

# **FINAL DRAINAGE LETTER AND PLAN**

## **EQUIPMENT RESOURCES 7340 UTAH LANE EL PASO COUNTY, COLORADO**

**JANUARY, 2019**

***Prepared for:***

*T-P Enterprises Inc.  
5055 E 39<sup>th</sup> Avenue  
Denver CO 80207*

***Prepared by:***

*Core Engineering Group, LLC  
15004 1<sup>st</sup> Avenue S.  
Burnsville, MN 55306*

*Project No. 315.003*



**CORE**  

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**ENGINEERING GROUP**

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**APPENDIX A***VICINITY MAP**SCS SOILS INFORMATION**FEMA FIRM MAP***APPENDIX B***HYDROLOGY & HYDRAULIC CALCULATIONS***APPENDIX C***WATER QUALITY CALCULATIONS***APPENDIX D***DRAINAGE MAP**STORM PIPE PLAN & PROFILE**POROUS LANDSCAPE DETENTION DETAILS*



El Paso County Development Services  
Engineering Division  
2880 International Circle, Suite 110  
Colorado Springs, CO. 80910

**RE: Equipment Resources  
7340 Utah Lane  
El Paso County, Colorado**

Dear Representative:

In accordance with the requirements of the El Paso County Development Code, a final drainage letter has been prepared for Equipment Resources, an existing development located at 7340 Utah Lane. The purpose of this letter is to support the approval of the use variance for this property

This report has been prepared under the current El Paso County Drainage Criteria.

Seven (7) complete copies of the drainage report and plan are hereby transmitted for your review and approval. If there are any questions or comments concerning this report, please contact the undersigned.

Sincerely,

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Richard L. Schindler, P.E. #33997

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Date

cc: file, client

**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 El Paso County for drainage reports and said report is in conformity with the 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.

Richard L. Schindler, P.E. #33997 Date  
For and on Behalf of Core Engineering Group, LLC

**OWNER'S STATEMENT**

I, the Owner, have read and will comply with all the requirements specified in the drainage report and plan.

T-P Enterprises Inc. Date  
Business Name

By

Title  
5055 E. 39<sup>th</sup> Avenue  
Address  
Denver, CO 80207

**FLOODPLAIN STATEMENT**

To the best of my knowledge and belief, this development is not located within a designated floodplain as shown on Flood Insurance Rate Map Panel No. 08041C0529 G, effected December 7, 2018. (See Appendix A, FEMA FIRMette Exhibit)

Richard L. Schindler, #33997 Date

**EL PASO COUNTY**

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

County Engineer/ECM Administrator Date

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## 1.0 INTRODUCTION

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### Property Location

Equipment Resources is located at 7340 Utah Lane, El Paso County, Colorado, adjacent to and west of Utah Lane and approximately 0.2 miles south of East Woodmen Road, between Powers Boulevard and Marksheffel Road. The property is located in a portion of the north one-half of Section 8, Township 13 South, Range 65 West of the 6<sup>th</sup> Principal Meridian in the County of El Paso, State of Colorado. See **Appendix A** for vicinity map.

### Property Description

Equipment Resources, located at 7340 Utah Lane contains 4.92 acres and is adjacent to Utah Lane. Storm water is directed westerly and southerly with moderate slopes to 2-existing water quality and sedimentation swales, runoff then continues in a southerly direction.

Currently the site contains an existing structure with gravel parking and a storage yard for the contractor's equipment. No additional construction is anticipated at this time.

Existing soils in the area consist mostly of the Blakeland Complex, a deep and somewhat excessively drained soil. Permeability of the soil is rapid, which gives it a Hydrologic Group 'A' rating. Other characteristics of this soil, is slow surface runoff and the hazard of erosion is moderate.

According to the current FEMA Flood Insurance Rate Map (FIRM) number 08041C0529 G, effective December 7, 2018 shows that this site is not located within 100 year FEMA floodplain. See **Appendix A** for FEMA FIRMette Flood Map.

### Purpose and Scope

The purpose of this report is to support the use variance request for this property. This report confirms and verifies the findings and conclusions from the previously approved drainage reports. In addition to the existing 2-Grass Swale Sedimentation Swales, 2-Porous Landscape Detention facilities will be constructed. No other construction is planned for this site.

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## 2.0 DRAINAGE DESIGN CRITERIA

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The supporting drainage design and calculations were performed in accordance with the City of Colorado Springs and El Paso County "Drainage Criteria Manual (DCM)", dated November, 1991, the El Paso County "Engineering Criteria Manual", and the UDFCD "Urban Storm Drainage Criteria Manual" Volumes 1, 2 and 3.

The Rational Method as outlined in Section 6.3.0 of the May 2014 "Drainage Criteria Manual" and in Section 3.2.8.F of the El Paso County "Engineering Criteria Manual" was used for basins less than 130 acres to determine the rainfall and runoff conditions for the proposed development of the site. The runoff rates for the 5-year initial storm and 100-year major design storm were calculated.

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## 3.0 EXISTING HYDROLOGICAL CONDITIONS

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The property is located within the "Cottonwood Creek DBPS" (FOMO 2200) a studied drainage basin. The site is currently developed with an existing building, ground cover consists of native grasses and a gravel parking lot, this parking lot is located on the eastern portion of the site. There is also an existing stock pond on the site along the drainageway. No grading, construction or development is proposed near the existing drainageway on the western side of the site.

The previous approved drainage report and plan was prepared by using drainage criteria that was in effect in 2008, this report updates that criteria and conforms to the current Drainage Criteria Manuals.

#### Basin OS-1

Basin OS-1 is the west half of Utah Lane (graveled private drive), runoff is directed southerly to an existing 18" CMP that conveys runoff under the entrance to this property. The total flow from this 0.40 acre basin is 1.1cfs for the 5-year event and 2.2cfs for the 100-year storm event.

#### Basin OS-2

Basin OS-2 is located north of this site and flows from a portion of the existing animal hospital are directed southerly overland onto this property as shown on the attached final drainage plan. The total flow from this 0.81 acre basin is 2.2cfs for the 5-year event and 4.4cfs for the 100-year storm event.

#### Basin A1

Basin A1 is located on the easterly edge of and contains the existing building and gravel parking lot, runoff is directed overland westerly and southerly to the 2 existing Grass Swale Sedimentation Facilities as shown on the attached final drainage plan. The total flow from this 1.46 acre basin is 2.8cfs for the 5-year event and 6.4cfs for the 100-year storm event. This basin will require 2 proposed Porous Landscape Detention facilities to provide water quality for the impervious area (roof and concrete pads), the locations are shown on the attached final Drainage Plan. The PLD's will be discussed in greater detail in the water quality section of this report.

#### Basin A2

Basin A2 is used for a storage yard and is located on the westerly portion of this site, runoff is directed westerly overland to the existing drainageway that flows in a southerly direction, as shown on the attached final drainage plan. The total flow from this 3.46 acre basin is 4.2cfs for the 5-year event and 11.7cfs for the 100-year storm event.

#### Basin A

Basin A is the combined flow from basins A1 and A2 and is directed to the previously mentioned drainageway that flows in a southerly direction, as shown on the attached final drainage plan. The total flow from this 4.92 acre basin is 6.7cfs for the 5-year event and 17.6cfs for the 100-year storm event.

#### Design Point 1

Design Point 1 (DP-1) is located on the south edge of the property at the existing drainageway as shown on the attached final drainage plan, and is the combined runoff from basins A and OS-2. The total flow generated at this 5.73 acre design point is 7.9cfs for the 5-year event and 19.5cfs for the 100-year storm event.

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## **4.0 DEVELOPED HYDROLOGICAL CONDITIONS**

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The proposed conditions for this development consist of constructing 2- Porous Landscape Detention Facilities, grass swale, and underground PVC storm pipes that convey roof and concrete surface flow to the PLD, the locations are shown on the attached final drainage plan. No other construction is planned for this site.

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## **5.0 PROPOSED IMPROVEMENTS**

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No improvements are proposed for this site.

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## 6.0 GRADING AND EROSION CONTROL

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No grading or erosion control is proposed for this site.

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## 7.0 WATER QUALITY CONTROL

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Water quality for the impervious areas will be provided by 2 Porous Landscape Detention facilities; locations of these facilities are shown on the attached final drainage plan and noted as PLD #1 and PLD #2.

PLD #1 is located on the North side and collects flow from the North half of the roof. Roof flow is directed to several downspouts and routed north-northwesterly to a grass swale that flows westerly to PLD #1. The contributing area to this PLD is 3,960 square feet, and it requires a capture volume of 132 cubic feet, the minimum flat surface area is 79 square feet, the flat surface is 5' wide and 16' long, which gives an actual flat area of 80 square feet. Side slopes are 4:1 and a depth of 8.1" and gives an actual volume of 132.3 cubic feet. The outlet weir for additional runoff was designed for a 100 year flow of 5.0cfs, this weir has bottom length of 6.0', weir depth of 0.5', 4:1 side slope, flow depth to convey 5.0cfs is 0.34'.

PLD #2 is located on the South side and collects flow from the South half of the roof and the existing concrete pads. Roof flow is directed southerly to several downspouts and routed across the existing concrete pads to proposed 8" area inlets. These inlets will convey hard surface runoff southerly via 8" PVC storm laterals to an 8" PVC storm pipe that will route runoff westerly to PLD #2. The contributing area to this PLD is 4,665 square feet, and it requires a capture volume of 155.5 cubic feet, the minimum flat surface area is 93 square feet, the flat surface is 5' wide and 19' long, which gives an actual flat area of 95 square feet. Side slopes are 4:1 and a depth of 9" which gives an actual volume of 157.8 cubic feet. The outlet weir for additional runoff was designed for a 100 year flow of 5.6cfs, this weir has bottom length of 8.0', weir depth of 0.5', 4:1 side slope, flow depth to convey 5.6cfs is 0.35'.

### Water Quality Maintenance Recommendations:

<u>Required Action</u>	<u>Frequency</u>
Lawn mowing and lawn care	Routine, as needed
Debris and litter removal	Routine, as needed by inspection
Sediment removal	Routine, as needed by inspection
Landscaping removal and Replacement	5-10 years, or as needed by, inspection
Inspections	Routine, annual inspection is suggested

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## 8.0 FACILITIES

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There are no planned major drainage facilities for this area.

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## **9.0 DRAINAGE AND BRIDGE FEES**

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The site is located in the Cottonwood Creek Drainage Basin. There is no platting action proposed for this site, therefore no Drainage Fees are due.

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## **10.0 CONCLUSIONS**

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This drainage report has been prepared in compliance with the City of Colorado Springs/El Paso County Drainage Criteria Manual and the drainage studies for surrounding developments. No development improvements will be constructed for this site and will not generate an increase in runoff, and should not adversely affect downstream properties. The purpose of this report is to accompany the approval of the use variance for this property. This final drainage letter is in general conformance with the previously approved final drainage reports prepared by Core Engineering and WestWorks Engineering.

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## **11.0 REFERENCES**

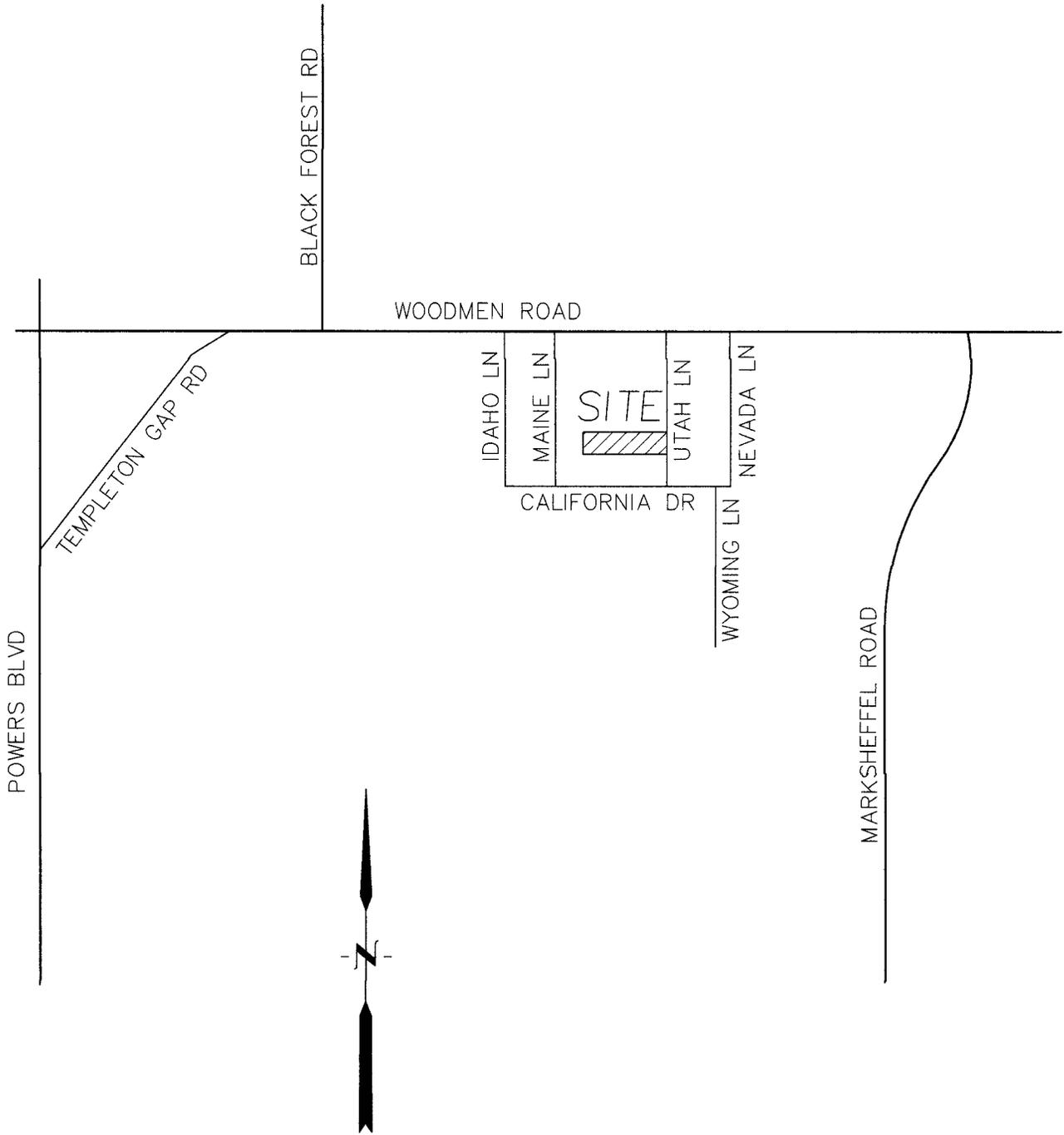
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1. City of Colorado Springs/El Paso County Drainage Criteria Manual, Vol. 1 & 2.
2. Soil Survey of El Paso County Area, Colorado by USDA, SCS.
3. The UDFCD "Urban Storm Drainage Criteria Manual" Volumes 1, 2 and 3.
4. Final Drainage Report for 7340 Utah Lane prepared by WestWorks Engineering, Dated 7/16/2004.
5. Final Drainage Report for Equipment Resources at 7340 Utah Lane, prepared by Core Engineering, dated 1/27/2009.

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**APPENDIX A – VICINTIY MAP, SOILS MAP, FEMA MAP**

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**CORE**  
**ENGINEERING GROUP**

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EMAIL: RichS@ceg1.com

VICINITY MAP  
EQUIPMENT RESOURCES  
7340 UTAH LANE

SCALE:  
NTS

DATE:  
JANUARY 2019

FIGURE NO.  
1

Custom Soil Resource Report  
Soil Map



Map Scale: 1:1,340 ft printed on A landscape (11" x 8.5") sheet.



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



## MAP LEGEND

-  Area of Interest (AOI)
-  Area of Interest (AOI)
- Soils**
-  Soil Map Unit Polygons
-  Soil Map Unit Lines
-  Soil Map Unit Points
- Special Point Features**
-  Blowout
-  Borrow Pit
-  Clay Spot
-  Closed Depression
-  Gravel Pit
-  Gravelly Spot
-  Landfill
-  Lava Flow
-  Marsh or swamp
-  Mine or Quarry
-  Miscellaneous Water
-  Perennial Water
-  Rock Outcrop
-  Saline Spot
-  Sandy Spot
-  Severely Eroded Spot
-  Sinkhole
-  Slide or Slip
-  Sodic Spot
-  Spoil Area
-  Stony Spot
-  Very Stony Spot
-  Wet Spot
-  Other
-  Special Line Features
- Water Features**
-  Streams and Canals
- Transportation**
-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads
- Background**
-  Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado  
 Survey Area Data: Version 16, Sep 10, 2018

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

Date(s) aerial images were photographed: Jun 7, 2016—Aug 17, 2017

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.

## El Paso County Area, Colorado

### 8—Blakeland loamy sand, 1 to 9 percent slopes

#### Map Unit Setting

*National map unit symbol:* 369v  
*Elevation:* 4,600 to 5,800 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

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

#### Description of Blakeland

##### Setting

*Landform:* Hills, flats  
*Landform position (three-dimensional):* Side slope, talf  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Alluvium derived from sedimentary rock and/or eolian deposits derived from sedimentary rock

##### Typical profile

*A - 0 to 11 inches:* loamy sand  
*AC - 11 to 27 inches:* loamy sand  
*C - 27 to 60 inches:* sand

##### Properties and qualities

*Slope:* 1 to 9 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Somewhat excessively drained  
*Runoff class:* 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  
*Calcium carbonate, maximum in profile:* 5 percent  
*Available water storage in profile:* Low (about 4.5 inches)

##### Interpretive groups

*Land capability classification (irrigated):* 3e  
*Land capability classification (nonirrigated):* 6e  
*Hydrologic Soil Group:* A  
*Ecological site:* Sandy Foothill (R049BY210CO)  
*Hydric soil rating:* No

#### Minor Components

##### Other soils

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

## Custom Soil Resource Report

### Pleasant

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

## 9—Blakeland-Fluvaquentic Haplaquolls

### Map Unit Setting

*National map unit symbol:* 36b6  
*Elevation:* 3,500 to 5,800 feet  
*Mean annual precipitation:* 13 to 17 inches  
*Mean annual air temperature:* 46 to 55 degrees F  
*Frost-free period:* 110 to 165 days  
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Blakeland and similar soils:* 60 percent  
*Fluvaquentic haplaquolls and similar soils:* 30 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Blakeland

#### Setting

*Landform:* Hills, flats  
*Landform position (three-dimensional):* Side slope, talf  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Sandy alluvium derived from arkose and/or eolian deposits  
derived from arkose

#### Typical profile

*A - 0 to 11 inches:* loamy sand  
*AC - 11 to 27 inches:* loamy sand  
*C - 27 to 60 inches:* sand

#### Properties and qualities

*Slope:* 1 to 9 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Somewhat excessively drained  
*Runoff class:* 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  
*Calcium carbonate, maximum in profile:* 5 percent  
*Available water storage in profile:* Low (about 4.5 inches)

#### Interpretive groups

*Land capability classification (irrigated):* 3e

## Custom Soil Resource Report

*Land capability classification (nonirrigated): 6e*  
*Hydrologic Soil Group: A*  
*Ecological site: Sandy Foothill (R049BY210CO)*  
*Hydric soil rating: No*

### Description of Fluvaquentic Haplaquolls

#### Setting

*Landform: Swales*  
*Down-slope shape: Linear*  
*Across-slope shape: Linear*  
*Parent material: Alluvium*

#### Typical profile

*H1 - 0 to 12 inches: variable*

#### Properties and qualities

*Slope: 1 to 2 percent*  
*Depth to restrictive feature: More than 80 inches*  
*Natural drainage class: Poorly drained*  
*Runoff class: Very high*  
*Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 6.00 in/hr)*  
*Depth to water table: About 0 to 24 inches*  
*Frequency of flooding: Occasional*  
*Frequency of ponding: None*  
*Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)*

#### Interpretive groups

*Land capability classification (irrigated): 6w*  
*Land capability classification (nonirrigated): 6w*  
*Hydrologic Soil Group: D*  
*Hydric soil rating: Yes*

### Minor Components

#### Other soils

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

#### Pleasant

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

# National Flood Hazard Layer FIRMette



38°56'33.64"N



104°41'10.76"W



USGS The National Map: Orthoimagery. Data refreshed October 2017.

## Legend

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

**SPECIAL FLOOD HAZARD AREAS**

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

0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X

Future Conditions 1% Annual Chance Flood Hazard Zone X  
Area with Reduced Flood Risk due to Levee. See Notes. Zone X  
Area with Flood Risk due to Levee Zone D

**OTHER AREAS OF FLOOD HAZARD**

NO SCREEN  
Area of Minimal Flood Hazard Zone X  
Effective LOMRs

**OTHER AREAS**

Area of Undetermined Flood Hazard Zone I  
Channel, Culvert, or Storm Sewer  
Levee, Dike, or Floodwall

**GENERAL STRUCTURES**

Cross Sections with 1% Annual Chance Water Surface Elevation  
Coastal Transect  
Base Flood Elevation Line (BFE)  
Limit of Study

**OTHER FEATURES**

Jurisdiction Boundary  
Coastal Transect Baseline  
Profile Baseline  
Hydrographic Feature

Digital Data Available  
No Digital Data Available  
Unmapped

**MAP PANELS**

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 1/25/2019 at 4:59:33 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

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**APPENDIX B – HYDROLOGY & HYDRAULIC CALCULATIONS**

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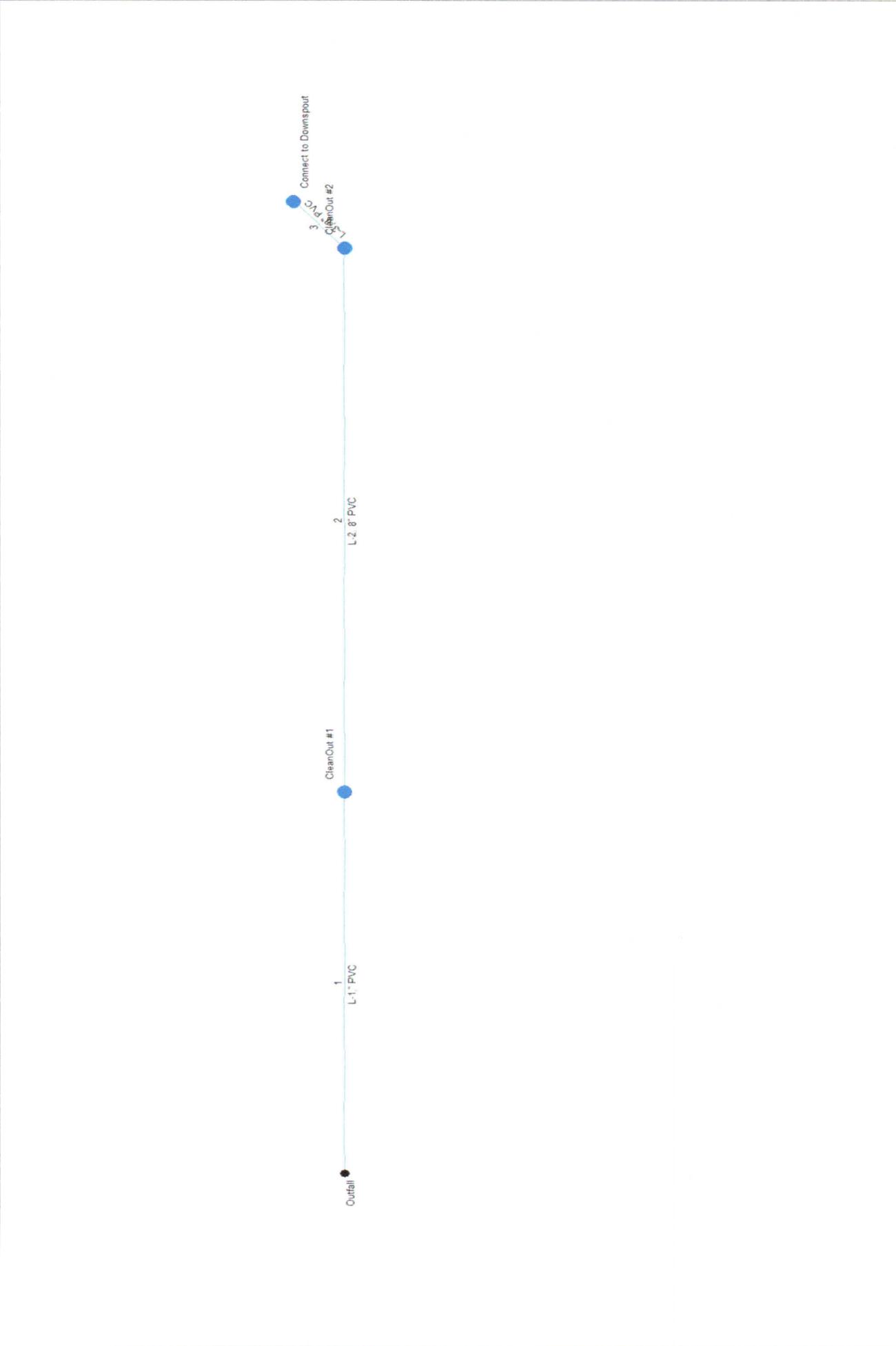








# Hydraflow Plan View



Project File: 315.003, 100 yr Roof Flow.stm

No. Lines: 3

02-25-2019

# Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L-1," PVC	1.00	8 c	116.0	6846.80	6856.40	8.276	6847.27	6856.87	n/a	6856.87	End
2	L-2, 8" PVC	1.00	8 c	165.0	6856.40	6858.05	1.000	6856.97	6858.52	n/a	6858.52	1
3	L-3, 8" PVC	1.00	8 c	20.0	6858.05	6859.05	5.000	6858.62	6859.52	n/a	6859.52 j	2

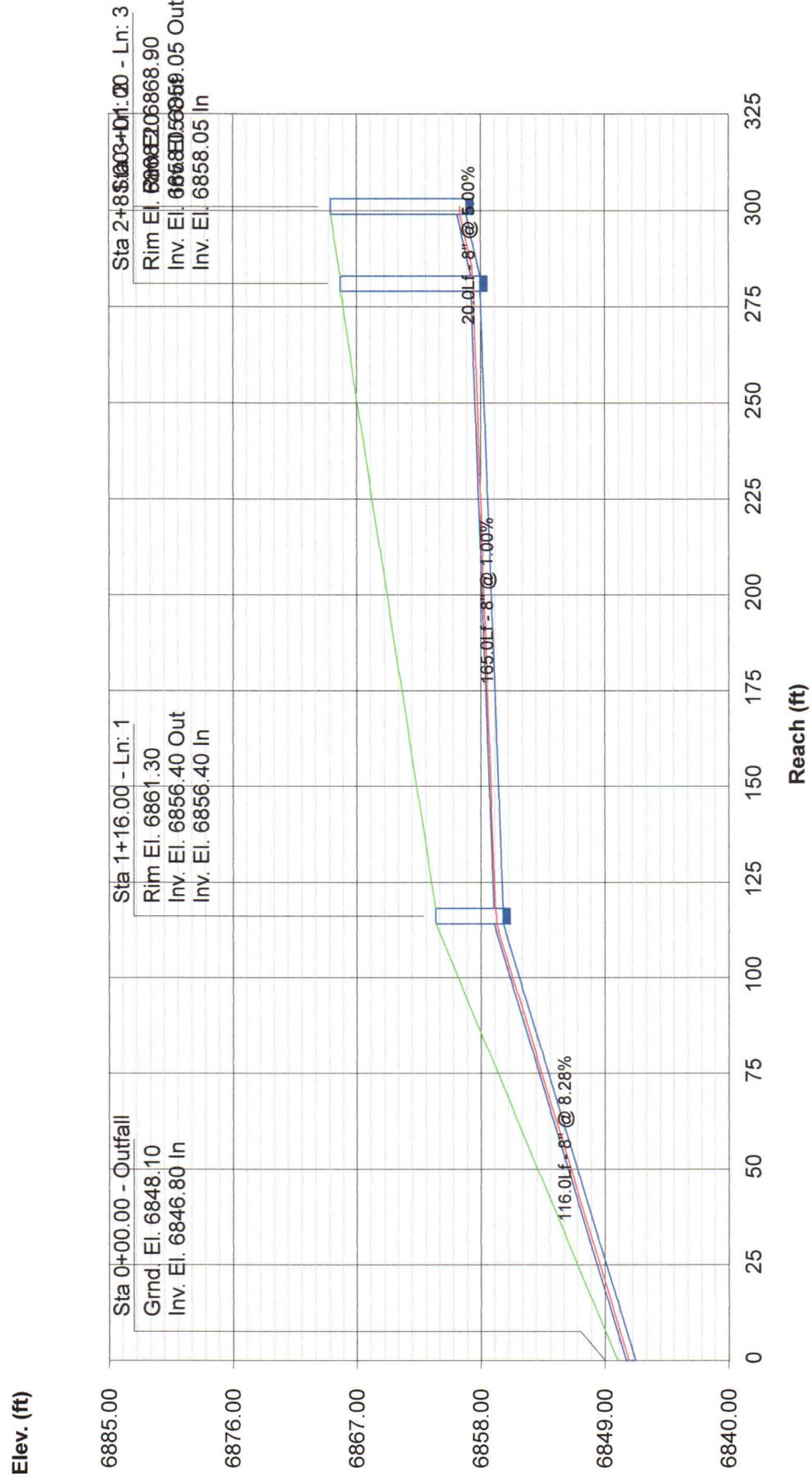
Project File: 315.003, 100 yr Roof Flow.stm

Number of lines: 3

Run Date: 02-25-2019

NOTES: c = cir; e = ellip; b = box; Return period = 100 Yrs. ; j - Line contains hyd. jump.

# Storm Sewer Profile



# Weir Report

## Weir Flow for Equipment Resources, North half PLD #1, 100yr Q=5.0cfs #315.003

### Trapezoidal Weir

Crest = Sharp  
Bottom Length (ft) = 6.00  
Total Depth (ft) = 0.50  
Side Slope (z:1) = 4.00

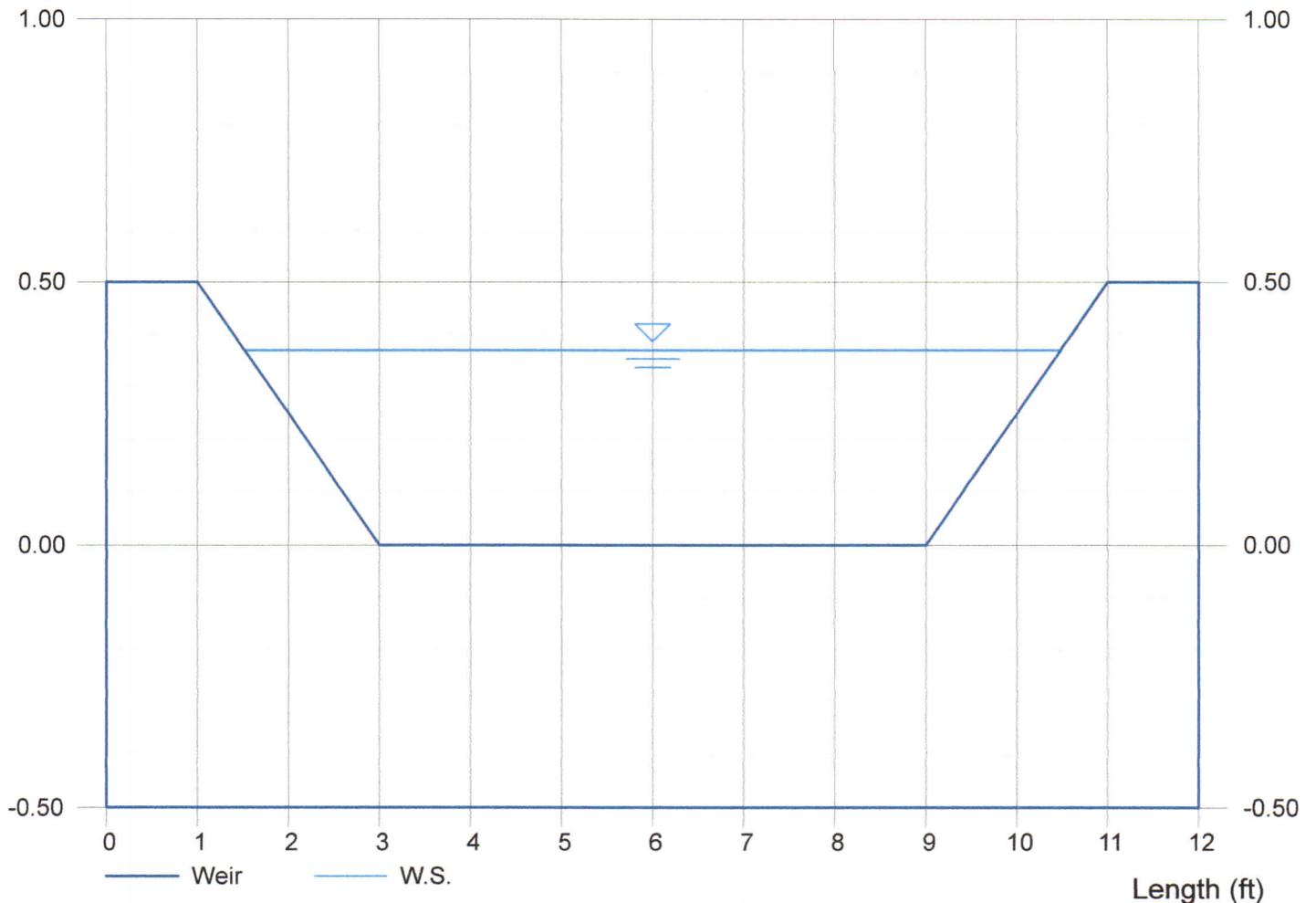
### Highlighted

Depth (ft) = 0.37  
Q (cfs) = 5.000  
Area (sqft) = 2.77  
Velocity (ft/s) = 1.81  
Top Width (ft) = 8.96

### Calculations

Weir Coeff. Cw = 3.10  
Compute by: Known Q  
Known Q (cfs) = 5.00

Depth (ft) Weir Flow for Equipment Resources, North half PLD #1, 100yr Q=5.0cfs #315.003 Depth (ft)



# Weir Report

## Weir Flow for Equipment Resources, South half PLD #2, 100yr Q=6.4cfs #315.003

### Trapezoidal Weir

Crest = Sharp  
Bottom Length (ft) = 8.00  
Total Depth (ft) = 0.50  
Side Slope (z:1) = 4.00

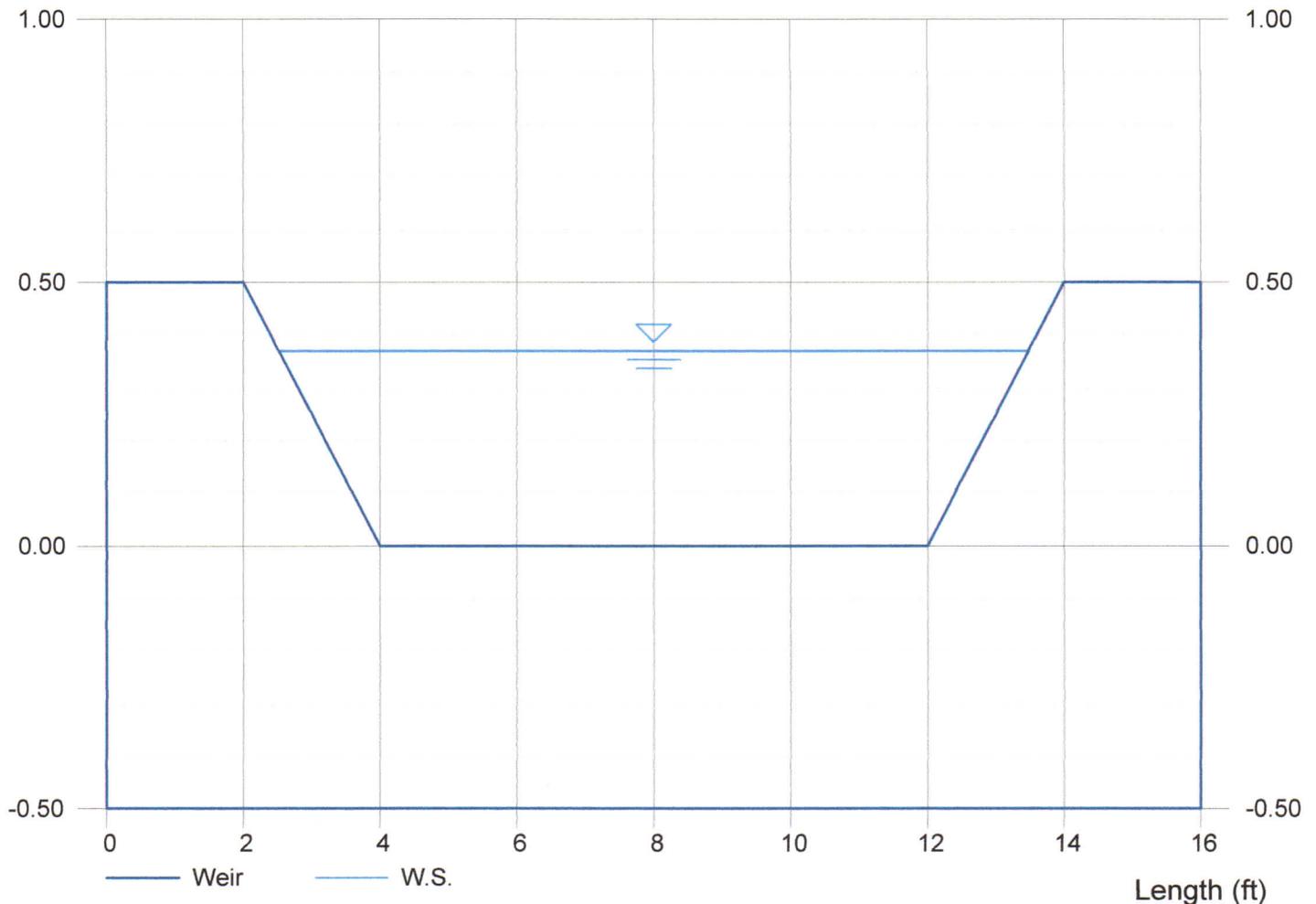
### Highlighted

Depth (ft) = 0.37  
Q (cfs) = 6.400  
Area (sqft) = 3.51  
Velocity (ft/s) = 1.82  
Top Width (ft) = 10.96

### Calculations

Weir Coeff. Cw = 3.10  
Compute by: Known Q  
Known Q (cfs) = 6.40

Depth (ft) Weir Flow for Equipment Resources, South half PLD #2, 100yr Q=6.4cfs #315.003 Depth (ft)



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**APPENDIX C – WATER QUALITY CALCULATIONS**

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**Design Procedure Form: Rain Garden (RG)**

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 2

Designer: Leonard Beasley  
 Company: Core Engineering Group  
 Date: January 1, 2019  
 Project: Equipment Resources (N. Half) #315.003  
 Location: 7340 Utah Lane, El Paso County, CO

PLD #1

<p>1. Basin Storage Volume</p> <p>A) Effective Imperviousness of Tributary Area, <math>I_a</math> (100% if all paved and roofed areas upstream of rain garden)</p> <p>B) Tributary Area's Imperviousness Ratio (<math>i = I_a/100</math>)</p> <p>C) Water Quality Capture Volume (WQCV) for a 12-hour Drain Time (<math>WQCV = 0.8 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)</math>)</p> <p>D) Contributing Watershed Area (including rain garden area)</p> <p>E) Water Quality Capture Volume (WQCV) Design Volume <math>Vol = (WQCV / 12) * Area</math></p> <p>F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm</p> <p>G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume</p> <p>H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)</p>	<p><math>I_a = </math> <input type="text" value="100.0"/> %</p> <p><math>i = </math> <input type="text" value="1.000"/></p> <p>WQCV = <input type="text" value="0.40"/> watershed inches</p> <p>Area = <input type="text" value="3,960"/> sq ft</p> <p><math>V_{WQCV} = </math> <input type="text" value="132.0"/> cu ft</p> <p><math>d_6 = </math> <input type="text"/> in</p> <p><math>V_{WQCV\ OTHER} = </math> <input type="text"/> cu ft</p> <p><math>V_{WQCV\ USER} = </math> <input type="text"/> cu ft</p>
<p>2. Basin Geometry</p> <p>A) WQCV Depth (12-inch maximum)</p> <p>B) Rain Garden Side Slopes (<math>Z = 4</math> min., horiz. dist per unit vertical) (Use "0" if rain garden has vertical walls)</p> <p>C) Minimum Flat Surface Area</p> <p>D) Actual Flat Surface Area</p> <p>E) Area at Design Depth (Top Surface Area)</p> <p>F) Rain Garden Total Volume (<math>V_T = ((A_{Top} + A_{Actual}) / 2) * Depth</math>)</p>	<p><math>D_{WQCV} = </math> <input type="text" value="8.1"/> in</p> <p><math>Z = </math> <input type="text" value="4.00"/> ft / ft</p> <p><math>A_{Min} = </math> <input type="text" value="79"/> sq ft</p> <p><math>A_{Actual} = </math> <input type="text" value="80"/> sq ft</p> <p><math>A_{Top} = </math> <input type="text" value="312"/> sq ft</p> <p><math>V_T = </math> <input type="text" value="132.3"/> cu ft</p>
<p>3. Growing Media</p>	<p>Choose One _____</p> <p><input checked="" type="radio"/> 18" Rain Garden Growing Media</p> <p><input type="radio"/> Other (Explain): _____</p>
<p>4. Underdrain System</p> <p>A) Are underdrains provided?</p> <p>B) Underdrain system orifice diameter for 12 hour drain time</p> <p style="margin-left: 20px;">i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice</p> <p style="margin-left: 20px;">ii) Volume to Drain in 12 Hours</p> <p style="margin-left: 20px;">iii) Orifice Diameter, 3/8" Minimum</p>	<p>Choose One _____</p> <p><input type="radio"/> YES</p> <p><input checked="" type="radio"/> NO</p> <p><math>y = </math> <input type="text" value="N/A"/> ft</p> <p><math>Vol_{12} = </math> <input type="text" value="N/A"/> cu ft</p> <p><math>D_o = </math> <input type="text" value="N/A"/> in</p>

Design Procedure Form: Rain Garden (RG)

Sheet 2 of 2

Designer: Leonard Beasley  
Company: Core Engineering Group  
Date: January 1, 2019  
Project: Equipment Resources (N. Half) #315.003  
Location: 7340 Utah Lane, El Paso County, CO

PLD #1

<p>5. Impermeable Geomembrane Liner and Geotextile Separator Fabric</p> <p>A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?</p>	<p>Choose One _____</p> <p><input type="radio"/> YES</p> <p><input checked="" type="radio"/> NO</p>
<p>6. Inlet / Outlet Control</p> <p>A) Inlet Control</p>	<p>Choose One _____</p> <p><input checked="" type="radio"/> Sheet Flow- No Energy Dissipation Required</p> <p><input type="radio"/> Concentrated Flow- Energy Dissipation Provided</p>
<p>7. Vegetation</p>	<p>Choose One _____</p> <p><input type="radio"/> Seed (Plan for frequent weed control)</p> <p><input type="radio"/> Plantings</p> <p><input checked="" type="radio"/> Sand Grown or Other High Infiltration Sod</p>
<p>8. Irrigation</p> <p>A) Will the rain garden be irrigated?</p>	<p>Choose One _____</p> <p><input type="radio"/> YES</p> <p><input type="radio"/> NO</p>
<p>Notes: _____</p> <p>_____</p> <p>_____</p>	

## Design Procedure Form: Rain Garden (RG)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 2

**Designer:** Leonard Beasley  
**Company:** Core Engineering Group  
**Date:** January 23, 2019  
**Project:** Equipment Resources (S. Half) #315.003  
**Location:** 7340 Utah Lane, El Paso County, CO

PLD #2

<p><b>1. Basin Storage Volume</b></p> <p>A) Effective Imperviousness of Tributary Area, <math>I_a</math> (100% if all paved and roofed areas upstream of rain garden)</p> <p>B) Tributary Area's Imperviousness Ratio (<math>i = I_a/100</math>)</p> <p>C) Water Quality Capture Volume (WQCV) for a 12-hour Drain Time (<math>WQCV = 0.8 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)</math>)</p> <p>D) Contributing Watershed Area (including rain garden area)</p> <p>E) Water Quality Capture Volume (WQCV) Design Volume <math>Vol = (WQCV / 12) * Area</math></p> <p>F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm</p> <p>G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume</p> <p>H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)</p>	<p><math>I_a = </math> <input type="text" value="100.0"/> %</p> <p><math>i = </math> <input type="text" value="1.000"/></p> <p>WQCV = <input type="text" value="0.40"/> watershed inches</p> <p>Area = <input type="text" value="4,665"/> sq ft</p> <p><math>V_{WQCV} = </math> <input type="text" value="155.5"/> cu ft</p> <p><math>d_6 = </math> <input type="text"/> in</p> <p><math>V_{WQCV\ OTHER} = </math> <input type="text"/> cu ft</p> <p><math>V_{WQCV\ USER} = </math> <input type="text"/> cu ft</p>
<p><b>2. Basin Geometry</b></p> <p>A) WQCV Depth (12-inch maximum)</p> <p>B) Rain Garden Side Slopes (<math>Z = 4</math> min., horiz. dist per unit vertical) (Use "0" if rain garden has vertical walls)</p> <p>C) Minimum Flat Surface Area</p> <p>D) Actual Flat Surface Area</p> <p>E) Area at Design Depth (Top Surface Area)</p> <p>F) Rain Garden Total Volume (<math>V_T = ((A_{Top} + A_{Actual}) / 2) * Depth</math>)</p>	<p><math>D_{WQCV} = </math> <input type="text" value="9.0"/> in</p> <p><math>Z = </math> <input type="text" value="4.00"/> ft / ft</p> <p><math>A_{Min} = </math> <input type="text" value="93"/> sq ft</p> <p><math>A_{Actual} = </math> <input type="text" value="95"/> sq ft</p> <p><math>A_{Top} = </math> <input type="text" value="326"/> sq ft</p> <p><math>V_T = </math> <input type="text" value="157.8"/> cu ft</p>
<p><b>3. Growing Media</b></p>	<p>Choose One _____</p> <p><input checked="" type="radio"/> 18" Rain Garden Growing Media</p> <p><input type="radio"/> Other (Explain): _____</p>
<p><b>4. Underdrain System</b></p> <p>A) Are underdrains provided?</p> <p>B) Underdrain system orifice diameter for 12 hour drain time</p> <p style="margin-left: 20px;">i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice</p> <p style="margin-left: 20px;">ii) Volume to Drain in 12 Hours</p> <p style="margin-left: 20px;">iii) Orifice Diameter, 3/8" Minimum</p>	<p>Choose One _____</p> <p><input checked="" type="radio"/> YES</p> <p><input type="radio"/> NO</p> <p><math>y = </math> <input type="text"/> ft</p> <p><math>Vol_{12} = </math> <input type="text"/> cu ft</p> <p><math>D_o = </math> <input type="text"/> in</p>

Design Procedure Form: Rain Garden (RG)

Sheet 2 of 2

Designer: Leonard Beasley  
Company: Core Engineering Group  
Date: January 23, 2019  
Project: Equipment Resources (S. Half) #315.003  
Location: 7340 Utah Lane, El Paso County, CO

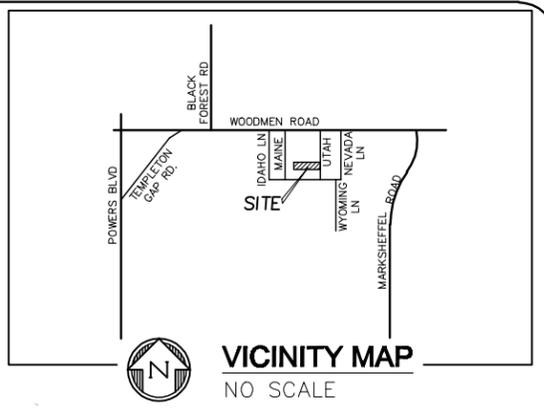
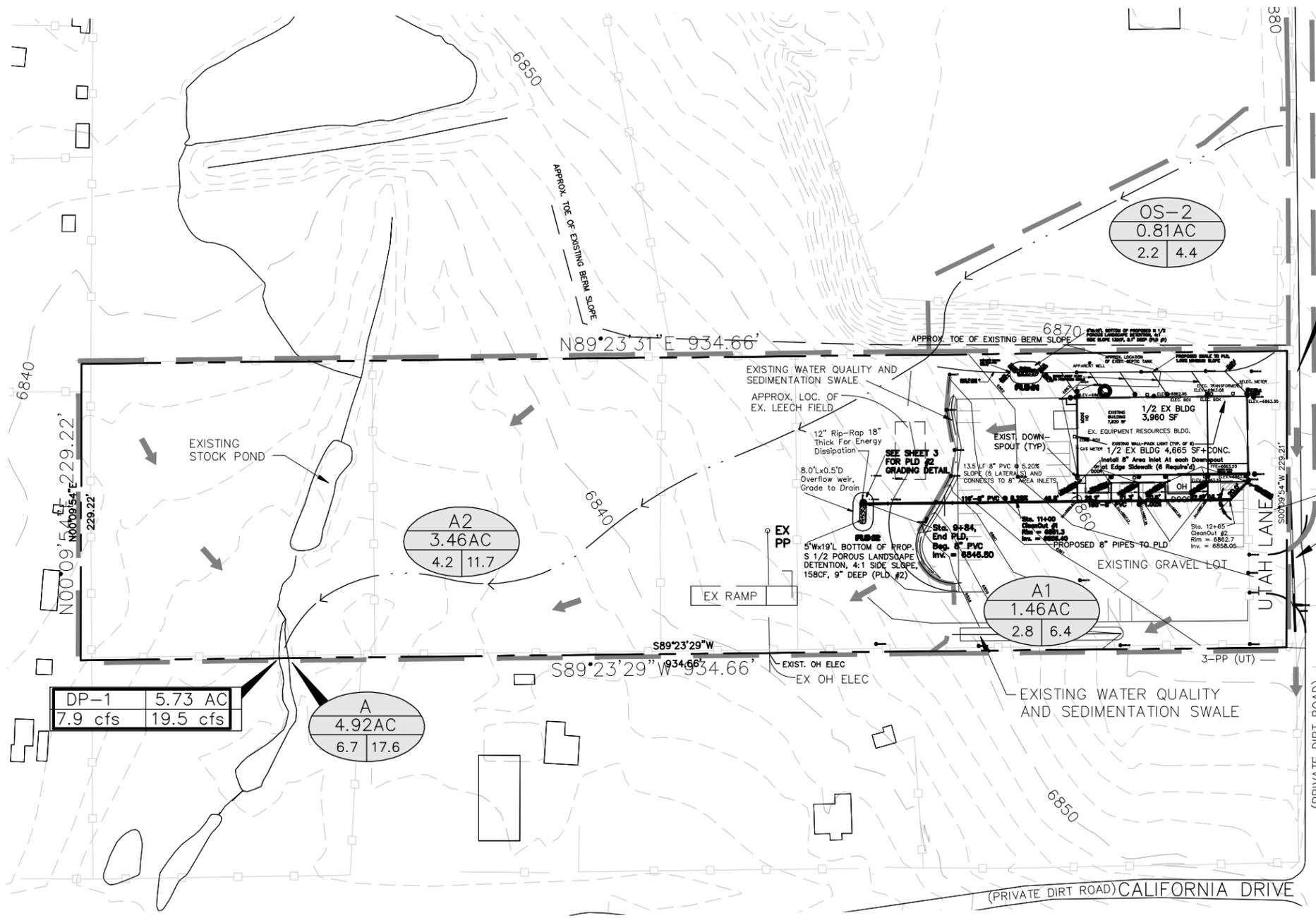
PLD #2

<p>5. Impermeable Geomembrane Liner and Geotextile Separator Fabric</p> <p>A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?</p>	<p>Choose One _____</p> <p><input type="radio"/> YES</p> <p><input checked="" type="radio"/> NO</p>
<p>6. Inlet / Outlet Control</p> <p>A) Inlet Control</p>	<p>Choose One _____</p> <p><input checked="" type="radio"/> Sheet Flow- No Energy Dissipation Required</p> <p><input type="radio"/> Concentrated Flow- Energy Dissipation Provided</p>
<p>7. Vegetation</p>	<p>Choose One _____</p> <p><input type="radio"/> Seed (Plan for frequent weed control)</p> <p><input type="radio"/> Plantings</p> <p><input checked="" type="radio"/> Sand Grown or Other High Infiltration Sod</p>
<p>8. Irrigation</p> <p>A) Will the rain garden be irrigated?</p>	<p>Choose One _____</p> <p><input type="radio"/> YES</p> <p><input type="radio"/> NO</p>
<p>Notes: _____</p> <p>_____</p> <p>_____</p>	

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**APPENDIX D – DRAINAGE MAP, STORM P&P, PLD #1 & #2**

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OS-1	
0.40AC	
1.1	2.2

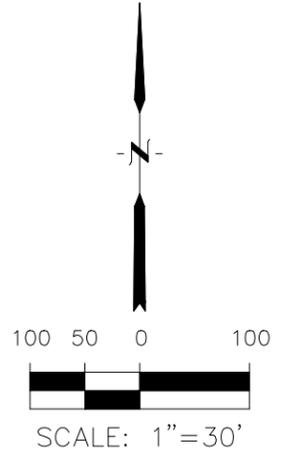
OS-2	
0.81AC	
2.2	4.4

A2	
3.46AC	
4.2	11.7

A1	
1.46AC	
2.8	6.4

A	
4.92AC	
6.7	17.6

DP-1	
5.73 AC	
7.9 cfs	19.5 cfs

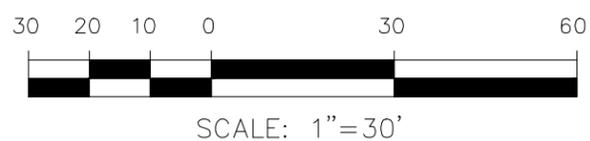
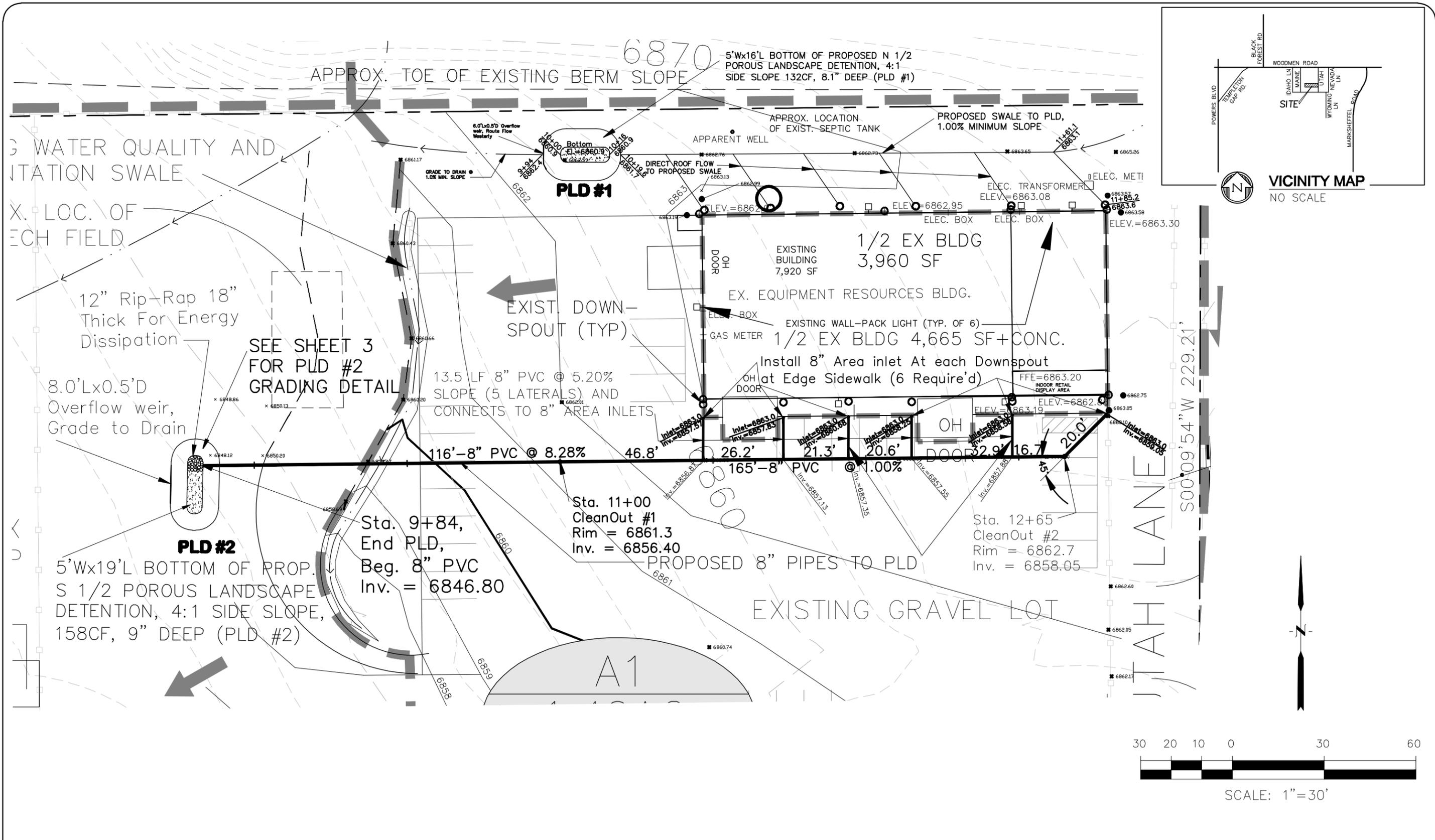


15004 1st AVENUE SOUTH  
 BURNSVILLE, MN 55306  
 PH: 719.570.1100  
 FAX: 719.570.1106  
 CONTACT: RICHARD L. SCHINDLER, P.E.  
 EMAIL: RichS@cegl.com

**FINAL DRAINAGE PLAN**  
**7340 UTAH LANE**  
**EL PASO COUNTY, COLORADO**

DATE:  
 January, 2019  
 SCALE:  
 1"=100'

JOB NO:  
 315.003  
 FIGURE NO:  
 1 of 5



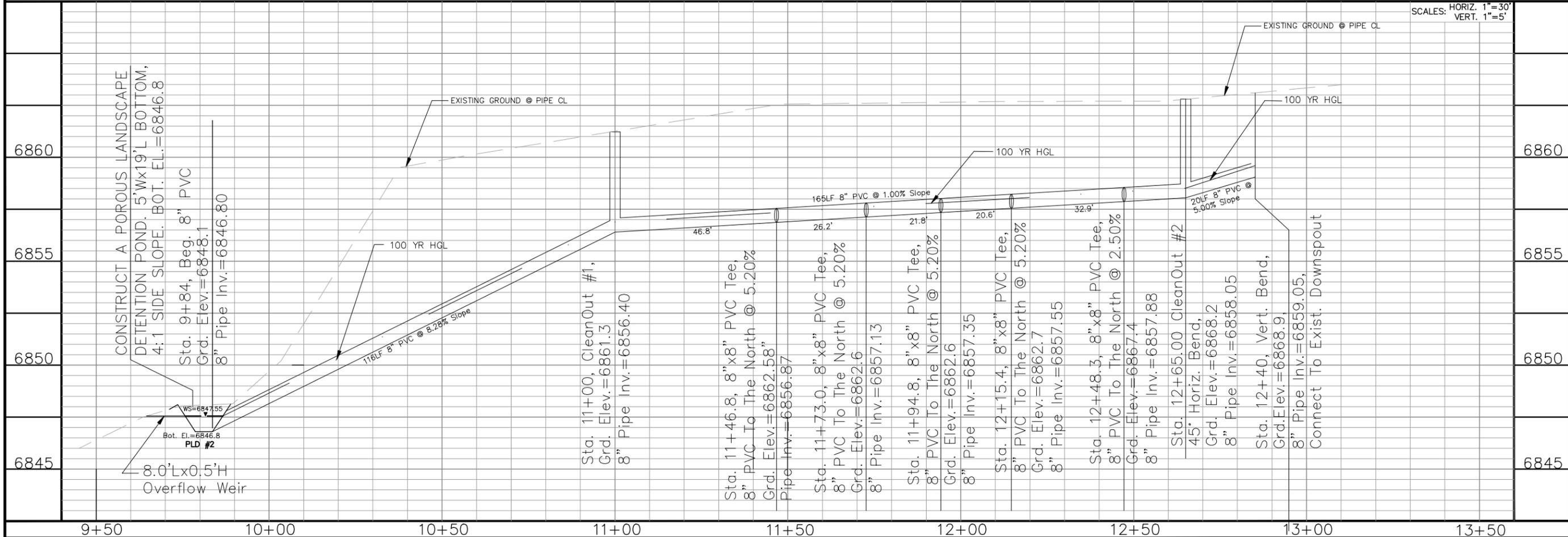
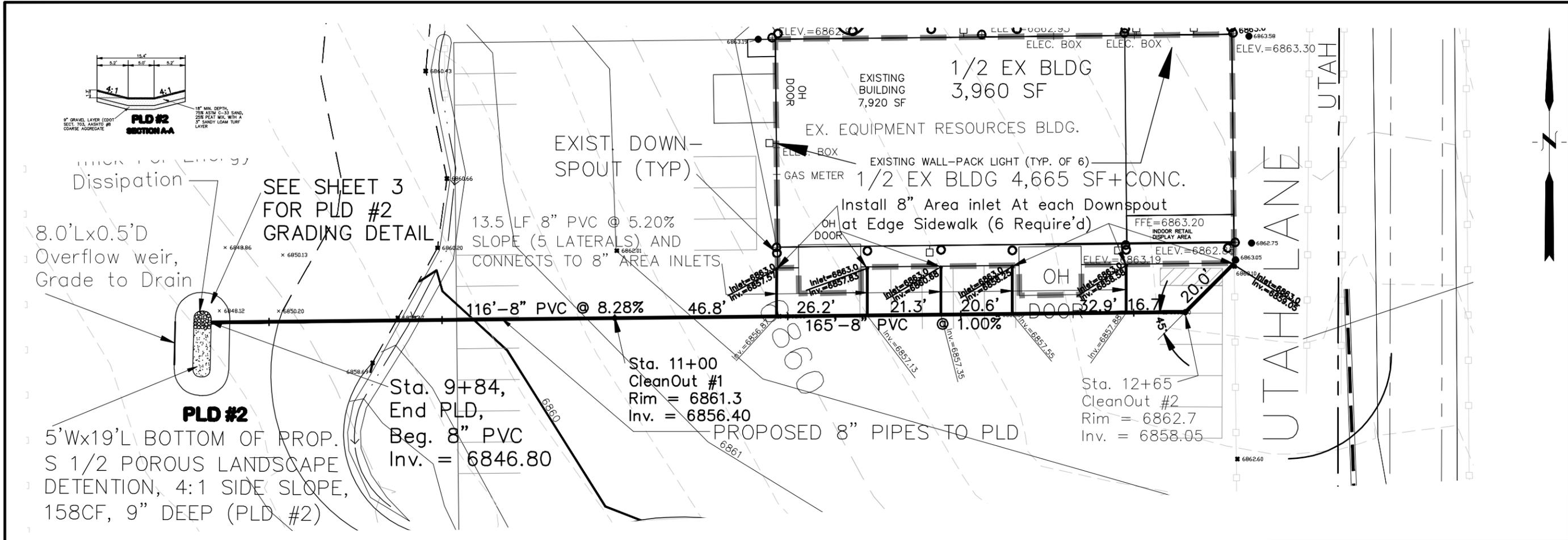

**CORE**  
ENGINEERING GROUP

15004 1st AVENUE SOUTH  
BURNSVILLE, MN 55306  
PH: 719.570.1100  
FAX: 719.570.1106  
CONTACT: RICHARD L. SCHINDLER, P.E.  
EMAIL: RichS@cegl.com

**FINAL DRAINAGE PLAN DETAILS**  
**7340 UTAH LANE**  
**EL PASO COUNTY, COLORADO**

DATE: January, 2019	JOB NO: 315.003
SCALE: 1"=30	FIGURE NO: 2 of 5





**CORE ENGINEERING GROUP**  
 15004 1st AVENUE SOUTH  
 BURNSVILLE, MN 55306  
 PH: 763.270.1100  
 FAX: 763.270.1106  
 EMAIL: RICH@cegi.com

**EQUIPMENT RESOURCES**  
 T-P ENTERPRISES, INC.  
 5055 E. 39th AVENUE  
 DENVER, COLORADO 80207  
 EL PASO COUNTY, COLORADO  
 CONTACT: DAVE FICKRELL

DATE: \_\_\_\_\_

NO. \_\_\_\_\_

DESCRIPTION \_\_\_\_\_

PREPARED FOR: T-P ENTERPRISES, INC.

PROJECT: EQUIPMENT RESOURCES

7340 UTAH LANE  
 EL PASO COUNTY, COLORADO

DRAWN: LAB  
 DESIGNED: LAB  
 CHECKED: RLS

PLAN AND PROFILE

8" STORM PIPE TO PLD #2

7340 UTAH LANE

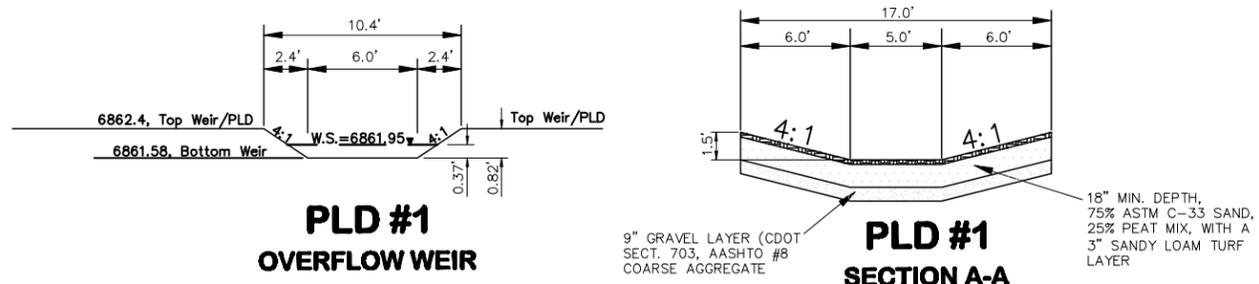
EL PASO COUNTY, COLORADO

DATE: FEB. 2019

PROJECT NO. 315.003

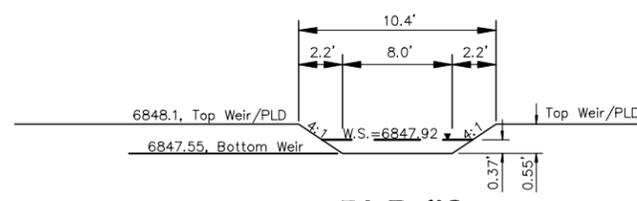
SHEET NUMBER 4 of 5

TOTAL SHEETS: \_\_\_\_\_



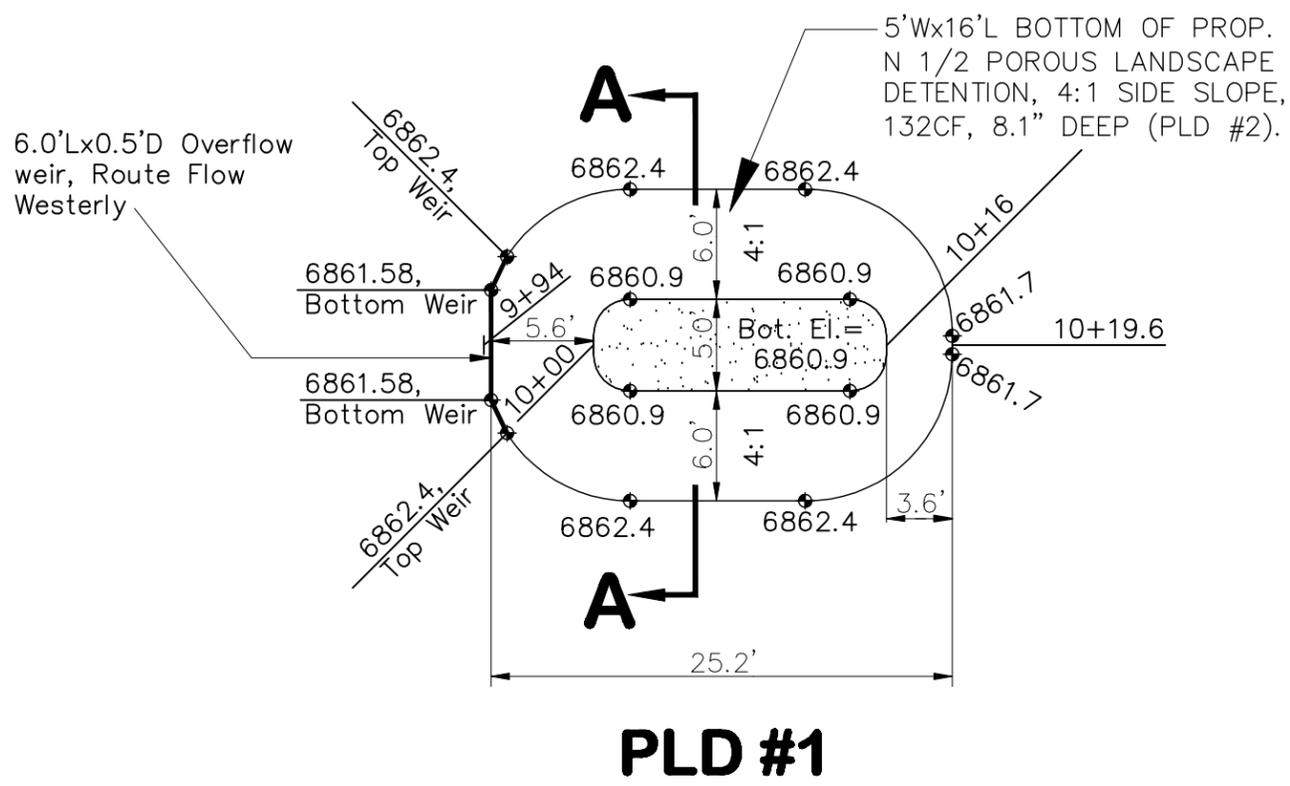
**PLD #1  
OVERFLOW WEIR**

**PLD #1  
SECTION A-A**  
18" MIN. DEPTH,  
75% ASTM C-33 SAND,  
25% PEAT MIX, WITH A  
3" SANDY LOAM TURF  
LAYER  
9" GRAVEL LAYER (CDOT  
SECT. 703, AASHTO #8  
COARSE AGGREGATE)

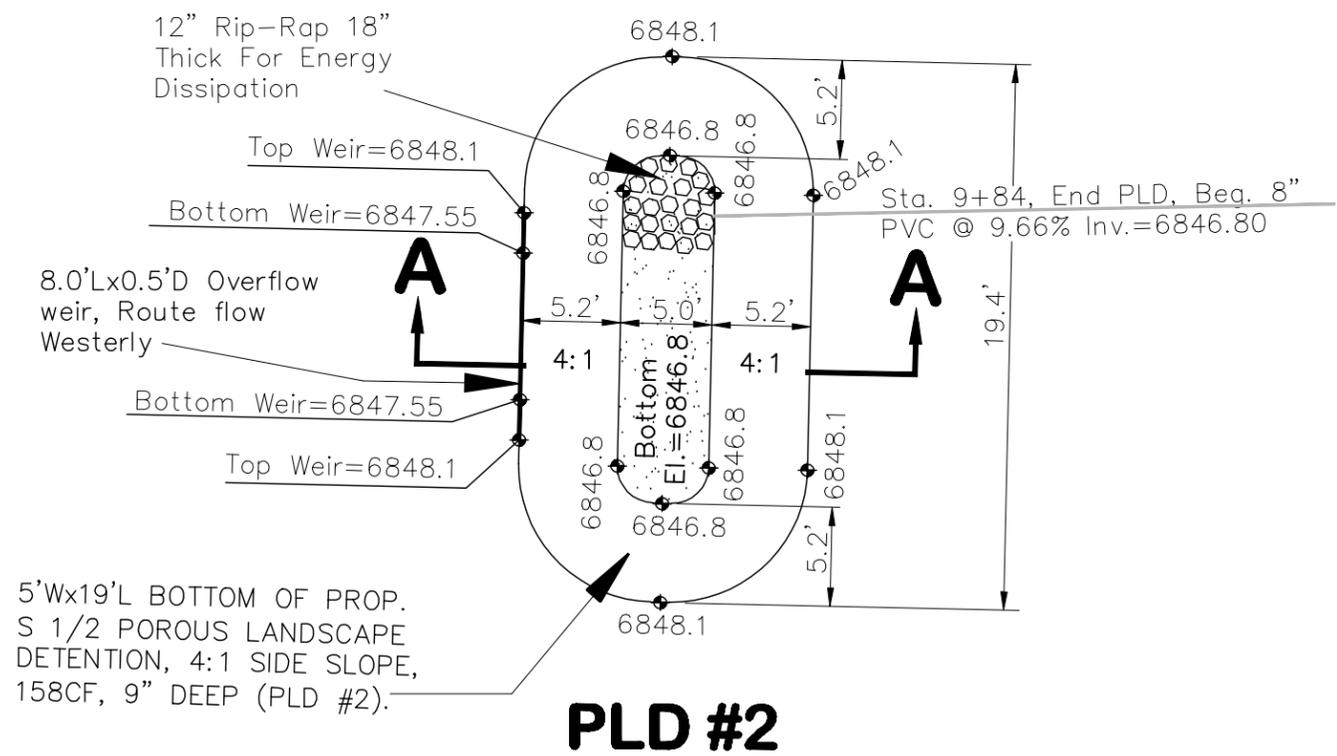


**PLD #2  
OVERFLOW WEIR**

**PLD #2  
SECTION A-A**  
18" MIN. DEPTH,  
75% ASTM C-33 SAND,  
25% PEAT MIX, WITH A  
3" SANDY LOAM TURF  
LAYER  
9" GRAVEL LAYER (CDOT  
SECT. 703, AASHTO #8  
COARSE AGGREGATE)



**PLD #1**



**PLD #2**