

**FINAL DRAINAGE REPORT  
FOR  
MEISMAN PROPERTY  
THAT PART OF S2 LY WLY OF HWY 85 AND SELY OF PLATTED...  
21255 CALLE PACIFICO POINT  
PUEBLO, COLORADO**

**APRIL 2022**

Prepared For:  
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Prepared By:  
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TNE Job No. 2071.00  
County Job No. PPR2173

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**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.

\_\_\_\_\_  
L Ducett, P.E. 32339  
On behalf of Terra Nova Engineering, Inc.

\_\_\_\_\_  
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.

\_\_\_\_\_  
Authorized Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Gary Meisman, Property Owner  
Printed Name, Title

\_\_\_\_\_  
N/A  
Business Name

\_\_\_\_\_  
612 Harvard St, Colorado Springs, CO 80911  
Address

---

**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.

\_\_\_\_\_  
Jennifer Irvine, P.E.  
County Engineer / ECM Administrator

\_\_\_\_\_  
Date

Conditions:

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**PURPOSE**

The purpose of this Final Drainage Report is to identify and analyze the proposed drainage patterns, determine proposed runoff quantities, size drainage structures for conveyance of developed runoff, and present solutions to drainage impacts on-site and off-site resulting from this development. The site has not previously been platted and has not been previously studied.

**GENERAL DESCRIPTION**

This Final Drainage Report (FDR) is an analysis of approximately 40.2 acres of undeveloped land located at 21255 Calle Pacifico Point. This site is being developed as a residential property with a house and a detached shop area to be used by the owners trucking business. The site is in the southeast quarter of Section 35, Township 17 South, Range 65 West of the 6<sup>th</sup> Principal Meridian within El Paso County. The parcels are bounded to the north by Calle Bernardo, Calle Pacifico Point, and Lot 52 Villa Casitas Filing No 3; to the east by Interstate 25; to the south by unplatted land (in Pueblo County); and to the west by lot 14 Villa Casitas Filing No 1 and Calle Bernardo (see vicinity map in appendix).

The site lies within the Young Hollow Drainage Basin, with storm runoff surface draining west to east across the site, then crossing under I-25 and railroad tracks in culverts, before continuing to surface flow east toward Fountain Creek.

Soils for this project are delineated by the map in the appendix as 16% Kim loam (43), 17% Schamber-Razor complex (82), and 22% Manzanola silty clay loam (MzC). Soils in the study area are shown as mapped by S.C.S. in the "Soils Survey of El Paso County Area" and contains soils of Hydrologic Group A, B, and C, with Hydrologic Groups A & B being used for this project.



The site is undeveloped with mostly grass and dirt surfaces, some scrub brush, and a small number of trees near I-25. The site drains to the east, with an average slope of 5%-6%.

## **EXISTING DRAINAGE CONDITIONS**

There are no existing structures on the site, though earthwork appears to have been done several times in the past. The west side of the site appears to have been graded in recent years, there is an older dirt road/path crossing the east side of the site, and there are a couple drainage ditches near the east edge of the property. There are offsite culverts crossing I-25 that runoff from the property flows through after leaving the site.

There are five drainage basins, two of which are offsite. See attached Existing Drainage Map (in appendix).

Basin OS-Z is 8.18 acres and drains to Design Point Z on the west property line of the site. This basin is offsite and runoff from this basin flows onto the site and into basin EX-B. Basin OS-Z has flows of  $Q_5 = 2.6$  cfs and  $Q_{100} = 17.6$  cfs.

Basin OS-Y is 13.1 acres and drains to Design Point Y at the southwest corner of the site. This basin is offsite and runoff from this basin flows onto the site and into basin EX-A. Basin OS-Y has flows of  $Q_5 = 4.0$  cfs and  $Q_{100} = 27.0$  cfs.

Basin EX-A is 10.7 acres and drains to Design Point A at a drainage ditch on the west side of the site. Runoff enters culverts under I-25 after leaving the site. Basin EX-A has flows of  $Q_5 = 3.0$  cfs and  $Q_{100} = 20.0$  cfs. Design Point A has combined flows of  $Q_5 = 7.0$  cfs and  $Q_{100} = 47.0$  cfs from basins OS-Y and EX-A.

Basin EX-B is 27.0 acres and drains to Design Point B at the east side of the site. Runoff enters culverts under I-25 after leaving the site. Basin EX-B has flows of  $Q_5 = 7.3$  cfs and  $Q_{100} = 48.9$  cfs. Design Point B has combined flows of  $Q_5 = 9.9$  cfs and  $Q_{100} = 66.5$  cfs from basins OS-Z and EX-B.

Basin EX-C is 1.16 acres on the side of the property and drains to Design Point C at the north side of the site. This is a downhill portion of the property that drains toward the adjacent road. Runoff leaves the site and enters a road side ditch before flowing east. Basin EX-C has flows of  $Q_5 = 0.3$  cfs and  $Q_{100} = 2.2$  cfs.

## **PROPOSED DRAINAGE CONDITIONS**

Runoff in the developed conditions consists of six basins; Four onsite basins and two offsite basins. Below is a description of the runoff in the developed conditions and how it will be safely routed, treated and detained. See appendix for calculations.

### Offsite Basins

See the Existing Drainage Conditions section for Basin OS-Z.

See the Existing Drainage Conditions section for Basin OS-Y.

### Onsite Basins

Basin PR-3 is 10.7 acres and drains to Design Point 3 at a drainage ditch on the west side of the site and includes the same area as Basin EX-A, but now includes a portion of the proposed gravel storage area. Runoff enters culverts under I-25 after leaving the site in the same way as the existing conditions. Basin PR-3 has flows of  $Q_5 = 3.4$  cfs and  $Q_{100} = 20.6$  cfs. Design Point 3 has combined flows of  $Q_5 = 7.4$  cfs and  $Q_{100} = 47.6$  cfs from basins OS-Y and PR-3. The increase in flows from the existing conditions at Design Point 3 is 0.4 cfs in the 5-year event and 0.6 in the 100-year event and is, therefore, not significant.

Basin PR-2 is 1.16 acres on the side of the property and drains to Design Point 2 at the north side of the site and includes the same area as Basin EX-C. This area still drains toward the adjacent road, but now includes small portions of a proposed 16' gravel driveway and a proposed 30' gravel driveway. Runoff leaves the site and enters a road side ditch before flowing east in the same way as the existing conditions. The disturbance in this basin is less than 1 acre and would qualify for an exclusion from the need for water quality treatment (Per ECM App I.7.1.C.1) as it is not practicable to capture runoff from this basin which is not able to drain towards control measures

and instead drains directly towards an existing gravel road. Basin PR-2 has flows of  $Q_5 = 0.5$  cfs and  $Q_{100} = 2.5$  cfs. The increase in flows from the existing conditions at Design Point 2 is 0.2 cfs in the 5-year event and 0.3 cfs in the 100-year event and is, therefore, not significant.

Basin PR-1 is 27.0 acres and drains to Design Point 1 at the east edge of the site. Basin PR-1 covers most of the site, includes the two proposed buildings, most of the gravel roads, a portion of the gravel storage area, and an area of concrete around the proposed shop building. There are existing drainage channels near the east end of the basin that direct runoff as it nears I-25 and enters a 6' X 7' RCP culvert which is in good condition and will not be significantly impacted by this site. Basin PR-1 has flows of  $Q_5 = 9.7$  cfs and  $Q_{100} = 48.9$  cfs. Design Point 1 has combined flows of  $Q_5 = 12.3$  cfs and  $Q_{100} = 66.5$  cfs from basins OS-Z and PR-1. This is an increase in flows of 2.4 cfs in the 5-year event no increase in the 100-year event which is easily handled by the existing drainage ditches and culvert beneath I-25.

Water quality treatment for the proposed impervious areas in Basin PR-1, Basin-PR-2, and Basin-PR-3 is provided by the landscaping / undeveloped areas downstream of the impervious areas. The Runoff Reduction Spreadsheet shows the areas being used (see appendix), and a visual representation of these areas is shown on the Proposed Drainage Map. There is much more landscaping / undeveloped area on the site than are required for water quality treatment. If future development affects these areas being used for water quality treatment, water quality treatment of the impervious areas proposed here may need to be revisited.

In an effort to protect receiving water and as part of the “four-step process to minimize adverse impacts of urbanization” this site was analyzed in the following manner:

1. Reduce Runoff- The proposed impervious areas on the site are surrounded by landscaping / undeveloped areas, which extend approximately 1,000 feet downstream of the proposed impervious areas. This will reduce the volume of runoff using ponding and infiltration. See the Runoff Reduction spreadsheet in the appendix for calculations showing how runoff from this impervious area is treated by the receiving pervious area.
2. Stabilize Drainageways- The existing drainageways onsite are next to I-25, approximately 1,000 feet from the area of the site to be developed, and are not directly connected to the

area to be developed. A couple diversion swales are proposed near the proposed structures, and these swales have been designed to be stable.

3. Provide Water Quality Capture Volume (WQCV)- The large landscaping / undeveloped areas will provide the water quality treatment for the proposed impervious areas. See the Runoff Reduction Spreadsheet in the appendix.
4. Consider Need for Industrial and Commercial BMPs- The proposed residence won't involve any industrial and commercial BMPs. The proposed shop building is expected to contain lubricants, solvents, and similar typically associated with basic truck maintenance, and appropriate BMPs should be implemented for this area. See SWMP for methods to contain possible spills.

## **HYDROLOGIC CALCULATIONS**

Hydrologic calculations were performed using the El Paso County Storm Drainage Design Criteria Manual - Volumes 1 & 2, latest editions. The Rational Method was used to estimate storm water runoff anticipated from design storms with 5-year and 100-year recurrence intervals.

## **HYDRAULIC CALCULATIONS**

Hydraulic calculations were estimated using the Manning's Formula and the methods described in the El Paso County Storm Drainage Design Criteria Manual – Volumes 1 & 2, latest editions. The pertinent data sheets are included in the appendix of this report.

Swale capacity calculation were performed for the proposed diversion swales.

## **FLOODPLAIN STATEMENT**

No portion of this site is within a designated F.E.M.A. floodplain, as determined by Flood Insurance Rate Map No. 08041C1170 G, dated December 7, 2018 (see appendix).

## **WATER QUALITY**

Water quality treatment for the proposed impervious areas in Basin PR-1, Basin PR-2, and Basin PR-3 is provided by the landscaping / undeveloped areas downstream of the impervious areas. The Runoff Reduction Spreadsheet shows the areas being used (see appendix), and a visual

representation of these areas is shown on the Proposed Drainage Map. There is much more landscaping / undeveloped area on the site than are required for water quality treatment. If future development affects these areas being used for water quality treatment, water quality treatment of the impervious areas proposed here may need to be revisited. Detention is not necessary as the increase in runoff is not significant.

## **CONSTRUCTION COST OPINION**

### **Public Reimbursable**

None

### **Public Non-Reimbursable**

None

### **Private Non-Reimbursable**

None

## **DRAINAGE FEES**

This drainage report is part of a site development application; therefore, no drainage fees are due.

## **MAINTENANCE**

There are no stormwater facilities proposed as part of this development.

## **SUMMARY**

Development of this site will not adversely affect the surrounding development. There are no known previous reports associated with this site. Water quality treatment for the proposed impervious areas is being provided by downstream landscaping / undeveloped areas.

## **BIBLIOGRAPHY**

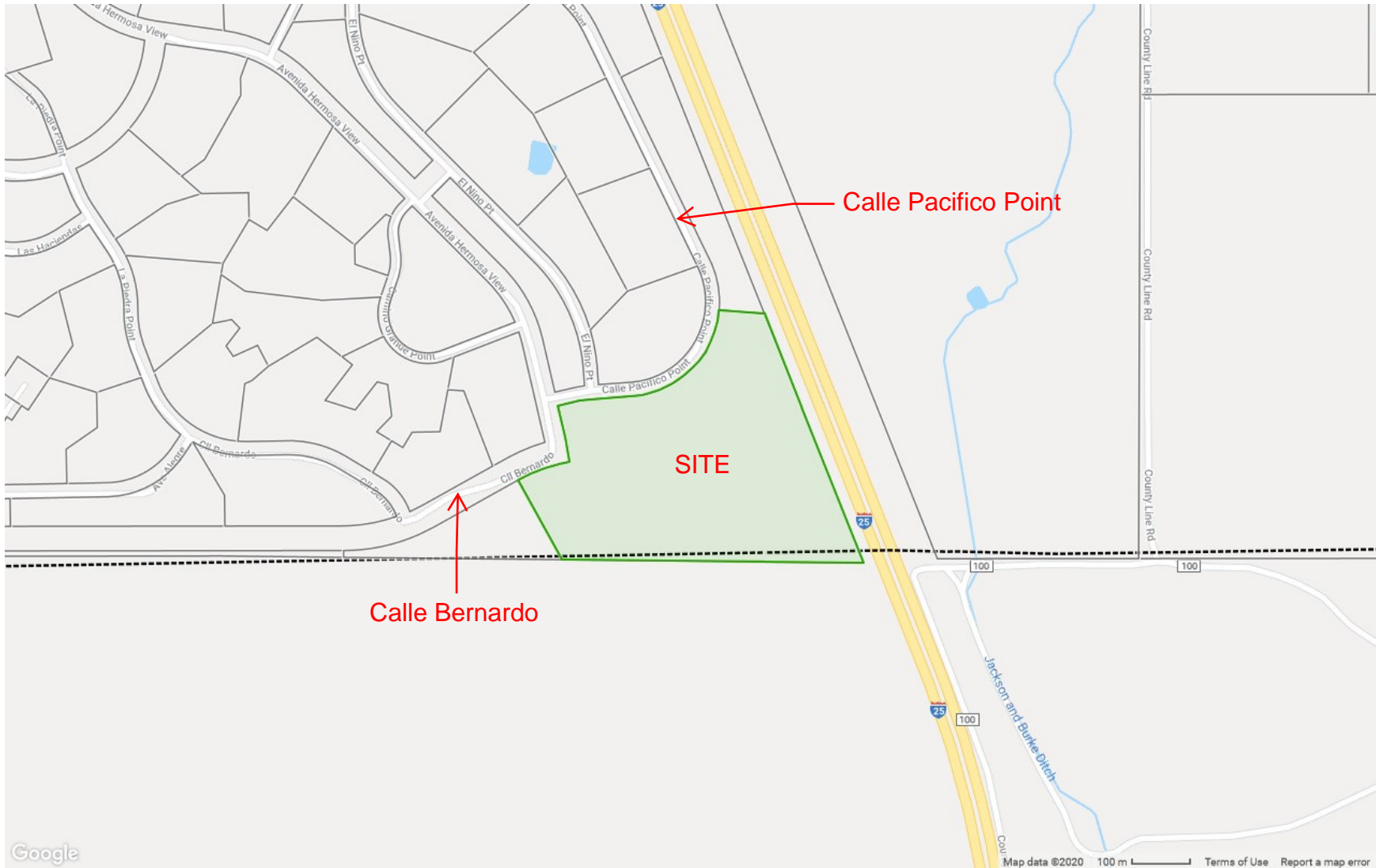
El Paso County Drainage Criteria Manual-Volumes 1 & 2, latest edition

El Paso County Board Resolution No 15-042 (Adoption of Chapter 6 and Section 3.2.1 Chapter 13 of the City of Colorado Springs Drainage Criteria Manual dated May 2014, Hydrology and Full Spectrum Detention)

## **VICINITY MAP**

**El Paso County - Community: Property Search**  
**Schedule Number: 5735000001**

**Meisman Property - Vicinity Map**



North is up ^



## **S.C.S. SOILS MAP**

## El Paso County Area, Colorado

### 43—Kim loam, 1 to 8 percent slopes

#### Map Unit Setting

*National map unit symbol:* 368k

*Elevation:* 5,300 to 5,600 feet

*Mean annual precipitation:* 12 to 14 inches

*Mean annual air temperature:* 48 to 52 degrees F

*Frost-free period:* 135 to 155 days

*Farmland classification:* Not prime farmland

#### Map Unit Composition

*Kim and similar soils:* 98 percent

*Minor components:* 2 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Kim

##### Setting

*Landform:* Fans, hills

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Calcareous loamy alluvium

##### Typical profile

*A - 0 to 6 inches:* loam

*C - 6 to 60 inches:* loam

##### Properties and qualities

*Slope:* 1 to 8 percent

*Depth to restrictive feature:* More than 80 inches

*Drainage class:* Well drained

*Runoff class:* Medium

*Capacity of the most limiting layer to transmit water*

*(Ksat):* Moderately high to high (0.60 to 2.00 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Calcium carbonate, maximum content:* 20 percent

*Maximum salinity:* Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)

*Available water capacity:* High (about 9.6 inches)

##### Interpretive groups

*Land capability classification (irrigated):* 3e

*Land capability classification (nonirrigated):* 4e

**Hydrologic Soil Group: B**

*Ecological site:* R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.

*Hydric soil rating:* No

**Minor Components**

**Other soils**

*Percent of map unit:* 1 percent

*Hydric soil rating:* No

**Pleasant**

*Percent of map unit:* 1 percent

*Landform:* Depressions

*Hydric soil rating:* Yes

**Data Source Information**

Soil Survey Area: El Paso County Area, Colorado

Survey Area Data: Version 18, Jun 5, 2020

Soil Survey Area: Pueblo Area, Colorado, Parts of Pueblo and Custer Counties

Survey Area Data: Version 19, Jun 5, 2020

## El Paso County Area, Colorado

### 82—Schamber-Razor complex, 8 to 50 percent slopes

#### Map Unit Setting

*National map unit symbol:* 369y

*Elevation:* 5,500 to 6,500 feet

*Mean annual precipitation:* 12 to 14 inches

*Mean annual air temperature:* 48 to 52 degrees F

*Frost-free period:* 135 to 170 days

*Farmland classification:* Not prime farmland

#### Map Unit Composition

*Schamber and similar soils:* 55 percent

*Razor and similar soils:* 43 percent

*Minor components:* 2 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Schamber

##### Setting

*Landform:* Breaks

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Alluvium derived from granite and/or colluvium derived from granite and/or eolian deposits derived from granite

##### Typical profile

*A - 0 to 5 inches:* gravelly loam

*AC - 5 to 15 inches:* very gravelly loam

*C - 15 to 60 inches:* very gravelly sand

##### Properties and qualities

*Slope:* 8 to 50 percent

*Depth to restrictive feature:* More than 80 inches

*Drainage class:* Well drained

*Runoff class:* Medium

*Capacity of the most limiting layer to transmit water (Ksat):* High  
(2.00 to 6.00 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Calcium carbonate, maximum content:* 15 percent

*Maximum salinity:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

*Available water capacity:* Low (about 3.0 inches)

##### Interpretive groups

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 7e

**Hydrologic Soil Group: A**

*Ecological site:* R069XY064CO - Gravel Breaks LRU's A & B  
*Hydric soil rating:* No

## **Description of Razor**

### **Setting**

*Landform:* Breaks  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Clayey slope alluvium over residuum weathered from shale

### **Typical profile**

*A - 0 to 3 inches:* clay loam  
*Bw - 3 to 9 inches:* clay loam  
*Bk - 9 to 31 inches:* clay  
*Cr - 31 to 35 inches:* weathered bedrock

### **Properties and qualities**

*Slope:* 8 to 15 percent  
*Depth to restrictive feature:* 20 to 40 inches to paralithic bedrock  
*Drainage class:* Well drained  
*Runoff class:* Medium  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Calcium carbonate, maximum content:* 15 percent  
*Gypsum, maximum content:* 5 percent  
*Maximum salinity:* Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)  
*Sodium adsorption ratio, maximum:* 15.0  
*Available water capacity:* Low (about 5.5 inches)

### **Interpretive groups**

*Land capability classification (irrigated):* 6e  
*Land capability classification (nonirrigated):* 6e  
*Hydrologic Soil Group:* D  
*Ecological site:* R069XY047CO - Alkaline Plains LRU's A & B  
*Other vegetative classification:* ALKALINE PLAINS (069AY047CO)  
*Hydric soil rating:* No

## **Minor Components**

### **Other soils**

*Percent of map unit:* 1 percent  
*Hydric soil rating:* No

### **Pleasant**

*Percent of map unit:* 1 percent  
*Landform:* Depressions

*Hydric soil rating:* Yes

## Data Source Information

Soil Survey Area: El Paso County Area, Colorado

Survey Area Data: Version 18, Jun 5, 2020

Soil Survey Area: Pueblo Area, Colorado, Parts of Pueblo and Custer Counties

Survey Area Data: Version 19, Jun 5, 2020

## El Paso County Area, Colorado

### MzC—Manzanola silty clay loam, 3 to 9 percent slopes

#### Map Unit Setting

*National map unit symbol:* 2rgrk

*Elevation:* 3,700 to 6,200 feet

*Mean annual precipitation:* 12 to 14 inches

*Mean annual air temperature:* 48 to 54 degrees F

*Frost-free period:* 130 to 170 days

*Farmland classification:* Not prime farmland

#### Map Unit Composition

*Manzanola and similar soils:* 85 percent

*Minor components:* 15 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Manzanola

##### Setting

*Landform:* Hillslopes, fan remnants

*Landform position (two-dimensional):* Backslope, footslope

*Landform position (three-dimensional):* Base slope, side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Alluvium derived from shale

##### Typical profile

*A - 0 to 5 inches:* silty clay loam

*Bt - 5 to 26 inches:* silty clay loam

*Btk - 26 to 37 inches:* silty clay loam

*Bk1 - 37 to 48 inches:* silty clay loam

*Bk2 - 48 to 79 inches:* silt loam

##### Properties and qualities

*Slope:* 3 to 9 percent

*Depth to restrictive feature:* More than 80 inches

*Drainage class:* Well drained

*Capacity of the most limiting layer to transmit water*

*(Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Calcium carbonate, maximum content:* 14 percent

*Gypsum, maximum content:* 3 percent

*Maximum salinity:* Nonsaline to very slightly saline (0.5 to 3.0 mmhos/cm)

*Sodium adsorption ratio, maximum:* 5.0

*Available water capacity:* High (about 11.1 inches)

### Interpretive groups

*Land capability classification (irrigated):* 6e

*Land capability classification (nonirrigated):* 6e

**Hydrologic Soil Group: C**

*Ecological site:* R069XY042CO - Clayey Plains LRU's A & B

*Forage suitability group:* Clayey (G069XW001CO)

*Other vegetative classification:* Loamy Plains #6  
(069XY006CO\_2), Clayey (G069XW001CO)

*Hydric soil rating:* No

### Minor Components

#### Fort

*Percent of map unit:* 5 percent

*Landform:* Fan remnants

*Landform position (two-dimensional):* Backslope

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Convex

*Across-slope shape:* Linear

*Ecological site:* R069XY006CO - Loamy Plains, LRU's A & B 10-14  
Inches, P.Z.

*Other vegetative classification:* Loamy Plains #6 (069XY006CO\_2),  
Loamy (G069XW017CO)

*Hydric soil rating:* No

#### Wilid

*Percent of map unit:* 5 percent

*Landform:* Hillslopes

*Landform position (two-dimensional):* Backslope

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Ecological site:* R069XY006CO - Loamy Plains, LRU's A & B 10-14  
Inches, P.Z.

*Other vegetative classification:* Loamy Plains #6 (069XY006CO\_2),  
Loamy (G069XW017CO)

*Hydric soil rating:* No

#### Razor

*Percent of map unit:* 5 percent

*Landform:* Pediments, hillslopes

*Landform position (two-dimensional):* Backslope

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear, convex

*Ecological site:* R069XY042CO - Clayey Plains LRU's A & B

*Other vegetative classification:* CLAYEY PLAINS (069AY042CO),  
Clayey, Dry-Saline (G069XW006CO)



*Hydric soil rating:* No

## Data Source Information

Soil Survey Area: El Paso County Area, Colorado

Survey Area Data: Version 18, Jun 5, 2020

Soil Survey Area: Pueblo Area, Colorado, Parts of Pueblo and Custer Counties

Survey Area Data: Version 19, Jun 5, 2020

## Pueblo Area, Colorado, Parts of Pueblo and Custer Counties

### CaE—Cascajo very gravelly sandy loam, 2 to 20 percent slopes

#### Map Unit Setting

*National map unit symbol:* 2t50z

*Elevation:* 4,260 to 5,900 feet

*Mean annual precipitation:* 10 to 12 inches

*Mean annual air temperature:* 50 to 54 degrees F

*Frost-free period:* 130 to 170 days

*Farmland classification:* Not prime farmland

#### Map Unit Composition

*Cascajo, very gravelly, and similar soils:* 85 percent

*Minor components:* 15 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Cascajo, Very Gravelly

##### Setting

*Landform:* Terraces

*Landform position (three-dimensional):* Tread, riser

*Down-slope shape:* Convex

*Across-slope shape:* Convex

*Parent material:* Old alluvium

##### Typical profile

*A - 0 to 4 inches:* very gravelly sandy loam

*Bk - 4 to 22 inches:* very gravelly loam

*2C1 - 22 to 39 inches:* extremely gravelly sand

*2C2 - 39 to 79 inches:* extremely gravelly sand

##### Properties and qualities

*Slope:* 2 to 20 percent

*Depth to restrictive feature:* More than 80 inches

*Drainage class:* Excessively drained

*Runoff class:* Low

*Capacity of the most limiting layer to transmit water*

*(Ksat):* Moderately high to high (0.60 to 6.00 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Calcium carbonate, maximum content:* 30 percent

*Maximum salinity:* Very slightly saline (2.0 to 3.9 mmhos/cm)

*Available water capacity:* Very low (about 1.7 inches)

##### Interpretive groups

*Land capability classification (irrigated):* 6e

*Land capability classification (nonirrigated):* 6e

**Hydrologic Soil Group: A**

*Ecological site:* R069XY064CO - Gravel Breaks LRU's A & B

*Hydric soil rating:* No

**Minor Components**

**Cascajo, gravelly**

*Percent of map unit:* 10 percent

*Landform:* Terraces

*Landform position (three-dimensional):* Riser

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Ecological site:* R069XY064CO - Gravel Breaks LRU's A & B

*Hydric soil rating:* No

**Kimera**

*Percent of map unit:* 5 percent

*Landform:* Interfluves

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Ecological site:* R069XY026CO - Sandy Plains LRU's A & B

*Other vegetative classification:* Loamy (G069XW017CO)

*Hydric soil rating:* No

**Data Source Information**

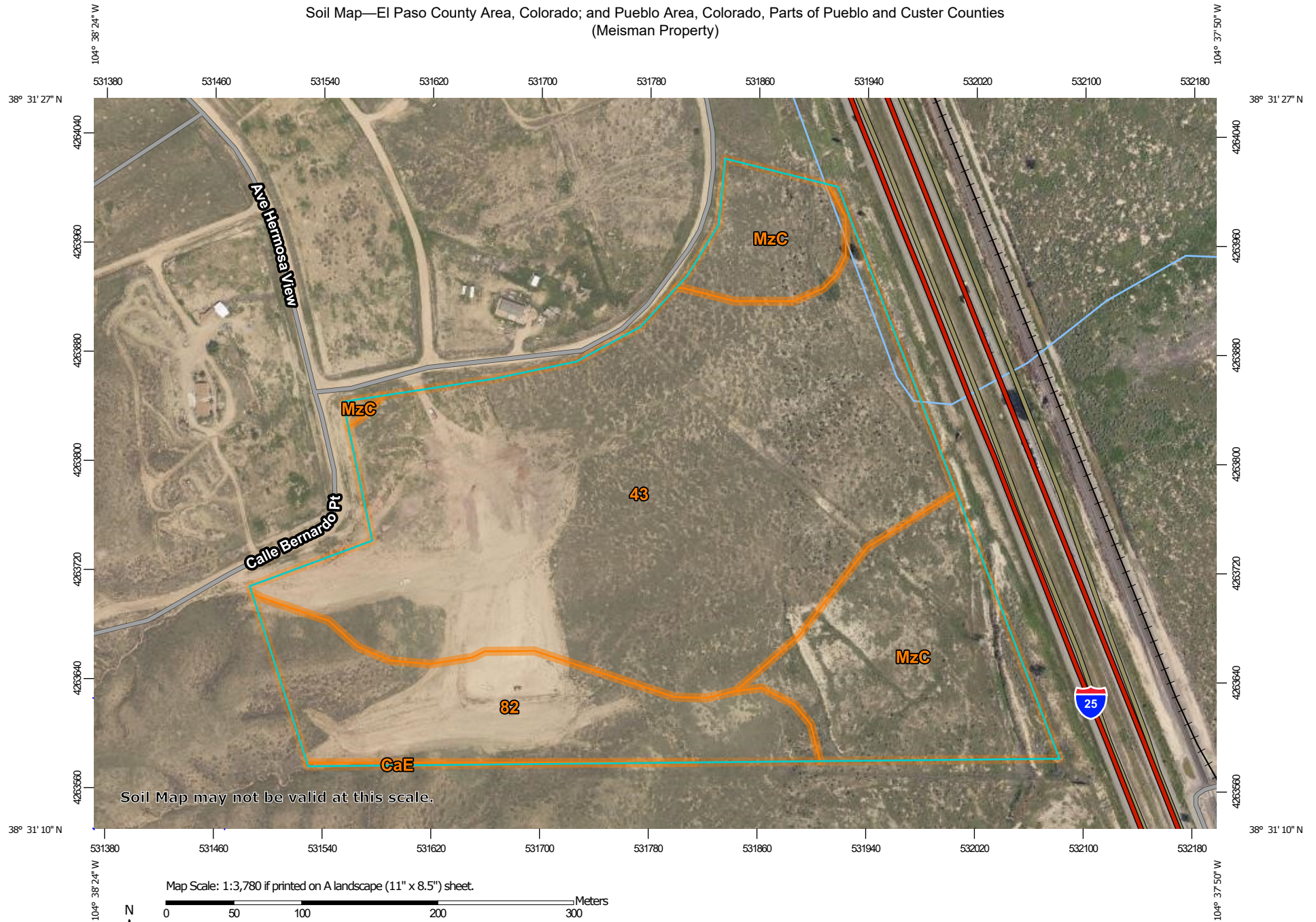
Soil Survey Area: El Paso County Area, Colorado

Survey Area Data: Version 18, Jun 5, 2020

Soil Survey Area: Pueblo Area, Colorado, Parts of Pueblo and Custer Counties

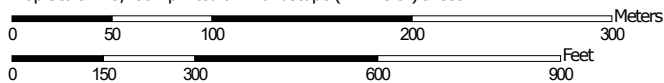
Survey Area Data: Version 19, Jun 5, 2020

Soil Map—El Paso County Area, Colorado; and Pueblo Area, Colorado, Parts of Pueblo and Custer Counties  
(Meisman Property)



Soil Map may not be valid at this scale.

Map Scale: 1:3,780 if printed on A landscape (11" x 8.5") sheet.



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



Natural Resources  
Conservation Service


Web Soil Survey  
National Cooperative Soil Survey

12/22/2020  
Page 1 of 4

Soil Map—El Paso County Area, Colorado; and Pueblo Area, Colorado, Parts of Pueblo and Custer Counties  
(Meisman Property)


## MAP LEGEND

### Area of Interest (AOI)

 Area of Interest (AOI)

### Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

### Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

### Water Features



Streams and Canals

### Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

### Background



Aerial Photography

## MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: El Paso County Area, Colorado

Survey Area Data: Version 18, Jun 5, 2020

Soil Survey Area: Pueblo Area, Colorado, Parts of Pueblo and Custer Counties

Survey Area Data: Version 19, Jun 5, 2020

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Aug 14, 2018—Sep 23, 2018



## MAP LEGEND

## MAP INFORMATION

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

## Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
43	Kim loam, 1 to 8 percent slopes	24.3	60.8%
82	Schamber-Razor complex, 8 to 50 percent slopes	6.8	17.1%
MzC	Manzanola silty clay loam, 3 to 9 percent slopes	8.7	21.8%
<b>Subtotals for Soil Survey Area</b>		<b>39.8</b>	<b>99.8%</b>
<b>Totals for Area of Interest</b>		<b>39.9</b>	<b>100.0%</b>

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CaE	Cascajo very gravelly sandy loam, 2 to 20 percent slopes	0.1	0.2%
<b>Subtotals for Soil Survey Area</b>		<b>0.1</b>	<b>0.2%</b>
<b>Totals for Area of Interest</b>		<b>39.9</b>	<b>100.0%</b>

## **FEMA FIRM MAP**



## NOTES TO USERS

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

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

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

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

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

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

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

NGS Information Services  
NOAA, NGS-12  
National Geodetic Survey  
SSM-C-3, #5202  
1315 East-West Highway  
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (201) 713-3242 or visit its website at <http://www.ngs.noaa.gov/>.

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

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

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

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

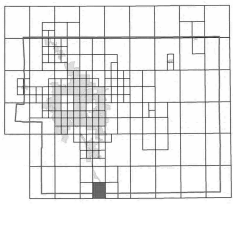
Contact **FEMA Map Service Center (MSC)** via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this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

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

### El Paso County Vertical Datum Offset Table

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

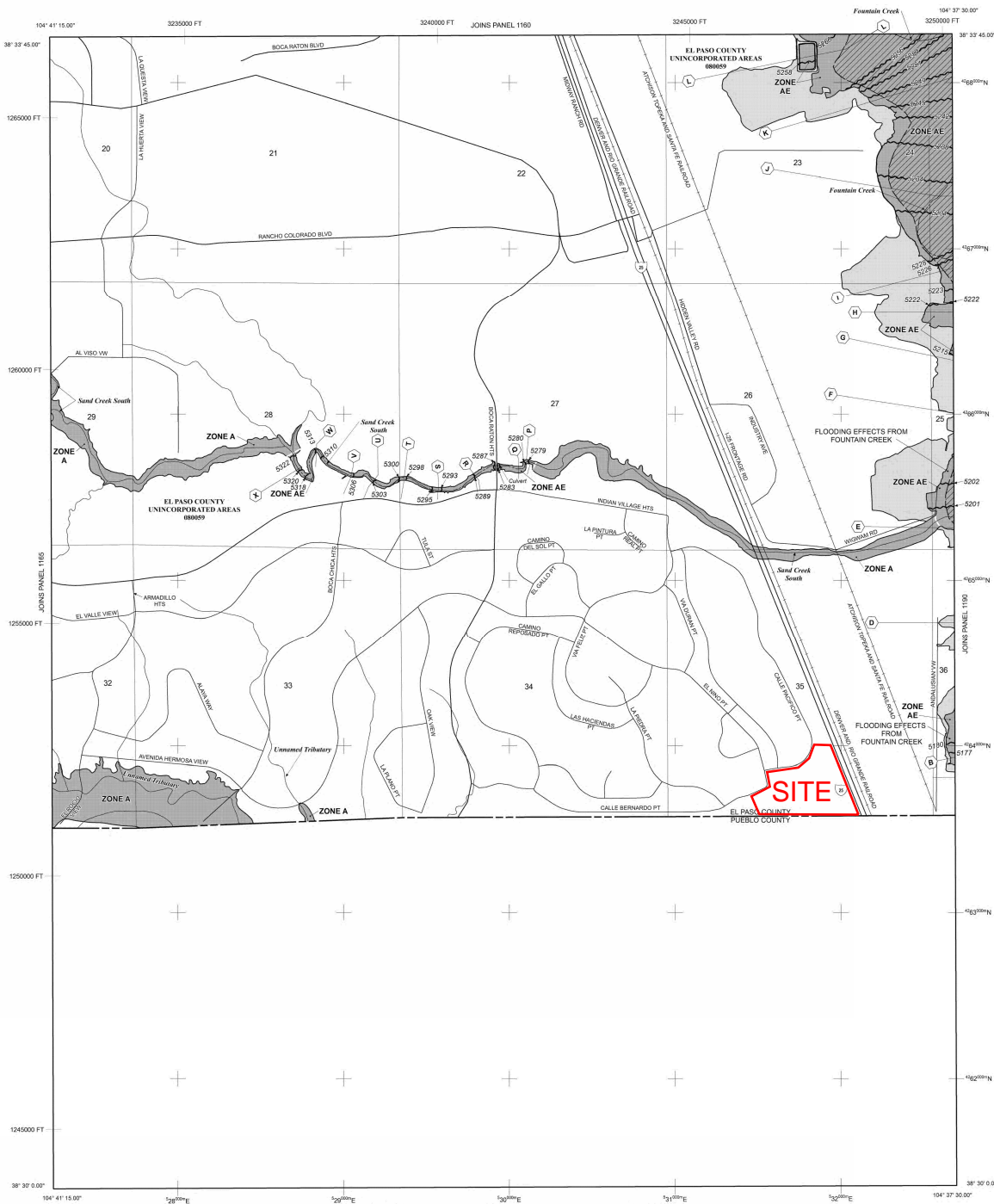
### Panel Location Map



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



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



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 17 SOUTH, RANGE 65 WEST.

## LEGEND

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

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

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

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

**OTHER FLOOD AREAS**

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

**OTHER AREAS**

**ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.

**ZONE D** Areas in which flood hazards are undetermined, but possible.

**COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS**

**OTHERWISE PROTECTED AREAS (OPAs)**

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

— Floodplain boundary

— Floodway boundary

— Zone D boundary

— CBRS and OPA boundary

— Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations; flood depths or flood velocities

— Base Flood Elevation line and value; elevation in feet\*

— Base Flood Elevation value where uniform within zone; elevation in feet\*

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

— Cross section line

— Transsect line

— Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)

— 1000-meter Universal Transverse Mercator grid ticks, zone 13

— 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (PROJCS 1983)

— Lambert Conformal Conic Projection

— Bench mark (See explanation in Notes to Users section of this FIRM legend)

— M1.5 River mile

— MAP REPOSITORIES

Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP

MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

DECEMBER 7, 2018: To update map to reflect the Community Map Change and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

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

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

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1170G

**FIRM**  
FLOOD INSURANCE RATE MAP  
EL PASO COUNTY,  
COLORADO  
AND INCORPORATED AREAS

PANEL 1170 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

COUNTY: EL PASO COUNTY

COMMUNITY: 08041C

PANEL: 1170

SUFFIX: G

MAP NUMBER  
08041C1170G

MAP REVISED  
DECEMBER 7, 2018

Federal Emergency Management Agency

## **HYDROLOGIC CALCULATIONS**

**MEISMAN PROPERTY**  
(Area Runoff Coefficient Summary)

**EXISTING CONDITIONS**

		<i>DEVELOPED</i>			<i>UNDEVELOPED</i>			<i>GRAVEL STREET</i>			<i>GRAVEL YARD</i>			<i>WEIGHTED</i>	
BASIN	TOTAL AREA	AREA	C <sub>5</sub>	C <sub>100</sub>	AREA	C <sub>5</sub>	C <sub>100</sub>	AREA	C <sub>5</sub>	C <sub>100</sub>	AREA	C <sub>5</sub>	C <sub>100</sub>	C <sub>5</sub>	C <sub>100</sub>
	(Acres)	(Acres)			(Acres)			(Acres)			(Acres)				
OS-Z	8.18	0.00	0.90	0.96	8.18	0.09	0.36	0.00	0.59	0.70	0.00	0.30	0.50	0.09	0.36
OS-Y	13.10	0.00	0.90	0.96	13.10	0.09	0.36	0.00	0.59	0.70	0.00	0.30	0.50	0.09	0.36
EX-A	10.70	0.00	0.90	0.96	10.70	0.09	0.36	0.00	0.59	0.70	0.00	0.30	0.50	0.09	0.36
EX-B	27.00	0.00	0.90	0.96	27.00	0.09	0.36	0.00	0.59	0.70	0.00	0.30	0.50	0.09	0.36
EX-C	1.16	0.00	0.90	0.96	1.16	0.09	0.36	0.00	0.59	0.70	0.00	0.30	0.50	0.09	0.36

**DEVELOPED CONDITIONS**

		<i>DEVELOPED</i>			<i>UNDEVELOPED</i>			<i>GRAVEL STREET</i>			<i>GRAVEL YARD</i>			<i>WEIGHTED</i>	
BASIN	TOTAL AREA	AREA	C <sub>5</sub>	C <sub>100</sub>	AREA	C <sub>5</sub>	C <sub>100</sub>	AREA	C <sub>5</sub>	C <sub>100</sub>	AREA	C <sub>5</sub>	C <sub>100</sub>	C <sub>5</sub>	C <sub>100</sub>
	(Acres)	(Acres)			(Acres)			(Acres)			(Acres)				
OS-Z	8.18	0.00	0.90	0.96	8.18	0.09	0.36	0.00	0.59	0.70	0.00	0.30	0.50	0.09	0.36
OS-Y	13.10	0.00	0.90	0.96	13.10	0.09	0.36	0.00	0.59	0.70	0.00	0.30	0.50	0.09	0.36
PR-3	10.70	0.00	0.90	0.96	10.06	0.09	0.36	0.00	0.59	0.70	0.64	0.30	0.50	0.10	0.37
PR-2	1.16	0.00	0.90	0.96	1.04	0.09	0.36	0.12	0.59	0.70	0.00	0.30	0.50	0.14	0.40
PR-1	27.00	0.65	0.90	0.96	25.13	0.09	0.36	0.71	0.59	0.70	0.51	0.30	0.50	0.13	0.39

Calculated by: JF

Date: #####

Checked by: LD

**MEISMAN PROPERTY  
AREA DRAINAGE SUMMARY**

**EXISTING CONDITIONS**

		WEIGHTED		OVERLAND				STREET / CHANNEL FLOW				$T_t$	INTENSITY		TOTAL FLOWS	
BASIN	AREA TOTAL (Acres)	$C_5$	$C_{100}$	$C_5$	Length (ft)	Height (ft)	$T_C$ (min)	Length (ft)	Slope (%)	Velocity (fps)	$T_t$ (min)	TOTAL (min)	$I_5$ (in/hr)	$I_{100}$ (in/hr)	$Q_5$ (c.f.s.)	$Q_{100}$ (c.f.s.)
		<i>* For Calcs See Runoff Summary</i>														
OS-Z	8.18	0.09	0.36	0.09	300	31.9	14.6	0	10.6%	1.6	0.0	14.6	3.5	6.0	2.6	17.6
OS-Y	13.10	0.09	0.36	0.09	300	24.8	15.8	0	8.3%	1.4	0.0	15.8	3.4	5.7	4.0	27.0
EX-A	10.70	0.09	0.36	0.09	300	13.7	19.3	0	4.6%	1.1	0.0	19.3	3.1	5.2	3.0	20.0
EX-B	27.00	0.09	0.36	0.09	300	11.6	20.4	0	3.9%	1.0	0.0	20.4	3.0	5.0	7.3	48.9
EX-C	1.16	0.09	0.36	0.09	300	16.4	18.2	0	5.5%	1.2	0.0	18.2	3.2	5.3	0.3	2.2

**DEVELOPED CONDITIONS**

		WEIGHTED		OVERLAND				STREET / CHANNEL FLOW				$T_t$	INTENSITY		TOTAL FLOWS	
BASIN	AREA TOTAL (Acres)	$C_5$	$C_{100}$	$C_5$	Length (ft)	Height (ft)	$T_C$ (min)	Length (ft)	Slope (%)	Velocity (fps)	$T_t$ (min)	TOTAL (min)	$I_5$ (in/hr)	$I_{100}$ (in/hr)	$Q_5$ (c.f.s.)	$Q_{100}$ (c.f.s.)
		<i>* For Calcs See Runoff Summary</i>														
OS-Z	8.18	0.09	0.36	0.09	300	31.9	14.6	0	10.6%	1.6	0.0	14.6	3.5	6.0	2.6	17.6
OS-Y	13.10	0.09	0.36	0.09	300	24.8	15.8	0	8.3%	1.4	0.0	15.8	3.4	5.7	4.0	27.0
PR-3	10.70	0.10	0.37	0.10	300	13.7	19.1	0	4.6%	1.1	0.0	19.1	3.1	5.2	3.4	20.6
PR-2	1.16	0.14	0.40	0.14	300	16.4	17.3	0	5.5%	1.2	0.0	17.3	3.3	5.5	0.5	2.5
PR-1	27.00	0.13	0.39	0.13	300	11.6	19.7	210	4.3%	1.0	3.5	23.2	2.8	4.7	9.7	48.9

Calculated by: JF

Date: 4/14/2022

Checked by: LD

# ***MEISMAN PROPERTY EXISTING SURFACE ROUTING SUMMARY***

<i>Design Point(s)</i>	<i>Contributing Basins</i>	<i>Area Ac</i>	<i>Flow</i>	
			<i>Q<sub>5</sub></i>	<i>Q<sub>100</sub></i>
<b>Z</b>	<b>OS-Z</b>	8.18	<b>2.6</b>	<b>17.6</b>
<b>Y</b>	<b>OS-Y</b>	13.10	<b>4.0</b>	<b>27.0</b>
<b>A</b>	<b>EX-A, OS-Y</b>	23.80	<b>7.0</b>	<b>47.0</b>
<b>B</b>	<b>EX-B, OS-Z</b>	35.18	<b>9.9</b>	<b>66.5</b>
<b>C</b>	<b>EX-C</b>	1.16	<b>0.3</b>	<b>2.2</b>

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

# ***MEISMAN PROPERTY PROPOSED SURFACE ROUTING SUMMARY***

<b><i>Design Point(s)</i></b>	<b><i>Contributing Basins</i></b>	<b><i>Area Ac</i></b>	<b><i>Flow</i></b>	
			<b><i>Q<sub>5</sub></i></b>	<b><i>Q<sub>100</sub></i></b>
<b><i>Design Point(s)</i></b>	<b><i>Contributing Basins</i></b>	<b><i>Area Ac</i></b>	<b><i>Flow</i></b>	
			<b><i>Q<sub>5</sub></i></b>	<b><i>Q<sub>100</sub></i></b>
<b>Z</b>	<b>OS-Z</b>	8.18	<b>2.6</b>	<b>17.6</b>
<b>Y</b>	<b>OS-Y</b>	13.10	<b>4.0</b>	<b>27.0</b>
<b>1</b>	<b>PR-1, OS-Z</b>	35.18	<b>12.3</b>	<b>66.5</b>
<b>2</b>	<b>PR-2</b>	1.16	<b>0.5</b>	<b>2.5</b>
<b>3</b>	<b>PR-3+OS-Y</b>	23.80	<b>7.4</b>	<b>47.6</b>

Calculated by: JF  
Date: 4/14/2022  
Checked by: LD

## **HYDRAULIC CALCULATIONS**

# MANNING'S EQUATION for OPEN CHANNEL FLOW

Project: Meisman Property

Location: Diversion Swale West of Shop Building (Capacity)

By: Dane Frank

Date: 1/25/2021

Chk By:

Date:

version 12-2004

Mannings Formula

$$Q = (1.486/n)AR_h^{2/3}S^{1/2}$$

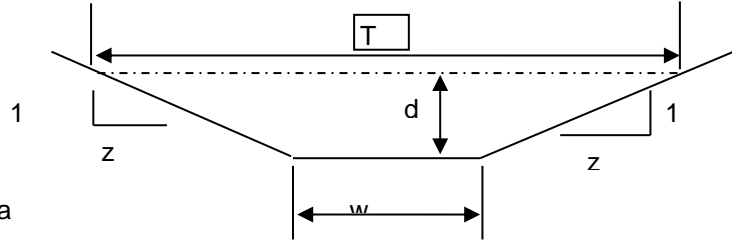
$$R = A/P$$

A = cross sectional area

P= wetted perimeter

S = slope of channel

n = Manning's roughness coefficient



$$V = (1.49/n)R_h^{2/3}S^{1/2}$$

$$Q = V \times A$$

INPUT

z (sideslope)= 4  
z (sideslope)= 4  
b (btm width, ft)= 4  
d (depth, ft)= 2  
S (slope, ft/ft) 0.05  
n low = 0.025  
n high = 0.035

Clear Data  
Entry Cells

		Low N		High N			
Depth, ft	Area, sf	Wetted Perimeter, ft	Hydraulic Radius, ft	Velocity, fps	Flow, cfs	Velocity, fps	Flow, cfs
2	24.00	20.49	1.17	14.7676498	354.424	10.54832	253.16
				T =		20	
				Dm =		1.200	
				Sc low =		0.0088	
				Sc high =		0.0173	
				.7 Sc		1.3 Sc	
				0.0062		0.0115	
				0.0121		0.0225	

s<sub>c</sub> = critical slope ft / ft

T = top width of the stream

d<sub>m</sub> = a/T = mean depth of flow

Created by: Mike O'Shea



# MANNING'S EQUATION for OPEN CHANNEL FLOW

Project: Meisman Property

Location: Diversion Swale West of House (Capacity)

By: Dane Frank

Date: 1/25/2021

Chk By:

Date:

version 12-2004

Mannings Formula

$$Q = (1.486/n)AR_h^{2/3}S^{1/2}$$

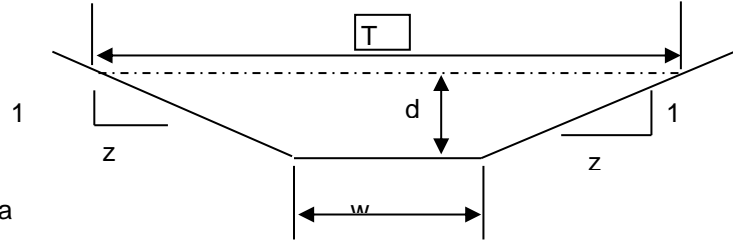
$$R = A/P$$

A = cross sectional area

P = wetted perimeter

S = slope of channel

n = Manning's roughness coefficient



$$V = (1.49/n)R_h^{2/3}S^{1/2}$$

$$Q = V \times A$$

INPUT

z (sideslope)= 8  
z (sideslope)= 8  
b (btm width, ft)= 4  
d (depth, ft)= 1  
S (slope, ft/ft) 0.02  
n low = 0.025  
n high = 0.035

Clear Data  
Entry Cells

				Low N		High N			
Depth, ft	Area, sf	Wetted Perimeter, ft	Hydraulic Radius, ft	Velocity, fps	Flow, cfs	Velocity, fps	Flow, cfs		
1	12.00	20.12	0.60	5.9551155	71.4614	4.253654	51.0438	T =	20
								Dm =	0.600
				Sc low =	0.0109	Sc high =	0.0213		
s <sub>c</sub> = critical slope ft / ft									
T = top width of the stream				.7 Sc	1.3 Sc	.7 Sc	1.3 Sc		
d <sub>m</sub> = a/T = mean depth of flow				0.0076	0.0141	0.0149	0.0277		

# Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 1

**Designer:** John Fornander  
**Company:** Terra Nova Engineering  
**Date:** April 14, 2022  
**Project:** Meisman Property  
**Location:** 21255 Calle Pacifico

## SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth 0.60 inches  
Depth of Average Runoff Producing Storm,  $d_6$  = 0.43 inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

Area Type	UIA:RPA	UIA:RPA	UIA:RPA	UIA:RPA								
Area ID	PR-1a	PR-1b	PR-1c	PR-3								
Downstream Design Point ID	1	1	1	3								
Downstream BMP Type	None	None	None	None								
DCIA (ft <sup>2</sup> )	--	--	--	--								
UIA (ft <sup>2</sup> )	37,000	33,000	32,000	26,000								
RPA (ft <sup>2</sup> )	37,000	33,000	32,000	26,000								
SPA (ft <sup>2</sup> )	--	--	--	--								
HSG A (%)	0%	0%	0%	100%								
HSG B (%)	100%	100%	100%	0%								
HSG C/D (%)	0%	0%	0%	0%								
Average Slope of RPA (ft/ft)	0.050	0.039	0.051	0.035								
UIA:RPA Interface Width (ft)	240.00	200.00	150.00	115.00								

## CALCULATED RUNOFF RESULTS

Area ID	PR-1a	PR-1b	PR-1c	PR-3								
UIA:RPA Area (ft <sup>2</sup> )	74,000	66,000	64,000	52,000								
L / W Ratio	1.28	1.65	2.84	3.93								
UIA / Area	0.5000	0.5000	0.5000	0.5000								
Runoff (in)	0.00	0.00	0.00	0.00								
Runoff (ft <sup>3</sup> )	0	0	0	0								
Runoff Reduction (ft <sup>3</sup> )	1542	1375	1333	1083								

## CALCULATED WQCV RESULTS

Area ID	PR-1a	PR-1b	PR-1c	PR-3								
WQCV (ft <sup>3</sup> )	1542	1375	1333	1083								
WQCV Reduction (ft <sup>3</sup> )	1542	1375	1333	1083								
WQCV Reduction (%)	100%	100%	100%	100%								
Untreated WQCV (ft <sup>3</sup> )	0	0	0	0								

## CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

Downstream Design Point ID	1	1	1	3								
DCIA (ft <sup>2</sup> )	0	0	0	0								
UIA (ft <sup>2</sup> )	102,000	102,000	102,000	26,000								
RPA (ft <sup>2</sup> )	102,000	102,000	102,000	26,000								
SPA (ft <sup>2</sup> )	0	0	0	0								
Total Area (ft <sup>2</sup> )	204,000	204,000	204,000	52,000								
Total Impervious Area (ft <sup>2</sup> )	102,000	102,000	102,000	26,000								
WQCV (ft <sup>3</sup> )	4,250	4,250	4,250	1,083								
WQCV Reduction (ft <sup>3</sup> )	4,250	4,250	4,250	1,083								
WQCV Reduction (%)	100%	100%	100%	100%								
Untreated WQCV (ft <sup>3</sup> )	0	0	0	0								

## CALCULATED SITE RESULTS (sums results from all columns in worksheet)

Total Area (ft <sup>2</sup> )	664,000
Total Impervious Area (ft <sup>2</sup> )	332,000
WQCV (ft <sup>3</sup> )	5,333
WQCV Reduction (ft <sup>3</sup> )	5,333
WQCV Reduction (%)	100%
Untreated WQCV (ft <sup>3</sup> )	0

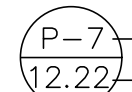
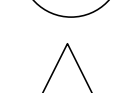
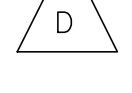

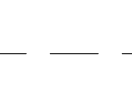
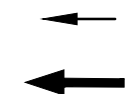
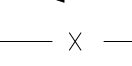


## **DRAINAGE MAPS**

MEISMAN PROPERTY  
EL PASO COUNTY  
EXISTING DRAINAGE MAP  
APRIL 2022

BASIN SUMMARY				
DESIGN POINT	BASIN	AREA (ACRES)	FLOW	
			5 YR (cfs)	100 YR (cfs)
Z	OS-Z	8.18	2.6	17.6
Y	OS-Y	13.1	4.0	27.0
A	EX-A	10.7	3.0	20.0
B	EX-B	27.0	7.3	48.9
C	EX-C	1.16	0.3	2.2

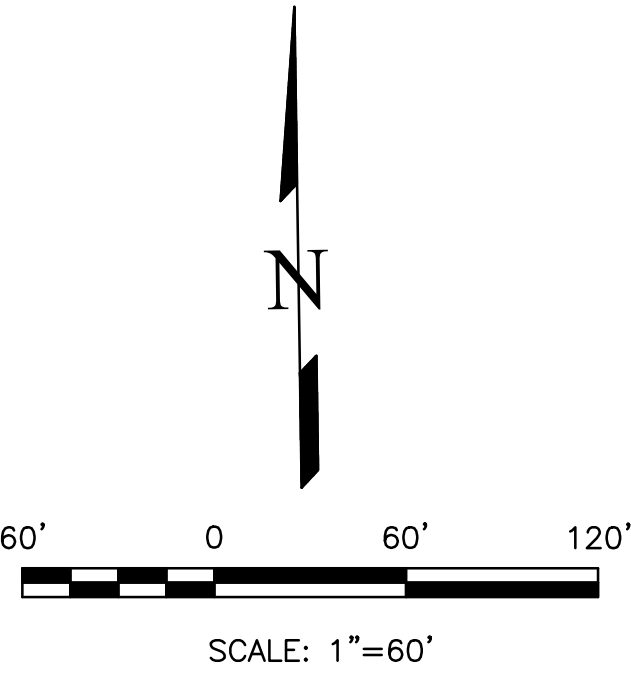
Design Point(s)	Contributing Basins	Area Ac	Flow	
			Q <sub>5</sub>	Q <sub>100</sub>
Z	OS-Z	8.18	2.6	17.6
Y	OS-Y	13.10	4.0	27.0
A	EX-A, OS-Y	23.80	7.0	47.0
B	EX-B, OS-Z	35.18	9.9	66.5
C	EX-C	1.16	0.3	2.2

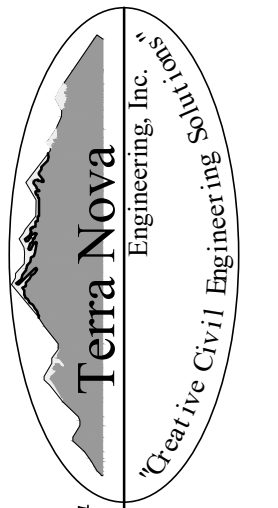
LEGEND

-  BASIN DESIGNATION  
 AREA IN BASIN (AC)
-  DESIGN POINT
-  BASIN BOUNDARY
-  EXISTING 1' CONTOUR
-  EXISTING 10' CONTOUR
-  GROUND SURFACE FLOW DIRECTION
-  ROAD AND DITCH FLOW DIRECTION
-  FENCE LINE

NOTES

1. ALL FEATURE SHOWN ARE EXISTING.
2. EXISTING VEGETATION ONSITE ARE GRASSES, SCRUB BRUSH, CACTUS, AND A COUPLE ISOLATED TREES NEAR THE EAST PROPERTY LINE.
3. THE OFFSITE BASINS ARE BASED ON USGS TOPO MAPS.



REVISIONS	NO.	DESCRIPTION	DATE
UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY THE APPROPRIATE REVIEWING AGENCIES, INC. APPROVES THEIR USE ONLY FOR THE PURPOSES DESIGNATED BY WRITTEN AUTHORIZATION.			
PREPARED FOR: <b>GARY MEISMAN</b> ATTN: 612 HARVARD ST COLORADO SPRINGS, CO 80911 719.492.0612			
 Terra Nova Engineering, Inc. Creative Civil Engineers Inc. 721 S. 23RD STREET COLORADO SPRINGS, CO 80904 OFFICE: 719-635-6422 FAX: 719-635-6426 www.terra-nova.com			
MEISMAN PROPERTY EXISTING DRAINAGE MAP			
DESIGNED BY DLF DRAWN BY DLF CHECKED BY LD H-SCALE AS SHOWN V-SCALE N/A JOB NO. 2071.00 DATE ISSUED 4/13/22 SHEET NO. 1 OF 4			



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BASIN SUMMARY				
DESIGN POINT	BASIN	AREA (ACRES)	FLOW	
			5 YR (cfs)	100 YR (cfs)
Z	OS-Z	8.18	2.6	17.6
Y	OS-Y	13.1	4.0	27.0
A	EX-A	10.7	3.0	20.0
B	EX-B	27.0	7.3	48.9
C	EX-C	1.16	0.3	2.2

Design Point(s)	Contributing Basins	Area Ac	Flow	
			Q <sub>5</sub>	Q <sub>100</sub>
Z	OS-Z	8.18	2.6	17.6
Y	OS-Y	13.10	4.0	27.0
A	EX-A, OS-Y	23.80	7.0	47.0
B	EX-B, OS-Z	35.18	9.9	66.5
C	EX-C	1.16	0.3	2.2

MEISMAN PROPERTY

EL PASO COUNTY

EXISTING OFFSITE DRAINAGE MAP

APRIL 2022

NOTES

1. ALL FEATURE SHOWN ARE EXISTING.
2. EXISTING VEGETATION ONSITE ARE GRASSES, SCRUB BRUSH, CACTUS, AND A COUPLE ISOLATED TREES NEAR THE EAST PROPERTY LINE.
3. THE OFFSITE BASINS ARE BASED ON USGS TOPO MAPS.

LEGEND

- P-7

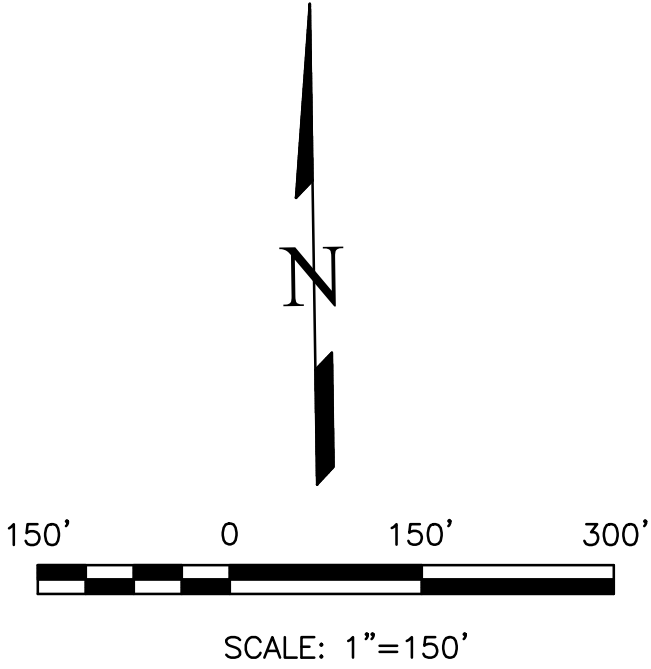
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BASIN DESIGNATION

AREA IN BASIN (AC)
- D

DESIGN POINT
- BASIN BOUNDARY
- EXISTING 1' CONTOUR
- EXISTING 10' CONTOUR
- GROUND SURFACE FLOW DIRECTION
- ROAD AND DITCH FLOW DIRECTION
- X

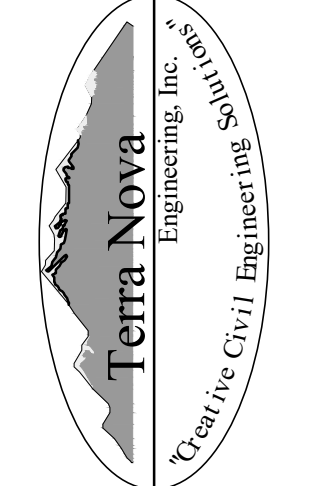
FENCE LINE



REVISIONS	NO.	DESCRIPTION	DATE

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PREPARED FOR:  
GARY MEISMAN  
ATTN:  
612 HARVARD ST  
COLORADO SPRINGS, CO 80911  
719.492.0612



721 S. 23RD STREET  
COLORADO SPRINGS, CO 80904  
OFFICE: 719-635-6422  
FAX: 719-635-6426  
www.tnec.com

MEISMAN PROPERTY	EXISTING OFFSITE DRAINAGE MAP
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DESIGNED BY DLF
DRAWN BY DLF
CHECKED BY LD
H-SCALE AS SHOWN
V-SCALE N/A
JOB NO. 2071.00
DATE ISSUED 4/13/22
SHEET NO. 2 OF 4



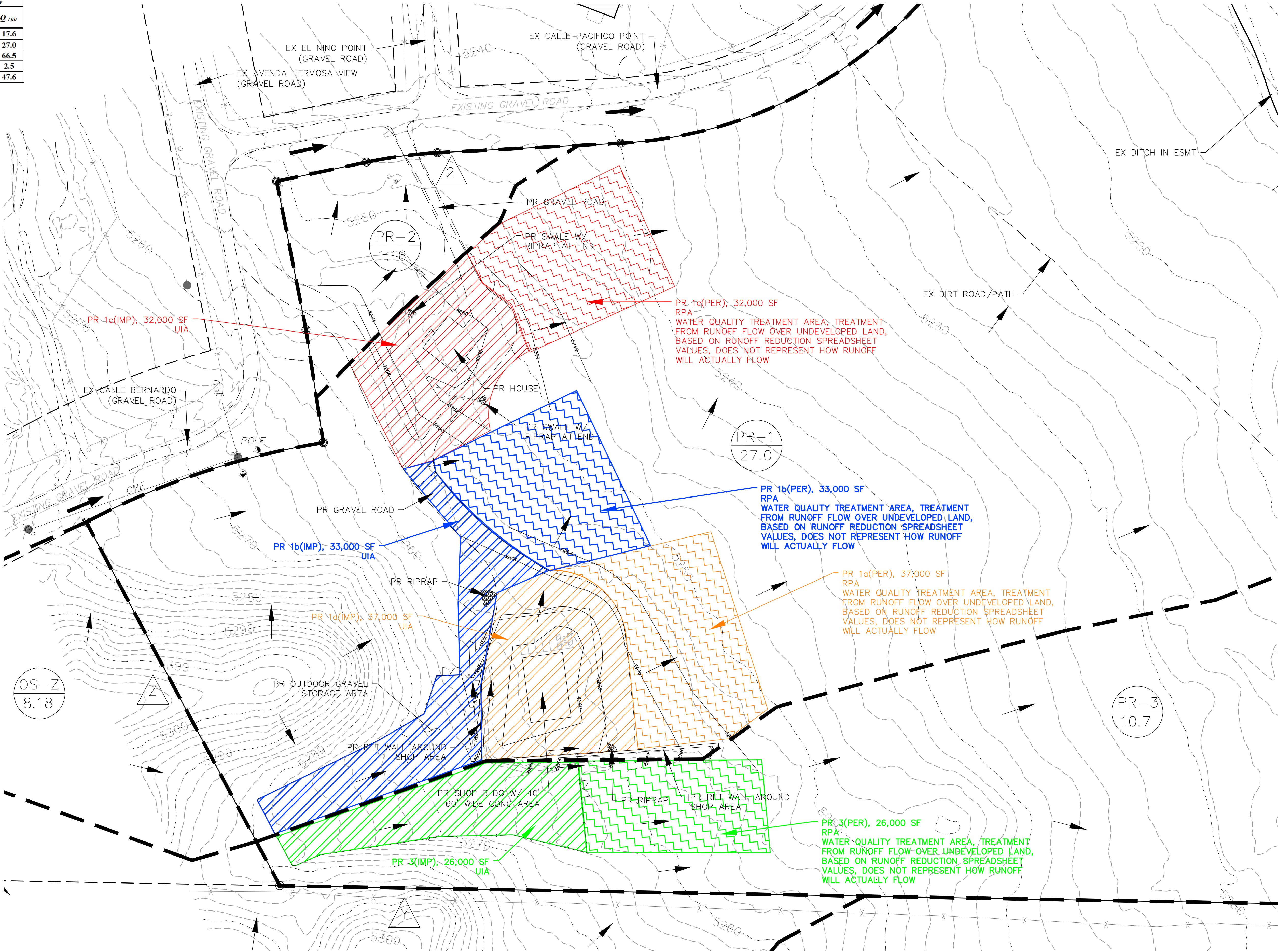
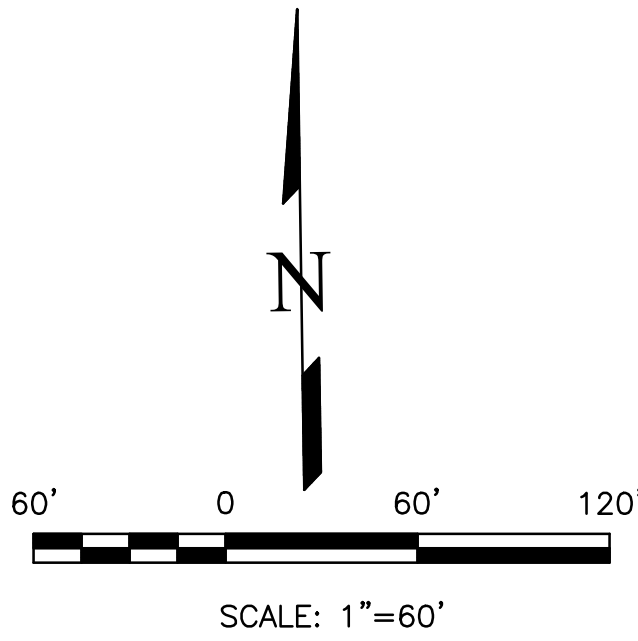
MEISMAN PROPERTY  
EL PASO COUNTY  
PROPOSED DRAINAGE MAP  
APRIL 2022

NOTES  
1. LANDSCAPING / UNDEVELOPED LAND IS BEING USED FOR WATER QUALITY TREATMENT. IF FUTURE DEVELOPMENT AFFECTS THESE AREAS, WATER QUALITY TREATMENT OF THE IMPERVIOUS AREAS PROPOSED HERE MAY NEED TO BE REVISITED.

BASIN SUMMARY					
DESIGN POINT	BASIN	AREA (ACRES)	FLOW		
			5 YR (cfs)	100 YR (cfs)	
Z	OS-Z	8.18	2.6	17.6	
Y	OS-Y	13.1	4.0	27.0	
3	PR-3	10.7	3.4	20.6	
2	PR-2	1.16	0.5	2.5	
1	PR-1	27.0	9.7	48.9	

Design Point(s)	Contributing Basins	Area Ac	Flow		
			Q <sub>5</sub>	Q <sub>100</sub>	
Z	OS-Z	8.18	2.6	17.6	
Y	OS-Y	13.10	4.0	27.0	
1	PR-1, OS-Z	35.18	12.3	66.5	
2	PR-2	1.16	0.5	2.5	
3	PR-3+OS-Y	23.80	7.4	47.6	

- LEGEND
- P-7 12.22 BASIN DESIGNATION AREA IN BASIN (AC)
  - D DESIGN POINT
  - BASIN BOUNDARY
  - EXISTING 1' CONTOUR
  - EXISTING 10' CONTOUR
  - GROUND SURFACE FLOW DIRECTION
  - ROAD AND DITCH FLOW DIRECTION
  - FENCE LINE



REVISIONS

NO.	DESCRIPTION	DATE

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www.terra-nova.com

MEISMAN PROPERTY

PROPOSED DRAINAGE MAP

DESIGNED BY DLF  
DRAWN BY DLF  
CHECKED BY LD

H-SCALE AS SHOWN  
V-SCALE N/A  
JOB NO. 2071.00  
DATE ISSUED 4/13/22  
SHEET NO. 3 OF 4

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BASIN SUMMARY				
DESIGN POINT	BASIN	AREA (ACRES)	FLOW	
			5 YR (cfs)	100 YR (cfs)
Z	OS-Z	8.18	2.6	17.6
Y	OS-Y	13.1	4.0	27.0
3	PR-3	10.7	3.4	20.6
2	PR-2	1.16	0.5	2.5
1	PR-1	27.0	9.7	48.9

Design Point(s)	Contributing Basins	Area Ac	Flow	
			Q <sub>5</sub>	Q <sub>100</sub>
Z	OS-Z	8.18	2.6	17.6
Y	OS-Y	13.10	4.0	27.0
1	PR-1, OS-Z	35.18	12.3	66.5
2	PR-2	1.16	0.5	2.5
3	PR-3+OS-Y	23.80	7.4	47.6

# MEISMAN PROPERTY

## EL PASO COUNTY


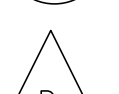



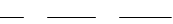



# PROPOSED OFFSITE DRAINAGE MAP

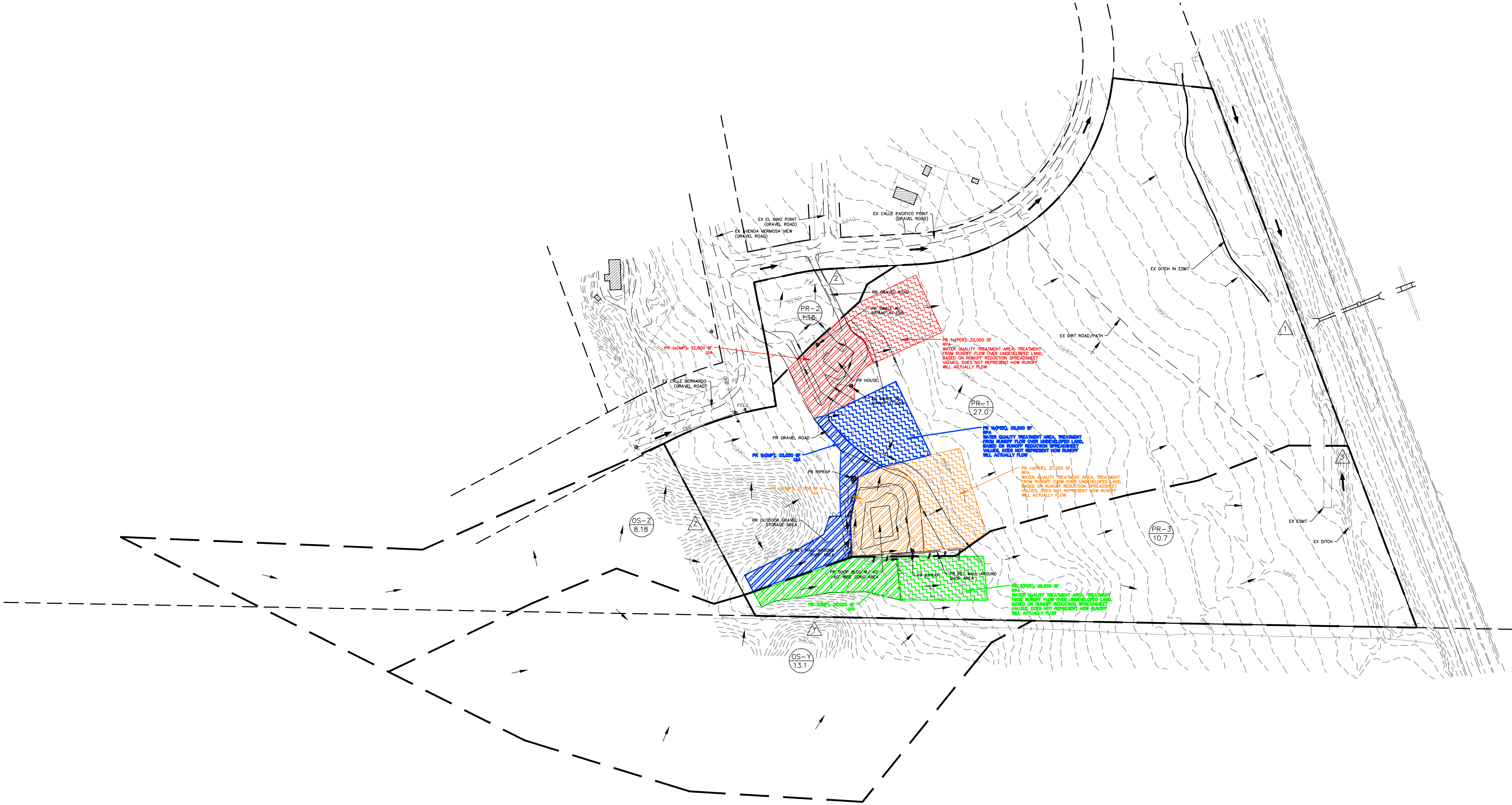
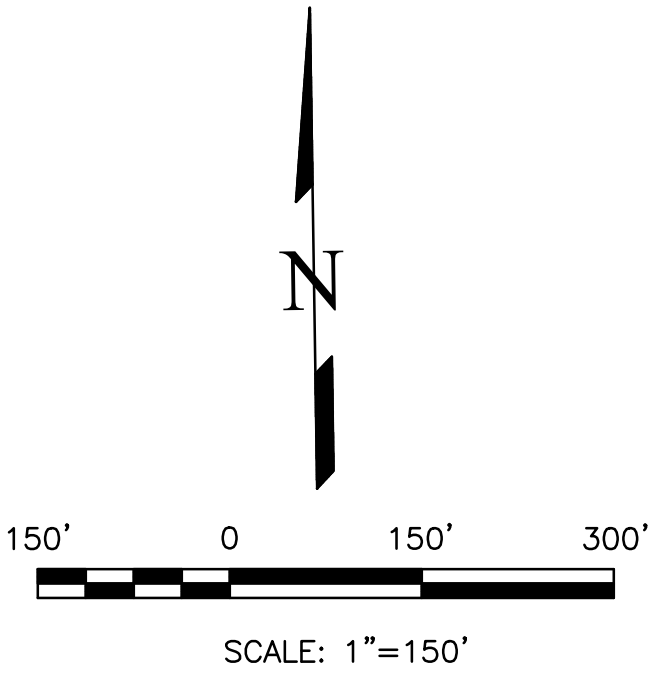
## APRIL 2022

### NOTES

1. THE OFFSITE BASINS ARE BASED ON USGS TOPO MAPS.

### LEGEND

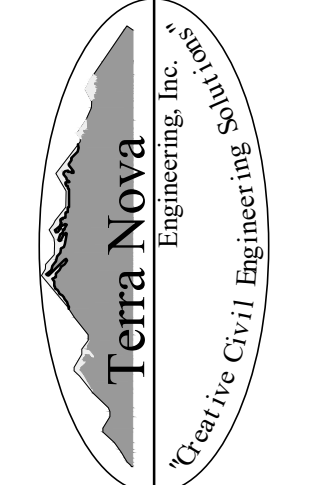
-  BASIN DESIGNATION
-  AREA IN BASIN (AC)
-  DESIGN POINT
-  BASIN BOUNDARY
-  EXISTING 1' CONTOUR
-  EXISTING 10' CONTOUR
-  GROUND SURFACE FLOW DIRECTION
-  ROAD AND DITCH FLOW DIRECTION
-  FENCE LINE



REVISIONS	NO.	DESCRIPTION	DATE

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MEISMAN PROPERTY	PROPOSED OFFSITE DRAINAGE MAP
------------------	-------------------------------

DESIGNED BY DLF
DRAWN BY DLF
CHECKED BY LD
H-SCALE AS SHOWN
V-SCALE N/A
JOB NO. 2071.00
DATE ISSUED 4/13/22
SHEET NO. 4 OF 4