1.47	
Alpha	1.09	Stream Power (lb/ft s)	7.75	11.97	
Frctn Loss (ft)	2.71	Cum Volume (acre-ft)	2884.56	113.25	1006.42
C & E Loss (ft)	0.02	Cum SA (acres)	57.60	25.55	13.07

Plan: Plan 02 BlackSquirrelCrk US to LBS RS: 29338 Profile: 100yr

E.G. Elev (ft)	5874.34	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.65	Wt. n-Val.	0.040	0.030	
W.S. Elev (ft)	5873.69	Reach Len. (ft)	252.33	279.96	309.87
Crit W.S. (ft)	5873.52	Flow Area (sq ft)	2370.88	1908.33	
E.G. Slope (ft/ft)	0.005841	Area (sq ft)	79903.99	1908.33	
Q Total (cfs)	23714.00	Flow (cfs)	9060.61	14653.39	
Top Width (ft)	2152.54	Top Width (ft)	1499.04	653.50	
Vel Total (ft/s)	5.54	Avg. Vel. (ft/s)	3.82	7.68	
Max Chl Dpth (ft)	63.69	Hydr. Depth (ft)	1.58	2.92	
Conv. Total (cfs)	310297.4	Conv. (cfs)	118557.9	191739.5	
Length Wtd. (ft)	269.03	Wetted Per. (ft)	1518.03	660.51	
Min Ch El (ft)	5865.76	Shear (lb/sq ft)	0.57	1.05	
Alpha	1.37	Stream Power (lb/ft s)	2.18	8.09	
Frctn Loss (ft)	1.06	Cum Volume (acre-ft)	2314.00	102.14	1006.42
C & E Loss (ft)	0.07	Cum SA (acres)	46.75	20.55	13.07

Plan: Plan 02 BlackSquirrelCrk US to LBS RS: 29058 Profile: 100yr

E.G. Elev (ft)	5873.21	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.42	Wt. n-Val.	0.040	0.030	
W.S. Elev (ft)	5872.79	Reach Len. (ft)	287.77	305.83	246.30
Crit W.S. (ft)	5872.14	Flow Area (sq ft)	3072.46	2250.44	
E.G. Slope (ft/ft)	0.002850	Area (sq ft)	73826.62	2250.44	
Q Total (cfs)	23714.00	Flow (cfs)	9697.36	14016.64	
Top Width (ft)	2132.85	Top Width (ft)	1511.67	621.18	
Vel Total (ft/s)	4.46	Avg. Vel. (ft/s)	3.16	6.23	
Max Chl Dpth (ft)	62.79	Hydr. Depth (ft)	2.03	3.62	
Conv. Total (cfs)	444230.0	Conv. (cfs)	181658.9	262571.1	
Length Wtd. (ft)	298.65	Wetted Per. (ft)	1530.15	622.46	
Min Ch El (ft)	5867.03	Shear (lb/sq ft)	0.36	0.64	
Alpha	1.36	Stream Power (lb/ft s)	1.13	4.01	
Frctn Loss (ft)	1.17	Cum Volume (acre-ft)	1868.74	88.78	1006.42
C & E Loss (ft)	0.04	Cum SA (acres)	38.03	16.46	13.07

Plan: Plan 02 BlackSquirrelCrk US to LBS RS: 28752 Profile: 100yr

E.G. Elev (ft)	5872.00	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.81	Wt. n-Val.	0.040	0.030	0.040
W.S. Elev (ft)	5871.19	Reach Len. (ft)	417.55	492.07	349.60
Crit W.S. (ft)	5871.15	Flow Area (sq ft)	2325.80	1713.03	37.10
E.G. Slope (ft/ft)	0.005756	Area (sq ft)	72441.63	1713.03	37.85
Q Total (cfs)	23714.00	Flow (cfs)	8801.44	14808.21	104.35
Top Width (ft)	2018.32	Top Width (ft)	1476.06	489.86	52.40
Vel Total (ft/s)	5.82	Avg. Vel. (ft/s)	3.78	8.64	2.81
Max Chl Dpth (ft)	66.19	Hydr. Depth (ft)	1.58	3.50	0.71
Conv. Total (cfs)	312574.8	Conv. (cfs)	116012.0	195187.3	1375.5
Length Wtd. (ft)	461.15	Wetted Per. (ft)	1494.79	490.96	52.74
Min Ch El (ft)	5865.79	Shear (lb/sq ft)	0.56	1.25	0.25
Alpha	1.54	Stream Power (lb/ft s)	2.12	10.84	0.71
Frctn Loss (ft)	2.54	Cum Volume (acre-ft)	1385.60	74.86	1006.32
C & E Loss (ft)	0.00	Cum SA (acres)	28.16	12.56	12.92

Plan: Plan 02 BlackSquirrelCrk US to LBS RS: 28260 Profile: 100yr

E.G. Elev (ft)	5869.46	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.84	Wt. n-Val.	0.040	0.030	0.040
W.S. Elev (ft)	5868.61	Reach Len. (ft)	295.34	373.33	252.51
Crit W.S. (ft)	5868.61	Flow Area (sq ft)	1486.06	1812.47	863.46
E.G. Slope (ft/ft)	0.005269	Area (sq ft)	42343.08	1812.47	21357.02
Q Total (cfs)	23714.00	Flow (cfs)	4940.00	15773.72	3000.28
Top Width (ft)	2122.34	Top Width (ft)	1067.76	480.20	574.38
Vel Total (ft/s)	5.70	Avg. Vel. (ft/s)	3.32	8.70	3.47
Max Chl Dpth (ft)	63.61	Hydr. Depth (ft)	1.39	3.77	1.50
Conv. Total (cfs)	326697.2	Conv. (cfs)	68056.1	217307.5	41333.6
Length Wtd. (ft)	339.82	Wetted Per. (ft)	1085.66	481.25	590.27
Min Ch El (ft)	5861.58	Shear (lb/sq ft)	0.45	1.24	0.48
Alpha	1.67	Stream Power (lb/ft s)	1.50	10.78	1.67
Frctn Loss (ft)	1.66	Cum Volume (acre-ft)	835.45	54.95	920.46
C & E Loss (ft)	0.00	Cum SA (acres)	15.97	7.08	10.40

Plan: Plan 02 BlackSquirrelCrk US to LBS RS: 27887 Profile: 100yr

E.G. Elev (ft)	5867.22	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.86	Wt. n-Val.	0.040	0.030	0.040
W.S. Elev (ft)	5866.36	Reach Len. (ft)	397.19	383.75	354.51
Crit W.S. (ft)	5866.36	Flow Area (sq ft)	1468.07	1673.62	1178.24
E.G. Slope (ft/ft)	0.004533	Area (sq ft)	37398.05	1673.62	33607.47
Q Total (cfs)	23714.00	Flow (cfs)	4745.68	15068.21	3900.11
Top Width (ft)	2113.69	Top Width (ft)	980.20	376.85	756.64
Vel Total (ft/s)	5.49	Avg. Vel. (ft/s)	3.23	9.00	3.31
Max Chl Dpth (ft)	61.36	Hydr. Depth (ft)	1.50	4.44	1.56
Conv. Total (cfs)	352234.9	Conv. (cfs)	70489.7	223815.0	57930.1
Length Wtd. (ft)	381.42	Wetted Per. (ft)	999.03	377.24	773.81
Min Ch El (ft)	5859.15	Shear (lb/sq ft)	0.42	1.26	0.43
Alpha	1.84	Stream Power (lb/ft s)	1.34	11.30	1.43
Frctn Loss (ft)	1.71	Cum Volume (acre-ft)	565.13	40.01	761.15
C & E Loss (ft)	0.01	Cum SA (acres)	9.03	3.40	6.54

Plan: Plan 02 BlackSquirrelCrk US to LBS RS: 27503 Profile: 100yr

E.G. Elev (ft)	5864.24	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.84	Wt. n-Val.	0.040	0.030	0.040
W.S. Elev (ft)	5863.40	Reach Len. (ft)	541.48	541.48	541.48
Crit W.S. (ft)	5863.40	Flow Area (sq ft)	1405.33	1733.70	1272.43
E.G. Slope (ft/ft)	0.004448	Area (sq ft)	36265.81	1733.70	37689.98
Q Total (cfs)	23714.00	Flow (cfs)	4342.88	15308.97	4062.14
Top Width (ft)	2247.47	Top Width (ft)	1000.05	395.86	851.56
Vel Total (ft/s)	5.38	Avg. Vel. (ft/s)	3.09	8.83	3.19
Max Chl Dpth (ft)	63.40	Hydr. Depth (ft)	1.41	4.38	1.49
Conv. Total (cfs)	355582.3	Conv. (cfs)	65119.9	229552.2	60910.3
Length Wtd. (ft)	541.48	Wetted Per. (ft)	1014.28	396.66	869.87
Min Ch El (ft)	5856.14	Shear (lb/sq ft)	0.38	1.21	0.41
Alpha	1.86	Stream Power (lb/ft s)	1.19	10.72	1.30
Frctn Loss (ft)	3.03	Cum Volume (acre-ft)	229.29	25.00	471.03
C & E Loss (ft)	0.03	Cum SA (acres)			

Plan: Plan 02 BlackSquirrelCrk LBS to ROB Split RS: 26962 Profile: 100yr

E.G. Elev (ft)	5860.54	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.11	Wt. n-Val.	0.040	0.030	0.040
W.S. Elev (ft)	5859.43	Reach Len. (ft)	465.72	464.14	428.10
Crit W.S. (ft)	5859.43	Flow Area (sq ft)	502.37	2289.31	1350.95
E.G. Slope (ft/ft)	0.006873	Area (sq ft)	624.75	2289.31	38094.59
Q Total (cfs)	29100.00	Flow (cfs)	1941.73	21723.14	5435.13
Top Width (ft)	1934.02	Top Width (ft)	395.88	650.21	887.93
Vel Total (ft/s)	7.02	Avg. Vel. (ft/s)	3.87	9.49	4.02
Max Chl Dpth (ft)	59.43	Hydr. Depth (ft)	1.27	3.52	1.52
Conv. Total (cfs)	351001.4	Conv. (cfs)	23421.0	262022.4	65558.0
Length Wtd. (ft)	457.52	Wetted Per. (ft)	397.67	651.73	904.82
Min Ch El (ft)	5852.51	Shear (lb/sq ft)	0.54	1.51	0.64
Alpha	1.44	Stream Power (lb/ft s)	2.10	14.30	2.58
Frctn Loss (ft)	2.63	Cum Volume (acre-ft)	2129.68	1029.84	11793.79
C & E Loss (ft)	0.06	Cum SA (acres)	204.42	322.40	459.92

Plan: Plan 02 BlackSquirrelCrk LBS to ROB Split RS: 26498 Profile: 100yr

E.G. Elev (ft)	5857.19	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.91	Wt. n-Val.	0.040	0.030	0.040
W.S. Elev (ft)	5856.28	Reach Len. (ft)	589.32	672.05	619.01
Crit W.S. (ft)	5856.22	Flow Area (sq ft)	1812.72	1546.48	1584.65
E.G. Slope (ft/ft)	0.004885	Area (sq ft)	9618.54	1546.48	47612.08
Q Total (cfs)	29100.00	Flow (cfs)	8246.97	15145.09	5707.94
Top Width (ft)	2115.05	Top Width (ft)	846.09	324.12	944.85
Vel Total (ft/s)	5.89	Avg. Vel. (ft/s)	4.55	9.79	3.60
Max Chl Dpth (ft)	61.28	Hydr. Depth (ft)	2.14	4.77	1.68
Conv. Total (cfs)	416331.8	Conv. (cfs)	117988.9	216679.8	81663.1
Length Wtd. (ft)	641.64	Wetted Per. (ft)	861.09	325.04	969.83
Min Ch El (ft)	5849.26	Shear (lb/sq ft)	0.64	1.45	0.50
Alpha	1.68	Stream Power (lb/ft s)	2.92	14.21	1.80
Frctn Loss (ft)	3.02	Cum Volume (acre-ft)	2074.93	1009.40	11372.64
C & E Loss (ft)	0.00	Cum SA (acres)	197.78	317.21	450.91

Plan: Plan 02 BlackSquirrelCrk LBS to ROB Split RS: 25826 Profile: 100yr

E.G. Elev (ft)	5854.17	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.92	Wt. n-Val.	0.040	0.030	0.040
W.S. Elev (ft)	5853.25	Reach Len. (ft)	304.11	312.29	311.37
Crit W.S. (ft)	5853.25	Flow Area (sq ft)	1154.09	1729.65	2261.09
E.G. Slope (ft/ft)	0.004533	Area (sq ft)	13100.01	1729.65	40890.34
Q Total (cfs)	29100.00	Flow (cfs)	4295.54	16706.52	8097.94
Top Width (ft)	2283.11	Top Width (ft)	625.11	350.07	1307.94
Vel Total (ft/s)	5.66	Avg. Vel. (ft/s)	3.72	9.66	3.58
Max Chl Dpth (ft)	43.25	Hydr. Depth (ft)	1.85	4.94	1.73
Conv. Total (cfs)	432199.1	Conv. (cfs)	63798.2	248128.6	120272.3
Length Wtd. (ft)	311.29	Wetted Per. (ft)	635.76	350.91	1319.62
Min Ch El (ft)	5846.21	Shear (lb/sq ft)	0.51	1.40	0.48
Alpha	1.85	Stream Power (lb/ft s)	1.91	13.47	1.74
Frctn Loss (ft)	1.60	Cum Volume (acre-ft)	1921.25	984.13	10743.80
C & E Loss (ft)	0.01	Cum SA (acres)	187.83	312.01	434.91

Plan: Plan 02 BlackSquirrelCrk LBS to ROB Split RS: 25513 Profile: 100yr

E.G. Elev (ft)	5852.31	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.01	Wt. n-Val.	0.040	0.030	0.040
W.S. Elev (ft)	5851.31	Reach Len. (ft)	62.66	62.66	62.66
Crit W.S. (ft)	5851.31	Flow Area (sq ft)	468.51	2663.68	1230.80
E.G. Slope (ft/ft)	0.005878	Area (sq ft)	468.51	2663.68	1230.80
Q Total (cfs)	29100.00	Flow (cfs)	1458.72	23465.79	4175.50
Top Width (ft)	2109.77	Top Width (ft)	409.84	753.22	946.71
Vel Total (ft/s)	6.67	Avg. Vel. (ft/s)	3.11	8.81	3.39
Max Chl Dpth (ft)	6.31	Hydr. Depth (ft)	1.14	3.54	1.30
Conv. Total (cfs)	379543.2	Conv. (cfs)	19025.7	306057.7	54459.9
Length Wtd. (ft)	62.66	Wetted Per. (ft)	409.92	753.89	946.81
Min Ch El (ft)	5845.00	Shear (lb/sq ft)	0.42	1.30	0.48
Alpha	1.45	Stream Power (lb/ft s)	1.31	11.42	1.62
Frctn Loss (ft)	0.41	Cum Volume (acre-ft)	1873.88	968.38	10593.26
C & E Loss (ft)	0.03	Cum SA (acres)	184.22	308.06	426.85

Plan: Plan 02 BlackSquirrelCrk LBS to ROB Split RS: 25451 Profile: 100yr

E.G. Elev (ft)	5851.74	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.28	Wt. n-Val.		0.030	0.040
W.S. Elev (ft)	5850.47	Reach Len. (ft)	614.30	724.17	589.89
Crit W.S. (ft)	5850.47	Flow Area (sq ft)		2839.33	660.04
E.G. Slope (ft/ft)	0.007260	Area (sq ft)		2839.33	660.04
Q Total (cfs)	29100.00	Flow (cfs)		26696.42	2403.58
Top Width (ft)	1547.47	Top Width (ft)		853.66	693.81
Vel Total (ft/s)	8.32	Avg. Vel. (ft/s)		9.40	3.64
Max Chl Dpth (ft)	6.21	Hydr. Depth (ft)		3.33	0.95
Conv. Total (cfs)	341522.5	Conv. (cfs)		313313.7	28208.8
Length Wtd. (ft)	685.77	Wetted Per. (ft)		853.85	693.91
Min Ch El (ft)	5844.26	Shear (lb/sq ft)		1.51	0.43
Alpha	1.19	Stream Power (lb/ft s)		14.17	1.57
Frctn Loss (ft)	4.02	Cum Volume (acre-ft)	1873.55	964.42	10591.90
C & E Loss (ft)	0.18	Cum SA (acres)	183.92	306.90	425.67

Appendix B Material Specifications

TABLE MT-1
Gradation Requirements for Riprap

	Pay Item Type	Stone Size d50 (inches)	Percent of Material Smaller Than Typical Stone	Typical Stone Dimensions (inches)	Typical Stone Weight (Pounds)
			70-100	12	85
Riprap	VL	6	50-70	9	35
			35-50	6	10
			2-10	2	0.4
Riprap			70-100	15	160
	L	9	50-70	12	85
			35-50	9	35
			2-10	3	1.3
Riprap			70-100	21	440
	M	12	50-70	18	275
			35-50	12	85
			2-10	4	3
Riprap			100	30	1,280
	H	18	50-70	24	650
			35-50	18	275
			2-10	6	10
Riprap			100	42	3,500
	VH	24	50-70	33	1,700
			35-50	24	650
			2-10	9	35

Table taken from CDOT's Standard Specifications for Road and Bridge Construction, 1999 and City of Colorado Springs/El Paso County Drainage Criteria Manual.

Table 8. Retention Basin Calculation
Schubert Ranch Sand Resource Pit Phase I

Designer: John Jankousky
Revision: 1/31/2024

The software (Excel spreadsheet with macros) MHFD-Detention, Version 4.06 (July 2022) from UDF
the runoff volumes for Basin 1 and Basin OFF-1. These runoff volumes for the WQCV, the 5-year st
storm are presented below and compared to the volume of the reclaimed pit. The results from the M
spreadsheet are attached.

The volume of available storage is much greater that the expected runoff volumes.

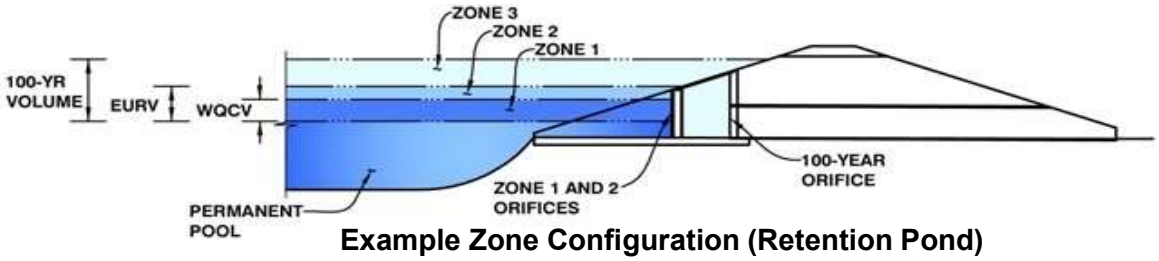
Note: The water quality capture volume (WQCV) is equivalent to the runoff from an 80th percentile s
means that 80 percent of the most frequently occurring storms are fully captured and treated and larg
treated.

Basin Designation	Runoff Volume, WQCV (acre-feet)	Runoff Volume, 5-year storm (acre-feet)	Runoff Volume, 100-year storm (acre-feet)
Basin 1	0.054	0.041	3.362
Basin OFF-1	1.521	1.613	27.863
Sum of Both Basins	**1.575**	**1.654**	**31.225**

Volume of Available Storage = The excavated and reclaimed pit will hold 2010 acre-feet

Project: **Schubert Ranch**

Basin ID: **Basin 1**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**RP**	
Watershed Area =	53.24	acres
Watershed Length =	2,529	ft
Watershed Length to Centroid =	1,265	ft
Watershed Slope =	0.033	ft/ft
Watershed Imperviousness =	2.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	12.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.054	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.050	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.03 in.) =	0.012	acre-feet	1.03	inches
5-yr Runoff Volume (P1 = 1.37 in.) =	0.041	acre-feet	1.37	inches
10-yr Runoff Volume (P1 = 1.67 in.) =	0.067	acre-feet	1.67	inches
25-yr Runoff Volume (P1 = 2.11 in.) =	0.968	acre-feet	2.11	inches
50-yr Runoff Volume (P1 = 2.47 in.) =	1.945	acre-feet	2.47	inches
100-yr Runoff Volume (P1 = 2.85 in.) =	3.362	acre-feet	2.85	inches
500-yr Runoff Volume (P1 = 3.82 in.) =	7.243	acre-feet	3.82	inches
Approximate 2-yr Detention Volume =	0.024	acre-feet		
Approximate 5-yr Detention Volume =	0.036	acre-feet		
Approximate 10-yr Detention Volume =	0.054	acre-feet		
Approximate 25-yr Detention Volume =	0.089	acre-feet		
Approximate 50-yr Detention Volume =	0.230	acre-feet		
Approximate 100-yr Detention Volume =	0.651	acre-feet		

Depth Increment =

Stage - Storage Description
Permanent Pool

TORAGE TABLE BUILDER

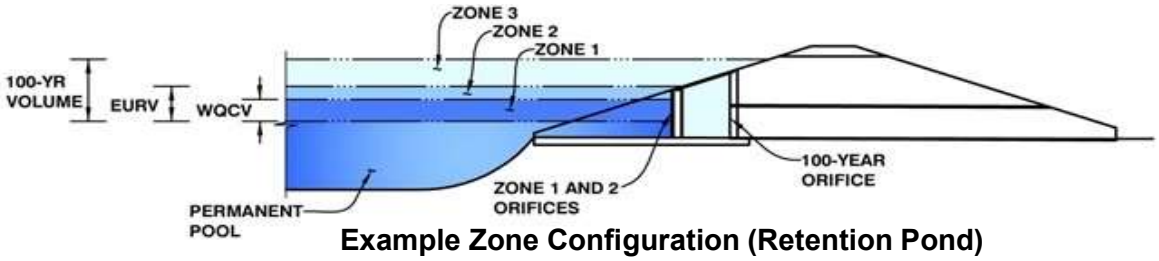
n 4.06 (July 2022)

ft

Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)

Project: **Schubert Ranch**

Basin ID: **Basin OFF-1**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**RP**	
Watershed Area =	376.97	acres
Watershed Length =	11,159	ft
Watershed Length to Centroid =	5,580	ft
Watershed Slope =	0.009	ft/ft
Watershed Imperviousness =	8.88%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	12.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	1.521	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	2.379	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.03 in.) =	0.655	acre-feet	1.03	inches
5-yr Runoff Volume (P1 = 1.37 in.) =	1.613	acre-feet	1.37	inches
10-yr Runoff Volume (P1 = 1.67 in.) =	2.441	acre-feet	1.67	inches
25-yr Runoff Volume (P1 = 2.11 in.) =	9.929	acre-feet	2.11	inches
50-yr Runoff Volume (P1 = 2.47 in.) =	17.291	acre-feet	2.47	inches
100-yr Runoff Volume (P1 = 2.85 in.) =	27.863	acre-feet	2.85	inches
500-yr Runoff Volume (P1 = 3.82 in.) =	55.651	acre-feet	3.82	inches
Approximate 2-yr Detention Volume =	1.227	acre-feet		
Approximate 5-yr Detention Volume =	1.783	acre-feet		
Approximate 10-yr Detention Volume =	2.466	acre-feet		
Approximate 25-yr Detention Volume =	3.719	acre-feet		
Approximate 50-yr Detention Volume =	5.349	acre-feet		
Approximate 100-yr Detention Volume =	9.315	acre-feet		

Depth Increment =

Stage - Storage Description
Permanent Pool

STORAGE TABLE BUILDER

n 4.06 (July 2022)

	ft							
Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)