

**FINAL DRAINAGE REPORT FOR
HUNSINGER SUBDIVISION
LOT 10, VAC W 20.0 FT OF OTERO AVE ADJ, BLK B CPRING CREST
AMD FIL - LOT K, VAC W 20.0 FT OF OTERO AVE ADJ, BLK B SPRING
CREST FIL NO 2 – LOT L, VAC W 20.0 FT OF OTERO AVE ADJ, BLK B
SPRING CREST FIL 2
10140 OTERO AVENUE
COLORADO SPRINGS, COLORADO**

MAY 2019

Prepared For:
HUNSINGER DEVELOPMENT CORPORATION
Attn: Steve Hunsinger
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Prepared By:
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Job No. 1609.00

PCD File No. VR-18-014

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COLORADO SPRINGS, COLORADO**

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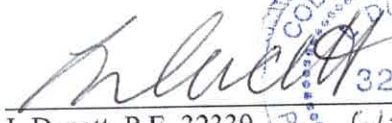
DRAINAGE MAPS

**FINAL DRAINAGE REPORT FOR
HUNSINGER SUBDIVISION**

LOT 10, VAC W 20.0 FT OF OTERO AVE ADJ, BLK B CPRING CREST AMD FIL - LOT K, VAC W 20.0
FT OF OTERO AVE ADJ, BLK B SPRING CREST FIL NO 2 - LOT L, VAC W 20.0 FT OF OTERO AVE
ADJ, BLK B SPRING CREST FIL 2
10140 OTERO AVENUE
COLORADO SPRINGS, COLORADO

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.

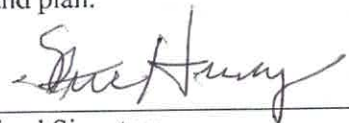


L Ducett, P.E. 32339


6/18/19
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

6/18/19
Date

Steve Hunsinger, Trustee
Printed Name, Title

Hunsinger Development Corporation, Inc Trust
Business Name

4406 College Park Ct CS, CO 80918
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

Conditions:

Approved

by Elizabeth Nijkamp
El Paso County Planning and Community Development
on behalf of Jennifer Irvine, County Engineer, ECM Administrator



10/03/2019 5:18:05 PM

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PURPOSE AND JUSTIFICATION

The purpose of this Final Drainage Report is to identify and analyze the existing drainage patterns, determine existing runoff quantities, and analyze the current development of this site as a residential subdivision. These lots have previously been platted and have not been part of previous drainage studies.

GENERAL DESCRIPTION

This Final Drainage Report for “HUNSINGER SUBDIVISION”, located at 10140 Otero Road, is an analysis of an approximately 697,800 sf (16.02 ac) basin. The site is platted as LOT 10, VAC W 20.0 FT OF OTERO AVE ADJ, BLK B CPRING CREST AMD FIL - LOT K, VAC W 20.0 FT OF OTERO AVE ADJ, BLK B SPRING CREST FIL NO 2 – LOT L, VAC W 20.0 FT OF OTERO AVE ADJ, BLK B SPRING CREST FIL 2; with Lot 10 currently in use as a residence, and Lot K and Lot L currently being grazing/pasture land. The proposed development is a subdivision into five residential lots.

The site is in the northwest quarter of Section 28, Township 12 South, Range 66 West of the 6th Principal Meridian within El Paso County. The parcels are bounded to the north by Old Ranch Road, to the east and south by Otero Avenue, and to the west by Lot 9 & E 153.00 ft of Lot 8 Blk B Spring Crest AMD Fil and Lot M, Vac W 20.0 ft of Otero Ave, Blk B Spring Crest Fil 2. (See vicinity map, Appendix A).

The site lies within the Kettle Creek Basin, with storm runoff draining into Kettle Creek at the southwest corner of the subdivision.

The site consists of 52% Columbine gravelly sandy loam (hydrologic group “A”) and 48% Stapleton-Bernal sandy loams (hydrologic group “B”) per the USDA, NRCS web soil survey. The

hydrologic group “A” was used to represent the soil types and determine the onsite basin overland flow. (See map in appendix)

The study area consists of mostly undeveloped land, which currently includes a residence and grazing/pasture land, with mostly grass and dirt surfaces. The southwest corner of the study area is wooded, with a smaller number of trees scattered about the remainder of the study area. Approximately 1% of the study area is currently impervious (from roofs) and none of the study area is currently paved. The site currently drains toward the southwest, with an average slope of 12%.

EXISTING DRAINAGE CONDITIONS

There are seven existing structures, and Kettle Creek, in the southwest corner of the site. There is an existing drainage channel on the east and south sides of the site along Otero Avenue that drains into Kettle Creek on the site. There are two pond areas on the site, and two culverts along Otero Avenue for drive access’ for the existing structures.

There are two offsite basins along the north side of the site where Old Ranch Road drains onto the site (as sheet flow). Offsite basin OS-1 is 0.37 acres and drains to Design Point Z. Offsite basin OS-1 has flows of $Q_5 = 1.2$ cfs and $Q_{100} = 2.7$ cfs. These flows are based on approximately 50% of the basin being impervious (half is paved and half is native grasses). See attached Existing Drainage Map (in appendix).

Offsite basin OS-2 is 0.17 acres and drains to Design Point Y. Offsite basin OS-2 has flows of $Q_5 = 0.4$ cfs and $Q_{100} = 1.2$ cfs. These flows are based on approximately 50% of the basin being impervious (half is paved and half is native grasses). See attached Existing Drainage Map (in appendix).

The site has one existing drainage basin (EX-A) which is 16.02 acres and drains to Design Point A. Drainage basin EX-A has flows of $Q_5 = 4.7$ cfs and $Q_{100} = 34.3$ cfs. These flows are based on approximately 1% of the basin being impervious. See attached Existing Drainage Map (in appendix). Some of the current drainage flows directly into Kettle Creek and some flows into a

drainage channel along Otero Avenue before flowing into Kettle Creek. All of the drainage enters Kettle Creek onsite.

PROPOSED DRAINAGE CONDITIONS

In the proposed condition the drainage pattern for the site will remain essentially unchanged. No significant grading is proposed as part of this subdivision. The impervious area for the site has been set at 11% at the direction of El Paso County. Drainage will continue to flow into Kettle Creek on the southwest corner of the site.

There are two offsite basins along the north side of the site where Old Ranch Road drains onto the site (as sheet flow). Offsite basin OS-1 is 0.37 acres and drains to Design Point Z. Offsite basin OS-1 has flows of $Q_5 = 1.2$ cfs and $Q_{100} = 2.7$ cfs. These flows are based on approximately 50% of the basin being impervious (half is paved and half is native grasses). See attached Existing Drainage Map (in appendix).

Offsite basin OS-2 is 0.17 acres and drains to Design Point Y. Offsite basin OS-2 has flows of $Q_5 = 0.4$ cfs and $Q_{100} = 1.2$ cfs. These flows are based on approximately 50% of the basin being impervious (half is paved and half is native grasses). See attached Existing Drainage Map (in appendix).

Basin PR-1 (16.02 acres) covers the entire site and includes roof area, gravel surfaces, and dirt/grass surfaces that sheet and channel flows to the southwest corner of the basin and Design Point 1, where Kettle Creek leaves the site. Basin PR-1 flow is 9.4 cfs for the 5 year event and 41.5 cfs for the 100 year event. These flows are based on 11% of the basin being impervious.

Flows within basin PR-1 will include only surface routing (no pipe routing). Surface routing includes sheet flow and channel flow directly into Kettle Creek and sheet flow into a channel along Otero Avenue before the channel flows into Kettle Creek on the southwest corner of the site.

The two existing pond areas onsite will be filled in or breached as part of this development.

Please see detailed calculations in the appendix.

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 (note: this is not an urban site):

1. Reduce Runoff- The proposed lots will be rural residential on 2.5 acre lots. The percent impervious has been set at 11% and was previously estimated to be lower than that. The vast majority of the site is expected to remain in a primarily natural condition (lots of native grasses with some bushes and trees). Due to this the impervious areas of the site will be scatters around the site and will likely all be surrounded by natural/pervious areas.
2. Stabilize Drainageways- The only existing or proposed drainage channel onsite is the Sand Creek channel, which is on a portion of the site that has already been developed (existing residence). There are no drainage channels in the to be developed area of the site to be stabilized.
3. Provide Water Quality Capture Volume (WQCV)- Water quality is not required for this site due to the disturbed area being less than one acre and this development being low density (rural) housing (2.5 acre or larger lots), per ECM Appendix I.7.1.B.
4. Consider Need for Industrial and Commercial BMPs- As this is a residential development, industrial and commercial BMPs do not apply.

HYDROLOGIC CALCULATIONS

Hydrologic calculations were performed using the City of Colorado Springs Storm Drainage Design Criteria Manual Volumes 1 & 2 May 2014. The Rational Method was used to estimate storm water runoff anticipated from design storms with 5-year and 100-year recurrence intervals.

HYDRAULIC CALCULATIONS

Not applicable.

WATER QUALITY

As the disturbed area included in this subdivision (from proposed building pads and 20' wide drive access ways) is less than one acre, no water quality treatment is required. Additionally, the percent impervious set for the subdivision is only 11%.

Flood control detention is not proposed as part of this development per the Drainage Basin Planning Study For Kettle Creek Basin not requiring flood control on this site, and this development being for low density residential and the disturbed area being less than one acre. The existing 100 year event flow for the site is $Q_{100} = 34.3$ cfs and the proposed flow is $Q_{100} = 41.5$ cfs, with a change in flow of $Q_{100\Delta} = 7.2$ cfs for the entire 16 acres site (or an additional 0.45 cfs of runoff per acre). Per the Drainage Basin Planning Study For Kettle Creek Basin, the existing 100 year event flow in Kettle Creek (as of 2015) at Design Point 1 is approximately 4,114 cfs (from Junction 24 in the DBPS). The increase in onsite runoff results in a 0.2% increase in Kettle Creek flow for the 100 year event. This change in runoff is considered negligible and therefore, does not warrant onsite flood control detention.

FLOODPLAIN STATEMENT

Approximately 0.43 ac of the southwest corner of the site is within the designated F.E.M.A. 100 year flood plain of Kettle Creek per Flood Insurance Rate Map No. 08041C0506 F dated March 17, 1997 (see appendix and drainage maps). The 100 year flood elevation is shown as 6,631 feet on the site.

No changes to the lot lines in or adjacent to this flood plain are proposed as part of this subdivision. Additionally, no new structures are proposed in the proposed lot that includes this flood plain.

EROSION CONTROL

As no significant grading is proposed as part of this subdivision, no erosion control measures have been included.

CONSTRUCTION COST OPINION

Not applicable.

DRAINAGE FEES

The existing site is in the Kettle Creek Basin (# FOMO3000). 2018 drainage fees due prior to final plat recordation for the Hunsinger Subdivision are as follows:

DRAINAGE FEES: 16 ac x 11% imp = 1.76 imp ac

1.76 imp ac x 0.75 x \$9,287 per imp ac = \$ 12,259

TOTAL \$ 12,259

There are no associated bridge fees in the Kettle Creek Basin.

MAINTENANCE

Not applicable.

SUMMARY

Subdivision of this site will not adversely affect the surrounding development. In the proposed condition the drainage pattern for the site will remain essentially unchanged. No significant grading is proposed as part of this subdivision. Water quality is not required due to the disturbed area included in this subdivision being less than 1 acre.

PREPARED BY:

TERRA NOVA ENGINEERING, INC.

Luanne Ducett, P.E.
President

BIBLIOGRAPHY

“City of Colorado Springs Drainage Criteria Manual Volumes 1 & 2, May 2014

“NRCS Soil Map for El Paso County Area, Colorado

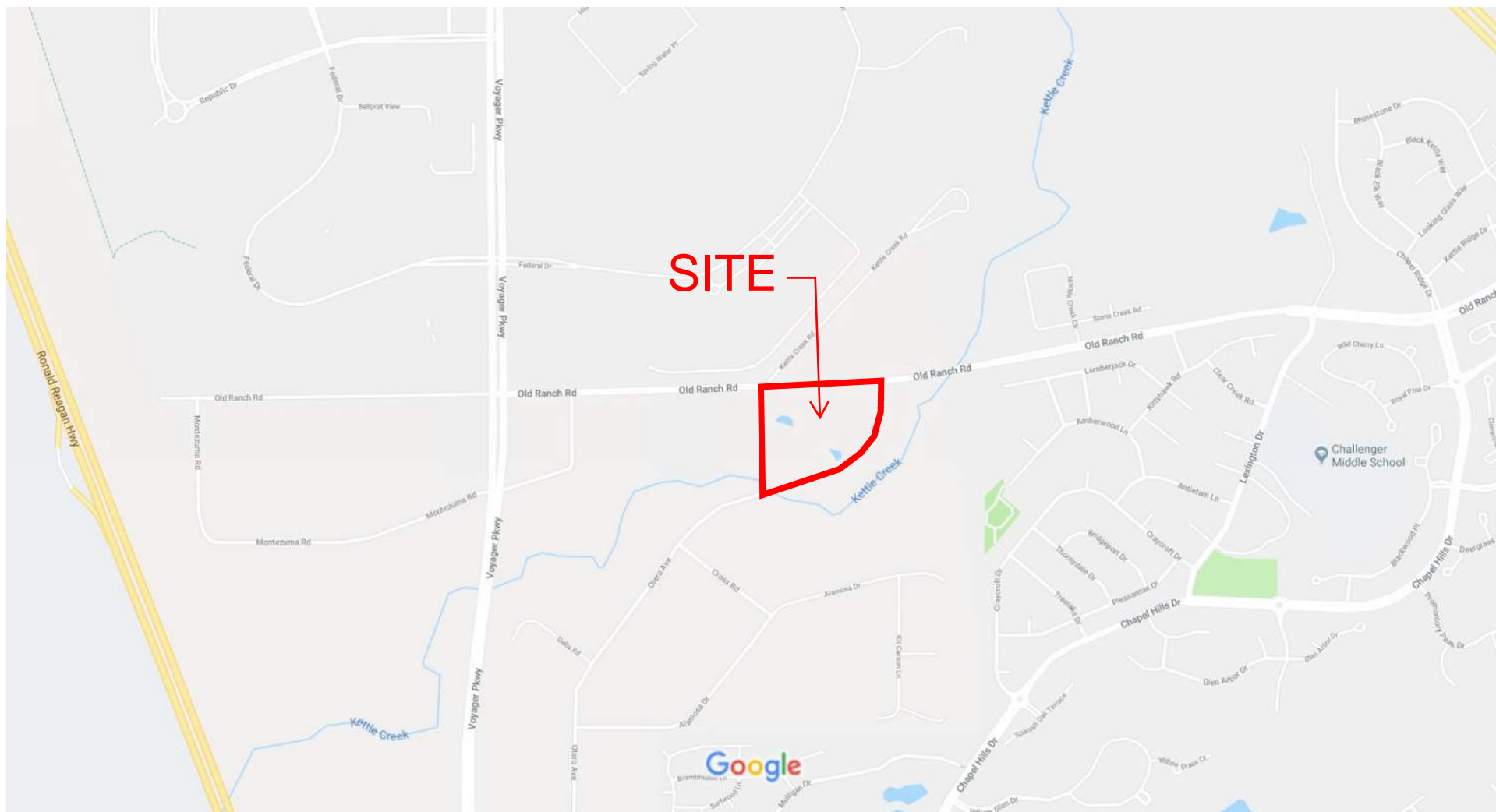
“F.E.M.A. Flood Insurance Rate Map No. 08041C0506 F dated March 17, 1997

“Drainage Basin Planning Study For Kettle Creek Basin, May 5, 2015

VICINITY MAP

Hunsinger Subdivision Vicinity Map

Google Maps



Map data ©2018 Google 500 ft



GENERAL LOCATION MAP

Hunsinger Subdivision

Location Map

SITE

Old Ranch Rd

Otero Ave

Google Earth

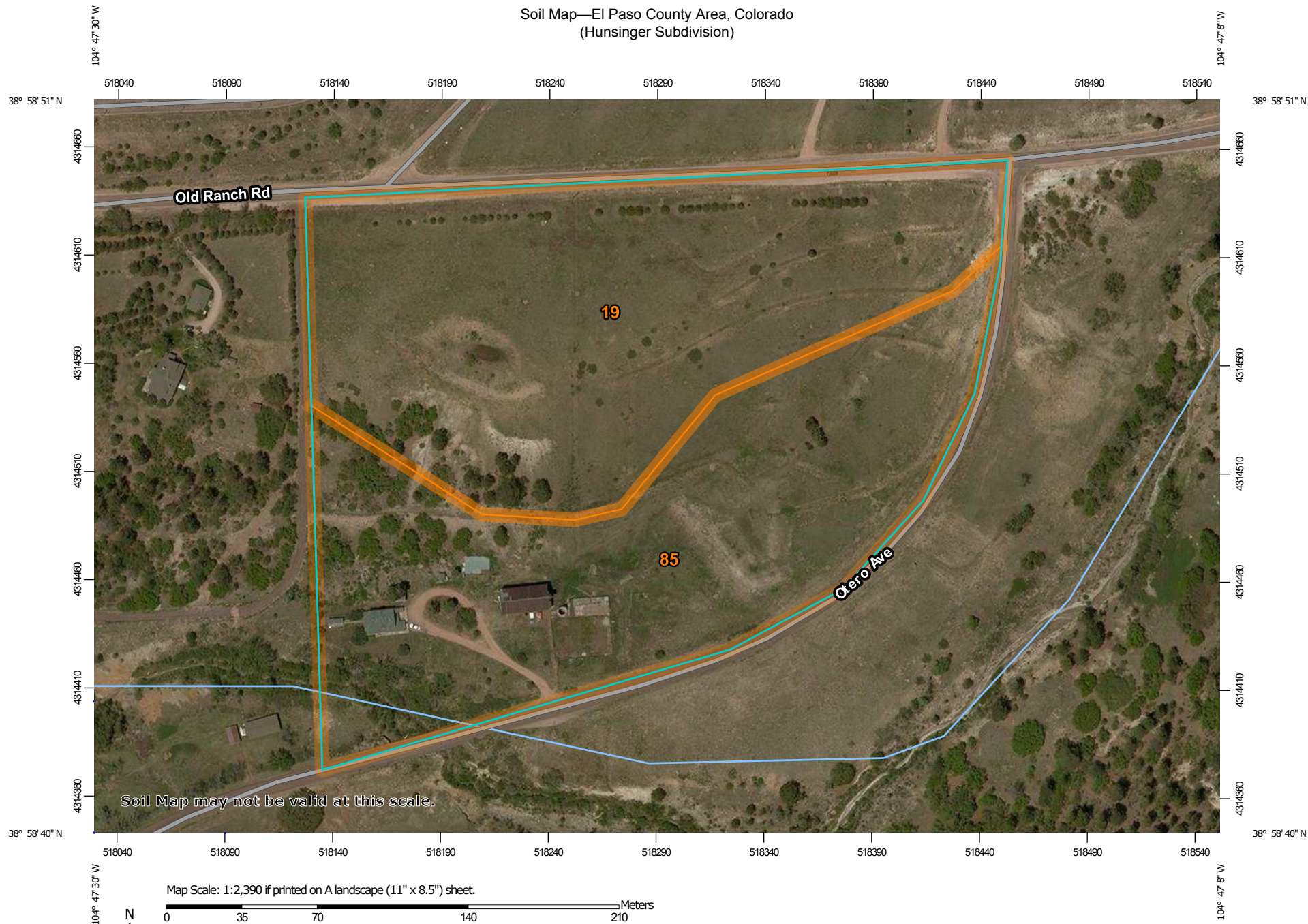
© 2018 Google



600 ft

NRCS SOIL MAP

Soil Map—El Paso County Area, Colorado (Hunsinger Subdivision)



Soil Map may not be valid at this scale.

Map Scale: 1:2,390 if printed on A landscape (11" x 8.5") sheet.

0 35 70 140 210 Meters

0 100 200 400 600 Feet

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



**Natural Resources
Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

5/23/2018
Page 1 of 3

Soil Map—El Paso County Area, Colorado
(Hunsinger Subdivision)

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 15, Oct 10, 2017

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

Date(s) aerial images were photographed: Jun 3, 2014—Jun 17, 2014

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
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	8.8	51.7%
85	Stapleton-Bernal sandy loams, 3 to 20 percent slopes	8.2	48.3%
Totals for Area of Interest		16.9	100.0%

El Paso County Area, Colorado

19—Columbine gravelly sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 367p

Elevation: 6,500 to 7,300 feet

Mean annual precipitation: 14 to 16 inches

Mean annual air temperature: 46 to 50 degrees F

Frost-free period: 125 to 145 days

Farmland classification: Not prime farmland

Map Unit Composition

Columbine and similar soils: 85 percent

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

Description of Columbine

Setting

Landform: Fan terraces, fans, flood plains

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Alluvium

Typical profile

A - 0 to 14 inches: gravelly sandy loam

C - 14 to 60 inches: very gravelly loamy sand

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Well drained

Runoff class: Very low

Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: A

Ecological site: Gravelly Foothill (R049BY214CO)

Hydric soil rating: No

Minor Components

Fluvaquentic haplaquolls

Percent of map unit:

Landform: Swales

Hydric soil rating: Yes

Other soils

Percent of map unit:

Hydric soil rating: No

Pleasant

Percent of map unit:

Landform: Depressions

Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado

Survey Area Data: Version 15, Oct 10, 2017

El Paso County Area, Colorado

85—Stapleton-Bernal sandy loams, 3 to 20 percent slopes

Map Unit Setting

National map unit symbol: 36b1

Elevation: 6,500 to 6,800 feet

Mean annual precipitation: 14 to 16 inches

Mean annual air temperature: 46 to 48 degrees F

Frost-free period: 125 to 145 days

Farmland classification: Not prime farmland

Map Unit Composition

Stapleton and similar soils: 40 percent

Bernal and similar soils: 30 percent

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

Description of Stapleton

Setting

Landform: Hills

Landform position (three-dimensional): Crest, side slope

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Sandy alluvium derived from arkose

Typical profile

A - 0 to 11 inches: sandy loam

Bw - 11 to 17 inches: gravelly sandy loam

C - 17 to 60 inches: gravelly loamy sand

Properties and qualities

Slope: 3 to 15 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Well drained

Runoff class: Low

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

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: B

Ecological site: Gravelly Foothill (R049BY214CO)

Hydric soil rating: No

Description of Bernal

Setting

Landform: Hills

Landform position (three-dimensional): Crest, side slope

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Residuum weathered from sandstone

Typical profile

A - 0 to 4 inches: sandy loam

Bt - 4 to 11 inches: sandy clay loam

C - 11 to 13 inches: sandy loam

R - 13 to 17 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 20 percent

Depth to restrictive feature: 8 to 20 inches to lithic bedrock

Natural 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

Available water storage in profile: Very low (about 1.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: D

Ecological site: Shallow Foothill (R049BY204CO)

Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:

Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado

Survey Area Data: Version 15, Oct 10, 2017

FEMA FIRM MAP

HYDROLOGIC CALCULATIONS

HUNSINGER SUBDIVISION
AREA RUNOFF COEFFICIENT (C) SUMMARY

EXISTING

		<i>DEVELOPED</i>			<i>UNDEVELOPED</i>			<i>WEIGHTED</i>		<i>WEIGHTED CA</i>	
BASIN	TOTAL AREA	AREA	C5	C100	AREA	C5	C100	C5	C100	CA5	CA100
	(Acres)	(Acres)			(Acres)						
<i>OS-1</i>	0.37	0.37	0.55	0.65	0.00	0.08	0.35	0.55	0.65	0.20	0.24
<i>OS-2</i>	0.17	0.17	0.55	0.65	0.00	0.08	0.35	0.55	0.65	0.09	0.11
<i>EX-A</i>	16.02	3.00	0.09	0.36	13.02	0.08	0.35	0.08	0.35	1.31	5.64

DEVELOPED

		<i>DEVELOPED</i>			<i>UNDEVELOPED</i>			<i>WEIGHTED</i>		<i>WEIGHTED CA</i>	
BASIN	TOTAL AREA	AREA	C5	C100	AREA	C5	C100	C5	C100	CA5	CA100
	(Acres)	(Acres)			(Acres)						
<i>OS-1</i>	0.37	0.37	0.55	0.65	0.00	0.08	0.35	0.55	0.65	0.20	0.24
<i>OS-2</i>	0.17	0.17	0.55	0.65	0.00	0.08	0.35	0.55	0.65	0.09	0.11
<i>PR-1</i>	16.02	16.02	0.16	0.41	0.00	0.08	0.35	0.16	0.41	2.56	6.57

Calculated by: DLF

Date: 10/18/2018

Checked by: _____

HUNSINGER SUBDIVISION RUNOFF SUMMARY

EXISTING

		WEIGHTED		OVERLAND				STREET / CHANNEL FLOW				T _c	INTENSITY		TOTAL FLOWS	
BASIN	AREA TOTAL (Acres)	C ₅	C ₁₀₀	C ₅	Length (ft)	Slope (ft/ft)	T _i (min)	Length (ft)	Slope (%)	Velocity (fps)	T _i (min)	TOTAL (min)	I ₅ (in/hr)	I ₁₀₀ (in/hr)	Q ₅ (c.f.s.)	Q ₁₀₀ (c.f.s.)
		* For Calcs See Runoff Summary														
OS-1	0.37	0.55	0.65	0.55	25	0.12	2.2	0	12.0%	0.7	0.0	2.2	5.9	11.0	1.2	2.7
OS-2	0.17	0.55	0.65	0.55	75	0.03	5.9	0	12.0%	0.7	0.0	5.9	4.8	8.6	0.4	1.0
EX-A	16.02	0.08	0.35	0.08	300	0.12	14.0	0	12.0%	0.7	0.0	14.0	3.6	6.1	4.7	34.3

DEVELOPED

		WEIGHTED		OVERLAND				STREET / CHANNEL FLOW				T _C	INTENSITY		TOTAL FLOWS	
BASIN	AREA TOTAL (Acres)	C ₅	C ₁₀₀	C ₅	Length (ft)	Slope (ft/ft)	T _t (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.)
		* For Calcs See Runoff Summary														
OS-1	0.37	0.55	0.65	0.55	25	0.12	2.2	0	12.0%	0.7	0.0	2.2	5.9	11.0	1.2	2.7
OS-2	0.17	0.55	0.65	0.55	75	0.03	5.9	0	12.0%	0.7	0.0	5.9	4.8	8.6	0.4	1.0
PR-1	16.02	0.16	0.41	0.16	300	0.12	13.0	0	12.0%	0.7	0.0	13.0	3.7	6.3	9.4	41.5

Calculated by: DLF

Date: 10/18/2018

Checked by: _____

HUNSINGER SUBDIVISION SURFACE ROUTING SUMMARY

<i>Design Point(s)</i>	<i>Contributing Basins</i>	<i>Flow</i>	
		<i>Q₅</i>	<i>Q₁₀₀</i>
<i>Z</i>	OS-1	1.2	2.7
<i>Y</i>	OS-2	0.4	1.0
<i>A</i>	OS-1, OS-2, EX-A	6.3	38.0
<i>I</i>	OS-1, OS-2, PR-1	11.0	45.2

Calculated by: DLF

Date: 10/18/2018

Checked by:

PAGES FROM KETTLE CREEK BASIN DBPS

**Drainage Basin Planning Study
For
Kettle Creek Basin**

Prepared for:

High Valley Land Company, Inc.
1755 Telestar Drive, Suite 211
Colorado Springs, CO 80920
Contact: Tom Taylor

Prepared by:

JR Engineering LLC
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JR Project Number: 25100.00
May 5, 2015

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- B. Hydrologic Calculations and Data
- C. Hydraulic Calculations and Data
- D. Photo Logs
- E. Unplatted Area Calculations
- F. Fee Calculations

“clean, straight, full stage, no rifts or deep pools”. The channel characteristics are assumed to remain consistent through all stages of development.

4.2.5 Cross-Sections

A total of 44 cross-sections were modeled along the reach, with cross-sections located at geometry changes and downstream of all crossings. Channel cross-section locations were manually selected to represent confluences, changes in channel geometry and slope. Each cross-section was adjusted to extend across the estimated floodplain and was placed perpendicular to the anticipated direction of flow in both the main channel and left/right floodplains. The cross-sections were bent in some locations to accomplish the requirement to lie perpendicular to the flow path as described in Chapter 3 of HEC-RAS Hydraulic Reference Manual.

There are existing bridges over Kettle Creek located at Powers Boulevard, Old Ranch Road, Otero Avenue, and Voyager Parkway (State Highway 83). At each of these locations, four cross-sections were added to the HEC-RAS model that included an upstream cross-section prior to flow contraction, a cross-section at the upstream face of the structure, a cross-section at the downstream face of the structure, and a downstream cross-section where flow is fully expanded. Pier location and dimensions and deck elevations were roughly measured in the field. Photos are included in **Appendix D**.

The cross sections generated from the surface TIN in AutoCAD Civil 3D may potentially represent the top of the vegetated surface and not necessarily the true channel invert. In locations where vegetation is sparse, and not deep, the channel invert is assumed to be accurately represented. In locations of dense and deep vegetative cover, the channel invert may not be accurately represented and could be shallower than what actually exists. This condition may result in cross sections with less flood capacity than actually exists and leads to a conservative estimation of floodplain widths.

Several non-critical model warnings were generated during model runs. To address model warnings by either defining numerous additional cross sections or by interpolating cross sections between every defined cross section would be necessary. Neither of these solutions was determined to be necessary given the level of detail required for this study and as such were not completed.

Expansion and contraction coefficients in the cross-sections were estimated based on the ratio of expansion and contraction of the effective flow area in the floodplain occurring at cross-sections and at major drainageway crossings. For subcritical flow conditions where the change in the stream cross-section is gradual, a contraction coefficient of 0.1 and expansion coefficient of 0.3 are typically used for hydraulic modeling. The channel characteristics for the study reach justified the use of these typical values. An contraction coefficient of 0.3 and an expansion coefficient of 0.5 were used at the two upstream sections and immediate downstream section at each bridge crossing in accordance with standard practice, which reflects the energy loss resulting from increased flow contraction approaching the bridge, and increased flow expansion when leaving the bridge.

4.2.6 Ineffective Flow Areas

Ineffective flow areas are used to describe portions of a cross section in which water does not actively flow. Ineffective flow is typically used at the upstream and downstream bounding cross sections of a drainageway crossing and for a side channel with stagnant storage. All ineffective flow is considered permanent and will not become effective flow until the barrier is overtopped. Ineffective flow areas were used at major drainageway crossings only and it was assumed that channel invert irregularities are all contributing flow areas for the purposes of this study.

4.2.7 Bridges

The surface TIN was used to develop the bounding cross sections upstream and downstream of each major drainageway crossing, in addition to the approximate roadway characteristics at each crossing. The required inputs for bridge modeling include data for the deck/roadway, pier, and sloping abutments. This data was obtained from the surface topography and approximate measurements taken during the site inspection.

4.2.8 Detention Ponds

No existing detention ponds lie along the study reach except for the regional detention facility located on the upstream side of I-25. Information from the U.S. Air Force Academy Kettle Creek Watershed Hydrology Study (AFA Study) was used to determine the storage and water surface elevations of the Kettle Creek detention facility.

4.2.9 Steady Flow and Boundary Conditions

Steady flow data were entered for the study reach based on the results of the hydrologic modeling in Section 3. Steady flow data corresponding to the peak flow for flood events with recurrence intervals of 2-, 5-, 10-, 25-, 50- and 100-years for historic, existing, and future hydrologic conditions was entered for each reach at points of significant hydrologic change as determined in the hydrologic model. A summary of hydrologic flows for each tributary at different points is provided in tabular form in **Appendix B**.

The upstream boundary condition for the reach was based on the estimated normal depth of Kettle Creek based on invert slope. The downstream boundary conditions were based on water surface elevations in the I-25 regional detention pond obtained from the AFA Study. A mix of supercritical and subcritical flow conditions was evaluated. The mixed flow regime was selected to provide conservative water surface elevations while reflecting maximum velocities, in order to present the results most consistent with actual flood conditions in the channel.

4.3 Approximate Floodplains

After the HEC-RAS model analysis was complete, the 100-year water surface elevations were exported back to AutoCAD Civil 3D. Approximate floodplains for the existing and future 100-year floods were delineated for Kettle Creek and are shown in **Figures 4-1** and **4-2**. Due to negligible differences in the water surface profiles at the scale shown, the existing and future flow results are shown as one water surface profile. The FEMA floodplains for the Kettle Creek watershed are overlaid in the plan for comparison to the results of this analysis. Flood profiles for the existing and future 100-year floods are shown in **Figure 4-3** through **Figure**

The regional detention alternatives presented herein only are considered for the purposes of attenuating developed flow rates. Consideration of regional detention alternatives will have significant environmental impacts as discussed in Section 5. Sub-regional detention alone will not reduce flow rates in Kettle Creek to historic levels, as past development in the upper portion of the basin is a contributing factor to the increased flows under existing conditions. Regional detention must be owned and maintained by a public entity, with ownership and maintenance responsibilities clearly defined to ensure the proper function of the facility in perpetuity.

6.3 Sub-Regional Detention

The anticipated approach is sub-regional detention with full spectrum detention and water quality treatment. Any future development in the Kettle Creek basin within the City of Colorado Springs shall have sub-regional detention for each development/phase. Detention facilities serving drainage basins between 20 and 130 acres are considered “sub-regional detention”. Sub-regional detention may be constructed by a public entity such as a municipality or special district to serve several landowners in the upstream watershed or by a single landowner. It may be possible for a single landowner to construct sub-regional detention if the upper part of the watershed is owned by others and if the necessary conditions are achieved. Sub-regional detention should be addressed in subsequent Master Development Drainage Plans (MDDP) for individual development projects. The ownership and maintenance of these ponds are anticipated to be public or quasi-public. In order to be considered for public maintenance the contributory area shall be in the range of 70-120 acres. A conceptual map illustrating the locations of required sub-regional detention facilities is shown in **Figure 6-1**.

6.3.1 Full Spectrum Detention

The full spectrum detention approach, as defined in Chapter 13 of the DCM, shall be implemented as the standard detention approach. Impervious surfaces associated with development increase peak flows, frequency of runoff and total volume of stormwater surface runoff when compared to pre-development conditions. This increase is most pronounced for the smaller, more frequent storms and can result in stream degradation and water quality impacts as well as flooding during large storm events.

In addition to detaining developed conditions stormwater discharge for flood control and for water quality considerations, it is also important to expand the focus to the range of flows responsible for transporting the most bedload in the receiving stream. This range depends on reach specific characteristics but is between the annual event and the 5-year event. Runoff events in this range can produce geomorphic changes in local receiving streams resulting in severe erosion, loss of riparian habitat, and water quality degradation.

Outflow hydrographs from traditional flood-control detention facilities tend to maintain flows near the maximum release rates for relatively long periods of time. This allows hydrographs released from multiple independent ponds to overlap and add to each other to generate flows exceeding pre-development conditions. Traditional flood-control detention concepts can result in an increase in total watershed discharges even if individual detention facilities each control peak discharges to pre-developed conditions. Full spectrum detention modeling reduces urban runoff peaks to levels similar to pre-development conditions for a wide range of storms over an entire watershed, even with multiple independent detention facilities. A result of full

spectrum detention is that discharges from storms smaller than approximately the 2-year event will be reduced to very low flows near or below the sediment carrying threshold value for downstream drainageways.

6.3.2 Water Quality

Each sub-regional detention pond shall detain flows not only for flood control, but also for water quality. The Water Quality Capture Volume (WQCV) is intended to capture most runoff events and reduce their pollutant load prior to discharging into drainageways. The size of this storage element depends primarily on the amount of tributary impervious area and can be reduced by implementing development practices that reduce the effective imperviousness, discussed in more detail below.

Future development in the basin shall consider other land planning and engineering design approaches to manage stormwater runoff and water quality. Low Impact Development (LID) is a comprehensive approach with the goal of mimicking the pre-development hydrologic regime. LID emphasizes conservation of natural features and use of engineered, on-site, small-scale hydrologic controls that infiltrate, filter, store, evaporate, and detain runoff close to its source. Portions of the site that aid in reducing the developed conditions discharge should be preserved, which may include mature trees, stream corridors, wetlands, and NRCS Type A/B soils with higher infiltration rates.

Minimizing Directly Connected Impervious Area (MDCIA) includes a variety of runoff reduction strategies based on reducing impervious areas and routing runoff from impervious surfaces over grassy areas to slow runoff and promote infiltration. MDCIA is a technique for reducing runoff peaks and volumes following urbanization. Paved areas can be reduced in extent to the minimum amount practical, and implement methods to route runoff over grassed areas rather than directly into storm sewer. When soils vary over the site, concentrate new impervious areas over NRCS Type C and D soils, while preserving NRCS Type A and B soils for landscape areas and other permeable surfaces. Increasing the number and lengths of flow paths will all reduce the impact of the development.

Volume reduction is a key hydrologic objective, as opposed to peak flow reduction being the only objective. Volume reduction is emphasized not only to reduce pollutant loading and peak flows, but also to move toward hydrologic regimes with flow durations and frequencies closer to the natural hydrologic regime.

6.4 Limited Channel Stabilization Alternative

Channel improvements may be necessary in the main study reach of Kettle Creek to limit erosion and deposition resulting from high velocities as determined in Section 4. However, grading and grade control structures may not be feasible in Kettle Creek due to the disturbance they would cause with the presence of the Preble’s meadow jumping mouse. Conceptual check structure placement is provided for reference, should grade control structures become an option in the future.

The locations of these conceptual check structures were determined by areas where mean channel velocities exceeded 5 feet per second for the 100-year event. Future grade between check structures was estimated to stabilize at approximately 0.20 percent. Check structure placement was shown to lower velocities above 5

LEGEND

- JOVENCHI-I LLC
- 260 EB LLC
- HIGH VALLEY LAND COMPANY INC
- KETTLE CREEK LLC & VENEZIA JOHN FAMILY TRUST
- ESTIMATED LOCATION OF PROPOSED SUBREGIONAL PONDS
- EXISTING LOCATION OF SUBREGIONAL PONDS
- KETTLE CREEK BASIN BOUNDARY

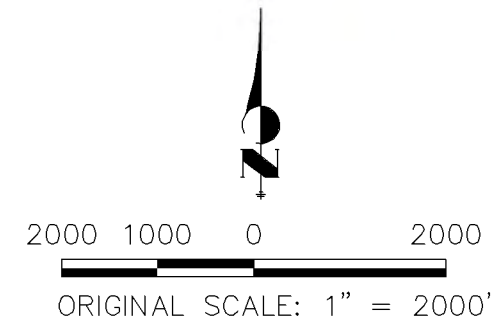
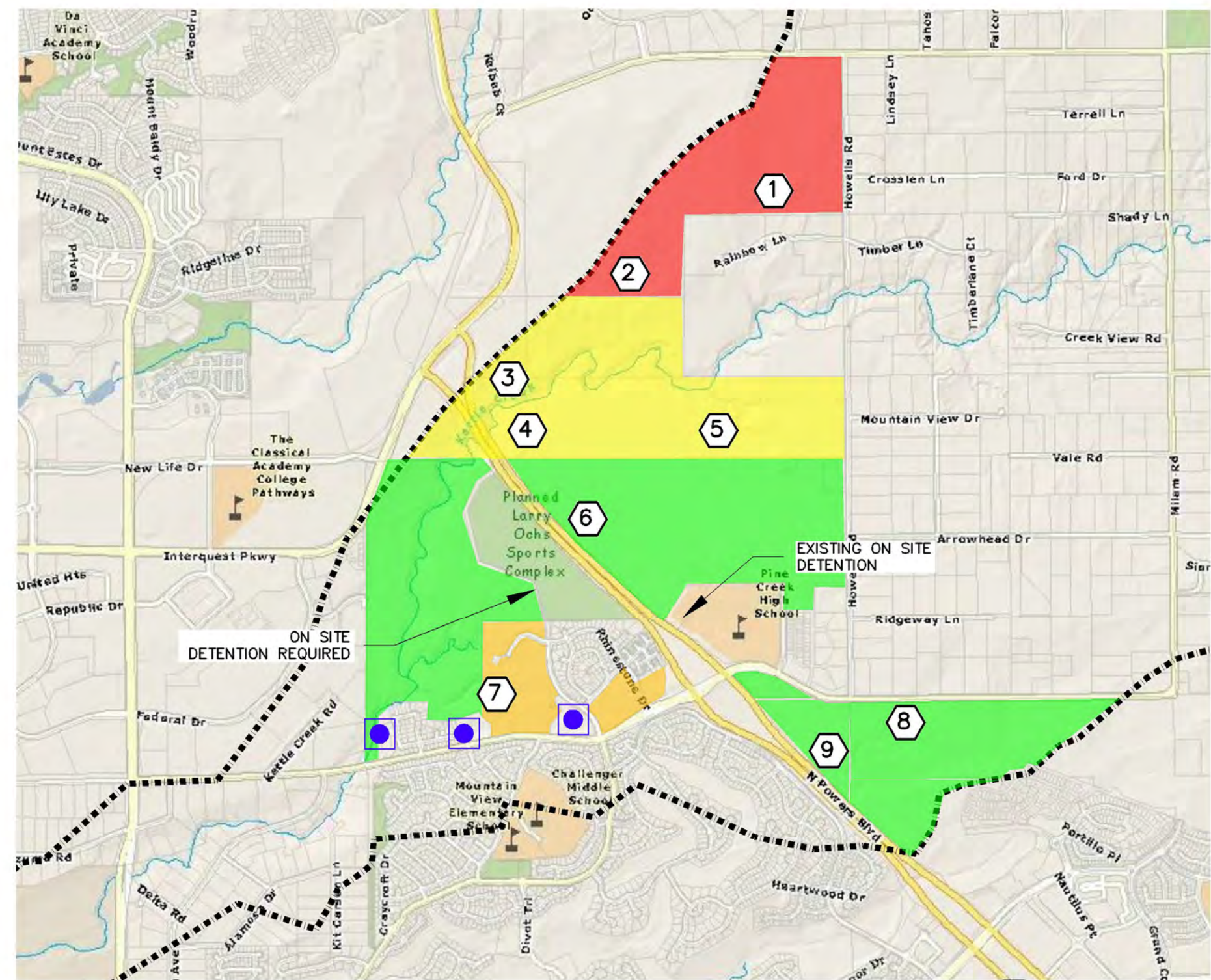


FIGURE 6-1
SUBREGIONAL POND
LOCATIONS
KETTLE CREEK DBPS
JOB NO. 25100.00
MAY 2015


DRAINAGE MAPS

HUNSINGER SUBDIVISION
EL PASO COUNTY
EXISTING DRAINAGE MAP
OCTOBER 2018

<u>BASIN SUMMARY</u>				
DESIGN POINT	BASIN	AREA (ACRES)	FLOW	
			5 YR (cfs)	100 YR (cfs)
Z	OS-1	0.37	1.2	2.7
Y	OS-2	0.17	0.4	1.0
A	EX-A	16.02	4.7	34.3

<u>DRAINAGE SUMMARY</u>				
DESIGN POINT	BASIN TRIBUTARY	AREA (ACRES)	FLOW	
			5 YR (cfs)	100 YR (cfs)
Z	OS-1	0.37	1.2	2.7
Y	OS-2	0.17	0.4	1.0
A	OS-1, OS-2, EX-A	16.56	6.3	38.0

LEGEND


 BASIN DESIGNATION
 AREA IN BASIN (AC)

 DESIGN POINT






 BASIN BOUNDARY

— — — — — EXISTING 1' CONTOUR

— — — EXISTING 5' CONTOUR


 GROUND SURFACE FLOW DIRECTION

 ROAD AND DITCH FLOW DIRECTION YARD HYDRANT

 ELECTRIC METER

OE ——— OVERHEAD ELECTRIC LINE

UG ——— UNDERGROUND GAS LINE

↓^{FO} UNDERGROUND FIBER-OPTIC MARKER

 TELEPHON PEDESTAL

 UNDERGROUND TELEPHONE MARKER

UTILITY POLE

→ GUY WIRE

STREET SIGN

MAIL BOX

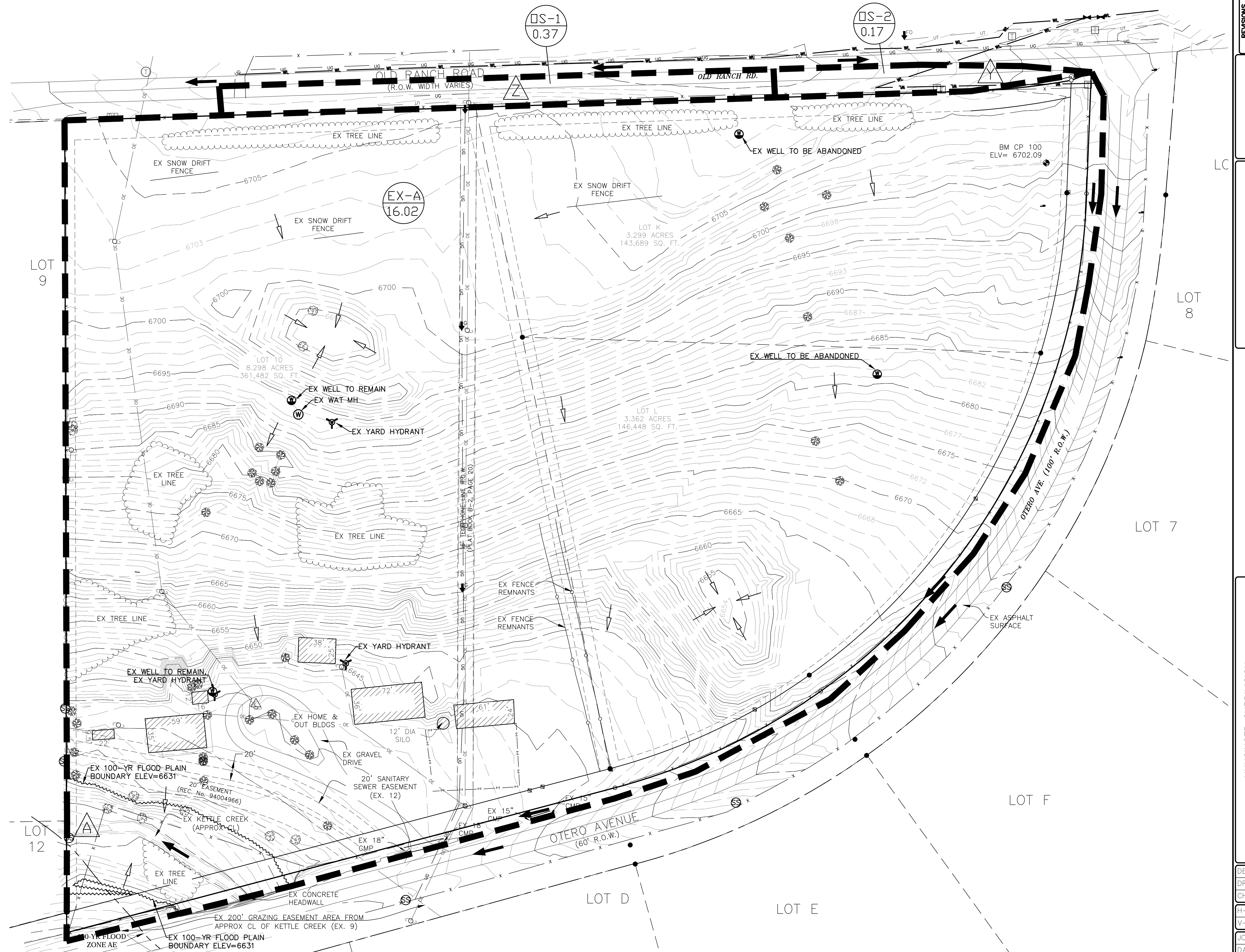
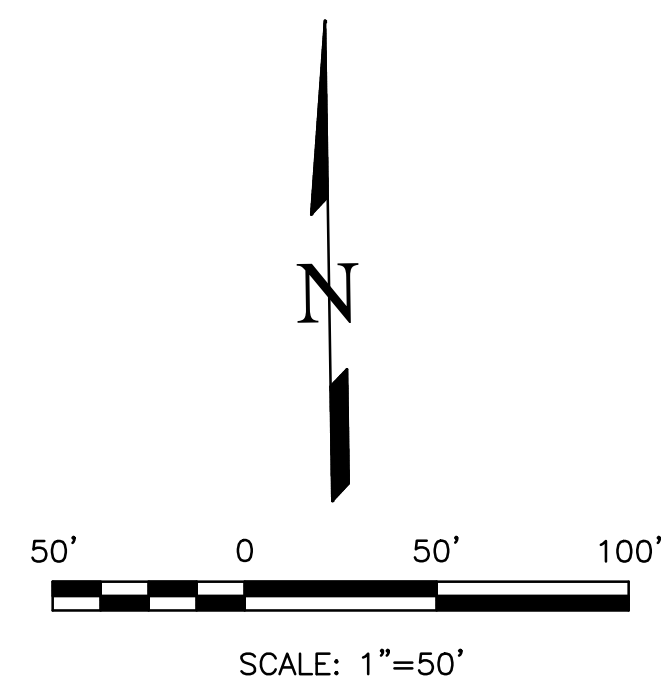
CHAIN-LINK FENCE

x _____ BARBED WIRE FENCE

OLIVE SWALE

 FXTREE

EX. SANITARY SEWER MANHOLE



LINE NO.	DESCRIPTION	DATE
1	REVD PER 6/2/16 CTY COMMENTS	8/22/16

UNTIL SUCH TIME AS THESE
DRAWINGS ARE APPROVED
BY THE APPROPRIATE
REVIEWING AGENCIES,
TERRA NOVA ENGINEERING,
INC. APPROVES THEIR USE
ONLY FOR THE
PURPOSES DESIGNATED BY
WRITTEN AUTHORIZATION.

PREPARED FOR:
HUNSINGER DEVELOPMENT CORP
ATTN: STEVE HUNSINGER
4406 COLLEGE PARK COURT
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721 S. 23RD STREET
COLORADO SPRINGS, CO 80904

OFFICE: 719-635-6422
FAX: 719-635-6426
www.tnesinc.com

HUNSINGER SUBDIVISION

EXISTING DRAINAGE PLAN

DESIGNED BY JF
DRAWN BY JF
CHECKED BY LD
SCALE AS SHOWN
SCALE N/A
PRICE NO. 1609.00
DATE ISSUED 10/18/18
SHEET NO. 1 OF 2

HUNSINGER SUBDIVISION
EL PASO COUNTY
PROPOSED DRAINAGE MAP
OCTOBER 2018

BASIN SUMMARY

DESIGN POINT	BASIN	AREA (ACRES)	5 YR (cfs)	100 YR (cfs)
Z	OS-1	0.37	1.2	2.7
Y	OS-2	0.17	0.4	1.0
1	PR-1	16.02	9.4	41.5

DRAINAGE SUMMARY

DESIGN POINT	BASIN TRIBUTARY	AREA (ACRES)	5 YR (cfs)	100 YR (cfs)
Z	OS-1	0.37	1.2	2.7
Y	OS-2	0.17	0.4	1.0
1	OS-1, OS-2, PR-1	16.56	11.0	45.2

LEGEND

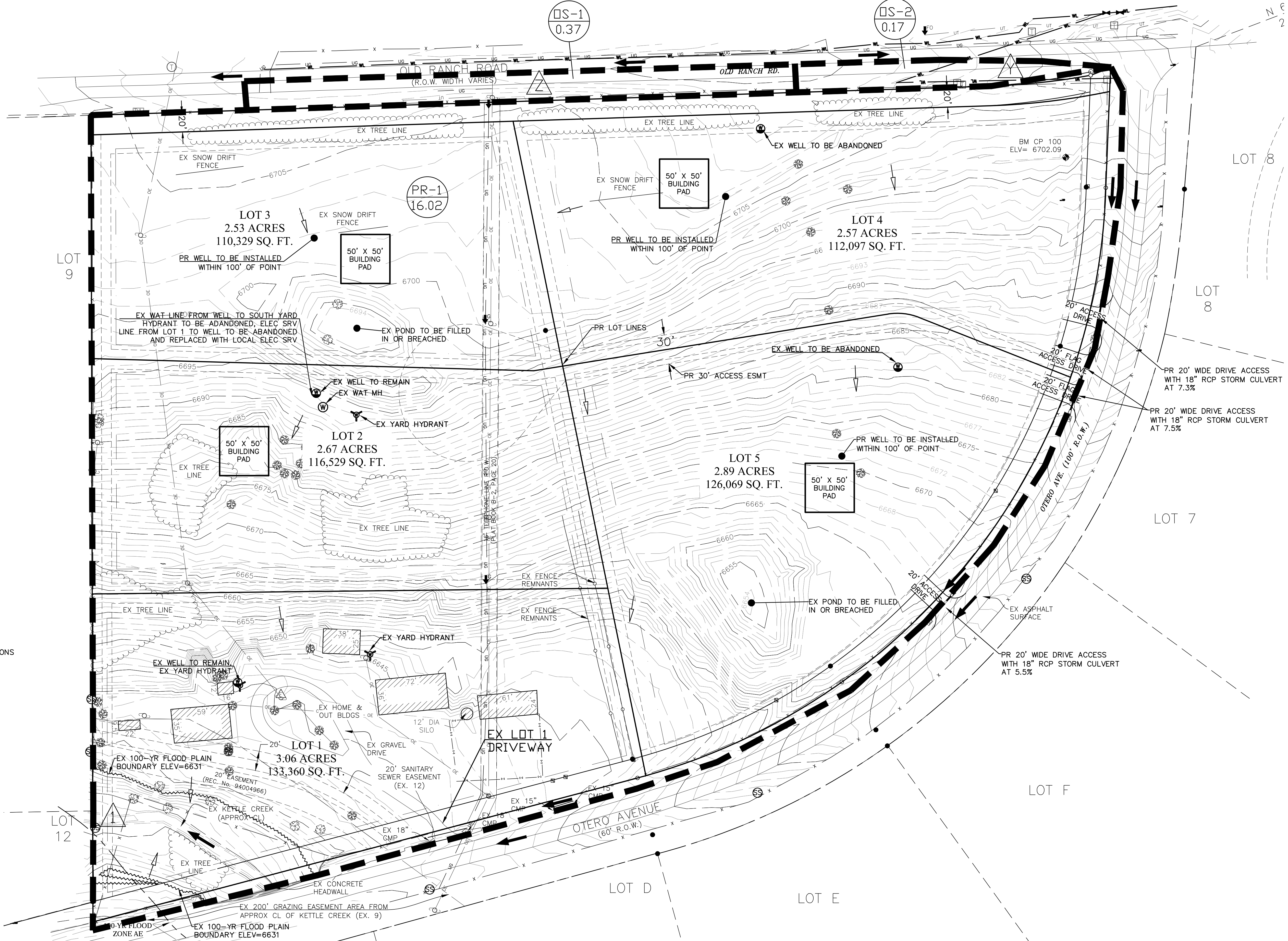
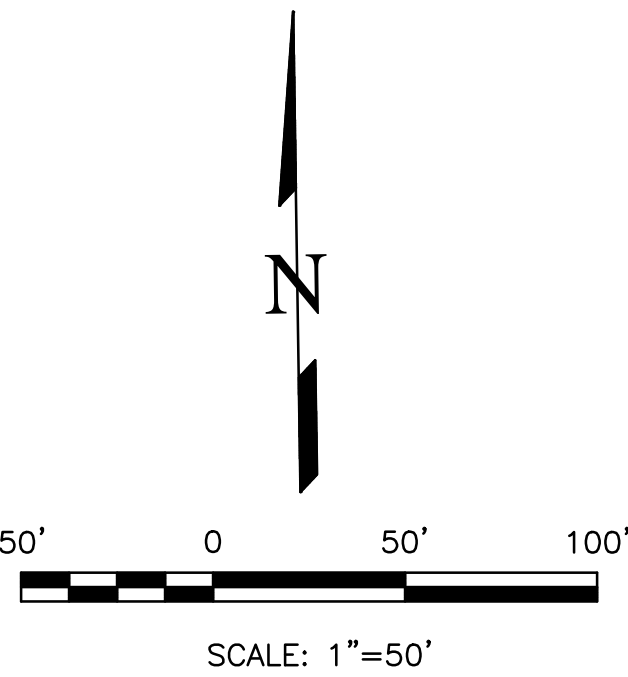
- Basin Designation**
P-7 12.22
AREA IN BASIN (AC)
- Design Point**
D
- Basin Boundary**
—
- Existing 1' Contour**

- Existing 5' Contour**

- Ground Surface Flow Direction**
→
- Road and Ditch Flow Direction**
→
- Yard Hydrant**
H
- Electric Meter**
M
- Overhead Electric Line**
—OE—
- Underground Gas Line**
—UG—
- Underground Fiber-Optic Marker**
F0
- Telephone Pedestal**
T
- Underground Telephone Marker**
T
- Utility Pole**
P
- Guy Wire**
—G—
- Street Sign**
S
- Mailbox**
M
- Chain-Link Fence**
—CL—
- Barbed-Wire Fence**
—X—
- CL EX SWALE**
—
- EX TREE**
T
- EX SANITARY SEWER MANHOLE**
SS

NOTES

1. PR BUILDING PAD AND DRIVE ACCESS LOCATIONS ARE SUGGESTIONS
2. NO SIGNIFICANT GRADING CHANGES ARE INCLUDED IN THIS PLAN



DESIGNED BY LD
DRAWN BY DLF
CHECKED BY LD

H-Scale AS SHOWN
V-Scale N/A

JOB NO. 1609.00
DATE ISSUED 10/18/18
SHEET NO. 2 OF 2

REVISIONS
NO. DESCRIPTION
1. REV'D PER 6/2/16 CTD COMMENTS 8/22/16

UNLESS SUCH TIME AS THESE DRAWINGS ARE APPROVED BY THE ENGINEER, THE ENGINEER'S NAME AND FIRM ARE NOT TO BE USED FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF THE ENGINEER.

PREPARED FOR:
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