

April 11, 2019

Platte Valley Commercial Corp.  
4900 Main St.  
Kansas City, MO. 64112

**Re: Notification of proposed changes to the FEMA Flood Insurance Rate Map (FIRM) and proposed changes to the floodway for Happy Canyon Creek associated with the Belford Avenue Bridge and Happy Canyon Creek Project.**

**Notice for Property: No Address, Parcel #: 2233-050-00-009**

To Whom It May Concern,

The Flood Insurance Rate Map (FIRM) for a community depicts the Special Flood Hazard Area (SFHA), the area which has been determined to be subject to a 1% (100-year) or greater chance of flooding in any given year. The floodway is the portion of the floodplain that includes the channel of a river or other watercourse and the adjacent land area that must be reserved in order to discharge the 1% annual chance (base) flood without cumulatively increasing the water-surface elevation by more than a designated height. The FIRM is used to determine flood insurance rates and to help the community with floodplain management.

Belford South Metropolitan District is applying for a Conditional Letter of Map Revision (CLOMR) from the Federal Emergency Management Agency (FEMA) to revise FIRM's 08035C0062G and 08035C0066G for the Town of Parker, Douglas County, Colorado. Manhard Consulting Ltd is proposing a new bridge structure over Happy Canyon Creek that will connect Belford Avenue from S. Peoria St. to the west to S. Chambers Road to the east. The Belford Ave. Bridge structure will be built in phases. The first phase includes the eastbound roadway lanes, sidewalk and southern half of the bridge structure. A future phase will include the westbound lanes, sidewalk and remaining north half of the bridge structure.

The proposed project will result in increases in the 1% annual chance (base) water-surface elevations for a portion of Happy Canyon Creek, when comparing existing conditions to proposed conditions. A rise does occur on your property.

Once the project has been completed, a Letter of Map Revision (LOMR) request should be submitted that will, in part, revise the following flood hazards along Happy Canyon Creek.

1. The floodway will be revised from downstream (north) of E-470 to north of Filbert Avenue along Happy Canyon Creek.
2. Base Flood Elevations (BFEs) will both increase and decrease along Happy Canyon Creek. On your property, the BFEs will increase.
3. The SFHA will both increase and decrease along Happy Canyon Creek. On your property, the SFHA will increase about 0.5 feet.

This letter is to inform you of the proposed project that may affect flood elevations on your property at Parcel #: 2233-050-00-009 located in Douglas County, Colorado. This letter is also to inform you of the potential changes to the effective flood hazard information that would result after the project is completed and a LOMR request is submitted to FEMA.

Maps and detailed analysis of the proposed flood hazard revisions can be reviewed at the Town of Parker at 20120 E. Mainstreet, Parker, CO 80138. If you have any questions or concerns about the proposed project or its effect on your property, you may contact Mr. Rick Moore at either 303-708-

0500 or by email at [rick.moore@manhard.com](mailto:rick.moore@manhard.com) or Mr. Jacob James at the Town of Parker at 303-840-9546.

Sincerely,

Michael Vickers  
Belford South Metropolitan District 8390  
East Crescent Parkway, Suite 500  
Greenwood Village, CO 80111



## UDFCD DLOMC Submittal - BFE Comparison Table

<b>Project Name :</b>	115360-01 Compark/Belford Avenue
<b>Flooding Source:</b>	Happy Canyon Creek
<b>Company:</b>	Felsburg Holt & Ullevig
<b>Completed By:</b>	ZJG

SOURCE DATA											COMPARISONS				
HYDRAULIC CROSS-SECTION INFO.						BASE FLOOD ELEVATIONS (NAVD)									
Effective Cross-Section ID (Letter)	Corrected Effective Cross-Section ID	Corrected Effective Stream Station	Existing Cross-Section ID	Proposed Cross-Section ID	Proposed Stream Station	EFFECTIVE	DUP. EFF.	COR. EFF.	EXISTING	PROPOSED	DUP. EFF vs. EFF.	COR. EFF. vs. EFF.	EX. vs. COR. EFF.	PP. vs. COR. EFF.	PP. vs. EFF.
						BFE	BFE	BFE	BFE	BFE	BFE	BFE	BFE	BFE	BFE
10111	10111	10111	10111	10111	10111	5767.4	5767.4	5767.4	5767.4	5767.4	0.0	0.0	0.0	0.0	0.0
10157	10157	10157	10157	10157	10157	5767.9	5767.9	5767.9	5767.9	5767.9	0.0	0.0	0.0	0.0	0.0
10326	10326	10326	10326	10326	10326	5768.5	5768.5	5768.5	5768.5	5768.5	0.0	0.0	0.0	0.0	0.0
10548	10548	10548	10548	10548	10548	5770.4	5770.4	5770.5	5770.5	5770.5	0.0	0.0	0.0	0.0	0.1
10595	10595	10597	10595	10595	10597	5771.3	5771.3	5772.1	5772.1	5772.1	0.0	0.8	0.0	0.0	0.8
10679	10679	10691	10679	10679	10691	5772.1	5772.1	5772.5	5772.5	5772.5	0.0	0.4	0.0	0.0	0.4
-	10725	10735	10725	10725	10735	5773.8	5773.8	5775.0	5775.0	5775.6	0.0	1.3	0.0	0.6	1.8
10749	-	-	-	-	-	5774.9	5774.9	5775.4	5775.4	5775.9	0.0	0.4	0.0	0.5	1.0
-	-	-	-	10750	10764	5774.9	5774.9	5775.4	5775.4	5775.9	0.0	0.4	0.0	0.6	1.0
-	10775	10786	10775	-	-	5774.9	5774.9	5775.7	5775.7	5776.0	0.0	0.8	0.0	0.3	1.1
-	-	-	-	10810	10823	5774.9	5774.9	5775.6	5775.6	5776.1	0.0	0.6	0.0	0.6	1.2
-	-	-	-	10819	10833	5775.0	5775.0	5775.6	5775.6	5776.1	0.0	0.6	0.0	0.6	1.2
-	-	-	-	10825	10838	5775.0	5775.0	5775.5	5775.5	5776.2	0.0	0.5	0.0	0.6	1.2
10842	10842	10856	10842	-	-	5775.0	5775.0	5775.5	5775.5	5776.1	0.0	0.5	0.0	0.7	1.2
-	10900	10922	10900	10900	10915	5774.9	5774.9	5775.7	5775.7	5776.0	0.0	0.8	0.0	0.3	1.1
10974 (K)	10974	10995	10974	10974	10989	5774.9	5774.9	5775.5	5775.5	5776.0	0.0	0.6	0.0	0.5	1.1
-	11100	11050	11100	11100	11043	5774.9	5774.9	5775.4	5775.4	5776.1	0.0	0.5	0.0	0.7	1.2
11153	11153	11187	11153	-	-	5774.8	5774.8	5775.7	5775.7	5776.3	0.0	0.9	0.0	0.6	1.5
-	11180	11230	11180	11180	11215	5774.9	5774.9	5775.5	5775.5	5776.4	0.0	0.6	0.0	0.9	1.5
-	11280	11321	11280	11280	11312	5775.0	5775.0	5776.0	5776.0	5776.5	0.0	1.0	0.0	0.4	1.5
-	11370	11424	11370	11370	11411	5775.4	5775.4	5776.3	5776.3	5776.4	0.0	0.9	0.0	0.1	1.0
-	11385	11440	11385	11385	11426	5775.8	5775.8	5776.5	5776.5	5776.3	0.0	0.7	0.0	-0.1	0.5
-	11400	11458	11400	11400	11441	5775.8	5775.8	5776.5	5776.5	5776.5	0.0	0.7	0.0	-0.1	0.7
-	11410	11465	11410	11410	11447	5775.9	5775.9	5776.6	5776.6	5776.5	0.0	0.7	0.0	-0.1	0.6
11494	11494	11544	11494	11494	11526	5776.8	5776.8	5777.2	5777.2	5777.1	0.0	0.4	0.0	-0.1	0.3
11620	11620	11680	11620	11620	11662	5779.3	5779.3	5779.7	5779.7	5779.7	0.0	0.4	0.0	0.0	0.3
11772 (L)	11772	11836	11772	-	-	5779.4	5779.4	5779.7	5779.7	5779.7	0.0	0.3	0.0	0.0	0.3
-	-	-	-	11800	11818	5779.5	5779.5	5779.8	5779.8	5779.8	0.0	0.3	0.0	0.0	0.3
-	-	-	-	11830	11979	5779.6	5779.6	5779.9	5779.9	5779.7	0.0	0.3	0.0	-0.2	0.1
-	-	-	-	11835	12011	5779.7	5779.7	5780.0	5780.0	5779.7	0.0	0.3	0.0	-0.2	0.1
11959	11959	12030	11959	11959	12017	5780.1	5780.1	5781.0	5781.0	5781.1	0.0	0.9	0.0	0.1	1.0
12129	12129	12213	12129	12129	12194	5781.6	5781.6	5783.0	5783.0	5783.0	0.0	1.3	0.0	0.0	1.3
12388	12388	12478	12388	12388	12460	5782.8	5782.8	5782.8	5782.8	5782.8	0.0	0.0	0.0	0.1	0.0
12541 (M)	12541	12631	12541	12541	12613	5784.7	5784.7	5784.7	5784.7	5784.4	0.0	0.0	0.0	-0.3	-0.3

-- = Not applicable or no direct comparison available

In anticipation, the FHAD Model was taken to be Effective in this comparison. Flows used were the 100-yr Future Flows (Q=8355 cfs @ E-470)



# UDFCD LOMC AGREEMENT TABLE

**PROJECT NAME:** 115360-01 Compark/Belford Avenue

**COMPANY:** Felsburg Holt & Ullevig

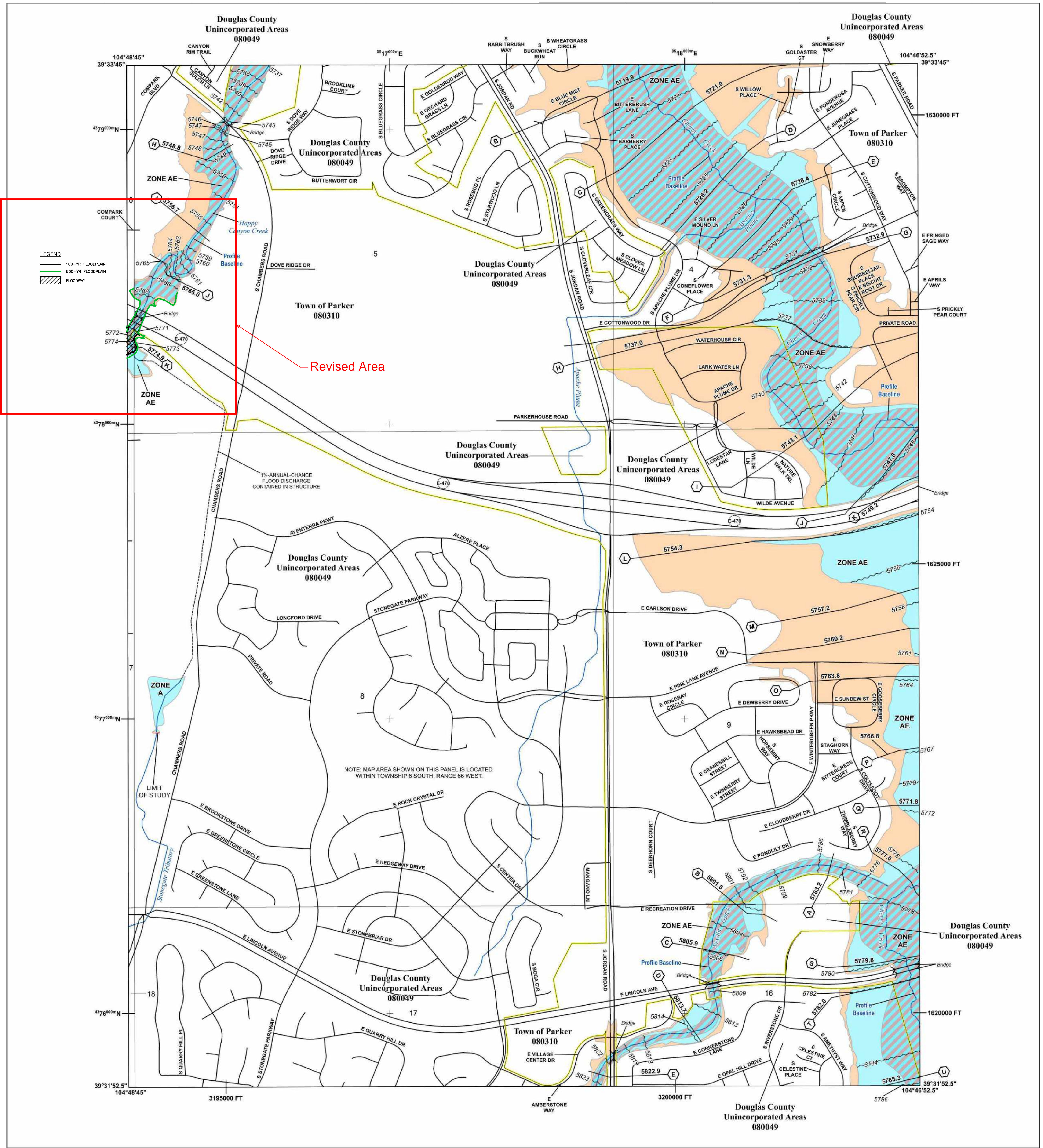
**COMPLETED BY:** ZJG

**Community(ies):** Town of Parker & Douglas County, CO  
**Flooding Source(s):** Happy Canyon Creek

**Page:** 1 **of** 1  
**Date:** 4/19/2019

Reference Location	Stream Station	Cross Section #	Channel Distance (ft)			Cumulative Channel Distance (ft)			Base Floodplain Width (ft)			Floodway Width (ft)			Comments
			Model	Map	% Difference	Model	Map	% Difference	Model	Map	Difference (ft)	Model	Map	Difference (ft)	
		10111	0	0	#DIV/0!	0	0	#DIV/0!	459	448	11	459	448	11	*
		10157	45	45	0%	45	45	0%	264	241	23	264	241	23	*
D/S XS - E-470 Bridge		10326	169	169	0%	214	214	0%	92	91	1	92	91	1	*
U/S XS - E-470 Bridge		10548	223	223	0%	437	437	0%	116	117	1	116	117	1	*
		10595	46	48	4%	484	486	0%	121	140	19	121	140	19	*
		10679	94	94	0%	578	580	0%	104	110	6	104	110	6	*
		10725	43	44	2%	620	623	1%	185	185	0	185	185	0	*
D/S XS - E-470 Trail Crossing		10750	29	29	0%	650	653	1%	219	221	1	219	221	1	*
U/S XS - E-470 Trail Crossing		10810	59	59	0%	708	711	0%	285	284	1	285	284	1	*
		10819	9	9	5%	717	721	1%	292	291	0	292	291	0	*
		10825	6	6	4%	723	727	0%	295	291	4	295	291	4	*
		10900	77	76	1%	800	803	0%	245	250	5	245	250	5	*
		10974	74	74	0%	874	877	0%	205	211	6	205	211	6	*
D/S XS - Belford Avenue		11100	54	54	0%	928	931	0%	168	168	0	168	168	0	*
U/S XS - Belford Avenue		11180	168	169	0%	1097	1100	0%	179	183	4	179	183	4	*
		11280	87	86	1%	1183	1186	0%	186	187	0	186	187	0	*
		11370	66	66	0%	1249	1252	0%	185	192	7	185	192	7	*
		11385	15	15	0%	1264	1267	0%	171	172	1	171	172	1	*
		11400	15	15	0%	1279	1282	0%	164	162	2	164	162	2	*
		11410	6	6	0%	1285	1288	0%	159	159	0	159	159	0	*
		11494	128	129	0%	1414	1416	0%	127	124	3	127	124	3	*
		11620	136	136	0%	1550	1552	0%	236	240	4	236	240	4	*
		11800	179	179	0%	1729	1732	0%	200	200	1	200	200	1	*
		11830	30	32	5%	1759	1763	0%	203	203	0	203	203	0	*
		11835	6	6	0%	1765	1769	0%	202	203	1	202	203	1	*
		11959	130	130	0%	1895	1899	0%	209	209	1	209	209	1	*
		12129	182	182	0%	2077	2082	0%	303	295	8	303	295	8	*
		12388	259	266	3%	2336	2347	0%	353	342	11	353	342	11	*
		12541	153	153	0%	2489	2500	0%	477	487	10	477	487	10	*
<b>ACCEPTABLE TOLERANCES =</b>			<b>+/- 5% of Model</b>			<b>+/- 5% of Model</b>			<b>+/- 25 Feet</b>						

\* - Floodway = Floodplain



**FLOOD HAZARD INFORMATION**

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP  
 THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING  
 DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT  
[HTTP://MSC.FEMA.GOV](http://MSC.FEMA.GOV)

	Without Base Flood Elevation (BFE) Zone A, V, A99
	With BFE or Depth Zone AE, AO, AH, VE, AR
	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
	NO SCREEN Areas of Minimal Flood Hazard Zone X
	Area of Undetermined Flood Hazard Zone D
	Channel, Culvert, or Storm Sewer Accredited or Provisionally Accredited Levee, Dike, or Floodwall
	Non-accredited Levee, Dike, or Floodwall
	Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
	Coastal Transect
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
	Base Flood Elevation Line (BFE)
	Limit of Study
	Jurisdiction Boundary

**NOTES TO USERS**

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2827) or visit the FEMA Map Service Center website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map data for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

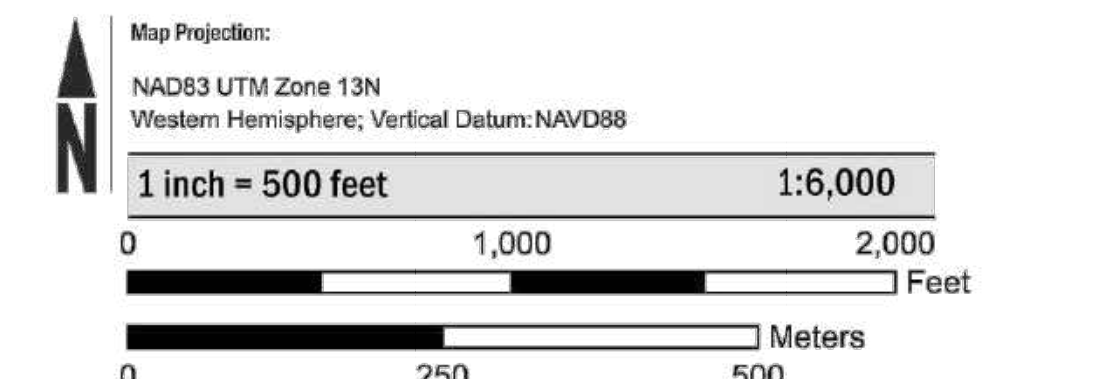
Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction. To determine if flood insurance is available in the community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on this FIRM was provided by the Douglas County GIS Department and the Town of Castle Rock GIS Department. Additional input was provided by the City of Lone Tree and Town of Parker. These data are current as of 2003.

LOGO

**SCALE**



**PANEL LOCATOR**

		0058	0059*	0078*
0061	0062	0066	0067	0086
0063	0064	0068	0069	0088

\* PANEL NOT PRINTED

**FEMA**  
 National Flood Insurance Program

**NATIONAL FLOOD INSURANCE PROGRAM**  
 FLOOD INSURANCE RATE MAP

**DOUGLAS COUNTY, COLORADO**  
 And Incorporated Areas  
 PANEL 66 OF 495

Panel Contains:

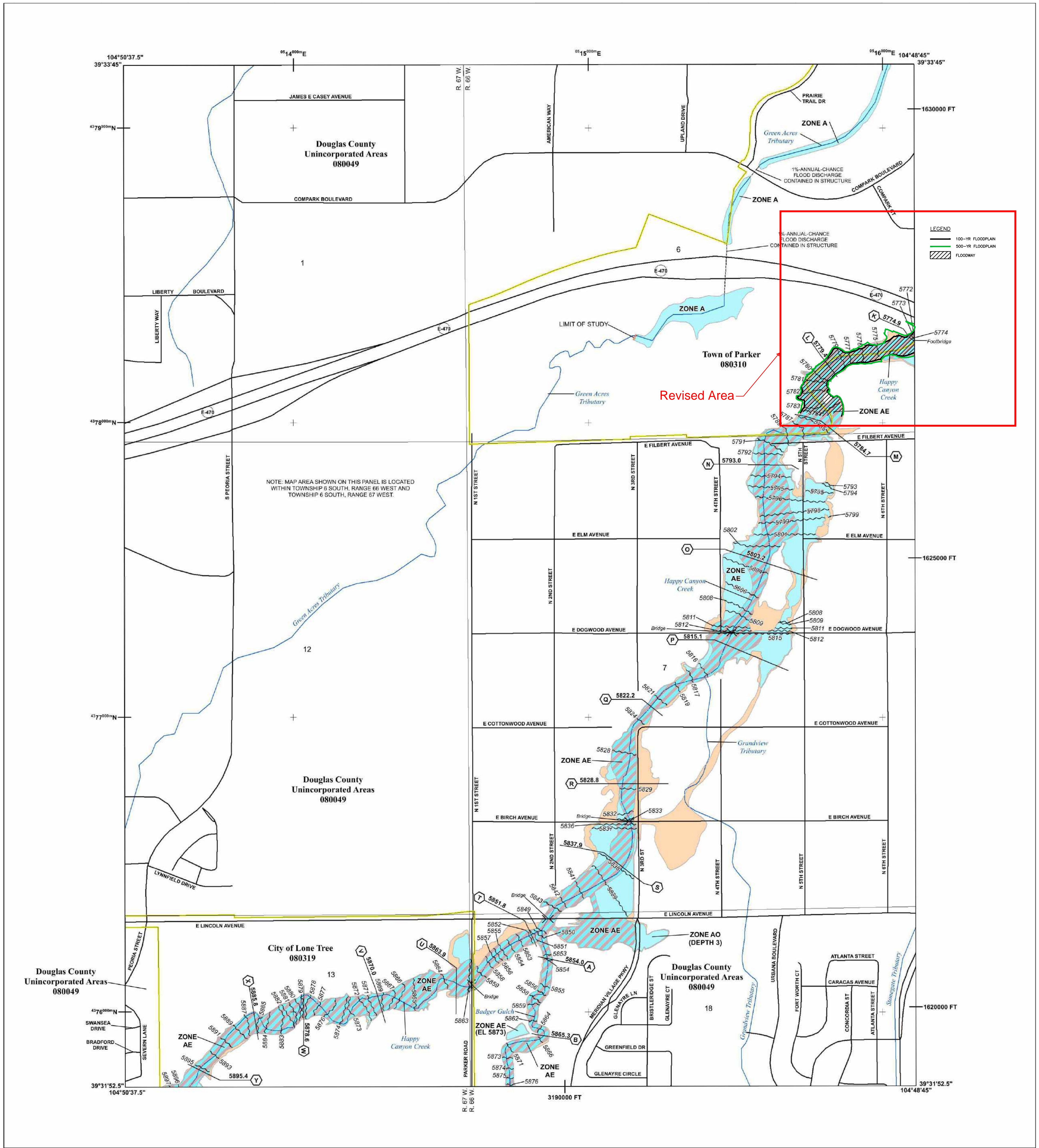
COMMUNITY	NUMBER	PANEL	SUFFIX
DOUGLAS COUNTY	080049	0066	H
PARKER, TOWN OF	080310	0066	H

PRELIMINARY  
 JUNE 30, 2016

VERSION NUMBER  
 2.3.3.2

MAP NUMBER  
 08035C0066H

MAP REVISED



**FLOOD HAZARD INFORMATION**

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT  
**THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTP://MSC.FEMA.GOV](http://MSC.FEMA.GOV)**

	Without Base Flood Elevation (BFE) Zone A, V, A99
	With BFE or Depth Zone AE, AO, AH, VE, AR
	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
	NO SCREEN Areas of Minimal Flood Hazard Zone X
	Area of Undetermined Flood Hazard Zone D
	Channel, Culvert, or Storm Sewer
	Levee, Dike, or Floodwall
	Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
	Coastal Transect
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
	Base Flood Elevation Line (BFE)
	Limit of Study
	Jurisdiction Boundary

**NOTES TO USERS**

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP) in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website.

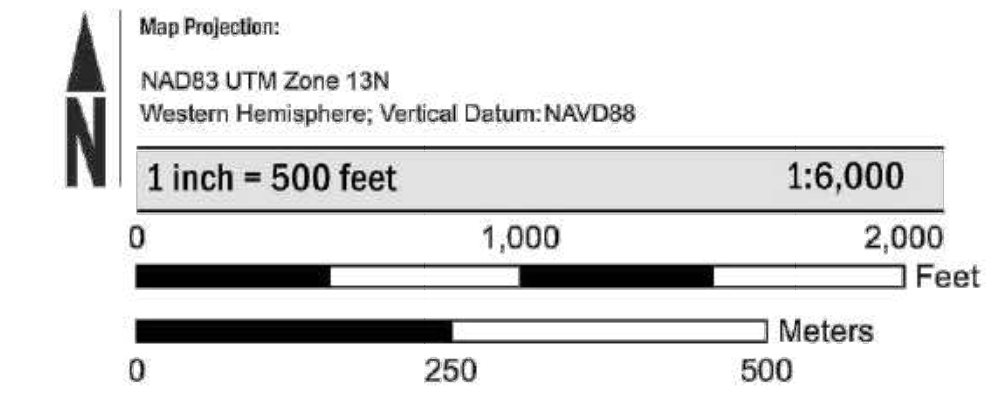
Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction.

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

Base map information shown on this FIRM was provided by the Douglas County GIS Department and the Town of Castle Rock GIS Department. Additional input was provided by the City of Lone Tree and Town of Parker. These data are current as of 2003.

**SCALE**



**PANEL LOCATOR**

	0054	0058	0059*	
0042	0061	<b>0062</b>	0066	0067
0044	0063	0064	0068	0069

\* PANEL NOT PRINTED

**National Flood Insurance Program**

**NATIONAL FLOOD INSURANCE PROGRAM**  
**FLOOD INSURANCE RATE MAP**

**DOUGLAS COUNTY, COLORADO**  
 and Incorporated Areas

PANEL 62 OF 495

Panel Contains:

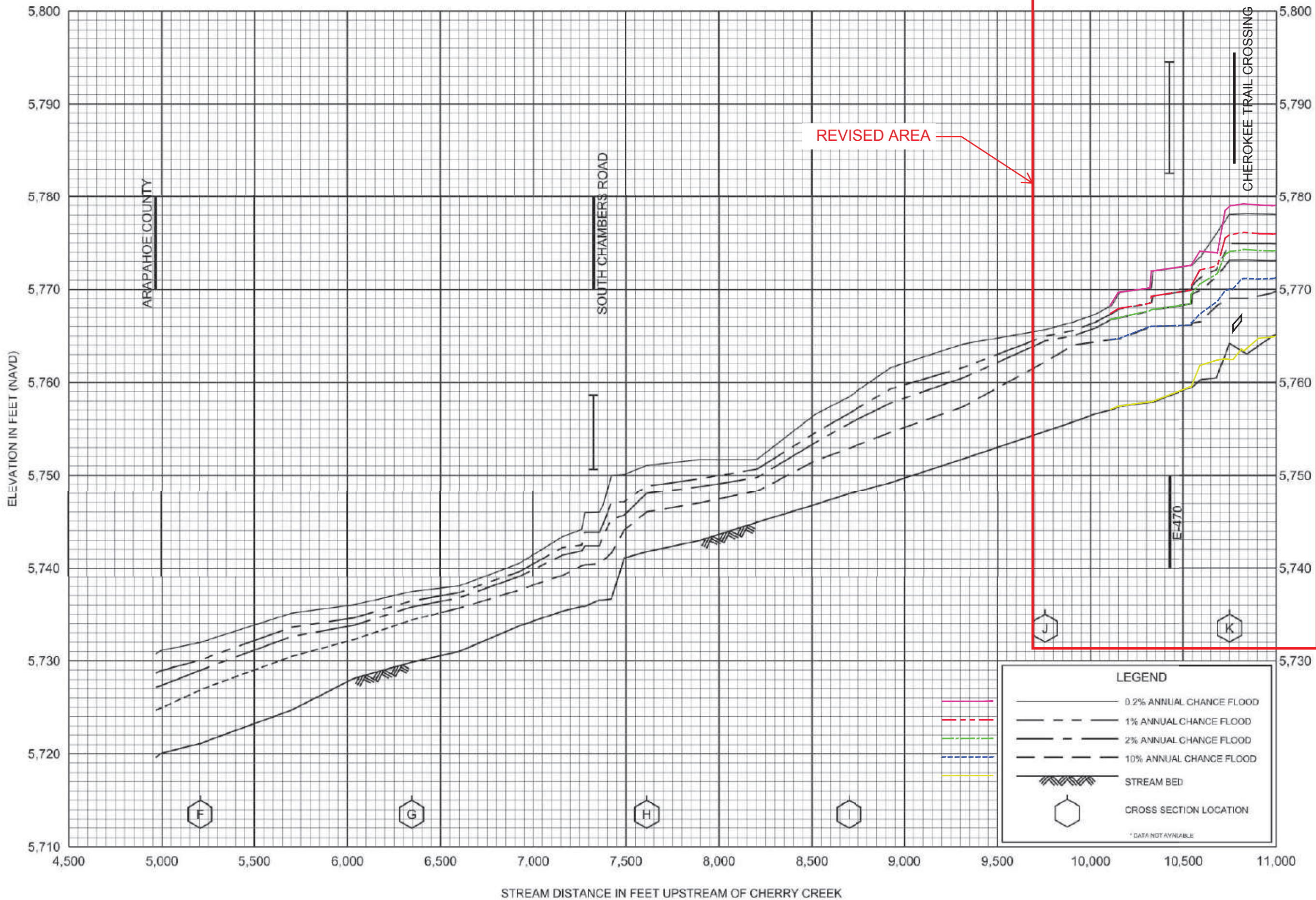
COMMUNITY	NUMBER	PANEL	SUFFIX
DOUGLAS COUNTY	080049	0062	H
LONE TREE, CITY OF	080319	0062	H
PARKER, TOWN OF	080310	0062	H

**REVISED PRELIMINARY**  
**12/13/2018**

VERSION NUMBER  
**2.3.3.2**

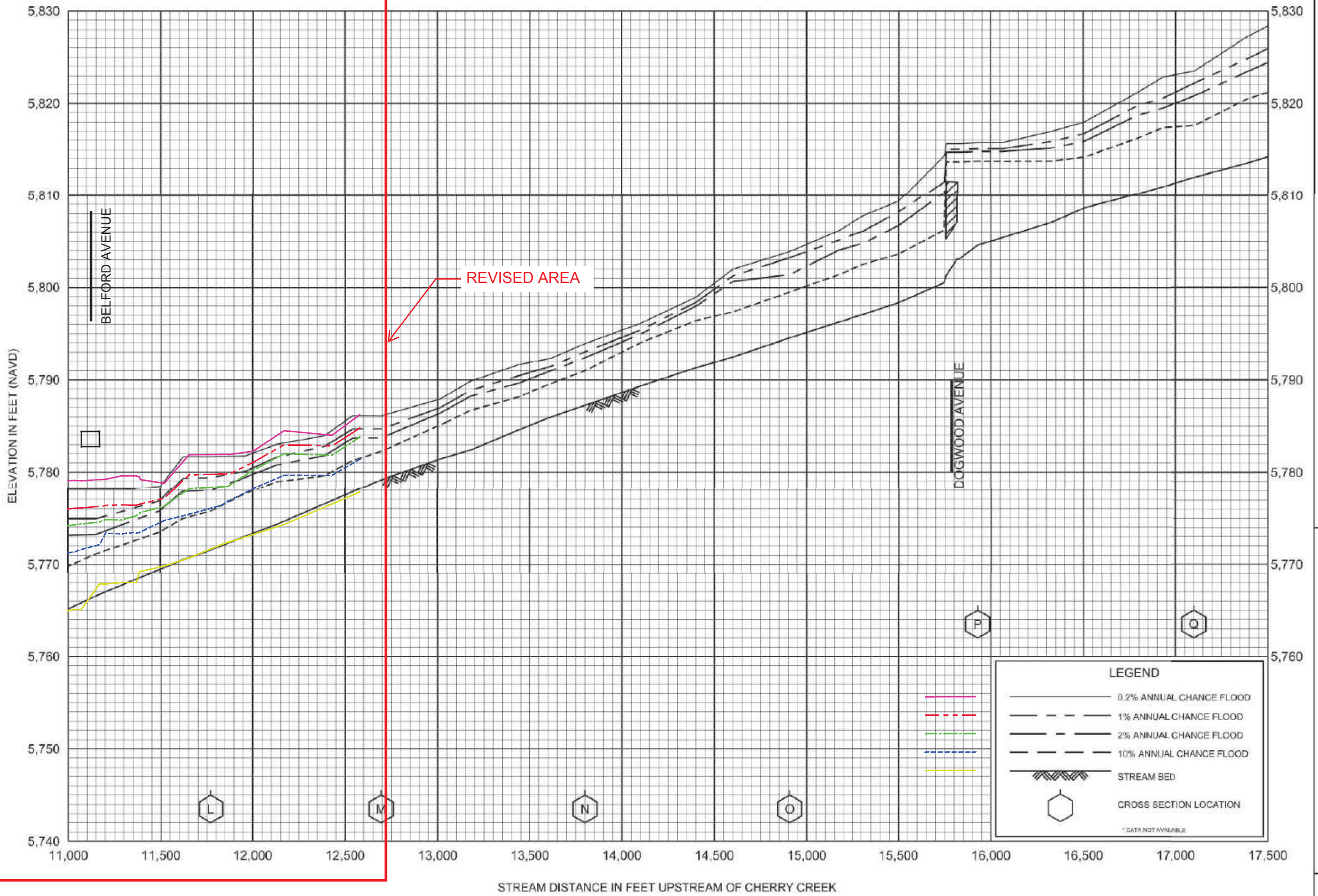
MAP NUMBER  
**08035C0062H**

MAP REVISED



FLOOD PROFILES  
HAPPY CANYON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY  
DOUGLAS COUNTY, CO  
AND INCORPORATED AREAS



FLOOD PROFILES

HAPPY CANYON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO  
AND INCORPORATED AREAS

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE <sup>1</sup>	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Happy Canyon Creek								
F	5,206	245	859	14.2	5,730.1	5,730.1	5,730.1	0.0
G	6,345	418	1,378	7.5	5,736.4	5,736.4	5,736.4	0.0
H	7,611	327	1,467	8.5	5,748.8	5,748.8	5,748.8	0.0
I	8,700	114	706	14.7	5,756.7	5,756.7	5,756.7	0.0
J	9,756	378	1,459	6.6	5,765.0	5,765.0	5,765.0	0.0
K	10,750	219	1,813	6.1	5,775.9	5,775.9	5,775.9	0.0
L	11,772	200	1,018	10.9	5,779.8	5,779.8	5,779.8	0.0
M	12,541	476	1,850	4.5	5,784.3	5,784.3	5,784.3	0.0
N	13,800	231	1,043	10.5	5,793.0	5,793.0	5,793.4	0.4
O	14,907	346	1,173	12.4	5,803.2	5,803.2	5,803.2	0.0
P	15,928	427	1,982	4.2	5,815.1	5,815.1	5,815.6	0.5
Q	17,100	90	605	16.6	5,822.2	5,822.2	5,822.3	0.1
R	18,063	205	968	12.8	5,828.8	5,828.8	5,828.8	0.0
S	19,040	233	1,778	4.3	5,837.9	5,837.9	5,838.4	0.5
T	20,347	160	914	7.0	5,851.8	5,851.8	5,851.8	0.0
U	21,423	315	1,808	5.5	5,863.9	5,863.9	5,863.9	0.0
V	22,534	207	740	14.7	5,870.0	5,870.0	5,870.0	0.0
W	23,660	270	905	12.7	5,878.6	5,878.6	5,878.6	0.0
X	24,604	241	805	13.6	5,885.8	5,885.8	5,885.8	0.0
Y	25,498	202	1,010	11.0	5,895.4	5,895.4	5,895.4	0.0
Z	26,842	220	681	11.5	5,906.5	5,906.5	5,906.5	0.0
AA	27,900	165	732	8.5	5,918.4	5,918.4	5,918.4	0.0
AB	29,034	415	1,552	3.9	5,932.4	5,932.4	5,932.4	0.0
AC	29,970	103	503	11.4	5,940.5	5,940.5	5,940.5	0.0

Revised Area

<sup>1</sup> Feet above confluence with Cherry Creek

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY  
**ARAPAHOE COUNTY, CO**  
**AND INCORPORATED AREAS**

FLOODWAY DATA

**HAPPY CANYON CREEK**

Vratio

$$V_{shear} / V_{fall} = V_* / w$$

$$V_{shear} = V_* = (g y, S, )^{1/2}$$

$$V_{*100} = (32.16 * 8.49 * 0.002589)^{1/2} = 0.84$$

$$V_{*500} = (32.16 * 11.45 * 0.00166)^{1/2} = 0.78$$

$$d_{50} \text{ size} = 0.005 \text{ ft (1.5 mm)}$$

$$V_{fall} = w = 0.7$$

$$V_{ratio100} = V_{*100} / w = 0.84 / 0.7 = 1.2$$

$$V_{ratio500} = V_{*500} / w = 0.78 / 0.7 = 1.1$$

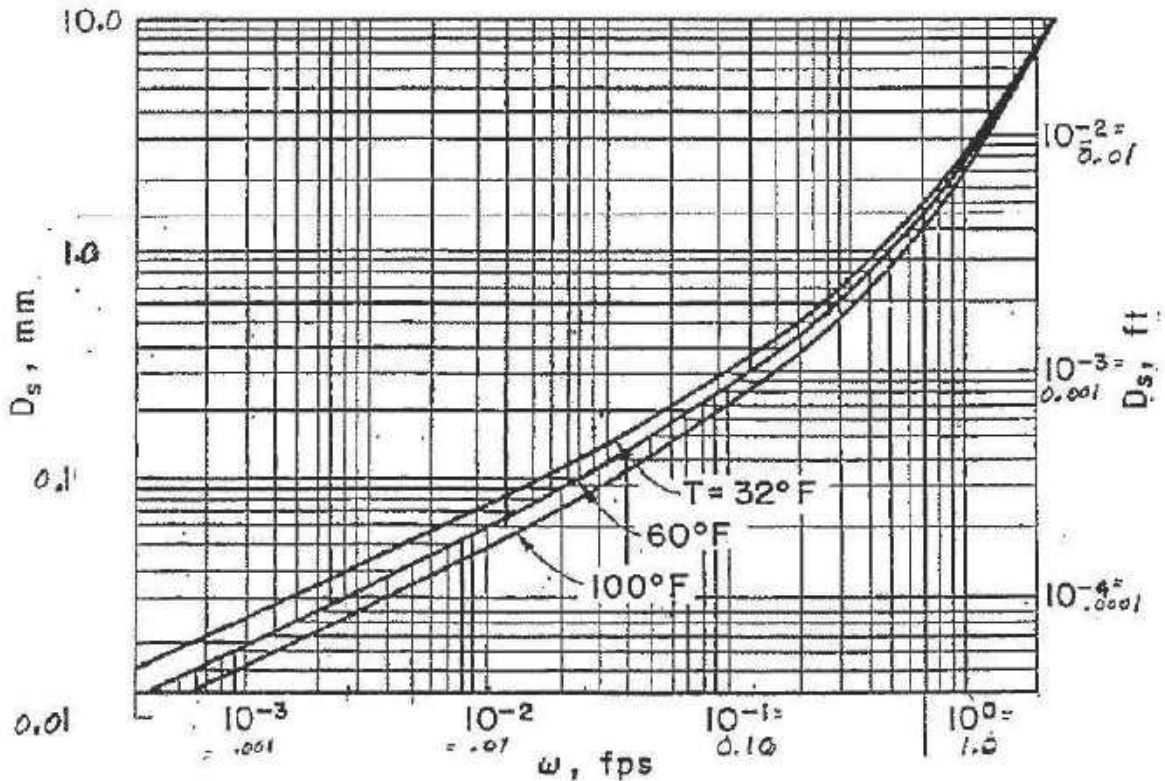


Figure 3. Fall Velocity of Sand-Sized Particles.

Determine if Contraction Scour is live bed or clear water

$$V_c = \frac{\text{Critical Velocity}}{11.52} y_1^{1/6} D_{50}^{1/3}$$

Upstream flow depth

$$V_{c100} = \frac{11.17}{11.52} \times 8.49^{1/6} \times 0.005^{1/3} = 2.73$$

$$V_{100 \text{ main channel}} = 8.21 \therefore \text{Live Bed Scour}$$

If  $V_{c100} < V_{100 \text{ MC}}$  then Live Bed Scour

If  $V_{c100} > V_{100 \text{ MC}}$  then Clear Water

$$V_{c500} = \frac{11.17}{11.52} \times 11.45^{1/6} \times 0.005^{1/3} = 2.87$$

$$V_{500 \text{ MC}} = 8.24 \therefore \text{Live Bed Scour}$$

CLEAR WATER SCOUR

Avg. Scour Depth  $y_s = \left[ \frac{Q^2}{120 D_m^{2/3} W^2} \right]^{3/7} - y_1$

$\left[ \frac{Q^2}{120 D_m^{2/3} W^2} \right]^{3/7}$  ———— depth of flow in channel  
 $- y_1$  ————  
 bottom width of bridge less piers (low chord)  
 $1.25 D_{50} = 1.25 * \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$

$y_{s,100} = \left[ \frac{Q^2}{120 * \frac{2}{3} * 2} \right]^{3/7} - \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$  ft.

**DOES NOT APPLY**

$y_{s,500} = \left[ \frac{Q^2}{120 * \frac{2}{3} * 2} \right]^{3/7} - \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$  ft.

LIVE BED SCOUR

$y_2 = \left\{ \frac{Q_2}{Q_1} \right\}^{0.7} * \left\{ \frac{W_1}{W_2} \right\}^{K_1} * (y_1)$   
 Flow in cont. main channel which is often  $Q_{total}$   
 Avg. bottom width of the main channel at approach cross section  
 Avg. depth in upstream main channel  
 Flow in approach main channel that transports sediment  
 Avg. bottom width of the contracted section.

$V * f_w$	$K_1$
< 0.5	0.59
0.5-2.0	0.64
2.0	0.69

$y_{2(100)} = \left\{ \frac{8303}{8027} \right\}^{0.857} * \left\{ \frac{160}{145} \right\}^{0.64} * 8.49 = 9.31$   
 $y_s = y_2 - y_1 = 9.31 - 8.49 = 0.82'$

$y_{2(500)} = \left\{ \frac{12024}{10913} \right\}^{0.857} * \left\{ \frac{160}{145} \right\}^{0.64} * 11.45 = 13.25$   
 $y_s = y_2 - y_1 = 13.25 - 11.45 = 1.8'$

Contraction Scour  
 100 yr =  $\frac{0.82'}{1}$   
 500 yr =  $\frac{1.8'}{1}$

Clear Water OR  
Live Bed Scour at Abutments

$$Y_s = Y_a \left[ 2.27 K_1 K_2 \left( \frac{a'}{Y_a} \right)^{0.43} \left( \frac{Fr}{Fr_{approach}} \right)^{0.61} + 1 \right]$$

Avg Depth in floodplain  
 Abutment coefficient  
 Coefficient of abutment angle  
 (To ineffective flow boundary)  
 Length of Abutment projected normal to flow  
 Approach Froude No.  
 Avg Depth in floodplain

Vert. wall abut. K=1.00  
 " " " " K=0.92  
 with wing walls SPIII through abut. K=0.55  
 $K_2 = (0/90)^{0.13}$   
 $K_2 = (90/90)^{0.13} = 1.0$

LEFT ABUTMENT

RIGHT ABUTMENT

$$Y_{s_{40}} = \frac{4.91}{40} \left[ 2.27 * 1.0 * 1.0 * \left( \frac{14}{4.91} \right)^{0.43} * \frac{0.7}{0.61} + 1 \right]$$

= 18.98

$$Y_{s_{40}} = \frac{4.91}{40} \left[ 2.27 * 1.0 * 1.0 * \left( \frac{12}{4.91} \right)^{0.43} * \frac{0.7}{0.61} + 1 \right]$$

= 18.08

$$Y_{s_{500}} = \frac{6.79}{500} \left[ 2.27 * 1.0 * 1.0 * \left( \frac{14}{6.79} \right)^{0.43} * \frac{0.49}{0.61} + 1 \right]$$

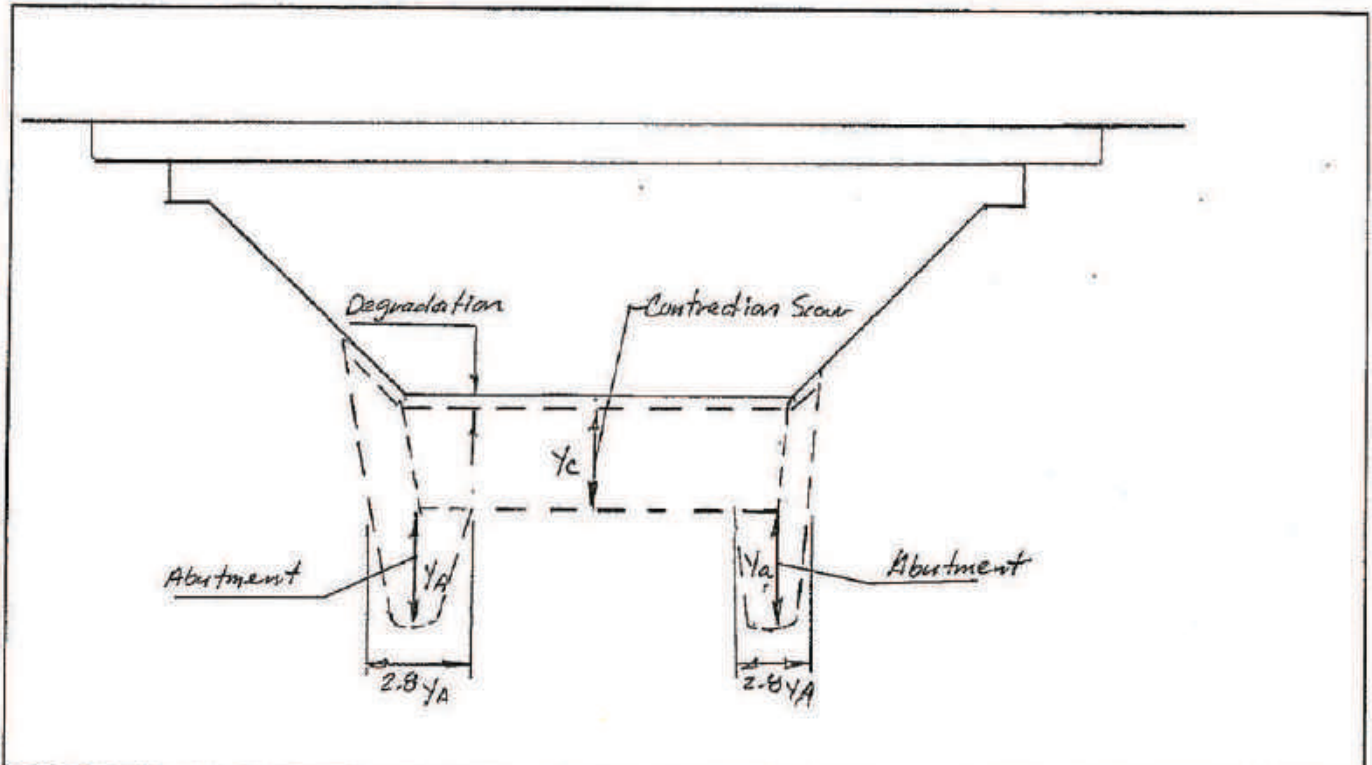
= 20.41

$$Y_{s_{500}} = \frac{6.79}{500} \left[ 2.27 * 1.0 * 1.0 * \left( \frac{12}{6.79} \right)^{0.43} * \frac{0.49}{0.61} + 1 \right]$$

= 19.53

Note:

Per HEC-18, Section 3.3.3, since abutment scour lacks field verification, riprap protection at the abutments makes it unnecessary to design abutments to resist the computed abutment scour depth. Also per HEC-18 Section 4.5.9 "Discussion of Abutment Scour Computations", it is stated that if properly vegetated in the overbanks, channel banks and areas adjacent to the abutment, scour depths as predicted with the Froehlich equation will probably not occur.



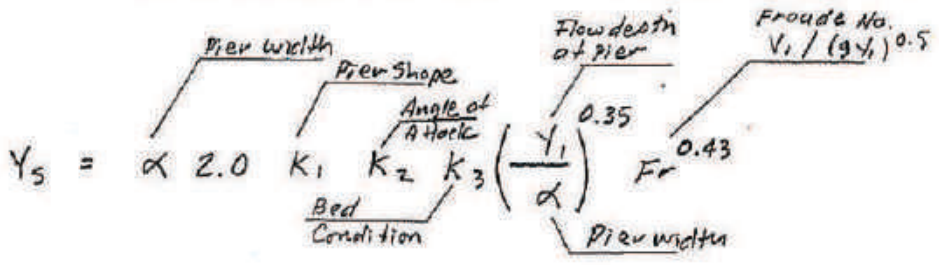
	100-YEAR			500-YEAR		
	LEFT	CHAN.	RT.	LEFT	CH.	RT.
Degradation	0	2.0	0	0	2.0	0
Contraction	0.82	0.82	0.82	1.8	1.8	1.8
Abutment	18.98	—	18.08	20.41	—	19.53
Total	19.8	2.82	18.9	22.21	3.8	21.33

Pier

Local Scour at Pier

100 yr      500 yr  
 $V = \underline{10.3} \text{ fps}$      $\underline{10.1} \text{ fps} = \text{Velocity upstream of the pier}$   
 $Y_1 = \underline{8.1} \text{ ft}$        $\underline{11.25} \text{ ft} = \text{Depth of flow upstream of pier}$

$\frac{D}{3.5 \text{ ft}} = \text{Angle of attack of the flow}$   
 $\frac{21 \text{ ft}}{3.5 \text{ ft}} = \text{Pier width}$   
 $\frac{21 \text{ ft}}{3.5 \text{ ft}} = \text{Pier Length } (3.5 \times 6)$   
 $\frac{1.0}{1.0} = k_1 \text{ Circular}$   
 $\frac{1.0}{1.0} = k_2$   
 $\frac{1.1}{1.1} = k_3$   
 $F_{100} = \underline{0.63}$        $F_{500} = \underline{0.53} = \text{Froude}$




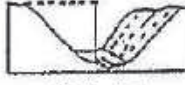
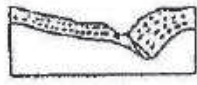
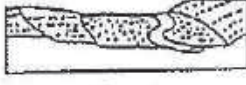
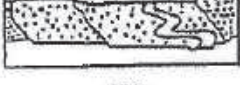





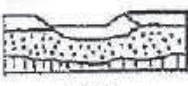






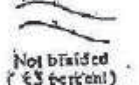

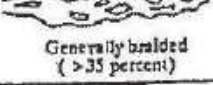
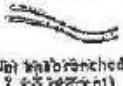

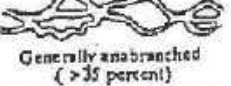
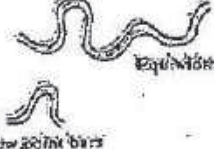

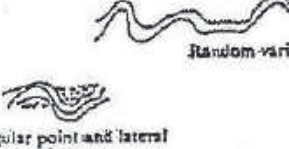


$$Y_{s_{100}} = \frac{3.5 \times 2.0 \times 1.0 \times 1.0 \times 1.1 \times \left(\frac{8.1}{3.5}\right)^{0.35} \times 0.63^{0.43}}{1}$$

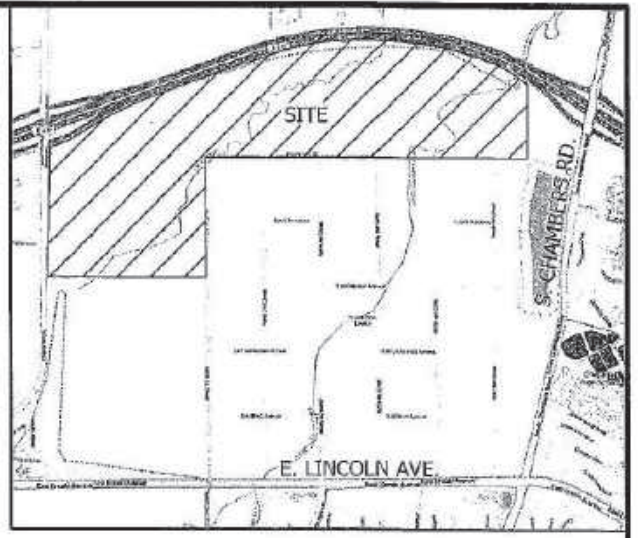
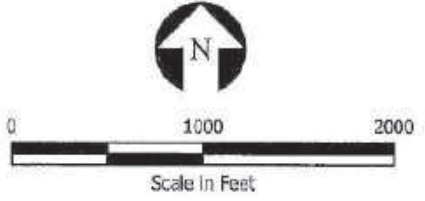
$$= \underline{8.47} \text{ ft.}$$

$$Y_{s_{500}} = \frac{3.5 \times 2.0 \times 1.0 \times 1.0 \times 1.1 \times \left(\frac{11.25}{3.5}\right)^{0.35} \times 0.53^{0.43}}{1}$$

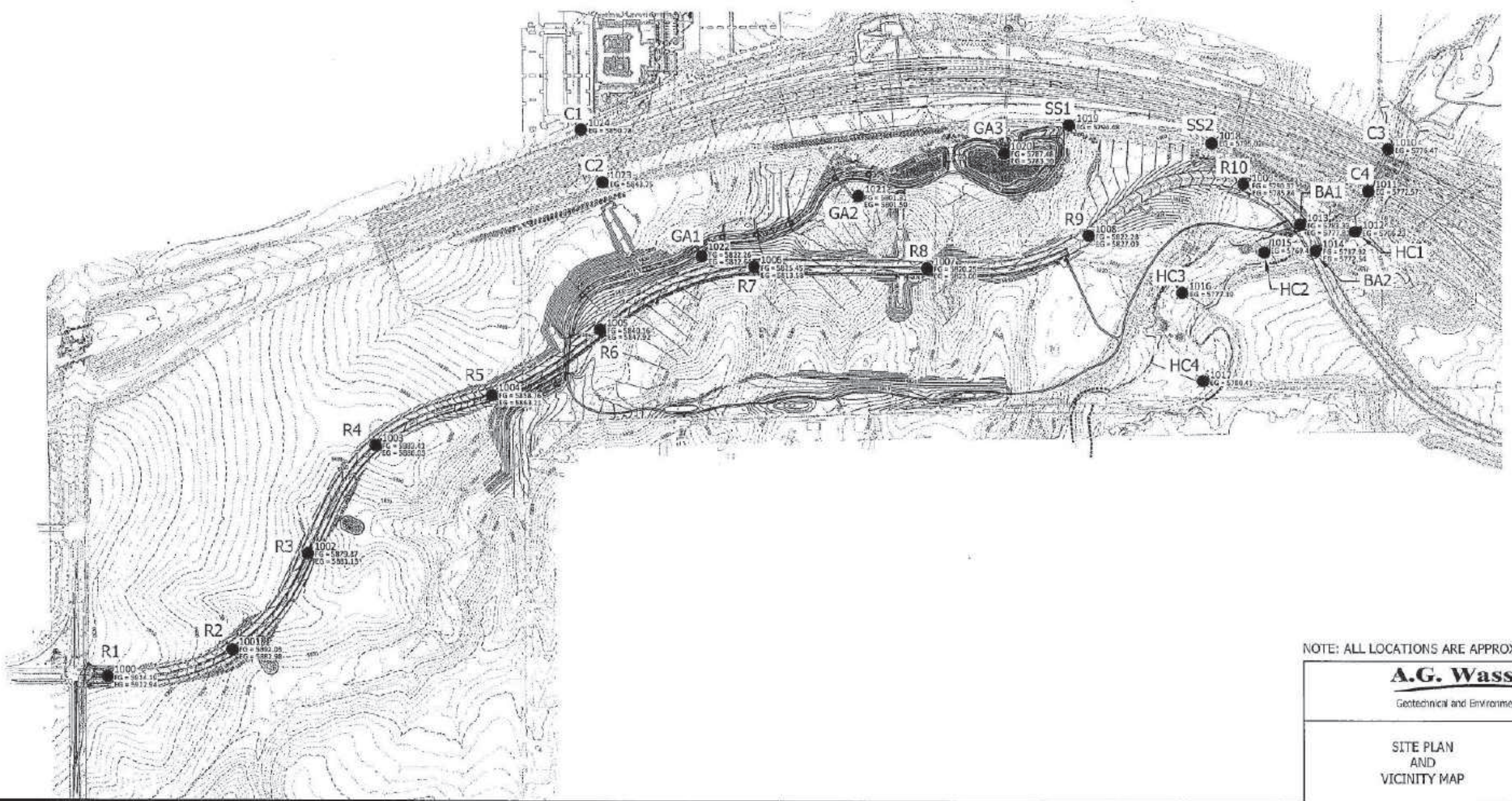
$$= \underline{8.82} \text{ ft.}$$

STREAM SIZE (SECT. 2.2.1)	Small ( < 100 ft. or 30 m wide )	Medium ( 100-500 ft. or 30-150 m )	Wide ( > 500 ft. or 150 m )		
FLOW HABIT (SECT. 2.2.2)	Ephemeral	(Intermittent)	Perennial but flashy	Perennial	
BED MATERIAL (SECT. 2.2.3)	Silt-clay	Silt	Sand	Gravel	Cobble or boulder
VALLEY SETTING (SECT. 2.2.4)	 No valleys; alluvial fan	 Low relief valley ( < 100 ft. or 30 m deep )	 Moderate relief ( 100-1000 ft. or 30-300 m )	 High relief ( > 1000 ft. or 300 m )	
FLOOD PLAINS (SECT. 2.2.5)	 Little or none ( < 2X channel width )	 Narrow ( 2-10 channel width )	 Wide ( > 10X channel width )		
NATURAL LEVELS (SECT. 2.2.6)	 Little or None	 Mainly on Concave	 Well Developed on Both Banks		
APPARENT INCISION (SECT. 2.2.7)	 Not Incised	 Probably Incised			
CHANNEL BOUNDARIES (SECT. 2.2.8)	 Alluvial	 Semi-alluvial	 Non-alluvial		
TREE COVER ON BANKS (SECT. 2.2.9)	< 50 percent of bankline	50-90 percent		> 90 percent	
SINUOSITY (SECT. 2.2.9)	 Straight Sinuosity 1-1.05	 Sinuous (1.06-1.25)	 Meandering (1.25-2.0)	 Highly meandering ( > 2 )	
BRAIDED STREAMS (SECT. 2.2.10)	 Not braided ( < 5 percent )	 Locally braided ( 5-35 percent )	 Generally braided ( > 35 percent )		
ANABRANCHED STREAMS (SECT. 2.2.11)	 Not anabranching ( < 5 percent )	 Locally anabranching ( 5-35 percent )	 Generally anabranching ( > 35 percent )		
VARIABILITY OF WIDTH AND DEVELOPMENT OF BARS (SECT. 2.2.12)	 Narrow point bars	 Wider at bends Wide point bars	 Random variation Irregular point and lateral bars		

## GEOMORPHIC FACTORS THAT AFFECT STREAM STABILITY



VICINITY MAP  
NOT TO SCALE



NOTE: ALL LOCATIONS ARE APPROXIMATE

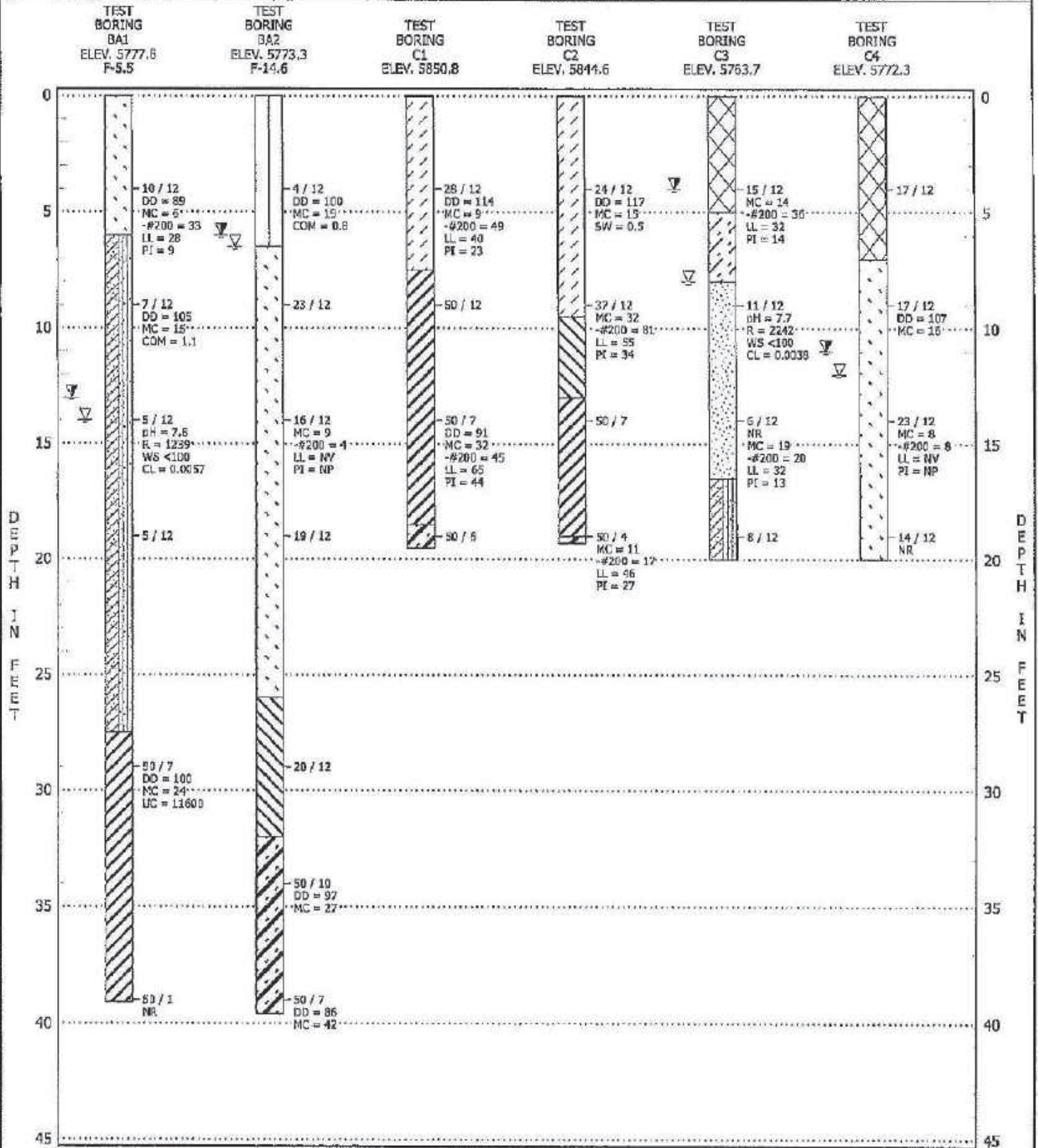
<b>A.G. Wassenaar</b> Geotechnical and Environmental Consultants <b>Inc.</b>	
SITE PLAN AND VICINITY MAP	PROJECT NO. 153733 FIGURE 1

CLIENT 470 Compark, LLC c/o MPV Compark Management, LLC

PROJECT NAME Compark Village South

PROJECT NUMBER 153733

PROJECT LOCATION Parker, Douglas County, Colorado



SEE FIGURE 7 FOR LEGEND AND NOTES TO TEST BORINGS

TEST BORING LOGS  
FIGURE 2



1. Estimate Mannings n For Flows over GSB

When upper **1/2** (+/- 1") of the rock depth (height) is left ungrouted: UDFCD Volume 2 Equation 9-1

$$n_{18^{\circ}-42^{\circ}(1/2)} = \frac{0.097 * (y/D)^{0.16}}{\ln(2.55 * Y/D)}$$

Upper limit:  $n \leq 0.15$  for above equation

~~$$n_{18^{\circ}-42^{\circ}(1/2)} = \frac{0.097 * \text{[Green Box]}^{0.16}}{\ln(2.55 * \text{[Green Box]})} = \frac{0.000}{\#NUM!} = \#NUM!$$~~

When upper **1/3** (+/- 1") of the rock depth (height) is left ungrouted: UDFCD Volume 2 Equation 9-2

$$n_{18^{\circ}-42^{\circ}(2/3)} = \frac{0.086 * y/D^{0.16}}{\ln(2.55 * y/D)}$$

Low-flow  $n$  y= 3  
d= 1.5

$$n_{18^{\circ}-42^{\circ}(2/3)} = \frac{0.086 * \text{[Green Box]}^{0.16}}{\ln(2.55 * \text{[Green Box]})} = \frac{0.096}{1.629} = 0.059$$

2

High-flow  $n$  y= 7.76  
d= 1.5

$$n_{18^{\circ}-42^{\circ}(2/3)} = \frac{0.086 * \text{[Green Box]}^{0.16}}{\ln(2.55 * \text{[Green Box]})} = \frac{0.114}{2.985} = 0.038$$

5.1733

Upper limit:  $n \leq 0.12$  for above equation  
 $y$  = depth of flow above top of rock, in feet  
 $D$  = diameter of the boulder, in feet

Outside the low-flow section

UDFCD Volume 2 Equation 9-7

$$R_p = \frac{V_c * S^{0.17}}{(S_s - 1)^{0.66}}$$

$$R_p = \frac{14.00 * 0.0075^{0.17}}{(2.55 - 1)^{0.66}} = \frac{6.09}{1.34} = 4.56$$

See Table 9-4 below  
Use 18" (B18) grouted boulders for protection outside of the low-flow section.

Within the low-flow section

UDFCD Volume 2 Equation 9-7

$$R_p = \frac{V_c * S^{0.17}}{(S_s - 1)^{0.66}}$$

$$R_p = \frac{9.03 * 0.100^{0.17}}{(2.55 - 1)^{0.66}} = \frac{6.11}{1.34} = 4.57$$

See Table 9-4 below  
Use 18" (B18) grouted boulders for protection within the low-flow section.

$V_c$  = Critical Velocity

$S$  = longitudinal slope along direction of flow in ft/ft

$S_s$  = Specific gravity of rock - assume 2.55

(For drops of 6-feet or less in height, use UD-Channels Spreadsheet to find the 100-year critical velocities in the low-flow and the main channels to size boulders for each section)

Note: This project will use B24 boulders grouted 2/3 of the height. UDFCD recommends a minimum of B24 size due to maintenance concerns.

Table 9-4. Boulder sizes for various rock sizing parameters

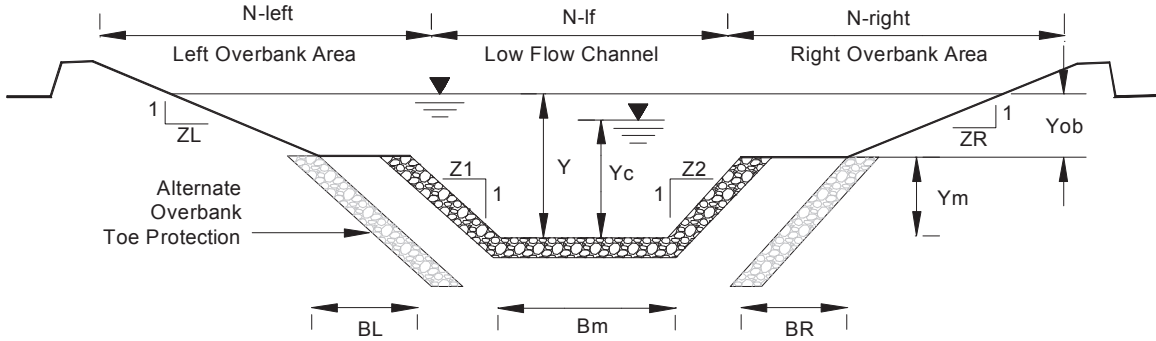
Rock Sizing Parameter, $R_p$	Grouted Boulders <sup>1</sup>
	Boulder Classification <sup>2</sup>
Less than 4.50	B18
4.50 to 4.99	B18
5.00 to 5.59	B24
5.60 to 6.99	B36
7.00 to 8.00	B48

<sup>1</sup> Grouted to no less than 1/3 the height (+1"-0"), no more than 2/3 (+0"-1") of boulder height.  
<sup>2</sup> See Open Channels chapter.

## Capacity Analysis of Composite Channel

**Project:** Happy Canyon Creek @ Belford Avenue - Drops

**Channel ID:** High & Low-Flow at 0.75% Slope



**Design Information (Input)**

Channel Invert Slope	So = 0.00750 ft/ft	Left Overbank Bottom Width	BL = 75.00 ft
Low Flow Channel Bottom Width	Bm = 15.00 ft	Left Overbank Side Slope	ZL = 0.03 ft/ft
Low Flow Channel Left Side Slope	Z1 = 4.00 ft/ft	Left Overbank Manning's n	n-left = 0.0350
Low Flow Channel Right Side Slope	Z2 = 4.00 ft/ft	Right Overbank Bottom Width	BR = 20.00 ft
Low Flow Channel Manning's Nn for Qd	n-lf = 0.0590	Right Overbank Side Slope	ZR = 2.50 ft/ft
Low Flow Channel Manning's Nn for Q100 (See USDCM Vol. II, n vs. Depth Graph)	n-m-Q100 = 0.0380	Right Overbank Manning's n	n-right = 0.0350
Low Flow Channel Bank-full depth	Ym = 3.00 ft	Overbank Flow Depth Yob (Y - Ym)	Yob = 4.85 ft

**Low Flow Channel Condition for Qd**

Top width	Tlf = 39.0 ft
Flow area	Alf = 81.0 sq ft
Wetted perimeter	Plf = 39.7 ft
<b>Discharge (Calculated)</b>	<b>Qlf = 284.8 cfs</b>
<b>Velocity</b>	<b>Vlf = 3.5 fps</b>
<b>Froude number</b>	<b>Fr-lf = 0.43</b>
Qd Critical Velocity	Vlfc = 6.74 fps
Qd Critical Depth	Ylfc = 1.88 ft

**Low Flow Channel Flow Condition for Q100**

Top width	Tm = 39.0 ft
Flow area	Am = 270.2 sq ft
Wetted perimeter	Pm = 39.7 ft
<b>Discharge</b>	<b>Qm = 3,292.1 cfs</b>
<b>Velocity</b>	<b>Vm = 12.2 fps</b>
<b>Froude number</b>	<b>Fr-m = 0.82</b>
100-Yr. Critical Velocity	Vmc = 14.0 fps
100-Yr. Critical Depth	Ymc = 7.0 ft

**Left Overbank Flow Condition for Q100**

Top width	TL = 75.1 ft
Flow area	AL = 364.0600 sq ft
Wetted perimeter	PL = 79.8500 ft
<b>Discharge</b>	<b>QL = 3,690.5 cfs</b>
<b>Velocity</b>	<b>VL = 10.1 fps</b>
<b>Froude number</b>	<b>FrL = 0.81</b>
100-Yr. Critical Velocity	VLc = 11.7 fps
100-Yr. Critical Depth in Overbanks	YLc = 4.2 ft

**Right Overbank Flow Condition for Q100**

Top width	TR = 32.1 ft
Flow area	AR = 126.4000 sq ft
Wetted perimeter	PR = 33.0600 ft
<b>Discharge</b>	<b>QR = 1,139.5 cfs</b>
<b>Velocity</b>	<b>VR = 9.0 fps</b>
<b>Froude number</b>	<b>FrR = 0.80</b>
100-Yr. Critical Velocity	VRc = 10.6 fps
100-Yr. Critical Depth in Overbanks	YRc = 4.2 ft

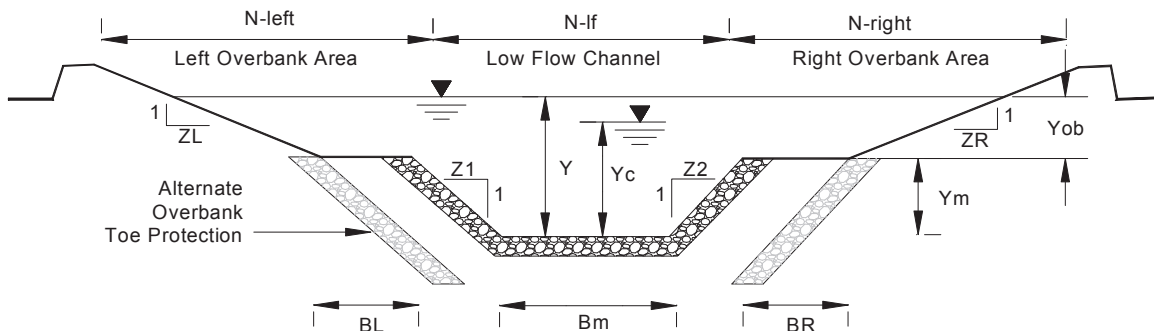
**Composite Cross-Section Flow Condition for Q100**

Top width	T = 146.3 ft	<b>Discharge</b>	<b>Q = 8,122.1 cfs</b>
Channel Depth Y	Y = 7.85 ft	<b>Velocity</b>	<b>V = 10.7 fps</b>
Flow area	A = 760.6 sq ft	<b>Froude number</b>	<b>Fr = 0.83</b>
Wetted perimeter	P = 152.7 ft	100-Yr. Critical Velocity	Vc = 12.2 fps
Cross-Sectional Manning's n (Calculated)	n = 0.0353	100-Yr. Critical Depth in Overbanks	Yc = 4.20 ft

## Capacity Analysis of Composite Channel

**Project:** Happy Canyon Creek @ Belford Avenue Drops

**Channel ID:** Low-Flow at 10:1



### Design Information (Input)

Channel Invert Slope	So = 0.10000 ft/ft	Left Overbank Bottom Width	BL = 75.00 ft
Low Flow Channel Bottom Width	Bm = 15.00 ft	Left Overbank Side Slope	ZL = 0.03 ft/ft
Low Flow Channel Left Side Slope	Z1 = 4.00 ft/ft	Left Overbank Manning's n	n-left = 0.0350
Low Flow Channel Right Side Slope	Z2 = 4.00 ft/ft	Right Overbank Bottom Width	BR = 20.00 ft
Low Flow Channel Manning's Nn for Qd	n-lf = 0.0590	Right Overbank Side Slope	ZR = 2.50 ft/ft
Low Flow Channel Manning's Nn for Q100 (See USDCM Vol. II, n vs. Depth Graph)	n-m-Q100 = 0.0380	Right Overbank Manning's n	n-right = 0.0350
Low Flow Channel Bank-full depth	Ym = 3.00 ft	Overbank Flow Depth Yob (Y - Ym)	Yob = 4.85 ft

### Low Flow Channel Condition for Qd

Top width	Tlf = 39.0 ft
Flow area	Alf = 81.0 sq ft
Wetted perimeter	Plf = 39.7 ft
Discharge (Calculated)	Qlf = 1,039.9 cfs
Velocity	Vlf = 12.8 fps
Froude number	Fr-lf = 1.57
Qd Critical Velocity	Vlfc = 9.03 fps
Qd Critical Depth	Ylfc = 3.81 ft

### Low Flow Channel Flow Condition for Q100

Top width	Tm = 39.0 ft
Flow area	Am = 270.2 sq ft
Wetted perimeter	Pm = 39.7 ft
Discharge	Qm = 12,020.9 cfs
Velocity	Vm = 44.5 fps
Froude number	Fr-m = 2.98
100-Yr. Critical Velocity	Vmc = 16.2 fps
100-Yr. Critical Depth	Ymc = 7.9 ft

### Left Overbank Flow Condition for Q100

Top width	TL = 75.2 ft
Flow area	AL = 364.1000 sq ft
Wetted perimeter	PL = 79.8500 ft
Discharge	QL = 13,478.3 cfs
Velocity	VL = 37.0 fps
Froude number	FrL = 2.96
100-Yr. Critical Velocity	VLc = 17.9 fps
100-Yr. Critical Depth in Overbanks	YLc = 10.0 ft

### Right Overbank Flow Condition for Q100

Top width	TR = 32.1 ft
Flow area	AR = 126.4000 sq ft
Wetted perimeter	PR = 33.0600 ft
Discharge	QR = 4,160.9 cfs
Velocity	VR = 32.9 fps
Froude number	FrR = 2.92
100-Yr. Critical Velocity	VRc = 14.6 fps
100-Yr. Critical Depth in Overbanks	YRc = 9.1 ft

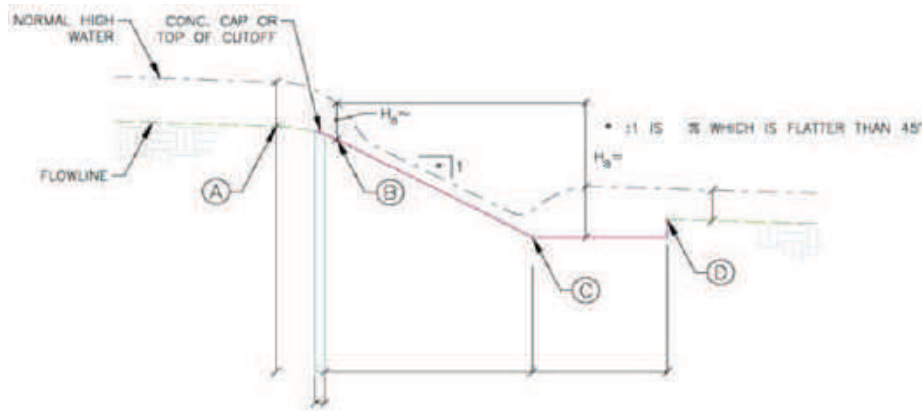
### Composite Cross-Section Flow Condition for Q100

Top width	T = 146.3 ft	Discharge	Q = 29,660.0 cfs
Channel Depth Y	Y = 7.85 ft	Velocity	V = 39.0 fps
Flow area	A = 760.7 sq ft	Froude number	Fr = 3.01
Wetted perimeter	P = 152.7 ft	100-Yr. Critical Velocity	Vc = 18.4 fps
Cross-Sectional Manning's n (Calculated)	n = 0.0353	100-Yr. Critical Depth in Overbanks	Yc = 8.07 ft

1. Lane's Weighed Creep Method

$$C_w = \frac{\left( \frac{L_H}{3} + L_V \right)}{H_s}$$

UDFCD Volume 2 Equation 9-5



From (A) to (B)     $L_H = 8.0$      $L_V = 0 + 0.25 = 0.25$  '     $H_s \sim 0.25$  (Change in water surface elevation between A & B)

$$C_w = \frac{\left( \frac{8.0}{3} + 0.3 \right)}{0.3} = 11.7 \quad 11.7 > 6.0 \quad \text{OK}$$

From (A) to (C)     $L_H = 38.0$      $L_V = 3 + 0.25 = 3.25$  '     $H_s = 1.06$  (Change in water surface elevation between A & C)

$$C_w = \frac{\left( \frac{38.0}{3} + 3.3 \right)}{1.1} = 15.0 \quad 15.0 > 6.0 \quad \text{OK}$$

$L_H$  = Horizontal creep distance  
 $L_V$  = Vertical creep distance  
 $C_w$  = Creep ratio  
 $H_s$  = Differential head between analysis points (ft)

Notes: Soil samples at the site located along Happy Canyon Creek provided by A.G. Wassenaar Inc. indicates coarse to medium lenses of clay/sand interbedded poorly graded sand with gravel, well-graded sand with silt and gravel material. Free groundwater was encountered at the time of drilling (March 2016) ranging in depths of 2 feet near the proposed ped. box culvert and 4 feet to 8 feet along the channel.

Table 9-3. Lane's weighted creep: Recommended minimum ratios

Material	Ratio
Very fine sand or silt	8.5
Fine sand	7.0
Medium sand	6.0
Coarse sand	5.0
Fine gravel	4.0
Medium gravel	3.0
Coarse gravel including cobbles	3.0
Boulders with some cobbles and gravel	3.0
Soft clay	3.0
Medium clay	2.0
Hard clay	1.8
Very hard clay or hardpan	1.6

Average LWC Ratio per UDFCD Table 9-3 to the right is:  $\rightarrow$  6.0

**REVETMENT RIPRAP DESIGN  
SIZING**

Project: Belford @ HCC                      By: CDT                      I:\115360-01 - Compark at Belford\CADD\Hydraulics\Calculations\  
Project No. 115360-01                      Date: 7/24/2017                      Happy Canyon Creek\Bridge Hydraulics

$d_{30} = y(S_f C_s C_v C_t) [V_{des} / (K_1 (S_g - 1) g y)^{2.5}]$   
 $d_{30}$  = Riprap particle size for which 30% is finer by weight, ft (adapted from USACE Engineering Manual No. 1110-2-1601, 1991)

y=	8.4	Local depth of flow above particle, ft		
S <sub>f</sub> =	1.2	Safety factor		
C <sub>s</sub> =	0.3	Stability coefficient (for blanket thickness=d100 or 1.5d50 whichever is greater, and uniformity ratio d85/d15 = 1.7 to 5.2) Use 0.30 for angular rock and 0.375 for rounded rock		
C <sub>v</sub> =	1.35	Velocity distribution coefficient		
		use 1.0 for straight channels or the inside of bends		
		use 1.283-0.2log(Rc/W) for the outside of bends (1 for Rc/W>26)=	1.35	
		Rc=	130	Centerline radius of curvature of Channel bend, ft
		W=	294	Width of water surface at upstream end of channel bend, ft
		Rc/W=	0.442177	
		use 1.25 downstream from concrete channels		
		use 1.25 at the end of dikes		
C <sub>t</sub> =	1	Blanket thickness coefficient given as a function of the uniformity ratio d85/d15		
		use 1.0 recommended because it is based on very limited data		
V <sub>des</sub> =	10.26	Characteristic velocity for design, defined as the depth-averaged velocity at a point 20% upslope from the toe of the revetment, ft/s		
		V <sub>des</sub> =	10.26	For natural channels use V <sub>des</sub> =V <sub>avg</sub> (1.74-0.52 log(Rc/W))
		V <sub>des</sub> =	10.59	For trapezoidal channels use V <sub>des</sub> =V <sub>avg</sub> (1.71-0.78 log(Rc/W))
V <sub>avg</sub> =	5.33	Channel cross sectional average velocity, ft/s		
K <sub>1</sub> =	1.00	Side slope correctional factor	H:1=	4
		k <sub>1</sub> =(1-(sin14°)	θ=	14.0      0.24 = radians
			K <sub>1</sub> =	1.00
S <sub>g</sub> =	2.65	Specific gravity of riprap (usually taken at 2.65)		
g=	32.2	Acceleration of gravity, 32.2 ft/s		

<b>d<sub>30</sub>=</b>	<b>0.67</b>	<b>Particle size for which 30% is finer by weight, ft</b>	
<b>d<sub>50</sub>=</b>	<b>0.81</b>	<b>d<sub>50</sub>=1.2d<sub>30</sub>, ft</b>	
<b>RIPRAP d<sub>50</sub> SIZE=</b>	<b>9.7</b>	<b>inches</b>	<b>Use Soil Riprap (12 inch) (2'-0" thick) @ 120+25 to 122+25 RT.</b>
<b>t=1.5d<sub>50</sub>=</b>	<b>14.5</b>	<b>Riprap Thickness, inches</b>	

Reference: Lagasse, et. al., NCHRP Report 568, Riprap Design Criteria, Recommended Specifications, and Quality Control, 2006

**REVETMENT RIPRAP DESIGN  
SIZING**

Project: Belford @ HCC                      By: CDT                      I:\115360-01 - Compark at Belford\CADD\Hydraulics\Calculations\  
Project No. 115360-01                      Date: 7/24/2017                      Happy Canyon Creek\Bridge Hydraulics

$d_{30} = y(S_f C_s C_v C_t) [V_{des} / (K_1 (S_g - 1) g y)^{2.5}]$   
 $d_{30}$  = Riprap particle size for which 30% is finer by weight, ft (adapted from USACE Engineering Manual No. 1110-2-1601, 1991)

y=	7.35	Local depth of flow above particle, ft		
S <sub>f</sub> =	1.2	Safety factor		
C <sub>s</sub> =	0.3	Stability coefficient (for blanket thickness=d100 or 1.5d50 whichever is greater, and uniformity ratio d85/d15 = 1.7 to 5.2) Use 0.30 for angular rock and 0.375 for rounded rock		
C <sub>v</sub> =	1.24	Velocity distribution coefficient		
		use 1.0 for straight channels or the inside of bends		
		use 1.283-0.2log(Rc/W) for the outside of bends (1 for Rc/W>26)=	1.26	
		Rc=	308	Centerline radius of curvature of Channel bend, ft
		W=	236	Width of water surface at upstream end of channel bend, ft
		Rc/W=	1.305085	
		use 1.25 downstream from concrete channels		
		use 1.25 at the end of dikes		
C <sub>t</sub> =	1	Blanket thickness coefficient given as a function of the uniformity ratio d85/d15		
		use 1.0 recommended because it is based on very limited data		
V <sub>des</sub> =	10.80	Characteristic velocity for design, defined as the depth-averaged velocity at a point 20% upslope from the toe of the revetment, ft/s		
		V <sub>des</sub> =	10.80	For natural channels use V <sub>des</sub> =V <sub>avg</sub> (1.74-0.52 log(Rc/W))
		V <sub>des</sub> =	10.42	For trapezoidal channels use V <sub>des</sub> =V <sub>avg</sub> (1.71-0.78 log(Rc/W))
V <sub>avg</sub> =	6.43	Channel cross sectional average velocity, ft/s		
K <sub>1</sub> =	1.00	Side slope correctional factor	H:1=	4
		k <sub>1</sub> =(1-(sin14°)	θ=	14.0      0.24 = radians
			K <sub>1</sub> =	1.00
S <sub>g</sub> =	2.65	Specific gravity of riprap (usually taken at 2.65)		
g=	32.2	Acceleration of gravity, 32.2 ft/s		

$d_{30}$  = 0.72      Particle size for which 30% is finer by weight, ft  
 $d_{50}$  = 0.87       $d_{50} = 1.2d_{30}$ , ft  
**RIPRAP d<sub>50</sub> SIZE = 10.4 inches**  
 $t = 1.5d_{50} = 15.6$       Riprap Thickness, inches

**Use Soil Riprap (12 inch) (2'-0" thick)  
@ 116+25 to 118+75 RT.**

Reference: Lagasse, et. al., NCHRP Report 568, Riprap Design Criteria, Recommended Specifications, and Quality Control, 2006

**REVETMENT RIPRAP DESIGN  
SIZING USING UDFCD CRITERIA**

Project: Belford @ HCC	By: CDT	I:\115360-01 - Compark at Belford\CADD\Hydraulics\Calculations\
Project No. 115360-01	Date: 7/24/2017	Happy Canyon Creek\Bridge Hydraulics

$$d_{50} \geq \frac{(V \cdot S^{0.17})}{(4.5) \cdot (G_s - 1)^{0.66}} \cdot 12$$

V=	14.58	Velocity, ft/s	<i>(Worst case velocity at Drop 2.)</i>
S=	0.0075	Longitudinal Slope, ft/ft	
G <sub>s</sub> =	2.65	Specific gravity of riprap (usually taken at 2.65)	

d <sub>50</sub> =	1.03	ft	
<b>RIPRAP d<sub>50</sub> SIZE=</b>	<b>12.3</b>	<b>inches</b>	
<b>t=1.75d<sub>50</sub>=</b>	<b>21.6</b>	<b>Riprap Thickness, inches</b>	

**Riprap for Approach to Drop Structures  
Soil Riprap (12 Inch) (2'-0" thick)**

Reference: UDFCD Manual, Volume 1, Section 8.1.1 Equation 8-11

**RIPRAP AT BRIDGE ABUTMENTS AND GUIDE BANKS  
SIZING**

Project: Belford @ HCC                      By: CDT                      I:\115360-01 - Compark at Belford\CADD\Hydraulics\Calculations\  
Project No. 115360-01                      Date: 7/24/2017                      Happy Canyon Creek\Bridge Hydraulics

$d_{50} = Y \cdot K / (S_g - 1) \cdot (V^2 / gy)$  for Froude numbers less than 0.80  
 $d_{50} = Y \cdot K / (S_g - 1) \cdot (V^2 / gy)^{0.14}$  for Froude numbers greater than 0.80  
 $d_{50}$  = Median stone diameter, ft (adapted from FHWA's HEC23, Legasse et al, 2001)  
 SBR = Set Back Ratio = Dist. From main channel / Flow depth in main channel

	Left Abutment	Right Abutment		
D =	114	37	Distance from main channel	
$Y_{ch}$ =	8.33	8.33	Flow depth in main channel	
SBR =	13.7	4.4	Set Back Ratio	
Q =	5317	1203	If SBR is >5, then $V = Q_{overbank} / A_{overbank}$ (Overbank flow only)	$Q_{total} = 8303 \text{ cfs}$
A =	762	198	If SBR is <5, then $V = Q_{total} / A_{total}$ (Entire bridge opening)	$A_{total} = 1150 \text{ (sq ft)}$
$V_{char.}$ =	7.0	7.2		
V =	7.56	7.66	Characteristic average velocity in the contracted section, ft/s	
$S_g$ =	2.65	2.65	Specific gravity of riprap (usually taken at 2.65)	
g =	32.2	32.2	Acceleration of gravity, 32.2 ft/s	
y =	8.24	8.24	Depth of flow in the contracted bridge opening, ft	
K =	1.02	1.02	For Froude <0.80 use K=0.89 for spill through and 1.02 for vertical wall abutments For Froude >0.80 use K=0.61 for spill through and 0.69 for vertical wall abutments	
F =	0.46	0.47	Froude number, $(V/(gy))^{0.5}$	
$d_{50}$ =	1.10	1.13	Median stone diameter, ft for Froude number less than 0.80	
$d_{50}$ =	4.11	4.12	Median stone diameter, ft for Froude number greater than 0.80	

	Left Abutment	Right Abutment	
$d_{50}$ =	1.10	1.13	Median stone diameter, ft
RIPRAP $d_{50}$ SIZE =	13.2	13.5	inches
$t = 1.5d_{50}$	19.8	20.3	Riprap Thickness, inches

**Riprap for Bridge Abutments**  
 Soil Riprap (18 Inch) (3'-0" thick)  
 & Riprap (18 Inch) (3'-0" thick)

Reference: Lagasse, et. al., NCHRP Report 568, Riprap Design Criteria, Recommended Specifications, and Quality Control, 2006



**RIPRAP FOR OVERTOPPING FLOW  
FOR SLOPES 4:1 AND FLATTER**

Project: Belford @ HCC      By: CDT      I:\115360-01 - Compark at Belford\CADD\Hydraulics\Calculations\  
 Proj. No. 115360-01      Date: 7/24/2017      Happy Canyon Creek\Bridge Hydraulics

**Weir formula**       $H=(Q/C*L)^{.67}$   
 Q= 2691 Discharge, cfs (FHAD Future 10yr c.f.s)  
 C= 2.6 Weir coefficient  
 L= 310 Length of broad crested weir, ft  
 H= 2.24 Overtopping depth, ft

**Median Rock Size**       $d_{50}=k_u*q^{.52}/C_u^{.25}*S^{.75}*(\sin a/Sg \cos a-1)(\cos a \tan p-\sin a)^{1.11}$   
 K<sub>u</sub>= 0.525 Constant for English units  
 q= 8.7 Unit discharge at failure, ft<sup>3</sup>/ft  
 C<sub>u</sub>= 4.5 Coefficient of uniformity of the riprap, d<sub>60</sub>/d<sub>10</sub>  
 S= 0.25 Slope of the embankment, ft/ft  
 S<sub>g</sub>= 2.65 Specific gravity of the riprap  
 α= 4 Slope of the embankment, H:1      H:1= 4.0      θ= 14.0      0.24 = radians  
 φ= 1 Angle of repose for riprap, H:1      H:1= 1.0      θ= 45.0      0.79 = radians  
 d<sub>50</sub>= 0.56 Smallest possible median rock size, d<sub>50</sub>, ft  
 d<sub>50</sub>= 6.7 Smallest possible median rock size, d<sub>50</sub>, in  
 Use a d<sub>50</sub> of 18 inches (from Table C8.1)

**Interstitial Velocity**       $V_i=(2.48(g*d_{50}^{.5})*(S^{.58}/C_u^{.22}))$   
 g= 32.2 Acceleration due to gravity, ft/sec  
 d<sub>50</sub>= 1.5 Particle size for which 50% is finer by weight, ft  
 S= 0.25 Slope, ft/ft  
 C<sub>u</sub>= 4.5 Coefficient of uniformity of the riprap, d<sub>60</sub>/d<sub>10</sub>  
 V<sub>i</sub>= 0.27 ft/sec  
 η= 0.45 porosity  
 V<sub>avg</sub>= 0.12 ft/sec

**Thickness of riprap as if all of the flow were through the riprap**       $t=q/V_{avg}$ , ft  
 t= 70.5 thickness of riprap layer, ft  
 2\*d<sub>50</sub>= 3.0 ft      **FALSE if "t" is < than 2\*d<sub>50</sub>, then design is complete and a 2d<sub>50</sub> thickness is ok**  
 Use a d<sub>50</sub> of 18 in.      **0 if "t" is > than 2\*d<sub>50</sub>, then continue**

**Allowable flow depth over riprap**       $h=(0.06(Sg-1)d_{50}\tan\phi)/(0.97S)$   
 h= 0.61 ft depth

**Calculate Manning roughness coefficient, n**       $n=.034(d_{50})^{.1667}$   
 n= 0.04

**Calculate Unit Discharge, q**       $q=1.489/n^*.y^{.67}*S^{.5}$   
 q<sub>1</sub>= 9.02 ft<sup>3</sup>/s/ft

**Calculate the Required Interstitial Flow through the riprap and the flow provided by a riprap thickness of 2d<sub>50</sub>**  
 q<sub>2</sub>= -0.34 ft<sup>3</sup>/s/ft      q<sub>2</sub>=q<sub>f</sub>-q<sub>1</sub>  
 q= 0.37 ft<sup>3</sup>/s/ft      q=2d<sub>50</sub>\*V<sub>avg</sub>

t=2d<sub>50</sub>= 36 in      **If q is > than or equal to q<sub>2</sub>, then the design is complete with a 2d<sub>50</sub>**  
 t= 18 in      **If not, then increase riprap size to next higher gradation (C8.1)**

Reference: Lagasse, et. al., NCHRP Report 568, Riprap Design Criteria, Recommended Specifications, and Quality Control, 2006

**Table C8.1. Minimum and maximum allowable particle size in inches.**

Nominal Riprap Class by Median Particle Diameter		d <sub>15</sub>		d <sub>50</sub>		d <sub>85</sub>		d <sub>100</sub>
Class	Size	Min	Max	Min	Max	Min	Max	Max
I	6 in	3.7	5.2	5.7	6.9	7.8	9.2	12.0
II	9 in	5.5	7.8	8.5	10.5	11.5	14.0	18.0
III	12 in	7.3	10.5	11.5	14.0	15.5	18.5	24.0
IV	15 in	9.2	13.0	14.5	17.5	19.5	23.0	30.0
V	18 in	11.0	15.5	17.0	20.5	23.5	27.5	36.0
VI	21 in	13.0	18.5	20.0	24.0	27.5	32.5	42.0
VII	24 in	14.5	21.0	23.0	27.5	31.0	37.0	48.0
VIII	30 in	18.5	26.0	28.5	34.5	39.0	46.0	60.0
IX	36 in	22.0	31.5	34.0	41.5	47.0	55.5	72.0
X	42 in	25.5	36.5	40.0	48.5	54.5	64.5	84.0

Cu, Coef. Of Uniform. (d <sub>60</sub> /d <sub>10</sub> )
4.5
4
4.5
4
3.7

Note: Particle size d corresponds to the intermediate (B) axis of the particle.

(CDOT)



Job Title: Compark at Belford By: ZJG Date: 03/05/18 Job No.: 115360-01

Subject: Riprap Apron Sizing For Single Circular Conduit Checked: Sheet 1 of 1

**1. Given Information**

**Structure Name and Location:**

Q	51.00	c.f.s	(design flow)
D	4.00	ft.	(pipe diameter)
n	0.013		(Manning's n)
S <sub>o</sub>	0.03500	ft./ft.	(pipe slope)
Assume flow is	Supercritical		Supercritical/Subcritical

Tailwater Depth (Y<sub>t</sub>) = 1.6 ft.  
 unknown, assume = 0.4\*D  
 $D/3 = \frac{4.00}{3} = 1.333$  ft.  
 Allowable Velocity = 5 fps  
 (Max.=7.0 fps if Clay, and 5.0 fps if Sandy)

**2. Manning Formula - Input CulvertMaster Results**

V	16.50	f.p.s.	(velocity)
y <sub>n</sub>	5.40	ft.	(normal depth of supercritical flow)
y <sub>n</sub> /D	1.35		
D <sub>a</sub>	4.70	ft	D <sub>a</sub> =(D+y <sub>n</sub> )/2, for supercritical flow

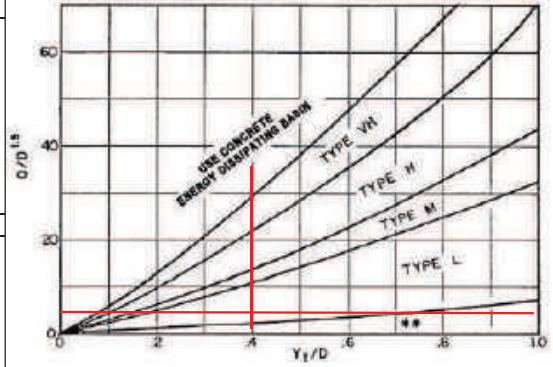


Figure 9-38. Riprap erosion protection at circular conduit outlet (valid for Q/D<sub>a</sub> ≤ 5.6.0)

**3. Required Rock Size**

$$Q/D^{1.5} = Q / D_p^{1.5} \quad \left| \begin{array}{l} D \text{ if subcritical or} \\ D_a \text{ if supercritical} \end{array} \right.$$

$$Q/D^{1.5} = 51.00 / (4.70)^{1.5}$$

$$Q/D^{1.5} = 5.01$$

$$y_t/D = 1.6 / 4.00$$

$$y_t/D = 0.40$$

Per Fig 9-38, use Type **L** riprap d<sub>50</sub> = **9** in.  
 d<sub>50</sub> = 0.42 ft check from putting eq. 9-18 into eq. 9-16 for supercritical  
 Minimum Thickness of d<sub>50</sub>  
 T<sub>MIN</sub> = 2 \* d<sub>50</sub> = 2 \* 9 = 18 in. = **1.5** ft.

Riprap Designation	d <sub>50</sub> (inches)
L	9
M	12
H	18
VH	24

**4. Extent of Protection**

Froude Parameter

$$\frac{Q}{D^{2.5}} = \frac{51.00}{4.00^{2.5}} = 1.6 > 6.0 \text{ by } \sim 0$$

so increase L<sub>pmax</sub> by 1/4D for every 1

Use Figure 9-35 to the right to find 1/(2Tanθ)

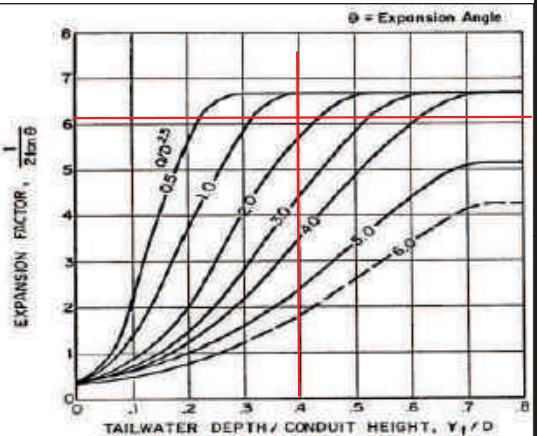
$$\frac{1}{2 \tan \theta} = 6.1 = \text{Expansion Factor}$$


Figure 9-35. Expansion factor for circular conduits

**5. Lp, Length of Protection**

where V is max. allow velocity

$$L_p = \frac{1}{2} \tan \theta \left( \frac{Q/V}{y_t} - D \right)$$

$$L_p = 6.1 \left( \frac{10.20}{1.6} - 4.00 \right)$$

$$L_p = 14.49 \text{ ft}$$

**L<sub>p</sub> CHECK**

$$L_{p \text{ Min}} = 3 * D = 12 \text{ ft}$$

$$L_{p \text{ Max}} = 10 * D + 1/4 D (0) = 40 \text{ ft}$$

USE = **14** ft

**7. T, Width of Protection**

$$T = 2 (L_p * \tan \theta) + \text{Diameter of conduit} = 2 * (14 * 1/(2 * \text{Expansion Factor})) + 4.00 = 6.3 \text{ ft. USE } 7 \text{ ft.}$$

**8. Summary**

Riprap Min. d <sub>50</sub> (in.)	T <sub>MIN</sub> , Min. Thickness (ft.)	L <sub>p</sub> , Min. Length (ft.)	T, Min. Width (ft.)	Riprap Quantity (C.Y.)	Filter Material (Class A) Quantity (C.Y.)
9	1.5	14	7		



1. Given Information		Structure Name and Location:	
Quantity	Width (ft)	Height (ft)	
2	10	3	
Q	625.00	c.f.s	(design flow)
n	0.013		(Manning's n)
S <sub>o</sub>	0.0210	ft./ft.	(pipe slope)
Assume flow is	Supercritical		(Supercritical or Subcritical)

Tailwater Depth (Y<sub>t</sub>) = if unknown or hydraulic jump downstream = 0.4\*H = **1.2** ft.  
 H / 3 = **1.0** ft.  
 Allowable Velocity = **5** fps  
 (Max.=7.0 fps if Clay, and 5.0 fps if Sandy)

2. Manning Formula - Input CulvertMaster Results			
V	2.74	f.p.s.	(velocity)
Y <sub>n</sub>	2.11	ft.	(normal depth of supercritical flow)
y <sub>t</sub> /D	#REF!		
H <sub>a</sub>	1.18	ft	H <sub>a</sub> =(H+y <sub>n</sub> )/2, for supercritical flow

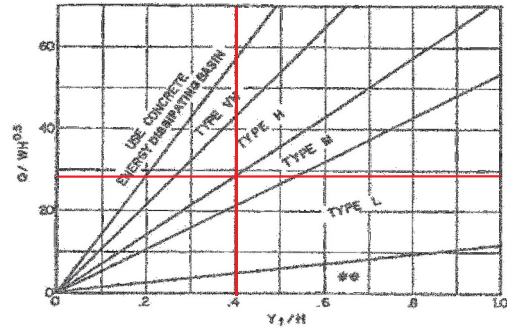


Figure MD-25 Riprap Erosion Protection at Rectangular Conduit Outlet Valid for  $Q/W H^{0.5} \leq 8.0$

3. Required Rock Size			
$Q/W H^{0.5}$	=	Q / $W H^{0.5}$	H if subcritical or H <sub>a</sub> if supercritical
	=	312.50 / 10.86	
	=	<b>28.8</b>	
y <sub>t</sub> /H	=	1.2 / 3.00	
y <sub>t</sub> /H	=	<b>0.40</b>	

Per Fig 9-38, use Type **M** riprap  $d_{50} =$  **12** in.  
 $d_{50} =$  = 10.99 ft check from putting eq. 9-18 into eq. 9-16 for supercritical  
 Minimum Thickness of  $d_{50}$   
 $T_{MIN} = 2 * d_{50} =$  **2.0** ft.

Riprap Designation	d <sub>50</sub> (inches)
L	9
M	12
H	18
VH	24

4. Extent of Protection			
Find equivalent rectangular conduit, where i stands for individual conduit, and H <sub>eq</sub> = box culvert height			
$W_{eq} = Q/W_i H_{eq}^{1.5}$	=	625.00 / 10 * 3 <sup>1.5</sup>	
$W_{eq}$	=	12.0 ft	
Froude Parameter where subscript i stands for individual conduit			
$\frac{Q}{W_{eq} H_{eq}^{3/2}}$	=	$\frac{625.00}{62.50}$	= <b>10.0</b> > 8.0 by <b>2</b> (insert whole number)
Use Figure 9-35 to the right to find Expansion Factor 1/(2Tanθ) (y-axis intercept)			
$\frac{1}{2Tan\theta}$	=	<b>1</b>	= Expansion Factor

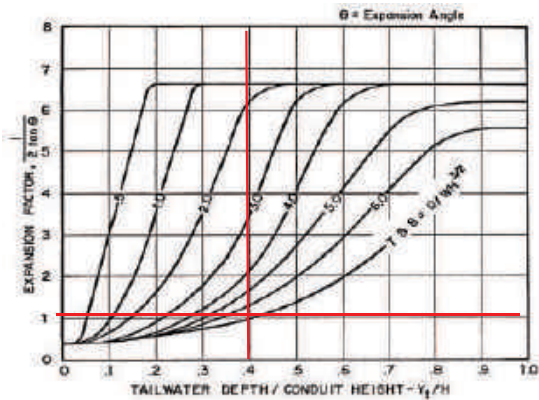


Figure 9-36. Expansion Factor for rectangular conduits.

5. L <sub>p</sub> , Length of Protection			
where V is max. allow velocity			
$L_p = 1/2 Tan\theta * (Q/V / y_t - W)$			
$L_p =$	$1.0 * (125.00 / 1.2 - 10.0)$		
$L_p =$	<b>94.17</b>	ft	
<b>L<sub>p</sub> CHECK</b>			
$L_{p Min} = 3 * H$	=	0.75	ft
$L_{p Max} = 10 * D + 1/4 D$	=	$10 * 2 + 0.5$	4.0 ft
USE L <sub>p</sub>	=	<b>4.0</b>	ft

7. T, Width of Protection			
$T = 2 * (L_p * Tan\theta) + W_{eq} = 2 * (4 * 1/(2 * Expansion Factor)) +$		12.0	= <b>16</b> ft.

8. Summary					
Riprap Min. d <sub>50</sub> (in.)	T <sub>MIN</sub> , Min. Thickness (ft.)	L <sub>p</sub> , Min. Length (ft.)	T, Min. Width (ft.)	Riprap Quantity (C.Y.)	Filter Material (Class A) Quantity (C.Y.)
12	2.0	4	16		

## **FREEBOARD REQUIREMENTS**

Project: Belford Avenue @ Happy Canyon Creek      File Name: Freeboard.xlsx  
Date: 24-Jul-17      FHU Project #: 115360-01

Fb =  $0.1 * Q^{0.3} + 0.008 * V^2$  (English Units)

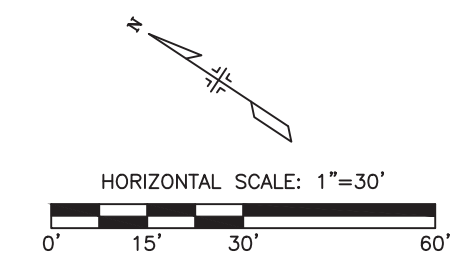
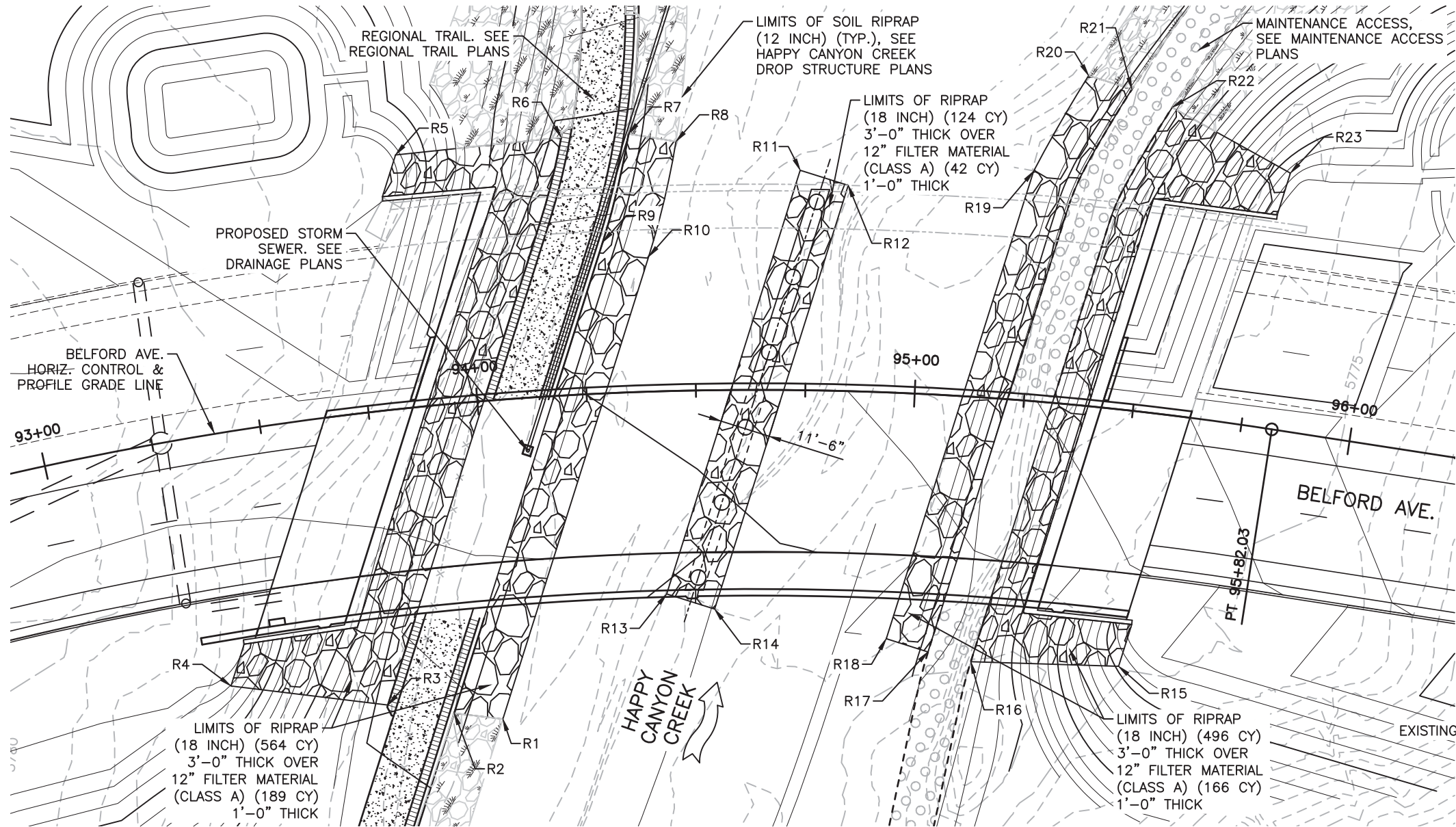
RE: UDFCD defers to CDOT Roadway Design Manual

### **REQUIRED FREEBOARD**

Q <sub>100</sub> =	8303	cfs	(Design Q)
V <sub>100</sub> =	8.21	fps	(Average Velocity)
Fb=	2.04	ft.	(Required Freeboard)

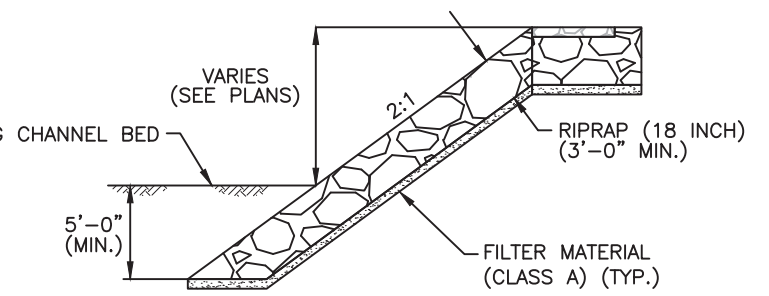
### **AVAILABLE FREEBOARD**

Low chord elevation =	5780.07
Design W.S. elevation =	<u>5776.33</u>
Available freeboard =	3.74 ft.

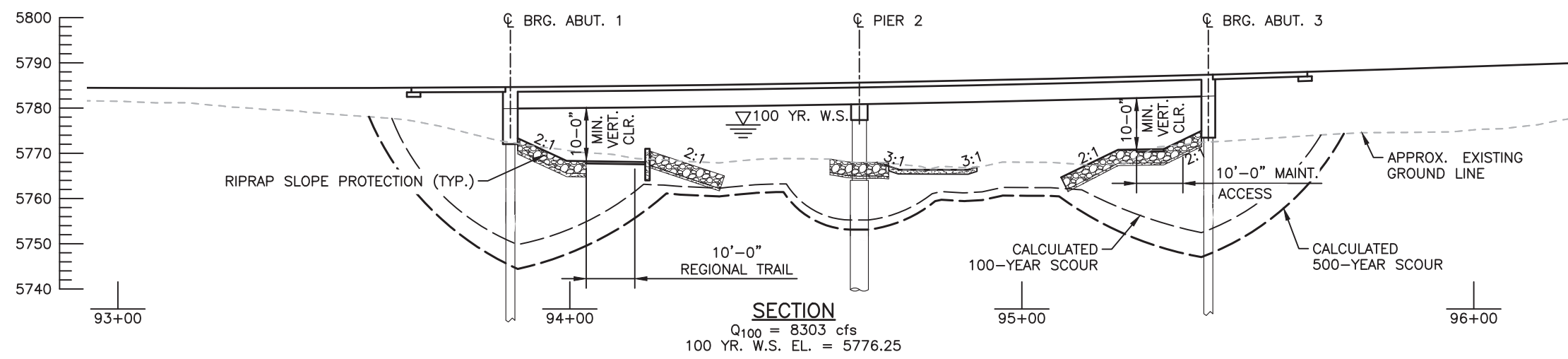


**RIPRAP (18 INCH) POINT DATA**

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
R1	27831.26	94408.21	5769.24	FINISHED GRADE
R2	27841.26	94403.19	5769.22	FINISHED GRADE
R3	27854.90	94396.36	5769.55	FINISHED GRADE
R4	27887.20	94380.16	5782.92	FINISHED GRADE
R5	27922.95	94502.06	5781.50	FINISHED GRADE
R6	27893.61	94526.31	5769.80	FINISHED GRADE
R7	27881.26	94535.51	5769.73	FINISHED GRADE
R8	27871.26	94540.03	5768.10	FINISHED GRADE
R9	27872.48	94511.60	5768.79	FINISHED GRADE
R10	27861.91	94514.64	5768.02	FINISHED GRADE
R11	27843.96	94550.26	5768.19	FINISHED GRADE
R12	27832.91	94553.44	5767.38	FINISHED GRADE
R13	27815.87	94452.72	5767.63	FINISHED GRADE
R14	27804.82	94455.90	5768.01	FINISHED GRADE
R15	27720.69	94496.05	5785.18	FINISHED GRADE
R16	27749.41	94478.25	5771.13	FINISHED GRADE
R17	27758.80	94474.71	5770.94	FINISHED GRADE
R18	27768.40	94471.94	5768.80	FINISHED GRADE
R19	27799.40	94579.55	5768.14	FINISHED GRADE
R20	27801.00	94604.71	5766.27	FINISHED GRADE
R21	27791.05	94607.58	5771.26	FINISHED GRADE
R22	27781.07	94609.21	5771.45	FINISHED GRADE
R23	27750.27	94611.63	5786.40	FINISHED GRADE



**RIPRAP (18 INCH) TYPICAL SLOPE SECTION @ BRIDGE**  
N.T.S.



**SECTION**  
Q<sub>100</sub> = 8303 cfs  
100 YR. W.S. EL. = 5776.25

I:\115360-01 - Compare at Belford\CADD\Bridge Drawings\Scott.Dankenbring

Print Date: 3/13/2018 8:58:39 AM  
 File Name: B115360-01HYD01.dwg  
 Horizontal Scale: 1"=30' Vertical Scale:  
**FELSBURG HOLT & ULLEVIG**  
 6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

Sheet Revisions		
Date	Comments	Initials



As Constructed  
 No Revisions:  
 Revised:  
 Void:

**BELFORD-HAPPY CANYON CREEK BRIDGE BRIDGE HYDRAULIC INFORMATION (1 OF 2)**  
 Designer: C. TWISS  
 Detailer: R. DILLON  
 Subset: BRIDGE  
 Structure Numbers  
 Sheets: B6 of 37

Project No./Code  
 Sheet Number **33**

**100-YEAR RECURRENCE INTERVAL**

FLOW UPSTREAM OF BRIDGE = 8303 CFS (FHAD)  
 DRAINAGE AREA = 17.5± SQ. MI.

**CHANNEL DESCRIPTION**

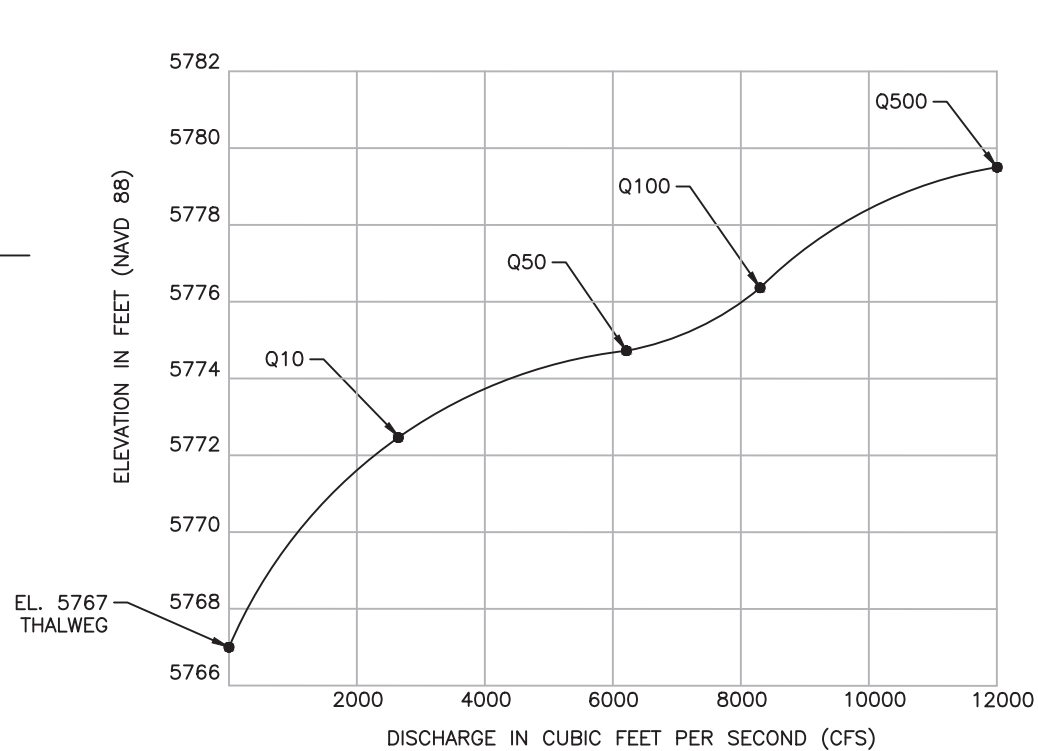
BOTTOM MATERIAL: COHESIVE  NONCOHESIVE   
 BOTTOM MAT. SIZE: CLAY  SILT  SAND  GRAVEL  COBBLES  OTHERS \_\_\_\_\_  
 STREAM FORM: STRAIGHT  MEANDERING  BRAIDED   
 MANNING'S "n" FOR DESIGN: CHANNEL 0.030 OVERBANK 0.035  
 DEBRIS -- BRUSH  TREES/LOGS  ICE  OTHER \_\_\_\_\_

**COMPARISON HYDRAULICS (100 YEAR EVENT)**  
 (AT SECTION LOCATED 32 FEET UPSTREAM OF BRIDGE)

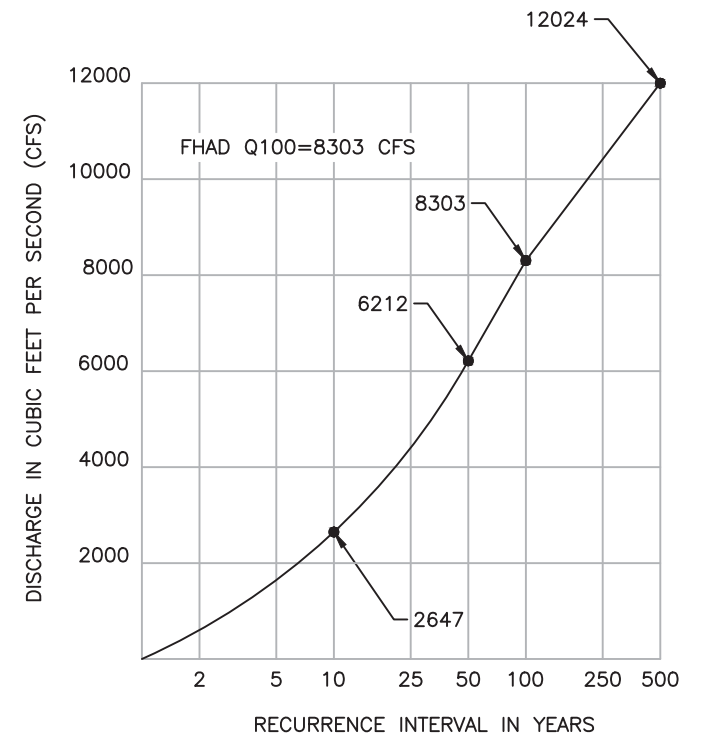
	VELOCITY (FT./SEC)		WS EL. (FT.)	MAX. BACKWATER (FT.)	FROUDE NO.
	AVERAGE	CHANNEL			
EXISTING CONDITIONS	9.90	13.70	5775.53	-	0.90
PROPOSED CONDITIONS	8.19	10.21	5776.35	-	0.63

**HYDRAULIC DATA**

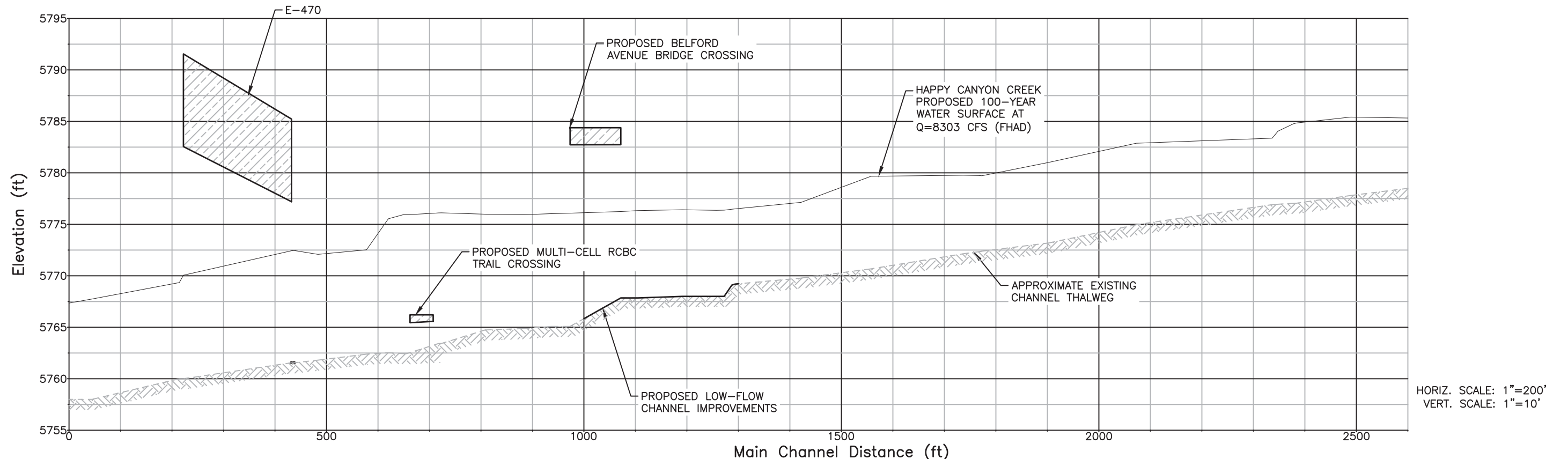
LOCATION	LOW CHORD ELEVATION AT ABUT. FRONT FACE		100-YEAR WATER SURFACE ELEVATION
	ABUT. 1	ABUT. 2	
S. SIDE (UPSTREAM)	5780.07	5782.73	5776.25
N. SIDE (DOWNSTREAM)	5780.07	5782.73	5776.10



**STAGE-DISCHARGE CURVE AT UPSTREAM FACE OF BELFORD AVENUE**



**DISCHARGE-FREQUENCY CURVE**



Print Date: 3/13/2018 8:58:53 AM  
 File Name: B115360-01HYD02.dwg  
 Horizontal Scale: VARIES Vertical Scale:  
 FELSBURG HOLT & ULLEVIG  
 6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

Sheet Revisions		
Date	Comments	Initials



As Constructed	BELFORD-HAPPY CANYON CREEK BRIDGE BRIDGE HYDRAULIC INFORMATION (2 OF 2)		Project No./Code
No Revisions:	Designer: C. TWISS	Structure Numbers	
Revised:	Detailer: K. TURNER		
Void:	Subset: BRIDGE	Sheets: B7 of 37	Sheet Number 34

I:\115360-01 - Compare at Belford\CADD\Bridge Drawings\Scott.Dankenbring

**STORM DRAINAGE INFRASTRUCTURE NOTES**

1. ALL STORM DRAINAGE IMPROVEMENTS ARE SUBJECT TO COMPLIANCE WITH THE COLORADO DEPARTMENT OF TRANSPORTATION (CDOT) CURRENT EDITION OF THE STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, M & S STANDARDS, AND ALL STANDARD SPECIAL PROVISIONS CURRENTLY USED BY CDOT, WITH THE MODIFICATIONS SET FORTH IN THE TOWN OF PARKER'S STORM DRAINAGE AND ENVIRONMENTAL CRITERIA MANUAL (SDECM), AS AMENDED.

2. THE CONTRACTOR SHALL COMPLY WITH THE "COLORADO WATER QUALITY CONTROL ACT" (TITLE 25, ARTICLE 8 CRS), THE "PROTECTION OF FISHING STREAMS" TITLE 33, ARTICLE 5, CRS), THE "CLEAN WATER ACT" (33 USC 1344), "CHERRY CREEK RESERVOIR CONTROL REGULATION NO. 72" (5 CCR 1002-72), THE REGULATION PROMULGATED, CERTIFICATION OR PERMITS ISSUES, AND THE REQUIREMENTS PRESENTED IN THE SDECM REVISION TO SECTION 107 AND THE CONSTRUCTION BMP PLAN. IN THE EVENT OF CONFLICTS BETWEEN THESE REQUIREMENTS AND WATER QUALITY CONTROL LAWS, RULES, OR REGULATIONS OF OTHER FEDERAL, OR STATE AGENCIES, THE MORE RESTRICTIVE LAWS, RULES, OR REGULATIONS SHALL APPLY.

3. INSPECTIONS: CONSTRUCTION SHALL NOT BEGIN UNTIL A GRADING PERMIT HAS BEEN ISSUED FOR THE PROJECT. THE CONTRACTOR SHALL NOTIFY THE TOWN OF PARKER ENGINEERING DEPARTMENT (PUBLIC WORKS) TO SCHEDULE INSPECTIONS A MINIMUM OF 48 HOURS PRIOR THE CONSTRUCTION OF ALL DRAINAGE INFRASTRUCTURE (STORM SEWERS, INLETS, MANHOLES, ENERGY DISSIPATORS, RIPRAP, GROUTED BOULDERS, DETENTION POND OUTLET STRUCTURES, FOREBAYS, TRICKLE CHANNELS, ETC). FAILURE TO NOTIFY THE ENGINEERING DEPARTMENT FOR INSPECTIONS MAY RESULT IN NON-ACCEPTANCE OF THE INFRASTRUCTURE BY THE TOWN. URBAN DRAINAGE AND FLOOD CONTROL DISTRICT MUST ALSO BE NOTIFIED IN A SIMILAR MANNER FOR ALL MAINTENANCE ELIGIBLE DRAINAGE INFRASTRUCTURES (CONSULT WITH STORMWATER ENGINEERING DIVISION).

4. STRUCTURAL BACKFILL (CDOT CLASS 1) SHALL BE COMPACTED TO CONFORM TO CDOT STANDARD SPECIFICATION 203.03. STRUCTURAL BACKFILL (CDOT CLASS 2) SHALL CONFORM TO CDOT STANDARD SPECIFICATION 203.07. AT THE CONTRACTOR'S OPTION, STRUCTURAL BACKFILL (SQUEEGEE) MEETING THE GRADATION REQUIREMENTS CONTAINED IN REVISION OF SECTION 206 OF THE CDOT STANDARD SPECIFICATIONS AS PRESENTED IN THE SDECM, MAY BE SUBSTITUTED FOR STRUCTURE BACKFILL (CLASS 1) OR CLASS 2) FOR BACKFILLING OF CULVERT PIPES, STORM SEWER PIPES, MANHOLES AND INLET STRUCTURES; HOWEVER, THE TOP 2 FEET BELOW SUBGRADE ELEVATION SHALL BE THE REQUIRED EMBANKMENT MATERIAL.

5. ALL EXCAVATIONS SHALL MEET OSHA REQUIREMENTS.

6. TESTING: PROBATIONARY ACCEPTANCE OF STORM DRAINAGE IMPROVEMENTS WILL BE CONTINGENT UPON SATISFACTORY TESTING RESULTS. IN ALL CASES WHERE TESTS INDICATE COMPACTION LESS THAN THAT REQUIRED BY TOWN SPECIFICATIONS, ADDITIONAL COMPACTION AND TESTS WILL BE REQUIRED UNTIL THE SPECIFICATIONS ARE MET. FREQUENCY OF TESTING WILL BE AS FOLLOWS:

- 1 TEST FOR SUBGRADE AND 1 TEST FOR BACKFILL AT EVERY ABOVE GROUND APPURTENANCE (MANHOLES, INLETS, ETC)
- 1 TEST EVERY 200 LF OF MAINLINE TRENCH EVERY 1 FOOT OF BACKFILL LIFT AND WITHIN 1 FOOT FROM ALL STRUCTURES.

7. ALLOWABLE STORM SEWER CONDUIT MATERIAL WITHIN THE TOWN OF PARKER SHALL BE LIMITED TO REINFORCED CONCRETE PIPE (RCP) CONFORMING TO CDOT STANDARD SPECIFICATION 706.02.

8. ALL RCP JOINTS SHALL BE MANUFACTURED IN ACCORDANCE WITH ASTM C443. RUBBER GASKETS SHALL BE USED ON ALL PIPE JOINTS CONFORMING TO ASTM C443. ALL RCP SECTIONS SHALL BE JOINED IN SUCH A MANNER THAT THE ENDS ARE FULLY ENTERED AND THE INNER SURFACES ARE REASONABLE FLUSH. AVERAGE JOINT GAP THAT EXCEEDS 1/2 INCH SHALL BE FILLED WITH AN APPROVED FLEXIBLE PLASTIC SEALANT.

9. JOINT RESTRAINTS AND TOE-WALLS, CONFORMING TO CDOT M&S STANDARD PLAN NO. M-601-11 SHALL BE USED ON ALL RCP FLARED END SECTION OUTFALLS.

10. EPOXY COATED REBAR SHALL BE USED AS REINFORCING STEEL ON ALL STORM INLETS AND STRUCTURES. REFERENCE CDOT M&S STANDARD PLAN NO. M-604-10, 11, 12, AND 13.

11. CDOT CLASS D CONCRETE SHALL BE USED FOR ALL CONCRETE DRAINAGE STRUCTURES.

12. PRE-CAST INLETS AND MANHOLE BASES SHALL NOT BE USED WITHIN THE TOWN OF PARKER RIGHT-OF-WAY, WITH THE EXCEPTION OF CDOT TYPE C AND D INLETS.

13. TWO- (2) MANHOLE ACCESS POINTS ARE REQUIRED ON ALL TYPE "R" CURB INLETS GREATER THAN OR EQUAL TO TEN (10) FEET IN LENGTH AS PRESENTED IN CDOT M&S STANDARD PLAN NO. M-604-12.

14. ALL GROUTING (BOULDERS, RIPRAP) SHALL BE IN ACCORDANCE WITH THE REVISION OF SECTION 506 OF THE CDOT STANDARD SPECIFICATIONS AS PRESENTED IN THE SDECM.

15. ALL BOULDERS AND RIPRAP SHALL BE SELECTED AND PLACED IN ACCORDANCE WITH THE REVISION OF SECTION 506 OF THE CDOT STANDARD SPECIFICATIONS AS PRESENTED IN THE SDECM.

16. CONTRACTOR SHALL REFER TO THE TOWN OF PARKER'S CONSTRUCTION BEST MANAGEMENT PRACTICES DETAILS AND NOTES FOR ALL REQUIREMENTS RELATING TO RE-VEGETATION, SEDIMENT AND EROSION CONTROL REQUIREMENTS FOR CONSTRUCTION ACTIVITIES.

17. PIPE BELLS SHALL NOT BE CAST INTO MANHOLE BASES OR INLETS.

**DROP STRUCTURE TABULATION**

INDEX		ITEM NO.	CONTRACT ITEM	UNIT	GSB	
BOOK	PAGE SHEET				PLAN	AS CONST.
		206	FILTER MATERIAL (CLASS A)	CY	1690	
		206	FILTER MATERIAL (CLASS C)	CY	61	
		206	STRUCTURE EXCAVATION	CY	130	
		206	STRUCTURE BACKFILL (CLASS 1)	CY	118	
		207	TOPSOIL	CY	832	
		501	STEEL SHEET PILING (TYPE II)	SF	11710	
		506	RIPRAP (12 INCH)	CY	76	
		506	SOIL RIPRAP (12 INCH)	CY	2884	
		506	SOIL RIPRAP (18 INCH)	CY	977	
		506	24 INCH GROUTED BOULDER	CY	602	
		601	CONCRETE CLASS D (BOX CULVERT)	CY	47	
		602	REINFORCING STEEL	LB	2352	
		602	REINFORCING STEEL (EPOXY COATED)	LB	740	
		603	48 INCH REINFORCED CONCRETE PIPE (CIP)	LF	187	
		603	48 INCH REINFORCED CONCRETE END SECTION	EA	1	
		603	10X3 FOOT CONCRETE BOX CULVERT (PRECAST)	LF	90	
		604	INLET TYPE D (10 FOOT)	EA	1	
		604	INLET SPECIAL	EA	1	
		619	8 INCH PLASTIC PIPE	LF	268	

NOTES:

1. 24 INCH GROUTED RIPRAP SHALL BE PAID FOR AS 24 INCH GROUTED BOULDERS.
2. SEE CBMP PLANS FOR TABULATION OF EROSION CONTROL ITEMS.
3. FOR UNCLASSIFIED EXCAVATION SEE EARTHWORK SUMMARY. COST OF EXCAVATION FOR ALL GROUTED BOULDERS AND SOIL RIPRAP IS INCLUDED IN THE COST OF THE BID ITEM.
4. DROP STRUCTURE TABULATION QUANTITIES HAVE BEEN CARRIED FORWARD TO THE SUMMARY OF APPROXIMATE QUANTITIES SHEETS.
5. 10X3 FOOT CONCRETE BOX CULVERT (PRECAST) QUANTITY SHOWN IS FOR THE DUAL BOX CULVERT AT CHEROKEE TRAIL.
6. THE PRESENCE OF GROUNDWATER IS ANTICIPATED AND THE CONTRACTOR SHALL BE RESPONSIBLE FOR DEWATERING DURING CONSTRUCTION FOR ALL STORM SEWER AND DROP STRUCTURE INFRASTRUCTURE. DEWATERING SHALL BE INCLUDED IN THE COST OF THE WORK AND NOT PAID FOR SEPARATELY.
7. THE SUGGESTED SEQUENCING FOR DEWATERING WHEN CONSTRUCTING THE DROP STRUCTURES INCLUDES CONSTRUCTING THE SHEET PILE CUTOFF WALLS FIRST, THEN INSTALLING DEWATERING WELLS OR TRENCHES TO DEWATER BELOW THE PROPOSED LOWEST EXCAVATION LIMITS.
8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL APPLICABLE DEWATERING PERMITS AND TREATMENT (AS REQUIRED) OF DISCHARGE FROM DEWATERING OPERATIONS.

I:\115360-01 - Compare at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\ Zach.Grady

Print Date: 4/16/2019 8:53:07 AM  
 File Name: H115360-01DROP01?ab.dwg  
 Horizontal Scale: N.T.S. Vertical Scale: N.T.S.

**FELSBURG HOLT & ULLEVIG**  
 6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

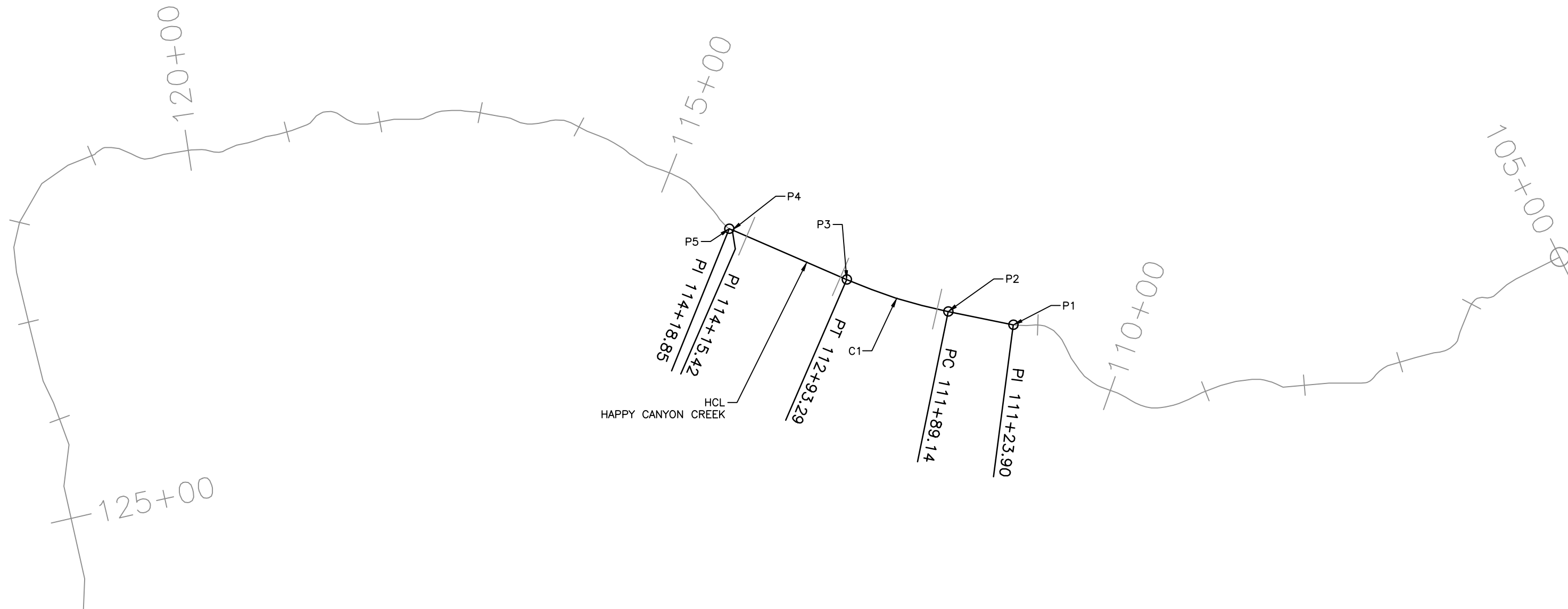
Sheet Revisions			
Date	Comments	Initials	
			(R-X)

**Manhard CONSULTING LTD**  
 8008 E. Arapahoe Court, Suite 110, Centennial, CO 80112 ph:303.708.0900 fax:303.708.0400 manhard.com  
 Civil Engineers • Surveyors • Water Resource Engineers • Water & Wastewater Engineers  
 Construction Managers • Environmental Scientists • Landscape Architects • Planners

As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE TABULATION			Project No./Code
No Revisions:	Designer:	CDT	Structure	
Revised:	Detailer:	KLT	Numbers	
Void:	Subset:	Drainage	Sheets:	DD-01 of 22

Sheet Number
--------------

I:\115360-01 - Compark at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\ Zach.Grady

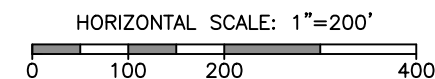
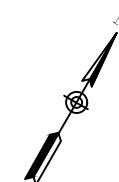


**COORDINATE DATA**

POINT	STATION	BEARING	NORTHING	EASTING
P1	PI 111+23.90		27812.91	94517.55
P2	PC 111+89.14	S71° 31' 51.06"W	27792.24	94455.67
P3	PT 112+93.29	C1	27769.74	94354.17
P4	PI 114+15.42	S83° 27' 55.88"W	27755.84	94232.84
P5	PI 114+18.85	S82° 04' 13.05"W	27755.40	94229.71

**CURVE DATA**

CURVE	DELTA	RADIUS	LENGTH	TANGENT
C1	11° 56' 4.83"	500	104.15	52.26



Print Date: 4/16/2019 8:53:16 AM  
 File Name: H115360-01DROP02Geom.dwg  
 Horizontal Scale: 1"=100' Vertical Scale: N.T.S.

Sheet Revisions		
Date	Comments	Initials



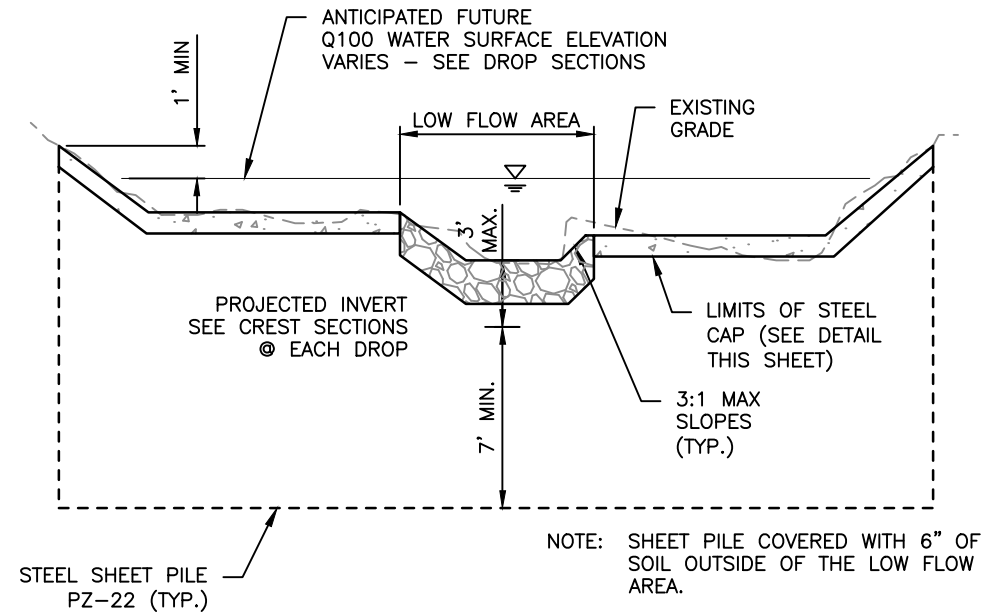
As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE HCL GEOMETRY LAYOUT		Project No./Code
No Revisions:	Designer: CDT	Structure Numbers	
Revised:	Detailer: KLT		
Void:	Subset: Drainage	Sheets: DD-02 of 22	Sheet Number



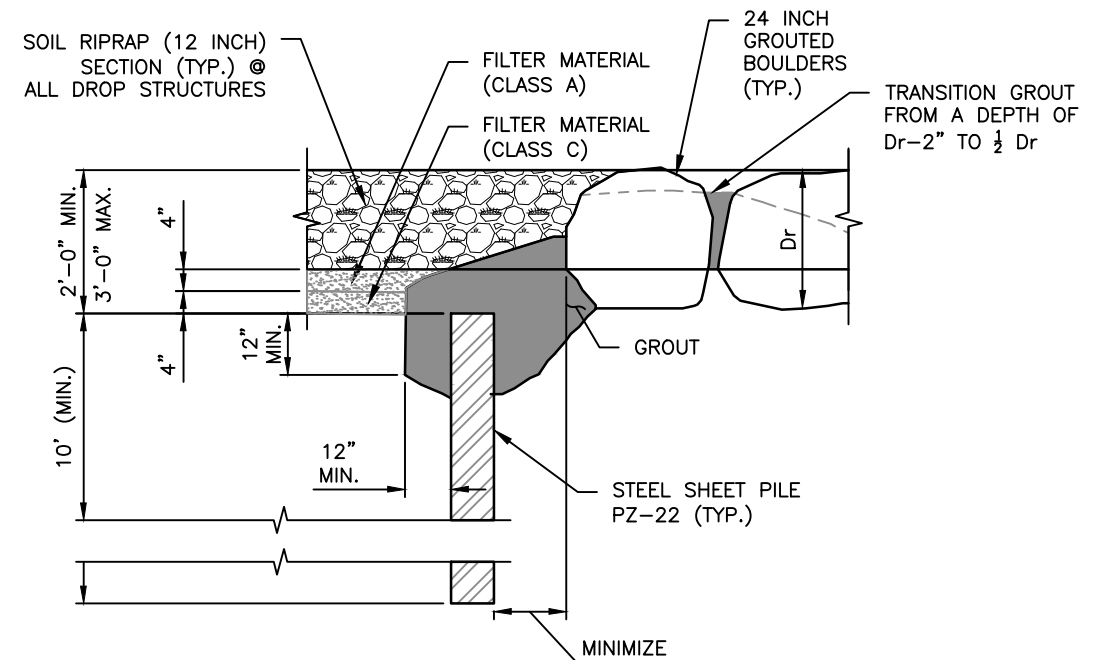
**FELSBURG  
HOLT &  
ULLEVIG**  
 6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832



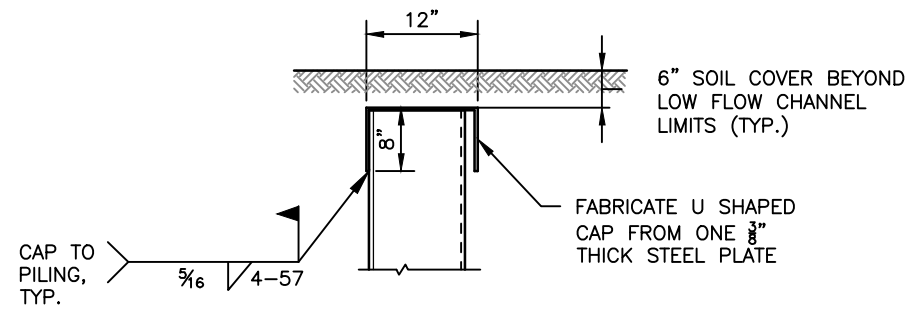
Know what's below.  
Call before you dig.



**SHEET PILE TYPICAL SECTION**  
N.T.S.



**SHEET PILE CUTOFF CONNECTION (GROUTED BOULDER)**  
N.T.S.



**STEEL SHEET PILE CAP DETAIL**  
N.T.S.

NOTE: STEEL CAP REQUIRED OUTSIDE OF GROUTED BOULDER SECTION ONLY. ALL INCIDENTAL ITEMS REQUIRED FOR THE STEEL SHEET PILE CAP SHALL BE INCLUDED IN THE COST OF STEEL SHEET PILING (TYPE II).

I:\115360-01 - Compark at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\ Zach.Grady

Print Date: 4/16/2019 8:53:22 AM
File Name: H115360-01DROPO3Sheet Pile Det.dwg
Horizontal Scale: N.T.S. Vertical Scale: N.T.S.
6300 South Syracuse Way, Suite 600 Centennial, CO 80111 tel 303.721.1440 fax 303.721.0832

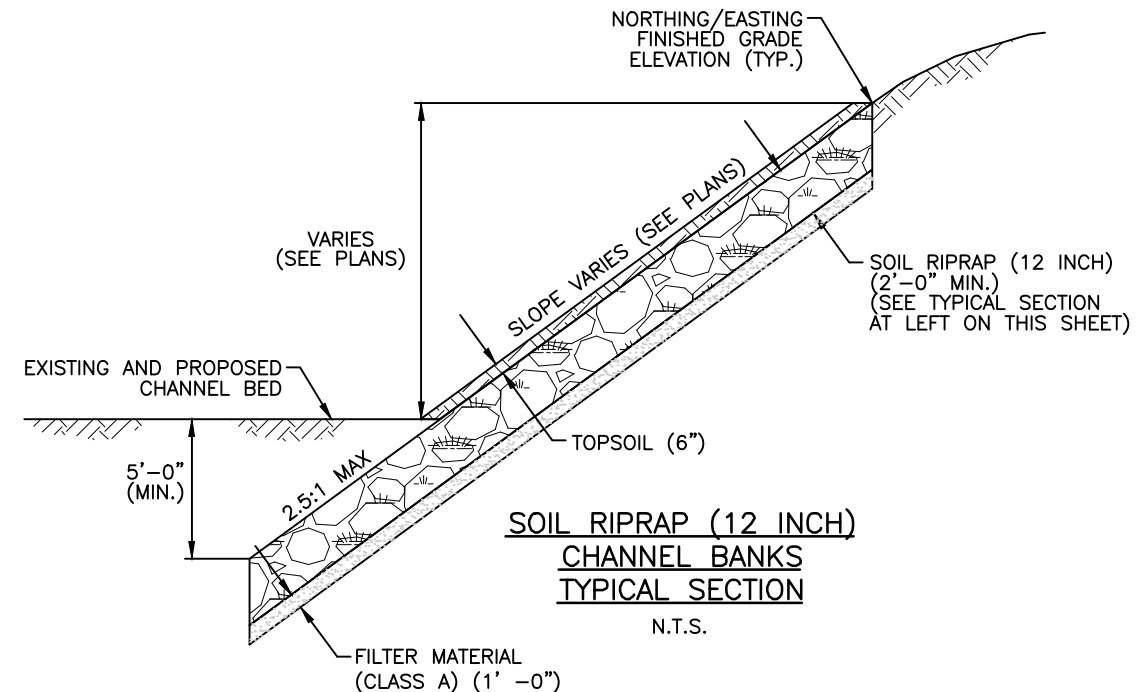
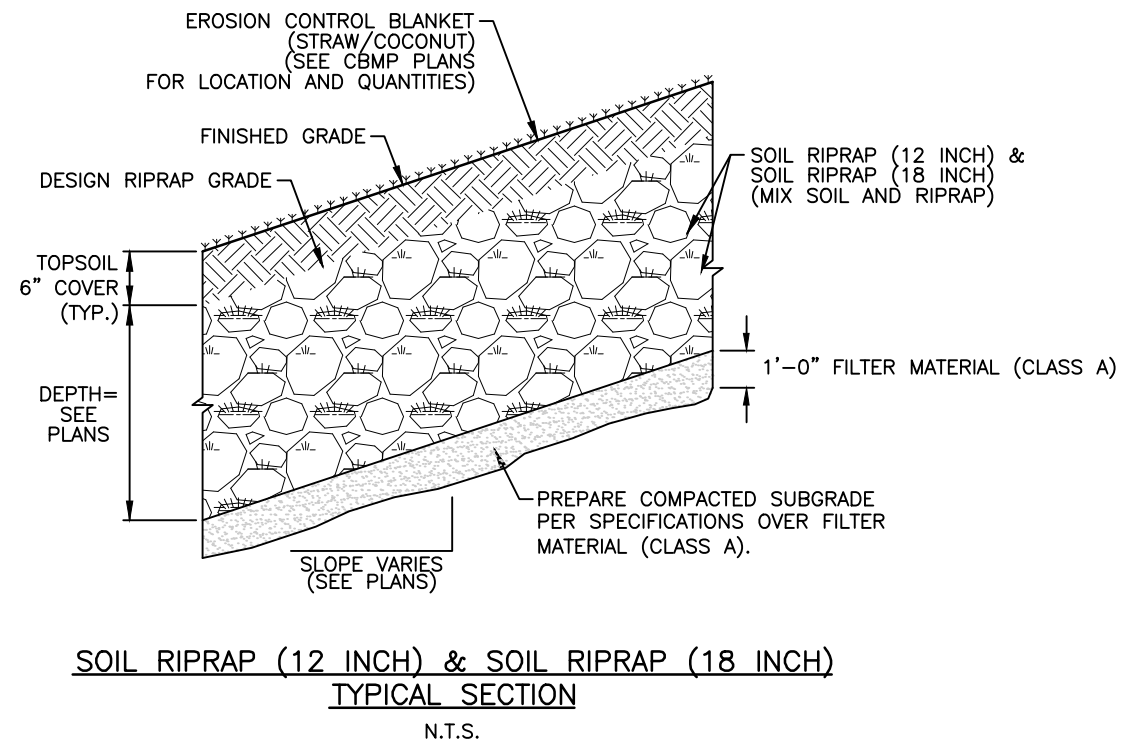
Sheet Revisions			
Date	Comments	Initials	



As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE SHEET PILE DETAILS		Project No./Code
No Revisions:			
Revised:	Designer: CDT	Structure Numbers	
	Detailer: KLT		
Void:	Subset: Drainage	Sheets: DD-03 of 22	Sheet Number



Know what's below.  
Call before you dig.



**SOIL RIPRAP (12 INCH) & SOIL RIPRAP (18 INCH) NOTES:**

- ELEVATION TOLERANCES FOR THE SOIL RIPRAP SHALL BE 0.10 FEET. THICKNESS OF SOIL RIPRAP SHALL BE NO LESS THAN THICKNESS SHOWN AND NO MORE THAN 2-INCHES GREATER THAN THE THICKNESS SHOWN.
- WHERE "SOIL RIPRAP" IS DESIGNATED ON THE CONTRACT DRAWINGS, RIPRAP VOIDS ARE TO BE FILLED WITH NATIVE SOIL. THE RIPRAP SHALL BE PRE-MIXED WITH THE NATIVE SOIL AT THE FOLLOWING PROPORTIONS BY VOLUME: 65% RIPRAP AND 35% SOIL. THE SOIL USED FOR MIXING SHALL BE NATIVE TOPSOIL AND BE INSTALLED IN A MANNER THAT RESULTS IN A DENSE, INTERLOCKED LAYER OF RIPRAP WITH RIPRAP VOIDS FILLED COMPLETELY WITH SOIL. SEGREGATION OF MATERIALS SHALL BE AVOIDED AND IN NO CASE SHALL THE COMBINED MATERIAL CONSIST PRIMARILY OF SOIL; THE DENSITY AND INTERLOCKING NATURE OF RIPRAP IN THE MIXED MATERIAL SHALL ESSENTIALLY BE THE SAME AS IF THE RIPRAP WAS PLACED WITHOUT SOIL.
- WHERE SPECIFIED (TYPICALLY AS "BURIED SOIL RIPRAP"), A SURFACE LAYER OF TOPSOIL SHALL BE PLACED OVER THE SOIL RIPRAP ACCORDING TO THE THICKNESS SPECIFIED ON THE CONTRACT DRAWINGS. THE TOPSOIL SURFACE LAYER SHALL BE COMPACTED TO APPROXIMATELY 85% OF THE MAXIMUM DENSITY AND WITHIN TWO PERCENTAGE POINTS OF OPTIMUM MOISTURE IN ACCORDANCE WITH ASTM D698. TOPSOIL SHALL BE ADDED TO ANY AREAS THAT SETTLE.
- ALL SOIL RIPRAP THAT IS BURIED WITH THE TOPSOIL SHALL BE REVIEWED AND APPROVED BY THE ENGINEER PRIOR TO ANY TOPSOIL PLACEMENT.
- CRIMP MULCH AS CALLED FOR IN THE CBMP PLANS AND SPECIFICATIONS.
- SEE DD-03 FOR SOIL RIPRAP AT DROP STRUCTURES.

RIPRAP AND SOIL RIPRAP GRADATION				
UDFCD RIPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSION (INCHES)	D <sub>50</sub> * (INCHES)	BID ITEM DESCRIPTION
TYPE M	70 - 100	21	12	RIPRAP (12 INCH)
	50 - 70	18		
	35 - 50	12		SOIL RIPRAP (12 INCH)
	2 - 10	4		
TYPE H	70 - 100	30	18	RIPRAP (18 INCH)
	50 - 70	24		
	35 - 50	18		SOIL RIPRAP (18 INCH)
	2 - 10	6		
TYPE VH	70 - 100	42	24	24 INCH GROUDED BOULDER
	50 - 70	33		
	35 - 50	24		
	2 - 10	9		

I:\115360-01 - Compark at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\ Zach.Grady

Print Date: 4/16/2019 8:53:32 AM  
 File Name: H115360-01DROP04Soil Riprap Det.dwg  
 Horizontal Scale: N.T.S Vertical Scale: N.T.S  
**FELSBURG HOLT & ULLEVIG**  
 6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

Sheet Revisions			
Date	Comments	Initials	



As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE DETAILS		Project No./Code
No Revisions:	Designer: CDT	Structure Numbers	
Revised:	Detailer: KLT	Sheets: DD-04 of 22	Sheet Number
Void:	Subset: Drainage		



Know what's below.  
Call before you dig.

### GROUT NOTES

#### BOULDER PLACEMENT NOTES:

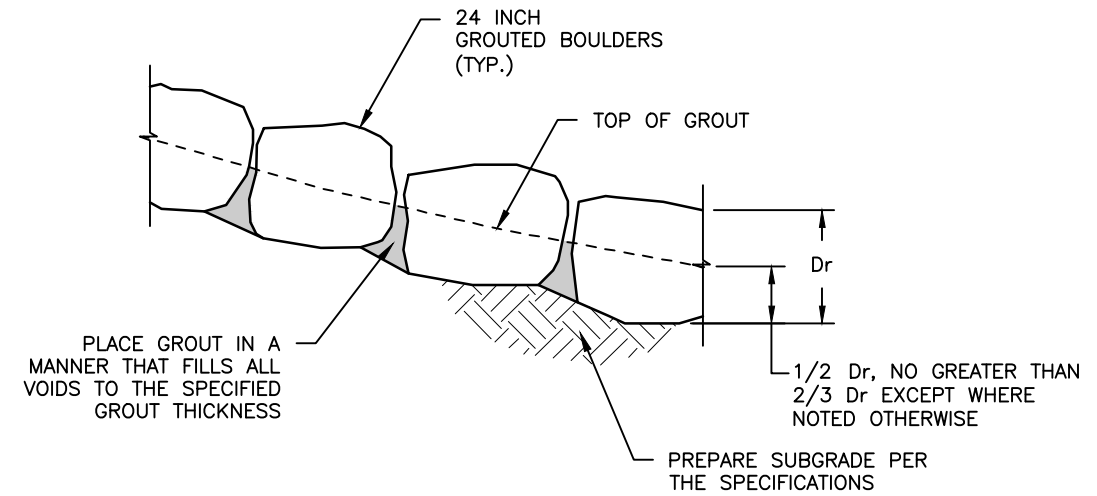
1. PLACE BOULDERS WITH THE REQUIRED BOULDER HEIGHT VERTICAL. PLACE BOULDERS AS TIGHTLY TOGETHER AS POSSIBLE (WITHOUT TOUCHING) WHILE PROVIDING ENOUGH ROOM BETWEEN THEM TO THOROUGHLY VIBRATE THE GROUT AND TO ENSURE NO GAPS IN THE GROUT. THE SMALL DIMENSION OF A 2X4 CAN BE USED AS A GUIDE TO CHECK MINIMUM SPACING.
2. BEFORE GROUTING, CLEAN ALL DIRT AND MATERIAL FROM ROCK THAT COULD PREVENT THE GROUT FROM BINDING TO THE ROCK. KEEP BOULDERS FROM TOUCHING. AVOID SLIDING BOULDERS AGAINST SUBGRADE TO PROPERLY POSITION.

#### MATERIAL SPECIFICATIONS:

1. ALL GROUT SHALL HAVE A MINIMUM 28-DAY COMPRESSIVE STRENGTH EQUAL TO 3200 PSI.
2. ONE CUBIC YARD OF GROUT SHALL HAVE A MINIMUM OF SIX (6) SACKS OF TYPE II PORTLAND CEMENT.
3. A MAXIMUM OF 25% TYPE F FLY ASH MAY BE SUBSTITUTED FOR THE PORTLAND CEMENT.
4. THE AGGREGATE SHALL BE COMPRISED OF 70% NATURAL SAND (FINES) AND 30% 3/8-INCH ROCK (COARSE).
5. THE GROUT SLUMP SHALL BE BETWEEN 4-INCHES TO 6-INCHES.
6. AIR ENTRAINMENT SHALL BE BETWEEN 5.5% AND 7.5%.
7. TO CONTROL SHRINKAGE AND CRACKING, 1.5 POUNDS OF FIBERMESH, OR EQUIVALENT, SHALL BE USED PER CUBIC YARD OF GROUT.
8. COLOR ADDITIVE IN REQUIRED AMOUNTS SHALL BE USED WHEN SO SPECIFIED BY CONTRACT.

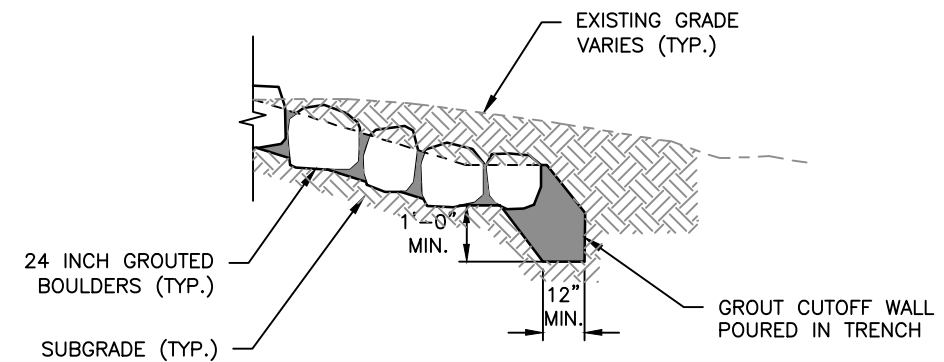
#### GROUT PLACEMENT SPECIFICATIONS:

1. SPECIAL PROCEDURES SHALL BE REQUIRED FOR GROUT PLACEMENT WHEN THE AIR TEMPERATURES ARE LESS THAN 40°F OR GREATER THAN 90°F. CONTRACTOR SHALL OBTAIN PRIOR APPROVAL FROM THE DESIGN ENGINEER OF THE PROCEDURES TO BE USED FOR PROTECTING THE GROUT.
2. GROUT SHALL BE DELIVERED BY MEANS OF A LOW PRESSURE (LESS THAN 10 PSI) GROUT PUMP USING A 2-INCH DIAMETER (MAXIMUM) NOZZLE.
3. FULL DEPTH PENETRATION OF THE GROUT INTO THE BOULDER VOIDS SHALL BE ACHIEVED BY INJECTING GROUT STARTING WITH THE NOZZLE NEAR THE BOTTOM AND RAISING IT AS THE GROUT FILLS, WHILE VIBRATING GROUT INTO PLACE USING A PENCIL VIBRATOR.
4. ALL GROUT BETWEEN BOULDERS SHALL BE TREATED WITH A BROOM FINISH.
5. AFTER GROUT PLACEMENT, EXPOSED BOULDER FACES SHALL BE CLEANED AND FREE OF GROUT.
6. ALL FINISHED GROUT SURFACES SHALL BE SPRAYED WITH A CLEAR LIQUID MEMBRANE CURING COMPOUND AS SPECIFIED IN ASTM C309.



**GROUTED BOULDER PLACEMENT DETAIL**

N.T.S.



**STRUCTURE EDGE WALL DETAIL**

N.T.S.

I:\115360-01 - Compare at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\ Zach.Grady

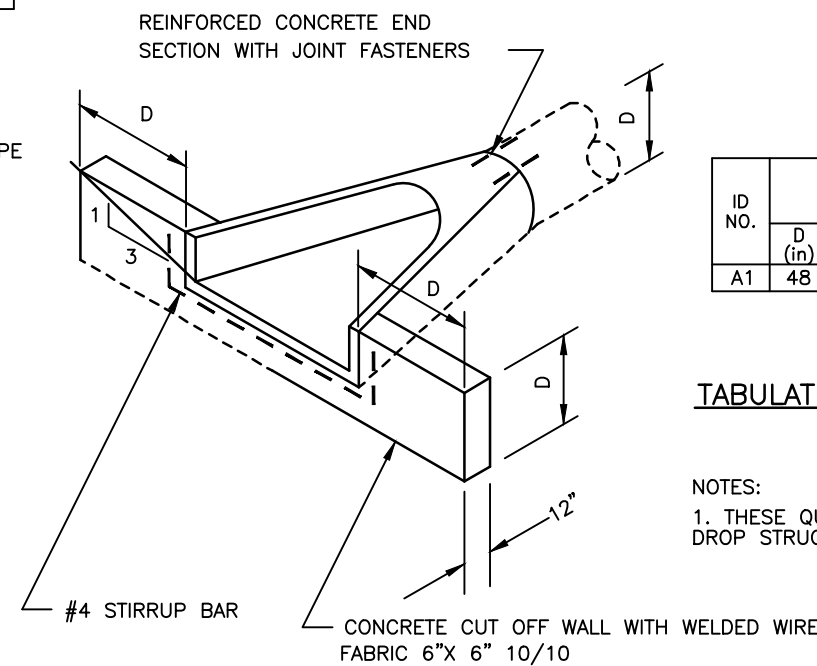
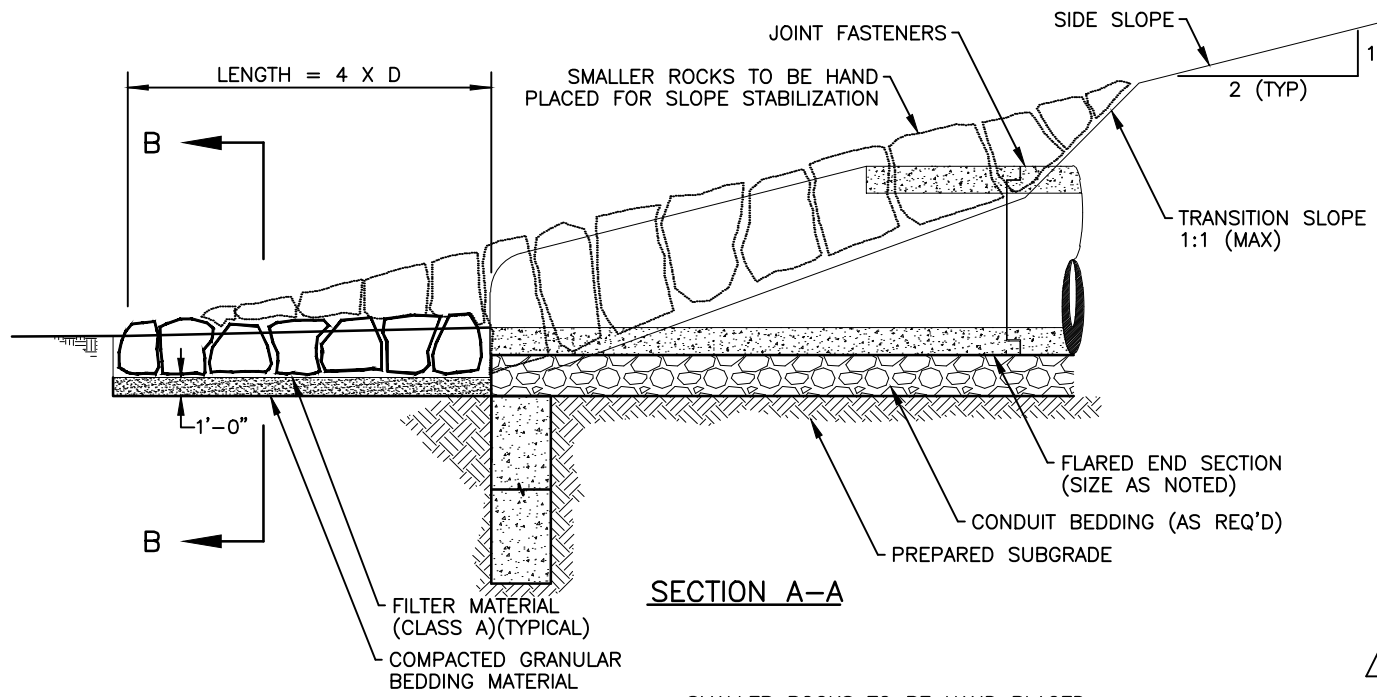
Print Date: 4/16/2019 8:53:45 AM	
File Name: H115360-01DROP05Grouted Boulder Det.dwg	
Horizontal Scale: N.T.S	Vertical Scale: N.T.S
6300 South Syracuse Way, Suite 600 Centennial, CO 80111 tel 303.721.1440 fax 303.721.0832	

Sheet Revisions			
(R-X)	Date	Comments	Initials



As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE DETAIL		Project No./Code
No Revisions:			
Revised:	Designer: CDT	Structure Numbers	
	Detailer: KLT		
Void:	Subset: Drainage	Sheets: DD-05 of 22	Sheet Number

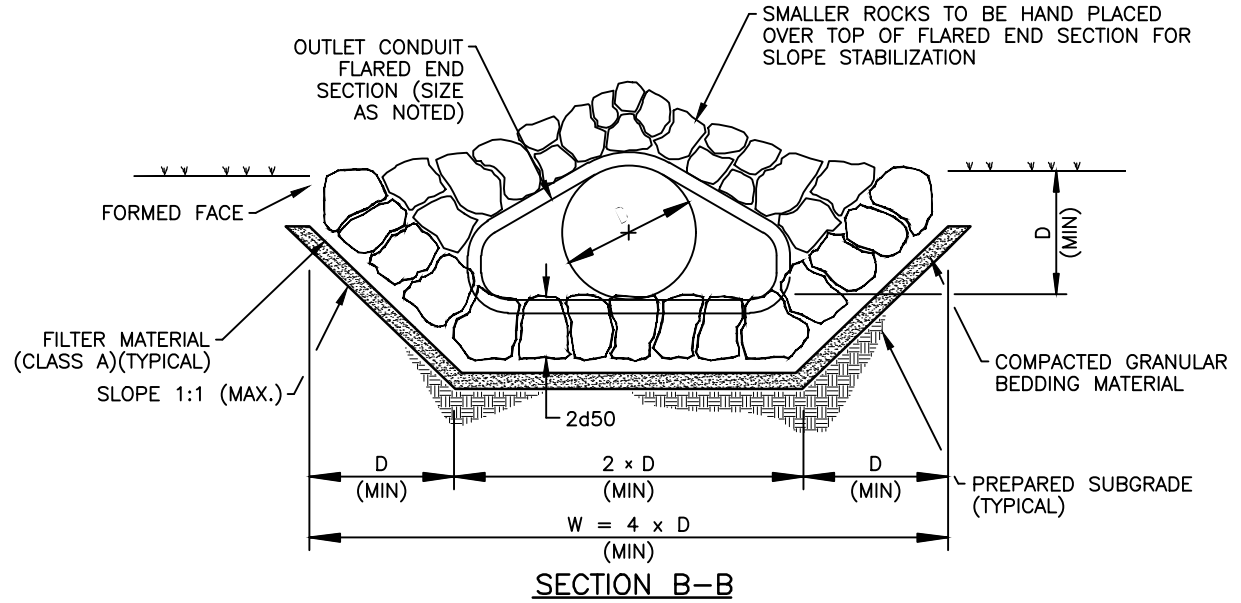
I:\115360-01 - Compare at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\ Zach.Grady



ID NO.	DIMENSIONS					QUANTITIES	
	D (in)	W (ft)	L (ft)	RIPRAP TYPE	d50 (in)	RIPRAP (12 INCH) (CY)	FILTER MATERIAL (CLASS A) (CY)
A1	48	16	16	M	12	19	9

**TABULATION OF RIPRAP AND GEOTEXTILE MATERIAL AT CULVERT INLETS & OUTLETS**

NOTES:  
1. THESE QUANTITIES HAVE BEEN CARRIED FORWARD TO THE DROP STRUCTURE TABULATION.



**CONCRETE TOEWALL AND END SECTION FOR REINFORCED CONCRETE PIPE**

- NOTES:
1. D= INSIDE DIAMETER OF REINFORCED CONCRETE PIPE.
  2. CONCRETE FOR THE TOEWALL SHALL BE CONCRETE CLASS D (WALL)
  3. EACH REINFORCED CONCRETE END SECTION SHALL BE CONNECTED TO THE REINFORCED CONCRETE PIPE WITH CONCRETE PIPE JOINT FASTENERS (2-EACH). CONCRETE PIPE JOINT FASTENERS SHALL BE INCLUDED IN THE COST OF THE REINFORCED CONCRETE END SECTION.
  4. ALL CONCRETE, REINFORCING, CONNECTIONS, STRUCTURE EXCAVATION, AND EXTRA WORK REQUIRED TO CONSTRUCT THE CONCRETE TOEWALL SHALL BE INCLUDED IN THE COST OF 48 INCH RCES.
  5. ALL REINFORCED CONCRETE PIPE EXTENSIONS SHALL HAVE A CONCRETE COLLAR AND SHALL BE INCLUDED IN THE COST OF THE REINFORCED CONCRETE PIPE.
  6. REMOVED RIPRAP MAY BE UTILIZED FOR RIPRAP (12 INCH) UNLESS DIRECTED OTHERWISE BY THE ENGINEER.

Print Date: 4/16/2019 8:53:54 AM  
 File Name: H115360-01DROP06?utlet Protection Det.dwg  
 Horizontal Scale: NTS Vertical Scale: NTS

**FELSBURG HOLT & ULLEVIG**  
 6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

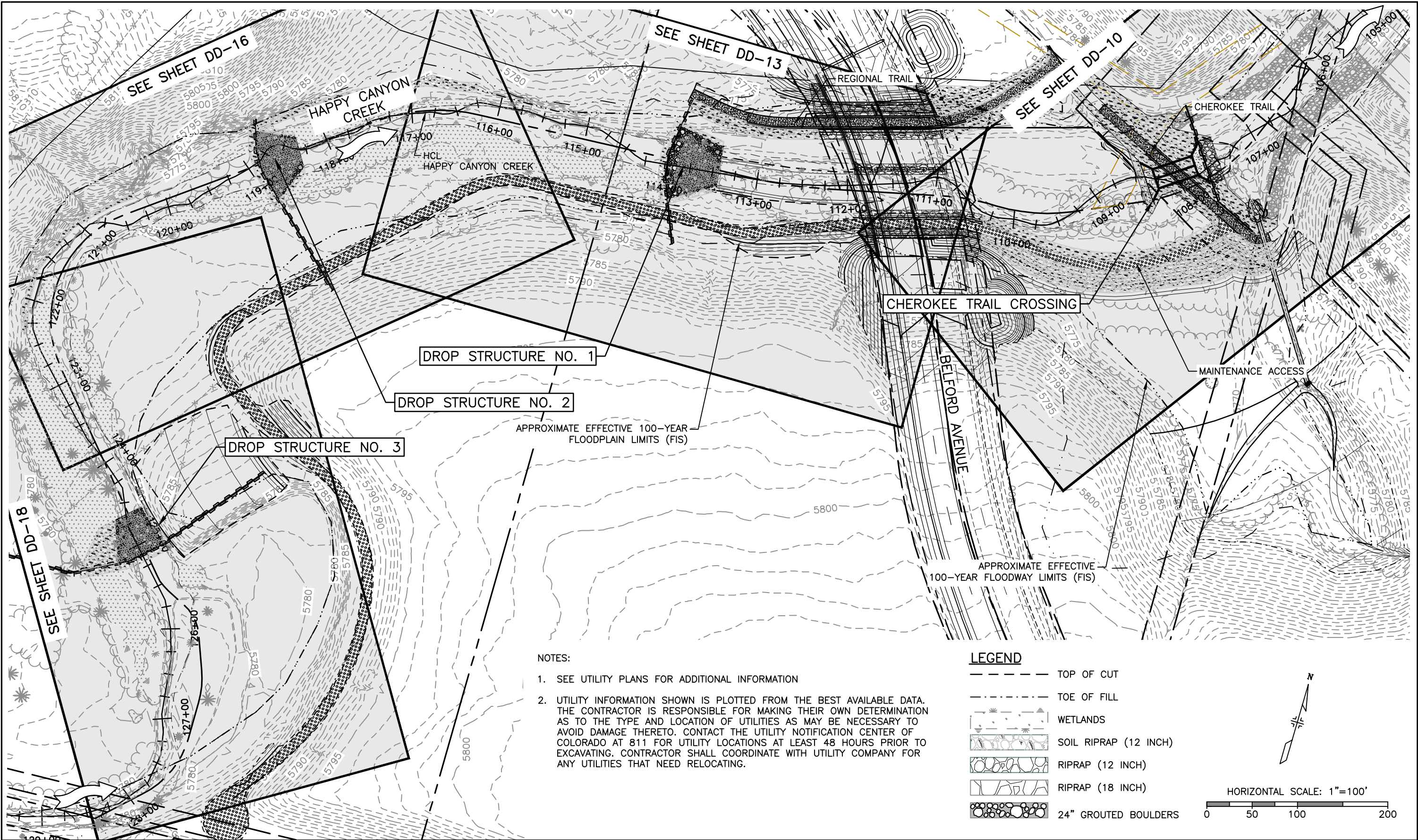
Sheet Revisions			
Date	Comments	Initials	

**Manhard CONSULTING LTD**

8008 E. Arapahoe Court, Suite 110, Centennial, CO 80112 ph:303.708.0900 fax:303.708.0400 manhard.com  
 Civil Engineers • Surveyors • Water Resource Engineers • Water & Wastewater Engineers  
 Construction Managers • Environmental Scientists • Landscape Architects • Planners

As Constructed	BELFORD-HAPPY CANYON CREEK DRAINAGE		Project No./Code
No Revisions:	OUTLET PROTECTION DETAILS		
Revised:	Designer: CDT	Structure Numbers	
Void:	Detailer: KLT	Sheets: DD-06 of 22	Sheet Number

I:\115360-01 - Compark at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\ Zach.Grady

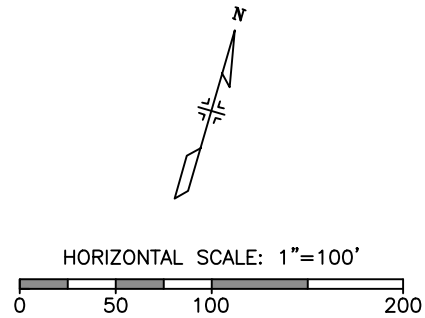


**NOTES:**

1. SEE UTILITY PLANS FOR ADDITIONAL INFORMATION
2. UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.

**LEGEND**

- TOP OF CUT
- TOE OF FILL
- [Symbol] WETLANDS
- [Symbol] SOIL RIPRAP (12 INCH)
- [Symbol] RIPRAP (12 INCH)
- [Symbol] RIPRAP (18 INCH)
- [Symbol] 24" GROUTED BOULDERS



Print Date: 4/16/2019 8:54:43 AM  
 File Name: H115360-01DROP07?eymap.dwg  
 Horizontal Scale: 1"=50' Vertical Scale: N.T.S.

**FELSBURG HOLT & ULLEVIG**  
 6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

Sheet Revisions			
Date	Comments	Initials	

**Manhard CONSULTING LTD**

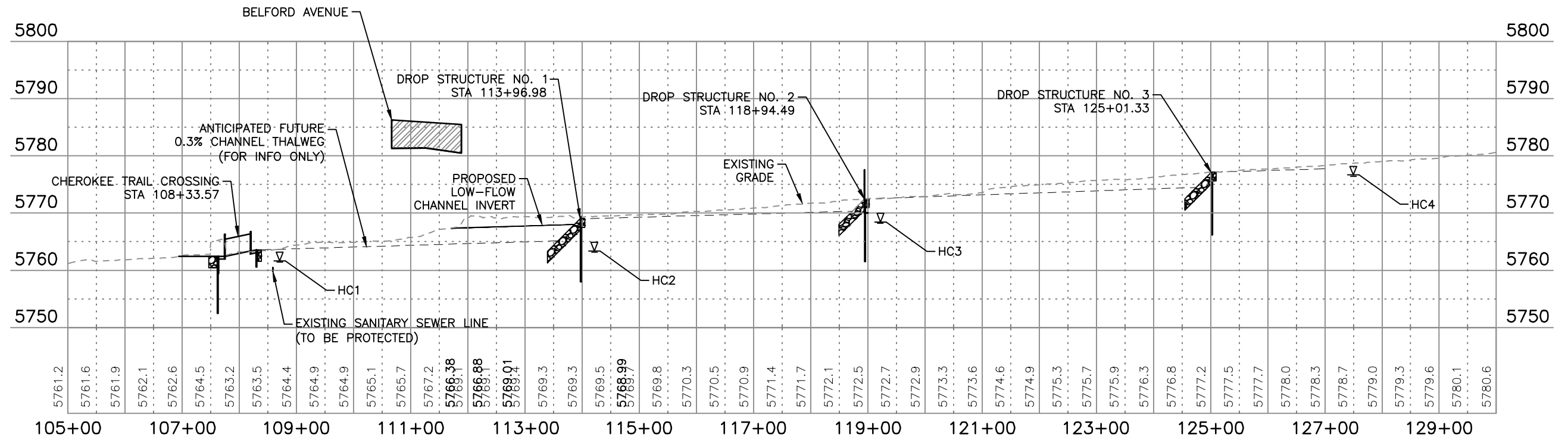
8008 E. Arapahoe Court, Suite 110, Centennial, CO 80112 ph:303.708.0900 fax:303.708.0400 manhard.com  
 Civil Engineers • Surveyors • Water Resource Engineers • Water & Wastewater Engineers  
 Construction Managers • Environmental Scientists • Landscape Architects • Planners

As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE PLAN		Project No./Code
No Revisions:	Designer: CDT	Structure Numbers	
Revised:	Detailer: KLT	Numbers	
Void:	Subset: Drainage	Sheets: DD-07 of 22	Sheet Number

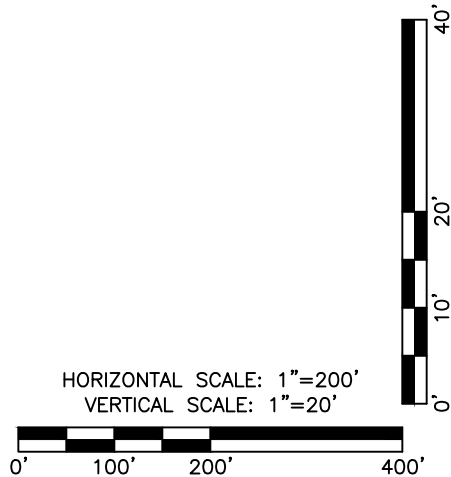
Project No./Code  
 Sheet Number

NOTES

- UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.
- SEE UTILITY PLANS FOR ADDITIONAL INFORMATION.



HAPPY CANYON CREEK PROFILE



▽ APPROX. GROUNDWATER ELEVATION

GROUNDWATER ELEVATIONS	
TEST BORING ID	APPROX. DEPTH BELOW SURFACE (FT.)
HC1	-2.0
HC2	-6.0
HC3	-4.0
HC4	-2.0

I:\115360-01 - Compark at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\ Zach.Grady

Print Date: 4/16/2019 8:55:45 AM  
 File Name: H115360-01DROP08?profile.dwg  
 Horizontal Scale: 1"=100' Vertical Scale: 1"=10'

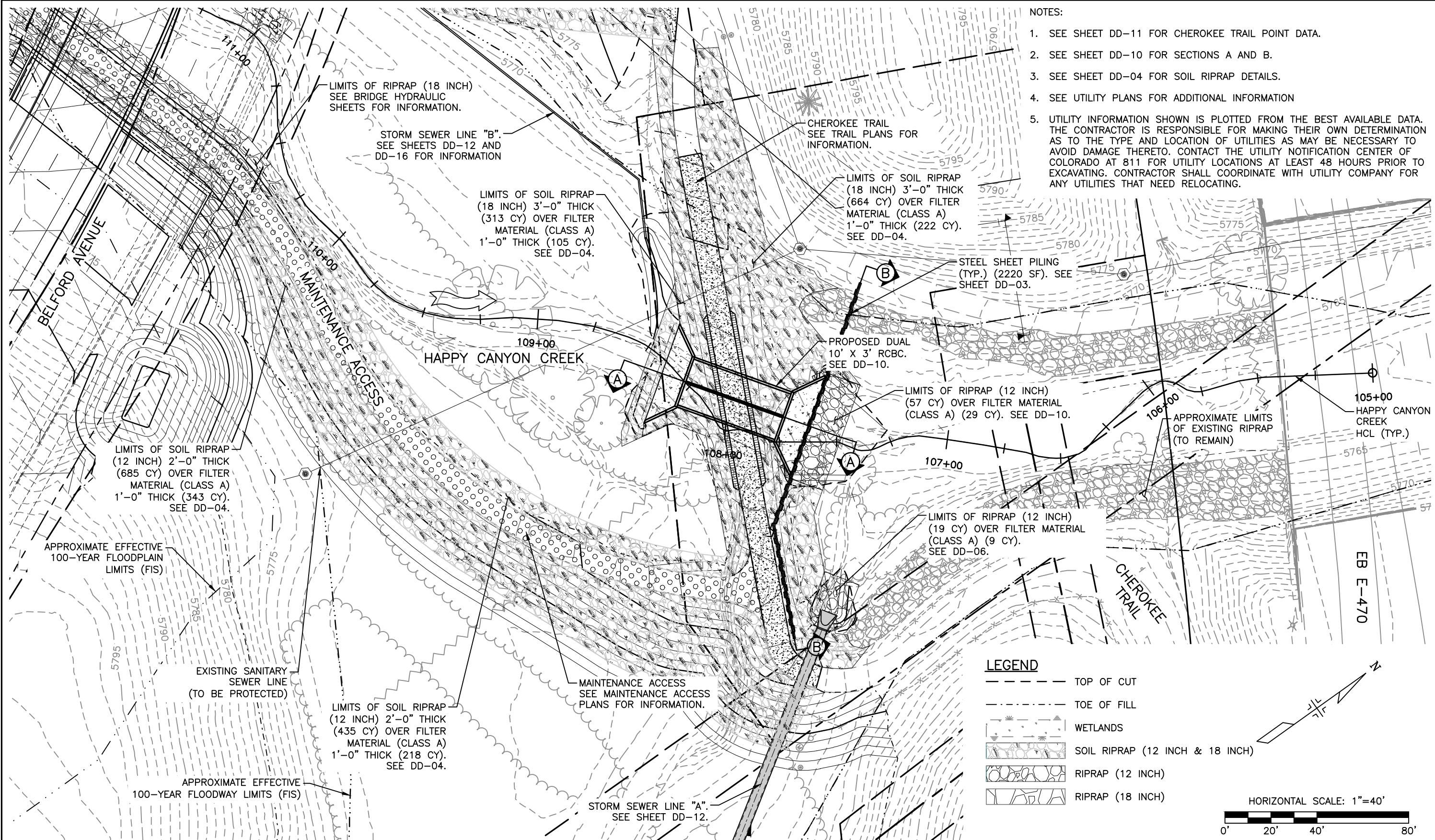
6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

Sheet Revisions		
Date	Comments	Initials

8008 E. Arapahoe Court, Suite 110, Centennial, CO 80112 ph:303.708.0900 fax:303.708.0400 manhard.com  
 Civil Engineers • Surveyors • Water Resource Engineers • Water & Wastewater Engineers  
 Construction Managers • Environmental Scientists • Landscape Architects • Planners

As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE PROFILE		Project No./Code
No Revisions:	Designer: CDT	Structure Numbers	
Revised:	Detailer: ZJG		
Void:	Subset: Drainage	Sheets: DD-08 of 22	Sheet Number

I:\115360-01 - Compark at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\ Zach.Grady



- NOTES:
1. SEE SHEET DD-11 FOR CHEROKEE TRAIL POINT DATA.
  2. SEE SHEET DD-10 FOR SECTIONS A AND B.
  3. SEE SHEET DD-04 FOR SOIL RIPRAP DETAILS.
  4. SEE UTILITY PLANS FOR ADDITIONAL INFORMATION
  5. UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.

**LEGEND**

- - - - - TOP OF CUT  
 - - - - - TOE OF FILL  
 WETLANDS  
 SOIL RIPRAP (12 INCH & 18 INCH)  
 RIPRAP (12 INCH)  
 RIPRAP (18 INCH)

HORIZONTAL SCALE: 1"=40'

Print Date: 4/16/2019 8:56:46 AM  
 File Name: H115360-01DROP09?herokeeTrailCrossing  
 Horizontal Scale: 1"=20' Vertical Scale: N.T.S.

**FELSBURG  
HOLT &  
ULLEVIG**

6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

Sheet Revisions			
Date	Comments	Initials	

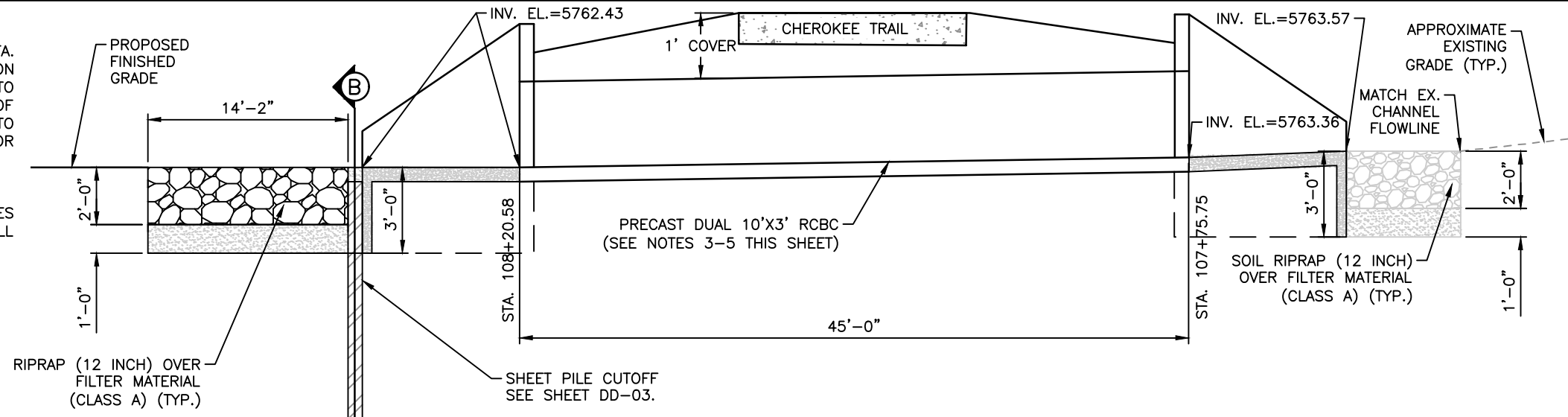
**Manhard  
CONSULTING LTD**

8008 E. Arapahoe Court, Suite 110, Centennial, CO 80112 ph:303.708.0900 fax:303.708.0400 manhard.com  
 Civil Engineers • Surveyors • Water Resource Engineers • Water & Wastewater Engineers  
 Construction Managers • Environmental Scientists • Landscape Architects • Planners

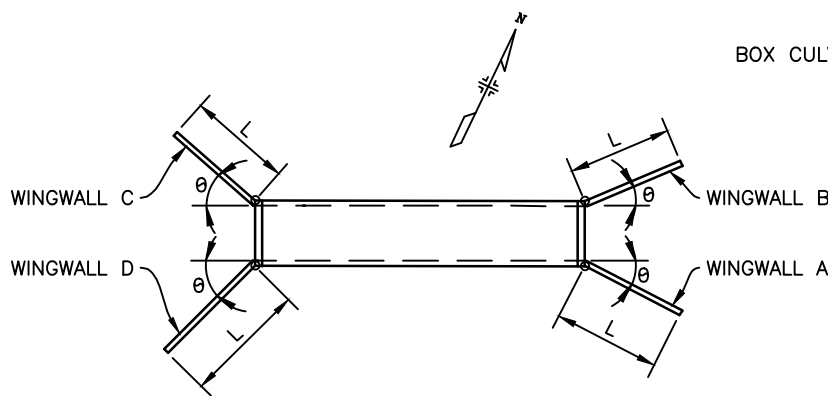
As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE CHEROKEE TRAIL PLAN		Project No./Code
No Revisions:	Designer: CDT	Structure Numbers	
Revised:	Detailer: ZJG	Sheets: DD-09 of 22	Sheet Number
Void:	Subset: Drainage		

**NOTES:**

1. UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.
2. SEE UTILITY PLANS FOR ADDITIONAL INFORMATION.
3. PRECAST BOX CULVERT MUST CONFORM TO CDOT M-STANDARDS M-603-2.
4. FOR CAST-IN-PLACE END SECTIONS, USE M-601-2 FOR WALL THICKNESSES AND REINFORCEMENT SIZE AND SPACINGS WITH S=10 FT, R=6 FT, AND FILL HEIGHT = 0-5 FT.
5. FOR WINGWALLS AND CONCRETE APRON, USE M-601-20.

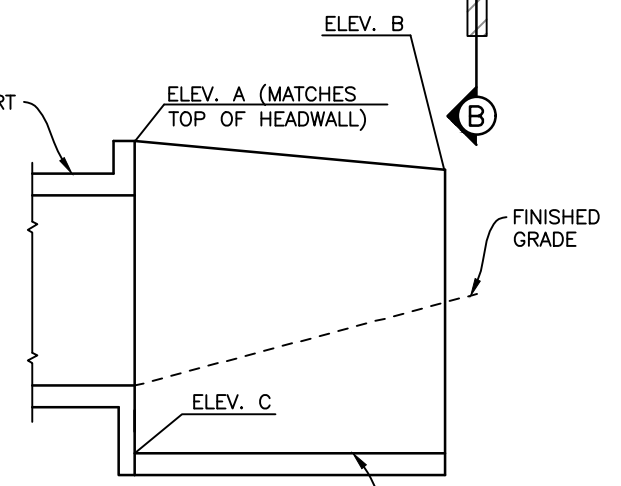


**(A) CHEROKEE TRAIL CROSSING PROFILE @ RCBC**  
 STA 107+48.70 TO 108+41.52  
 N.T.S.

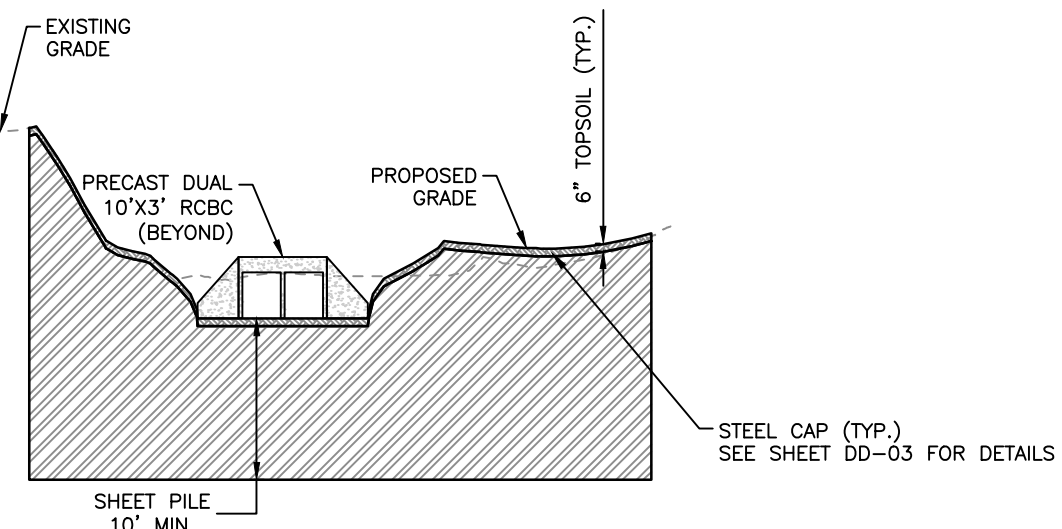


**WINGWALL LAYOUT AT BOX CULVERT**

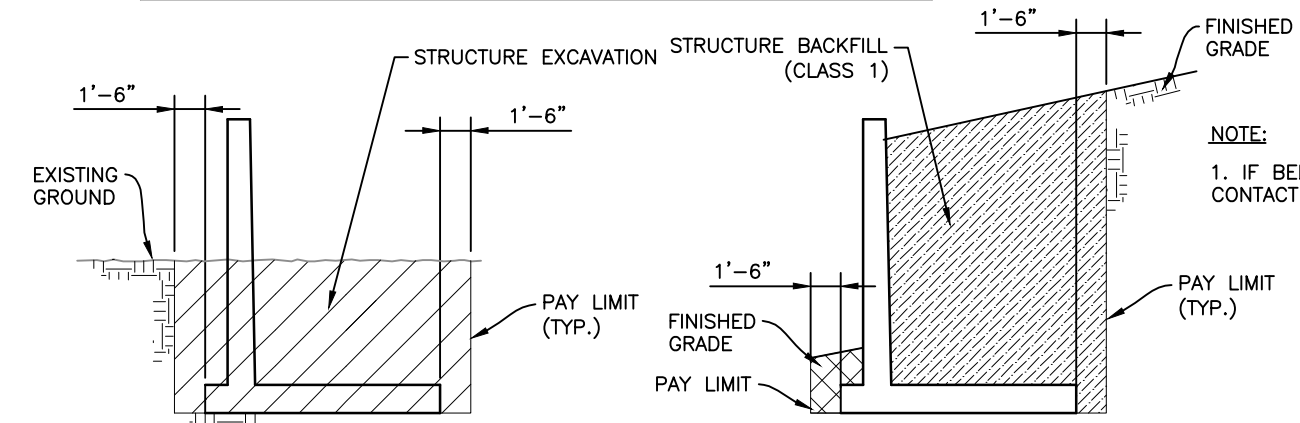
WINGWALL	θ	L	ELEV. A	ELEV. B	ELEV. C
A	45°0'0"	15'-6"	5767.18	5763.43	5760.43
B	45°0'0"	15'-6"	5767.18	5763.43	5760.43
C	45°0'0"	15'-6"	5768.11	5764.57	5761.36
D	45°0'0"	15'-6"	5768.11	5764.57	5761.36



**ELEVATION WINGWALLS**



**(B) CREST SECTION**  
 STA 107+63.54

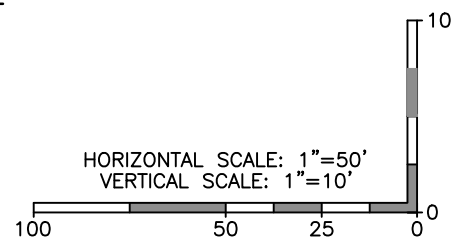


**WINGWALLS EXCAVATION**

**WINGWALLS BACKFILL**

**NOTE:**  
 1. IF BEDROCK IS ENCOUNTERED, CONTACT ENGINEER PRIOR TO PROCEEDING.

**CHEROKEE TRAIL CROSSING**



I:\115360-01 - Compare at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\ Zach.Grady

Print Date: 4/16/2019 8:56:51 AM	<p><b>Manhard CONSULTING LTD</b>  <small>800 E. Arapahoe Court, Suite 110, Centennial, CO 80112 ph:303.721.0832 fax:303.721.0832 manhard.com</small>  <small>Civil Engineers • Surveyors • Water Resource Engineers • Water &amp; Wastewater Engineers</small>  <small>Construction Managers • Environmental Scientists • Landscape Architects • Planners</small></p>	As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE CHEROKEE TRAIL PROFILE/DETAILS		Project No./Code																			
File Name: H115360-01DROP10Drop1 Prof Sect.dwg		No Revisions:																						
Horizontal Scale: 1"=50' Vertical Scale: 1"=10'		Revised:	Designer: CDT	Structure Numbers																				
<p><b>FELSBURG HOLT &amp; ULLEVIG</b>  <small>6300 South Syracuse Way, Suite 600 Centennial, CO 80111 tel 303.721.1440 fax 303.721.0832</small></p>	<table border="1"> <thead> <tr> <th colspan="3">Sheet Revisions</th> </tr> <tr> <th>Date</th> <th>Comments</th> <th>Initials</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>	Sheet Revisions			Date	Comments	Initials										<table border="1"> <tr> <td>Detailer: ZJG</td> <td>Numbers</td> <td></td> </tr> <tr> <td>Subset: Drainage</td> <td>Sheets: DD-10 of 22</td> <td>Sheet Number</td> </tr> </table>	Detailer: ZJG	Numbers		Subset: Drainage	Sheets: DD-10 of 22	Sheet Number	
	Sheet Revisions																							
Date	Comments	Initials																						
Detailer: ZJG	Numbers																							
Subset: Drainage	Sheets: DD-10 of 22	Sheet Number																						
		Void:																						

HAPPY CANYON CREEK CHEROKEE TRAIL STEEL SHEET PILE CUTOFF WALL POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
W1	27865.91	94895.02	5767.95	STEEL SHEET PILE WALL - TOP OF STEEL CAP EL.
W2	27887.19	94849.78	5767.36	STEEL SHEET PILE WALL - TOP OF STEEL CAP EL.
W3	27979.15	94785.85	5774.82	STEEL SHEET PILE WALL - TOP OF STEEL CAP EL.

HAPPY CANYON CREEK CHEROKEE TRAIL GRADING POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
G1	27872.10	94962.88	5779.00	FINISHED GRADE EL.
G2	27823.77	94932.12	5779.00	FINISHED GRADE EL.
G3	27808.04	94890.63	5779.00	FINISHED GRADE EL.
G4	27766.29	94809.24	5779.00	FINISHED GRADE EL.
G5	27745.18	94744.70	5779.00	FINISHED GRADE EL.

HAPPY CANYON CREEK CHEROKEE TRAIL SOIL RIPRAP POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
SR1	27769.57	94610.15	5777.00	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR2	27835.00	94932.41	5777.00	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR3	27801.00	94604.71	5765.86	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR4	27800.34	94633.29	5767.10	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR5	27797.05	94661.68	5769.72	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR6	27804.21	94763.47	5770.47	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR7	27862.90	94848.01	5766.25	SOIL RIPRAP (18 INCH) - FINISHED GRADE EL.
SR8	27885.85	94800.95	5767.60	SOIL RIPRAP (18 INCH) - FINISHED GRADE EL.
SR9	27876.75	94787.62	5765.88	SOIL RIPRAP (18 INCH) - FINISHED GRADE EL.
SR10	27853.55	94783.45	5766.72	SOIL RIPRAP (18 INCH) - FINISHED GRADE EL.
SR11	27913.61	94738.94	5766.30	SOIL RIPRAP (18 INCH) - FINISHED GRADE EL.
SR12	27871.26	94540.03	5768.10	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR13	27892.28	94575.67	5770.18	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR14	27920.57	94605.87	5772.85	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR15	27943.91	94626.32	5774.60	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR16	27967.25	94646.78	5775.74	SOIL RIPRAP (18 INCH) - FINISHED GRADE EL.
SR17	27912.28	94510.88	5777.00	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR18	27925.40	94519.82	5777.00	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR19	27937.08	94566.65	5777.00	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR20	27941.85	94573.12	5777.00	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR21	27962.56	94597.66	5777.00	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR22	27970.79	94607.21	5777.00	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR23	27995.66	94624.88	5777.00	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR24	27980.34	94661.67	5776.11	SOIL RIPRAP (18 INCH) - FINISHED GRADE EL.
SR25	27988.53	94666.66	5776.90	SOIL RIPRAP (18 INCH) - FINISHED GRADE EL.
SR26	27956.85	94747.12	5773.49	SOIL RIPRAP (18 INCH) - FINISHED GRADE EL.
SR27	27965.72	94770.00	5773.56	SOIL RIPRAP (18 INCH) - FINISHED GRADE EL.
SR28	27950.72	94782.27	5766.42	SOIL RIPRAP (18 INCH) - FINISHED GRADE EL.
SR29	27953.26	94821.86	5765.14	SOIL RIPRAP (18 INCH) - FINISHED GRADE EL.
SR30	27913.37	94849.59	5764.89	SOIL RIPRAP (18 INCH) - FINISHED GRADE EL.
SR31	27904.16	94855.99	5765.02	SOIL RIPRAP (18 INCH) - FINISHED GRADE EL.
SR32	27881.83	94903.47	5766.84	SOIL RIPRAP (18 INCH) - FINISHED GRADE EL.
SR33	27890.55	94916.56	5771.36	SOIL RIPRAP (18 INCH) - FINISHED GRADE EL.
SR34	27878.94	94919.88	5772.38	SOIL RIPRAP (18 INCH) - FINISHED GRADE EL.

I:\115360-01 - Compare at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\Zach.Grady

Print Date: 4/16/2019 8:57:02 AM  
 File Name: H115360-01DROP11? Cherokee Trail Point Data.dwg  
 Horizontal Scale: N.T.S. Vertical Scale: N.T.S.

**FELSBURG HOLT & ULLEVIG**  
 6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

Sheet Revisions			
Date	Comments	Initials	

**Manhard CONSULTING LTD**  
 8008 E. Arapahoe Court, Suite 110, Centennial, CO 80112 ph: 303.708.0900 fax: 303.708.0400 manhard.com  
 Civil Engineers • Surveyors • Water Resource Engineers • Water & Wastewater Engineers  
 Construction Managers • Environmental Scientists • Landscape Architects • Planners

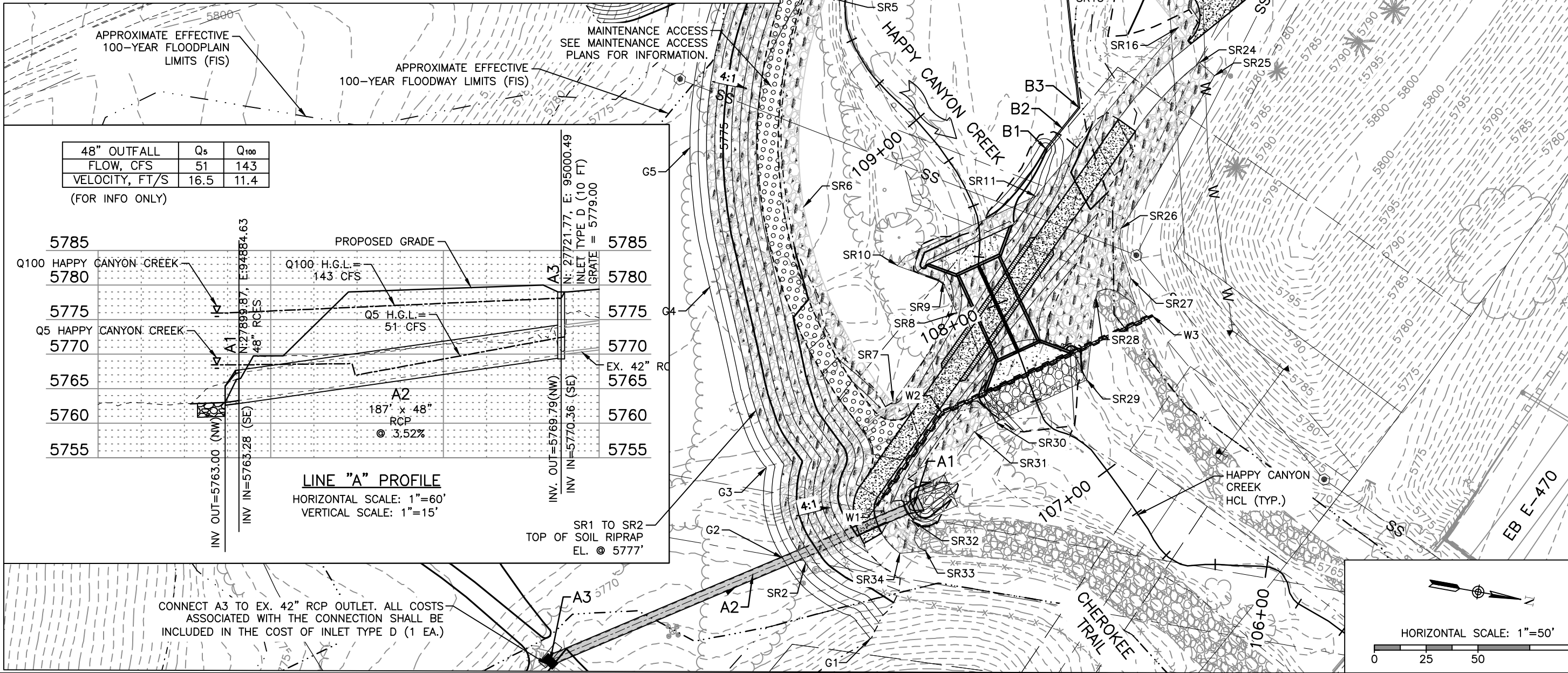
As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE CHEROKEE TRAIL POINT DATA DETAIL		Project No./Code
No Revisions:	Designer: CDT	Structure Numbers	
Revised:	Detailer: ZJG		
Void:	Subset: Drainage	Sheets: DD-11 of 22	Sheet Number

I.D.	NORTHING & EASTING	ITEM	LENGTH	PAY DEPTH	INV. IN	INV. OUT	NOTES
A1	N: 27899.87, E: 94884.63	48" RCES, RIPRAP			5763.28	5763.00	SEE DD-06 FOR DETAIL
A2		48" RCP	187'				
A3	N: 27721.77, E: 95000.49	TYPE D INLET		10'	5770.36	5769.79	CONNECT TO EX. 42" RCP
B1	N: 27914.54, E: 94715.62					5765.00	
B2		8" PLASTIC PIPE	27'				
B3	N: 27926.90, E: 94693.26					5765.13	45 DEGREE ELBOW/CLEANOUT
B4		8" PLASTIC PIPE	241'				

**LEGEND**

- TOP OF CUT
- - - - TOE OF FILL
- WETLANDS
- SOIL RIPRAP (12 INCH & 18 INCH)
- RIPRAP (12 INCH)
- RIPRAP (18 INCH)

- NOTES:
- UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.
  - SEE DD-11 FOR POINT DATA.



I:\115360-01 - Compare at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\ Zach.Grady

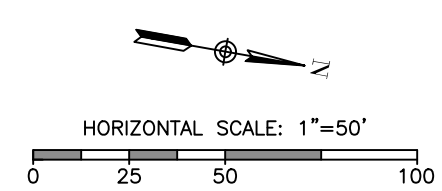
Print Date: 4/16/2019 8:58:06 AM  
 File Name: H115360-01DROP12Grading  
 CherokeeTrailCrossing.dwg  
 Horizontal Scale: 1"=25' Vertical Scale: N.T.S.

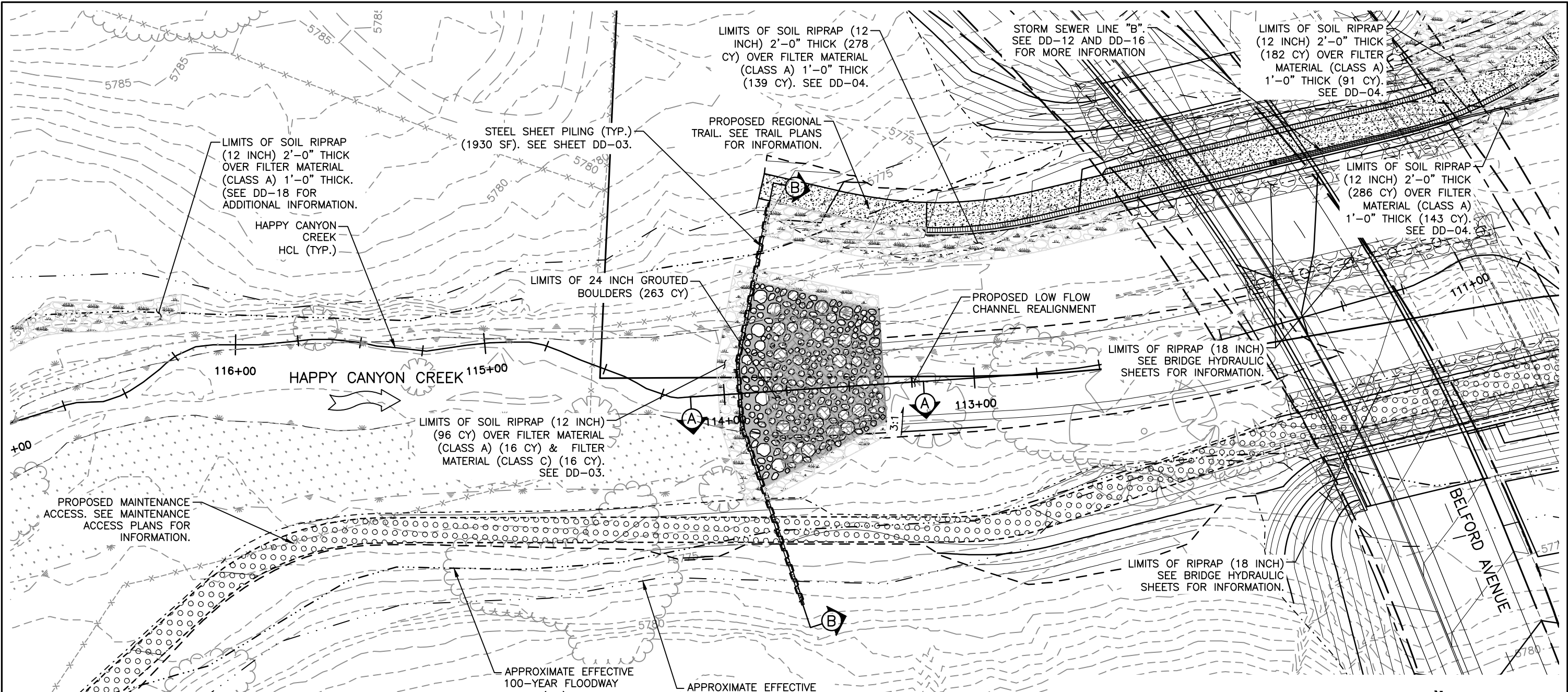
**FELSBURG HOLT & ULLEVIG**  
 6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

Sheet Revisions			
Date	Comments	Initials	

**Manhard CONSULTING LTD**  
 8008 E. Arapahoe Court, Suite 110, Centennial, CO 80112  
 303.708.0900 303.708.0400 manhard.com  
 Civil Engineers • Surveyors • Water Resource Engineers • Water & Wastewater Engineers  
 Construction Managers • Environmental Scientists • Landscape Architects • Planners

As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE CHEROKEE TRAIL GRADING DETAIL		Project No./Code
No Revisions:	Designer: CDT	Structure Numbers	
Revised:	Detailer: ZJG		
Void:	Subset: Drainage	Sheets: DD-12 of 22	Sheet Number

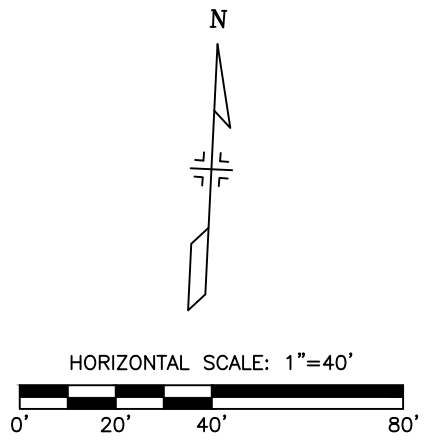




- NOTES:
- SEE SHEET DD-15 FOR DROP NO. 1 POINT DATA.
  - SEE SHEET DD-14 FOR SECTIONS A AND B.
  - SEE SHEET DD-04 FOR SOIL RIPRAP DETAILS.
  - SEE SHEET DD-05 FOR GROUTED BOULDER DETAILS.
  - SEE UTILITY PLANS FOR ADDITIONAL INFORMATION
  - UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.

**LEGEND**

- TOP OF CUT
- TOE OF FILL
- WETLANDS
- SOIL RIPRAP (12 INCH)
- RIPRAP (18 INCH)
- 24" GROUTED BOULDERS
- 24" GROUTED BOULDERS (BURIED)



Print Date: 4/16/2019 8:59:24 AM  
 File Name: H115360-01DROP13Drop1 Plan.dwg  
 Horizontal Scale: 1"=20' Vertical Scale: N.T.S.

Sheet Revisions			
Date	Comments	Initials	

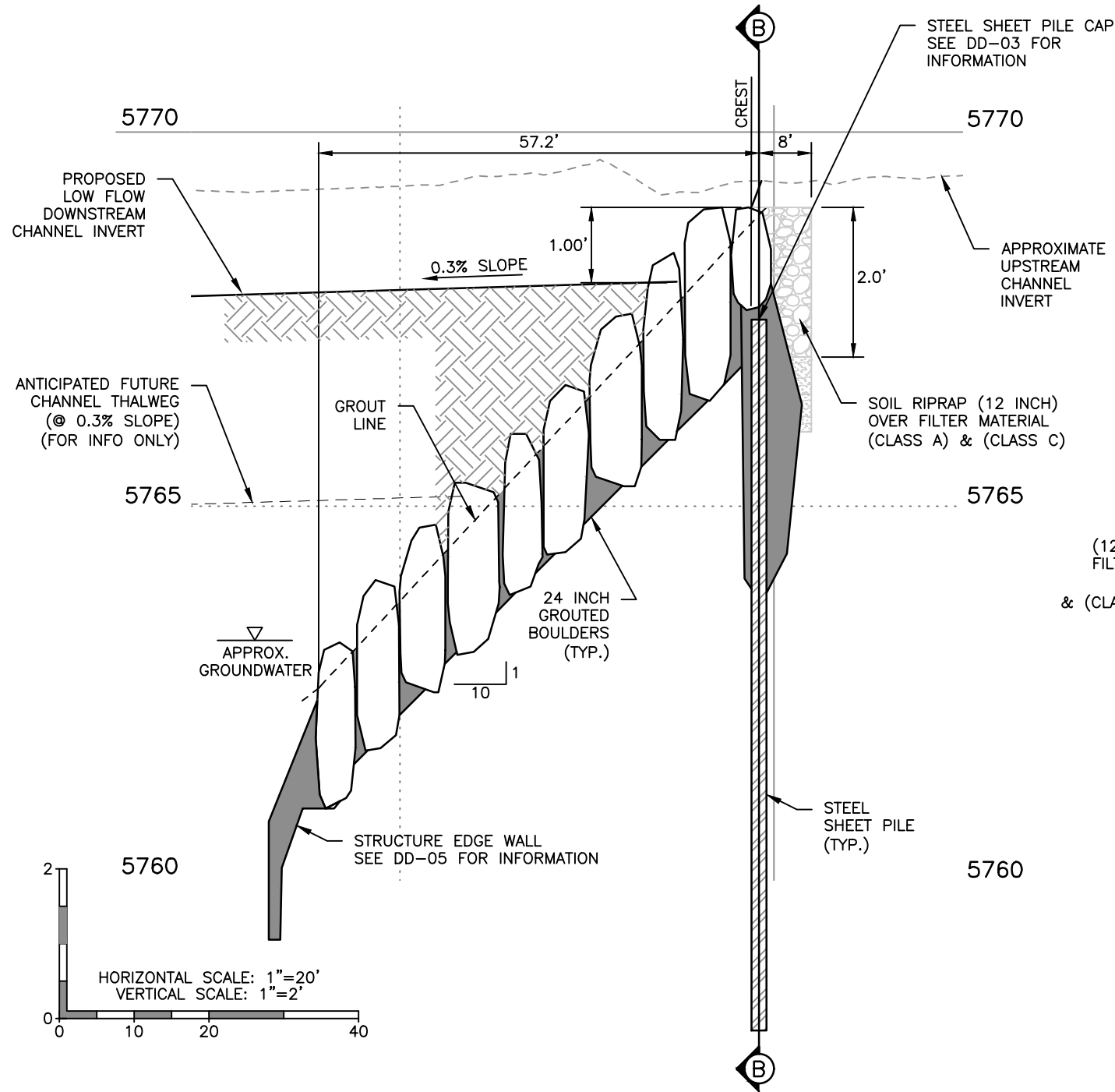
8008 E. Arapahoe Court, Suite 110, Centennial, CO 80112 ph:303.728.0900 fax:303.728.0400 manhard.com  
 Civil Engineers • Surveyors • Water Resource Engineers • Water & Wastewater Engineers  
 Construction Managers • Environmental Scientists • Landscape Architects • Planners

As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE DROP NO. 1 PLAN		Project No./Code
No Revisions:	Designer: CDT	Structure Numbers	
Revised:	Detailer: ZJG		
Void:	Subset: Drainage	Sheets: DD-13 of 22	Sheet Number

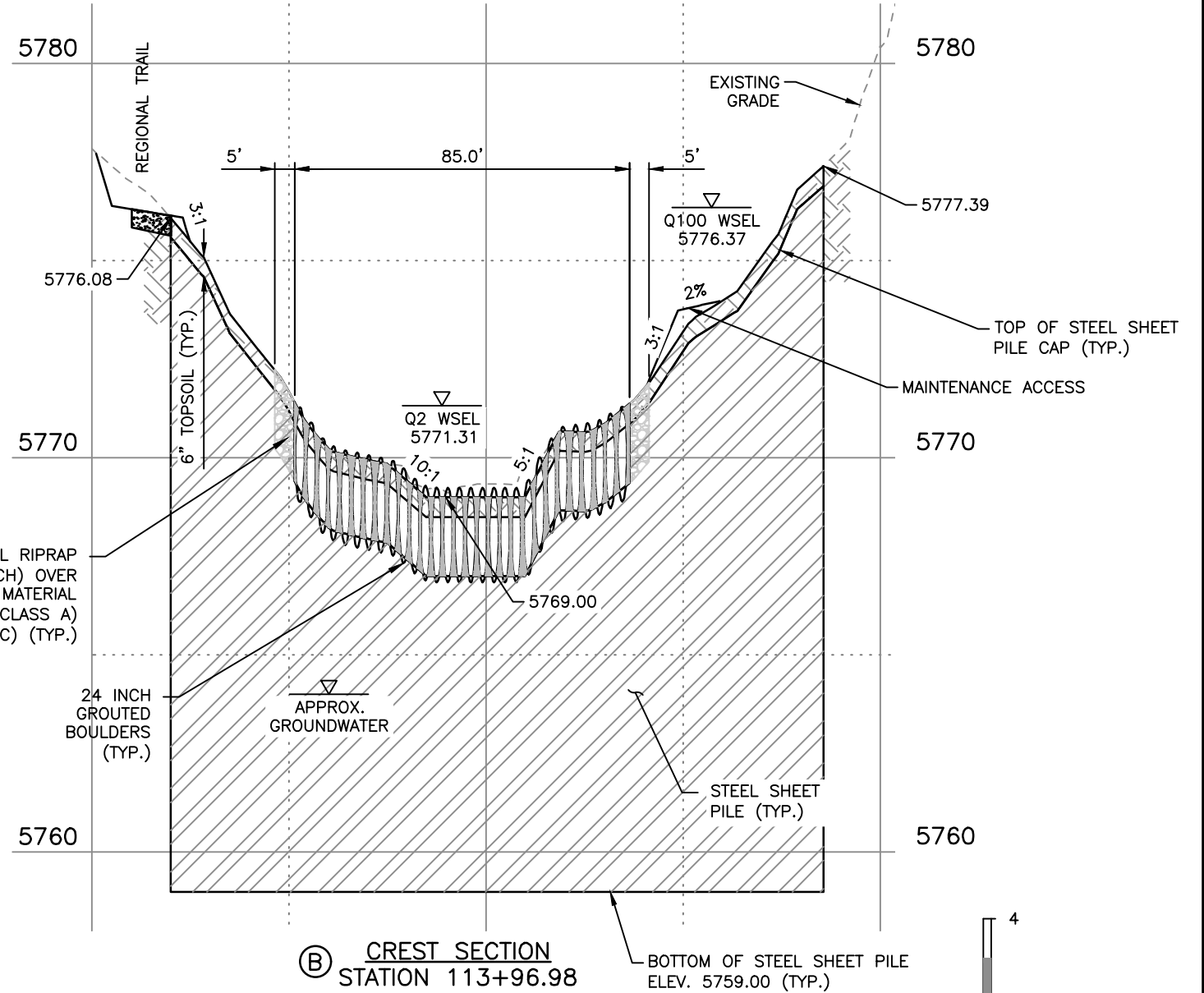
I:\115360-01 - Compark at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\ Zach.Grady

NOTES

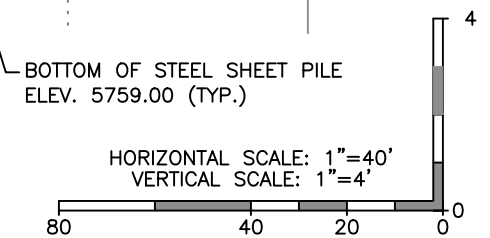
- UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.
- SEE UTILITY PLANS FOR ADDITIONAL INFORMATION.



(A) **GRAUDED BOULDER DROP NO. 1 PROFILE**  
STA 113+39.80 TO 114+04.98



(B) **CREST SECTION**  
STATION 113+96.98



HAPPY CANYON CREEK HYDRAULICS	
Q100=	8,303 C.F.S
Q100 VELOCITY =	14.17 F.P.S
FROUDE No.=	0.93
FOR INFO ONLY	

DROP STRUCTURE NO. 1

Print Date: 4/16/2019 8:59:50 AM  
 File Name: H115360-01DROP14Drop1 Prof Sect.dwg  
 Horizontal Scale: As Noted Vertical Scale: As Noted  
**FELSBURG HOLT & ULLEVIG**  
 6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

Sheet Revisions			
Date	Comments	Initials	



As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE DROP NO. 1 PROFILE/DETAILS		Project No./Code
No Revisions:	Designer: CDT	Structure Numbers	
Revised:	Detailer: ZJG		
Void:	Subset: Drainage	Sheets: DD-14 of 22	Sheet Number

I:\115360-01 - Compark at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\ Zach.Grady

I:\115360-01 - Compark at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\ Zach.Grady

**HAPPY CANYON CREEK DROP STRUCTURE NO. 1 STEEL SHEET PILE CUTOFF WALL POINT DATA**


POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
W1	27675.42	94283.50	5777.39	STEEL SHEET PILE WALL - TOP OF STEEL CAP EL.
W2	27745.87	94255.72	5767.00	STEEL SHEET PILE WALL - TOP OF STEEL CAP EL.
W3	27770.71	94252.88	5767.00	STEEL SHEET PILE WALL - TOP OF STEEL CAP EL.
W4	27834.84	94262.40	5776.14	STEEL SHEET PILE WALL - TOP OF STEEL CAP EL.

**HAPPY CANYON CREEK DROP STRUCTURE NO. 1 GROUTED BOULDER POINT DATA**

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
GB1	27721.52	94265.85	5771.33	24 INCH GROUTED BOULDER - TOP OF BOULDER EL.
GB2	27745.93	94256.22	5769.00	24 INCH GROUTED BOULDER - TOP OF BOULDER EL.
GB3	27770.77	94253.37	5769.00	24 INCH GROUTED BOULDER - TOP OF BOULDER EL.
GB4	27803.26	94258.21	5771.31	24 INCH GROUTED BOULDER - TOP OF BOULDER EL.
GB5	27794.60	94308.20	5763.28	24 INCH GROUTED BOULDER - TOP OF BOULDER EL.
GB6	27749.89	94313.32	5763.28	24 INCH GROUTED BOULDER - TOP OF BOULDER EL.
GB7	27748.38	64266.00	5768.00	24 INCH GROUTED BOULDER - TOP OF BOULDER EL.
GB8	27770.60	94263.46	5768.00	24 INCH GROUTED BOULDER - TOP OF BOULDER EL.

**HAPPY CANYON CREEK DROP STRUCTURE NO. 1 SOIL RIPRAP POINT DATA**

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
SR1	27821.75	94260.96	5774.00	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR2	27816.88	94288.38	5772.05	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR3	27814.14	94331.42	5770.00	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR4	27821.34	94373.78	5769.37	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR5	27831.26	94408.21	5769.24	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR6	27713.51	94259.36	5772.32	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR7	27744.91	94247.28	5770.17	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR8	27769.75	94244.43	5769.27	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR9	27809.53	94250.06	5772.74	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR10	27808.21	94258.94	5772.14	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR11	27799.78	94307.61	5770.41	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR12	27794.60	94308.20	5770.01	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR13	27749.89	94313.32	5770.02	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR14	27744.44	94313.95	5770.34	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR15	27716.81	94267.71	5771.86	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.

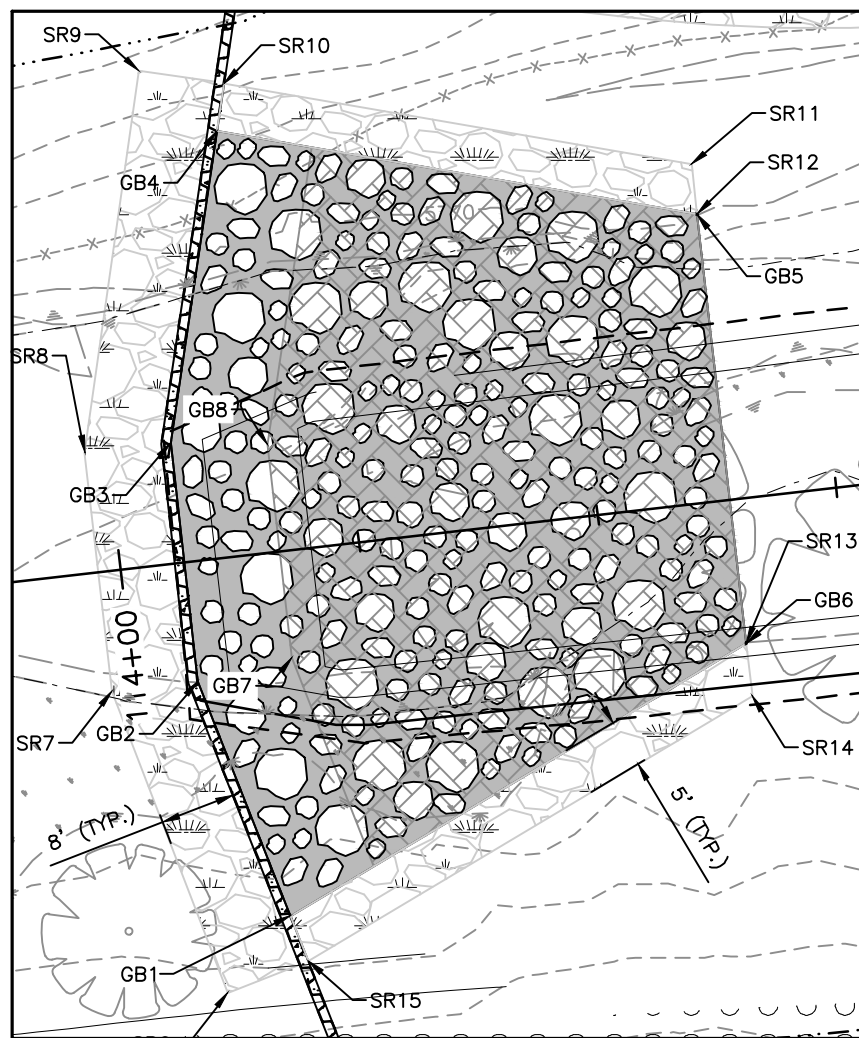
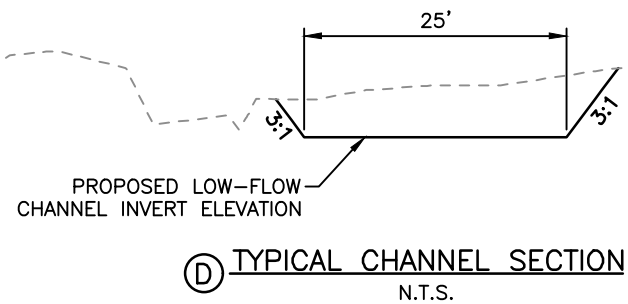
Print Date: 4/16/2019 9:00:16 AM  
 File Name: H115360-01DROP15Drop1 Point Data.dwg  
 Horizontal Scale: N.T.S. Vertical Scale: N.T.S.  
 6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

Sheet Revisions		
Date	Comments	Initials

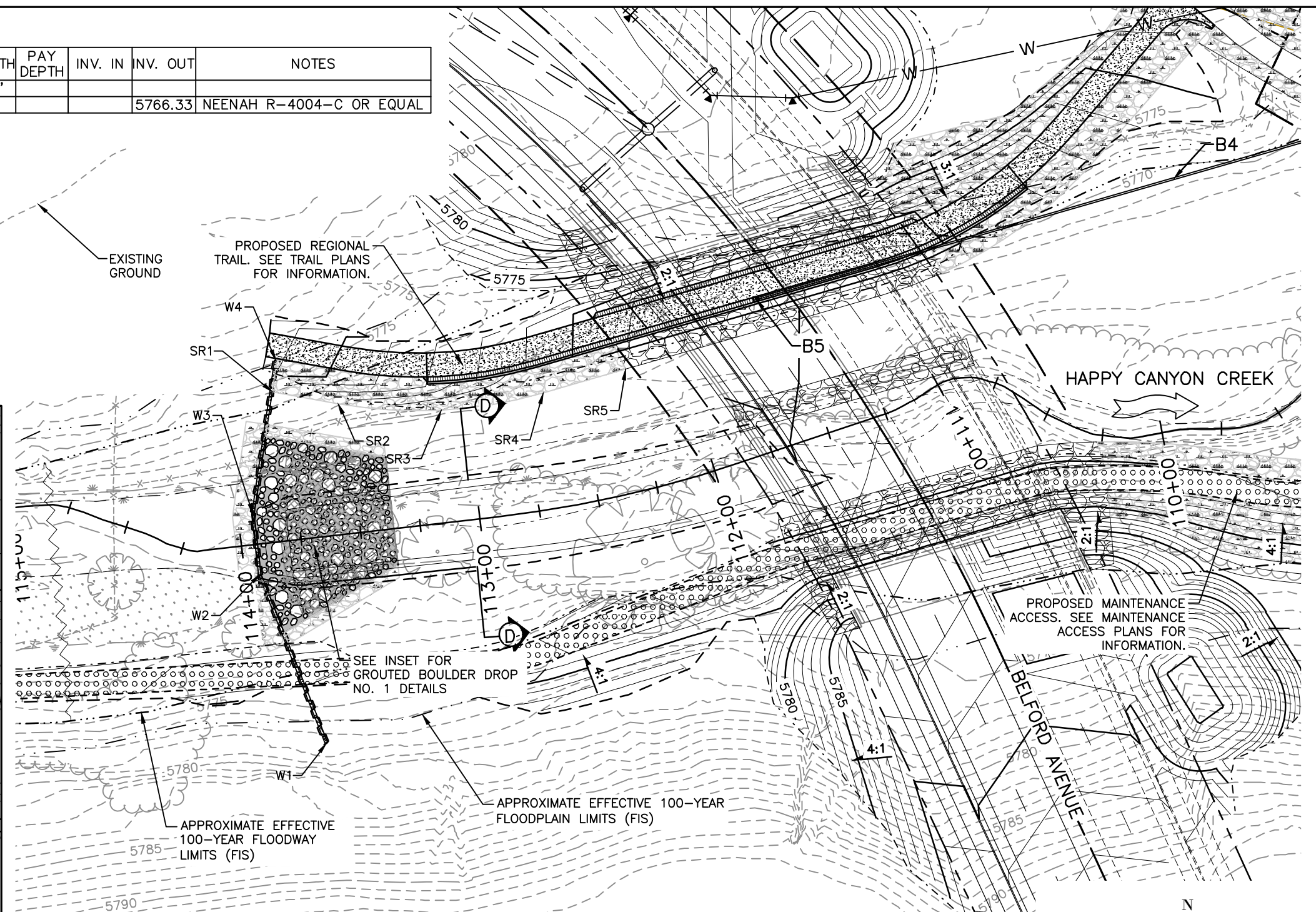


As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE DROP NO. 1 POINT DATA DETAIL		Project No./Code
No Revisions:	Designer: CDT	Structure	
Revised:	Detailer: ZJG	Numbers	
Void:	Subset: Drainage	Sheets: DD-15 of 22	Sheet Number

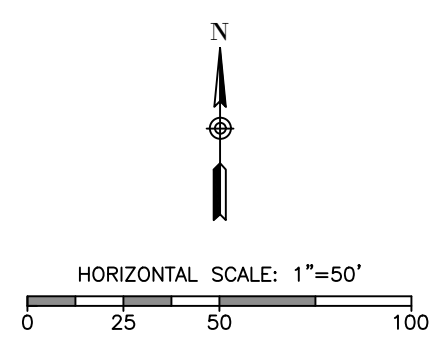
I.D.	NORTHING & EASTING	ITEM	LENGTH	PAY DEPTH	INV. IN	INV. OUT	NOTES
B4		8" PLASTIC PIPE	241'				
B5	N: 27860.43, E: 94462.48	INLET SPECIAL				5766.33	NEENAH R-4004-C OR EQUAL



**DROP NO. 1 DETAILS**  
HORIZONTAL SCALE: 1"=20'



- NOTES:
- UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.
  - SEE SHEET DD-15 FOR DROP NO. 1 POINT DATA.



I:\115360-01 - Compare at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure - Zach.Grady

Print Date: 4/16/2019 9:01:31 AM  
 File Name: H115360-01DROP16Grading Drop 1.dwg  
 Horizontal Scale: 1"=10' Vertical Scale: N.T.S.

Sheet Revisions			
Date	Comments	Initials	

As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE DROP NO. 1 GRADING DETAIL		Project No./Code
No Revisions:	Designer: CDT	Structure Numbers	
Revised:	Detailer: ZJG		
Void:	Subset: Drainage	Sheets: DD-16 of 22	Sheet Number

**FELSBURG  
HOLT &  
ULLEVIG**  
6300 South Syracuse Way, Suite 600  
Centennial, CO 80111  
tel 303.721.1440  
fax 303.721.0832

HAPPY CANYON CREEK DROP STRUCTURE NO. 2 STEEL SHEET PILE CUTOFF WALL POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
W1	27522.92	93938.45	5780.50	STEEL SHEET PILE WALL - TOP OF STEEL CAP EL.
W2	27627.11	93827.62	5770.47	STEEL SHEET PILE WALL - TOP OF STEEL CAP EL.
W3	27648.48	93814.39	5770.47	STEEL SHEET PILE WALL - TOP OF STEEL CAP EL.
W4	27680.82	93804.64	5780.50	STEEL SHEET PILE WALL - TOP OF STEEL CAP EL.

HAPPY CANYON CREEK DROP STRUCTURE NO. 2 CHANNEL REVETMENT SOIL RIPRAP POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
CR1	27384.46	93620.98	5776.96	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
CR2	27409.72	93613.85	5776.89	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
CR3	27455.43	93616.23	5776.93	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
CR4	27504.52	93635.29	5777.00	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
CR5	27521.43	93646.91	5777.11	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
CR6	27547.94	93676.17	5776.07	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
CR7	27561.71	93693.16	5776.00	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
CR8	27566.68	93697.18	5776.04	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
CR9	27681.39	93814.88	5776.99	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
CR10	27699.52	93838.94	5776.86	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
CR11	27713.46	93854.66	5777.09	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
CR12	27724.95	93872.92	5776.90	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
CR13	27732.94	93886.34	5777.00	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
CR14	27743.41	93902.84	5777.05	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
CR15	27754.96	93929.13	5776.62	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
CR16	27765.52	93944.63	5775.94	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
CR17	27769.88	93961.99	5775.77	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
CR18	27781.73	93978.73	5775.97	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
CR19	27782.09	94006.03	5775.95	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
CR20	27787.18	94029.84	5776.06	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.

HAPPY CANYON CREEK DROP STRUCTURE NO. 2 GROUTED BOULDER POINT DATA


POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
GB1	27602.62	93854.40	5774.52	24 INCH GROUTED BOULDER - TOP OF BOULDER EL.
GB2	27618.57	93837.43	5772.47	24 INCH GROUTED BOULDER - TOP OF BOULDER EL.
GB3	27655.65	93812.75	5772.47	24 INCH GROUTED BOULDER - TOP OF BOULDER EL.
GB4	27669.08	93808.70	5774.43	24 INCH GROUTED BOULDER - TOP OF BOULDER EL.
GB5	27673.96	93851.91	5768.00	24 INCH GROUTED BOULDER - TOP OF BOULDER EL.
GB6	27644.22	93870.17	5768.00	24 INCH GROUTED BOULDER - TOP OF BOULDER EL.

HAPPY CANYON CREEK DROP STRUCTURE NO. 2 DROP STRUCTURE SOIL RIPRAP POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
SR1	27592.36	93852.18	5775.35	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR2	27622.59	93820.43	5772.58	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR3	27644.06	93807.13	5772.41	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR4	27671.40	93798.60	5779.30	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR5	27675.20	93818.23	5773.98	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR6	27678.68	93848.83	5773.30	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR7	27673.98	93851.74	5773.00	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR8	27644.22	93870.17	5772.27	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR9	27638.87	93873.48	5773.38	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.
SR10	27598.92	93858.34	5775.22	SOIL RIPRAP (12 INCH) - FINISHED GRADE EL.

I:\115360-01 - Compark at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\ Zach.Grady

Print Date: 4/16/2019 9:01:43 AM  
 File Name: H115360-01DROP17Drop2 Point Data.dwg  
 Horizontal Scale: N.T.S. Vertical Scale: N.T.S.



6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

Sheet Revisions		
Date	Comments	Initials

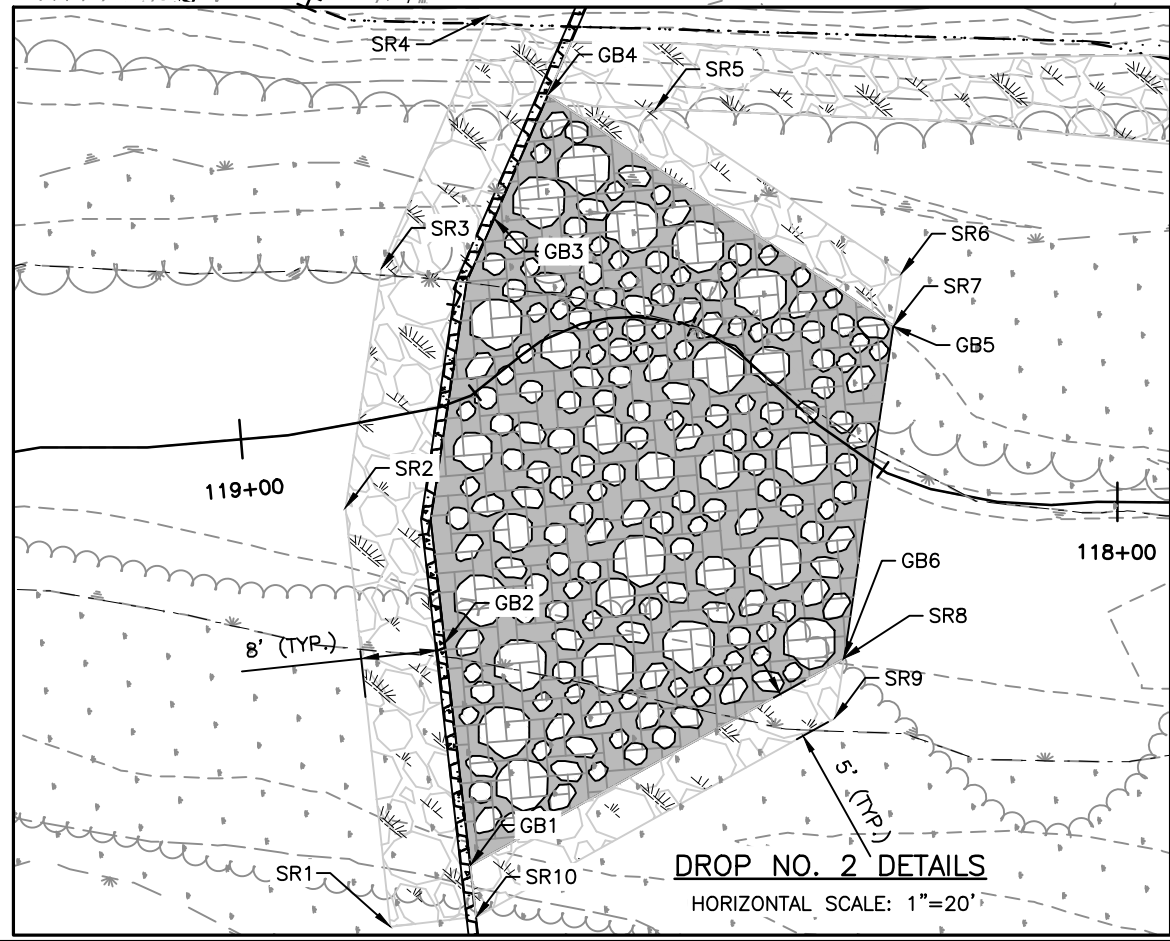
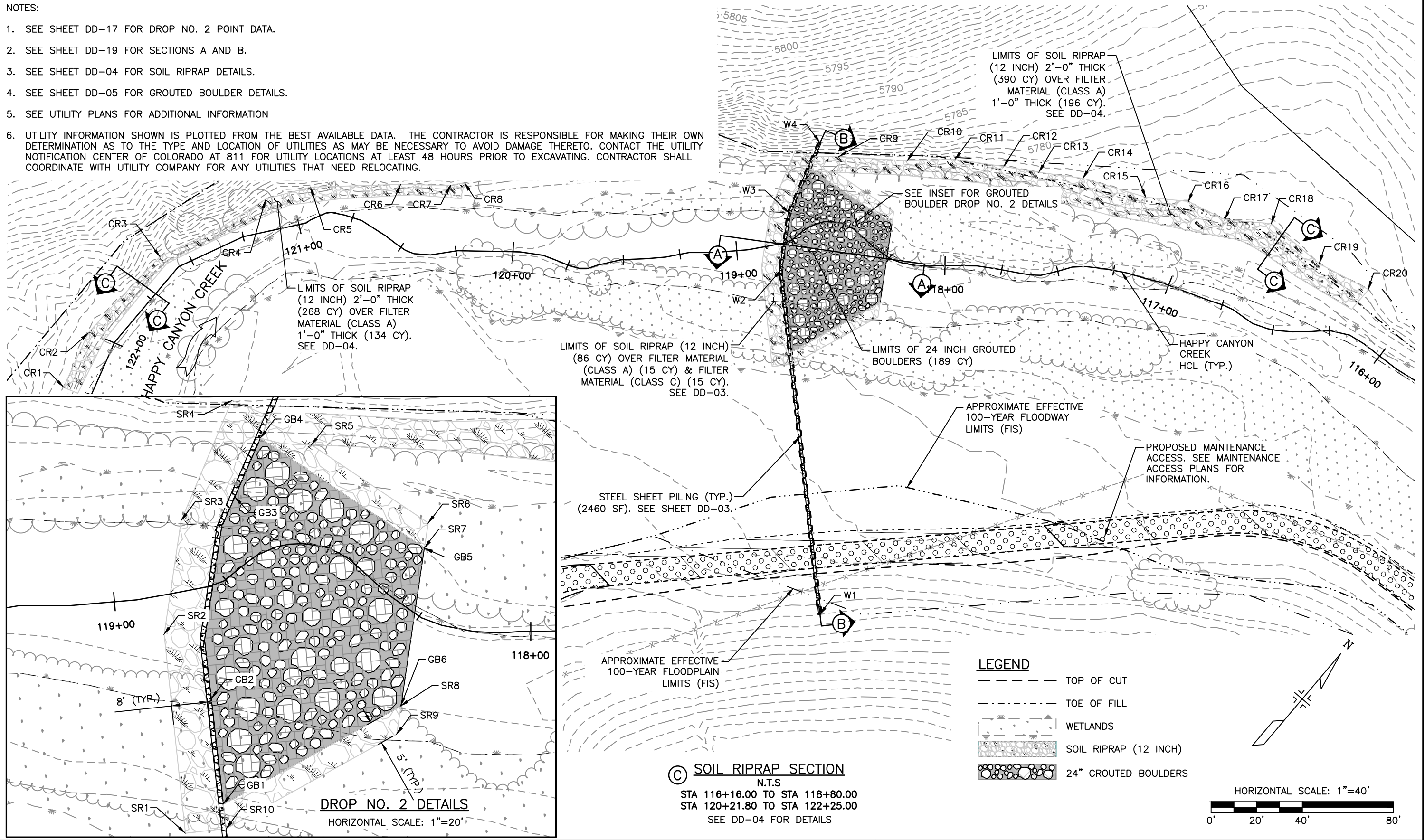


800 E. Arapahoe Court, Suite 110, Centennial, CO 80112 ph: 303.708.0900 fax: 303.708.0400 manhard.com  
 Civil Engineers • Surveyors • Water Resource Engineers • Water & Wastewater Engineers  
 Construction Managers • Environmental Scientists • Landscape Architects • Planners

As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE DROP NO. 2 POINT DATA DETAIL		Project No./Code
No Revisions:	Designer: CDT	Structure	
Revised:	Detailer: ZJG	Numbers	
Void:	Subset: Drainage	Sheets: DD-17 of 22	Sheet Number

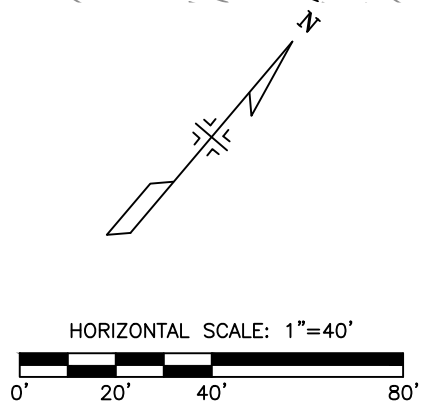
NOTES:

1. SEE SHEET DD-17 FOR DROP NO. 2 POINT DATA.
2. SEE SHEET DD-19 FOR SECTIONS A AND B.
3. SEE SHEET DD-04 FOR SOIL RIPRAP DETAILS.
4. SEE SHEET DD-05 FOR GROUTED BOULDER DETAILS.
5. SEE UTILITY PLANS FOR ADDITIONAL INFORMATION
6. UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.



© SOIL RIPRAP SECTION  
 N.T.S.  
 STA 116+16.00 TO STA 118+80.00  
 STA 120+21.80 TO STA 122+25.00  
 SEE DD-04 FOR DETAILS

- LEGEND**
- TOP OF CUT
  - TOE OF FILL
  - WETLANDS
  - SOIL RIPRAP (12 INCH)
  - 24" GROUTED BOULDERS



I:\115360-01 - Compare at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\ Zach.Grady

Print Date: 4/16/2019 9:02:36 AM  
 File Name: H115360-01DROP18Drop2 Plan.dwg  
 Horizontal Scale: 1"=20' Vertical Scale: N.T.S.

FELSBURG HOLT & ULLEVIG  
 6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

Sheet Revisions			
Date	Comments	Initials	

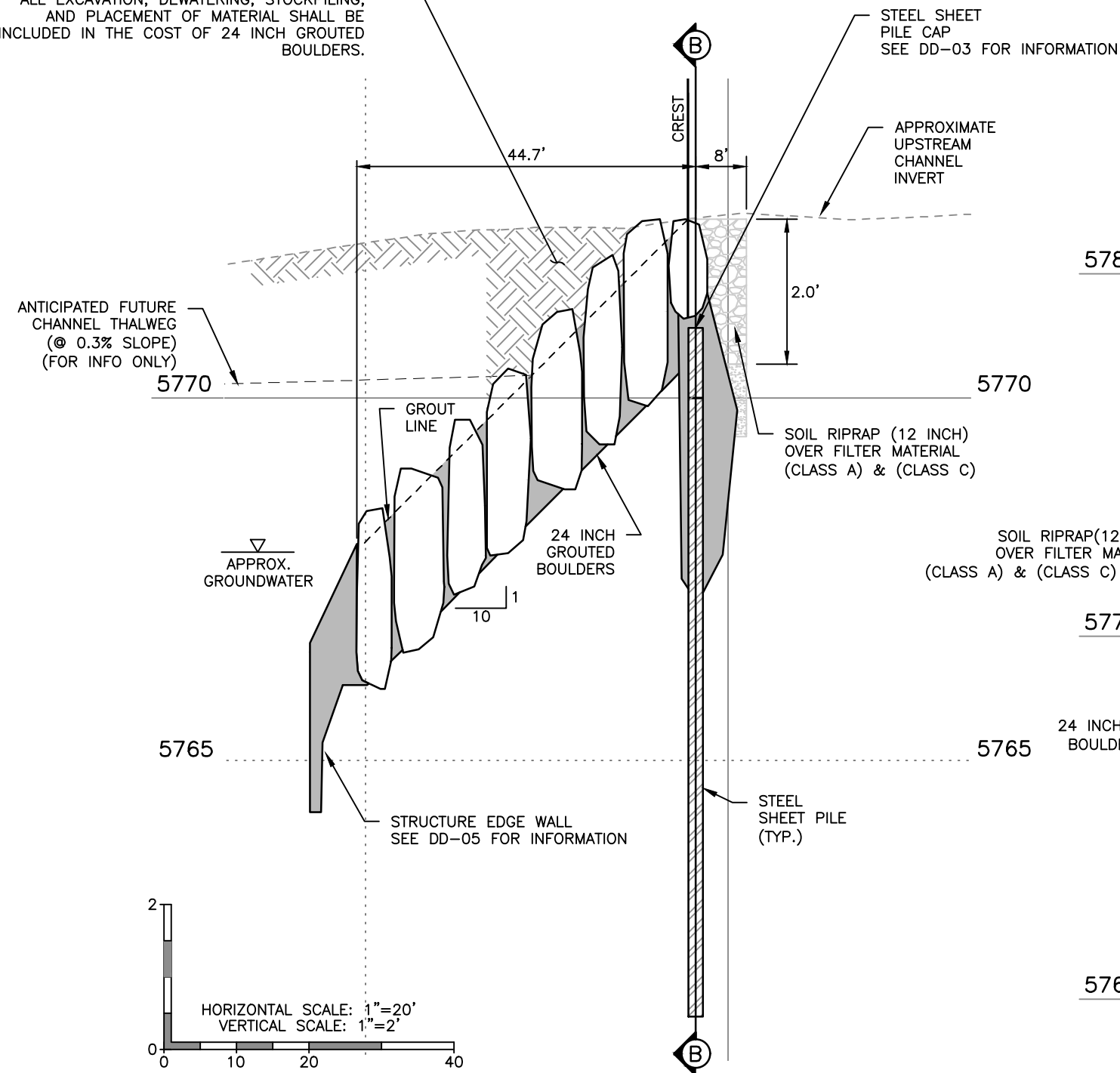
**Manhard CONSULTING LTD**  
8008 E. Arapahoe Court, Suite 110, Centennial, CO 80112 ph:303.728.0800 fax:303.728.0400 manhard.com  
 Civil Engineers • Surveyors • Water Resource Engineers • Water & Wastewater Engineers  
 Construction Managers • Environmental Scientists • Landscape Architects • Planners

As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE DROP NO. 2 PLAN		Project No./Code
No Revisions:	Designer: CDT	Structure Numbers	
Revised:	Detailer: ZJG		
Void:	Subset: Drainage	Sheets: DD-18 of 22	Sheet Number

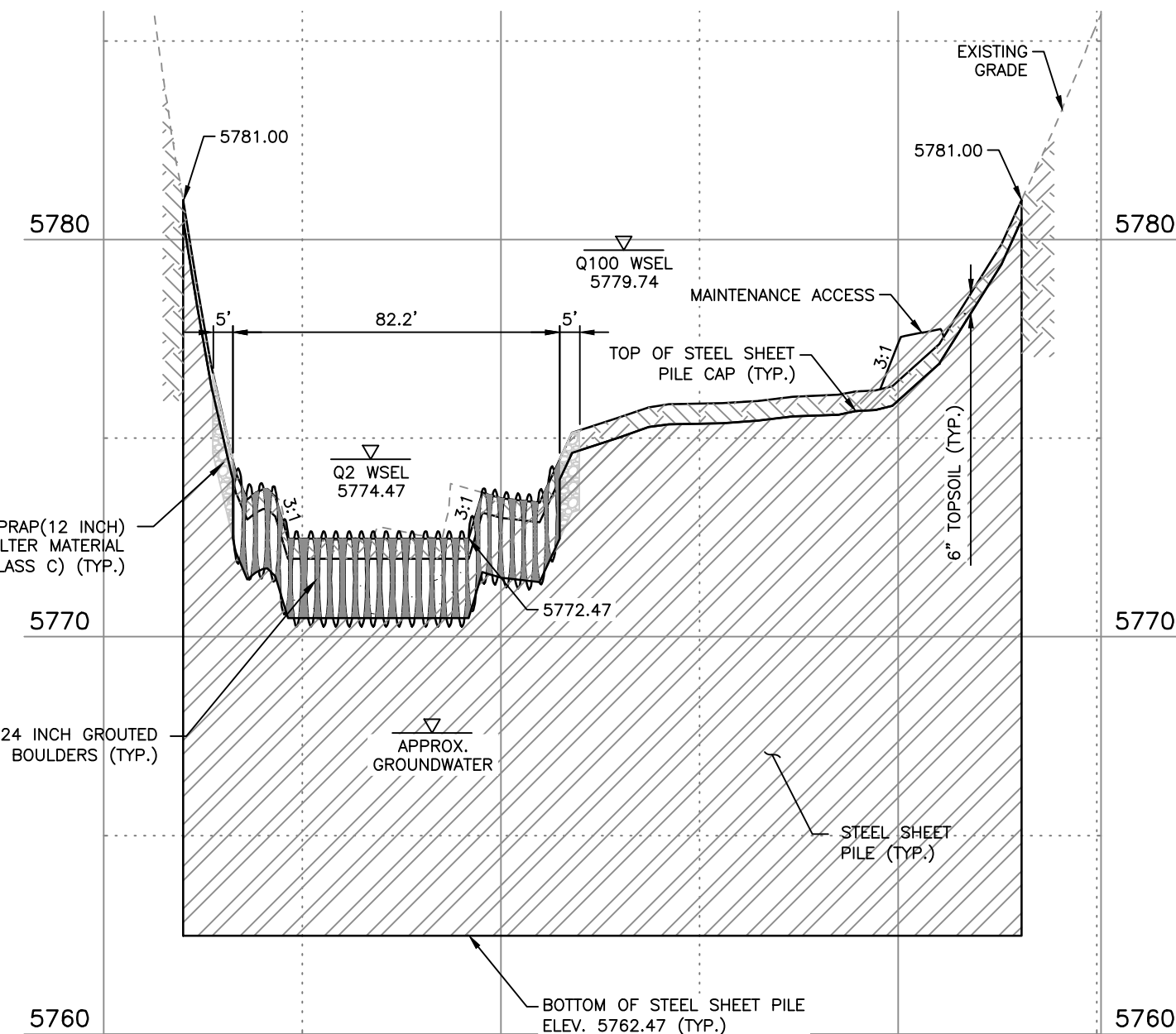
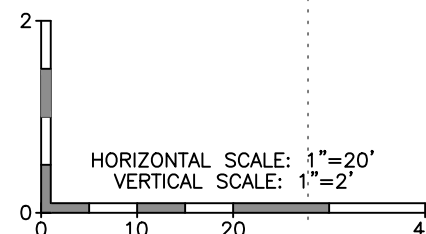
NOTES

- UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.
- SEE UTILITY PLANS FOR ADDITIONAL INFORMATION.

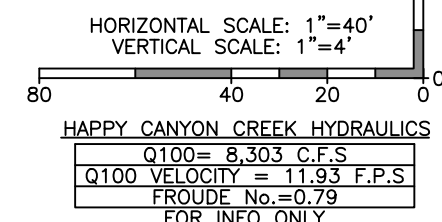
MATERIAL SHALL BE EXCAVATED FOR 24 INCH GROUDED BOULDERS AND STOCKPILED. STOCKPILED MATERIAL SHALL BE REAPPLIED AFTER DROP STRUCTURE IS CONSTRUCTED. ALL EXCAVATION, DEWATERING, STOCKPILING, AND PLACEMENT OF MATERIAL SHALL BE INCLUDED IN THE COST OF 24 INCH GROUDED BOULDERS.



**(A) GROUDED BOULDER DROP NO. 2 PROFILE**  
STA 118+49.81 TO 119+02.49



**(B) CREST SECTION**  
STATION 118+94.49



**DROP STRUCTURE NO. 2**

HAPPY CANYON CREEK HYDRAULICS  
Q100= 8,303 C.F.S  
Q100 VELOCITY = 11.93 F.P.S  
FROUDE No.=0.79  
FOR INFO ONLY

I:\115360-01 - Compark at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\ Zach.Grady

Print Date: 4/16/2019 9:03:07 AM  
File Name: H115360-01DROP19Drop2 Prof Sect.dwg  
Horizontal Scale: As Noted Vertical Scale: As Noted  
FELSBURG HOLT & ULLEVIG  
6300 South Syracuse Way, Suite 600  
Centennial, CO 80111  
tel 303.721.1440  
fax 303.721.0832

Sheet Revisions		
Date	Comments	Initials



As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE DROP NO. 2 PROFILE/DETAILS		Project No./Code
No Revisions:	Designer: CDT	Structure Numbers	
Revised:	Detailer: ZJG		
Void:	Subset: Drainage	Sheets: DD-19 of 22	Sheet Number

HAPPY CANYON CREEK DROP STRUCTURE NO. 3 STEEL SHEET PILE CUTOFF WALL POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
W1	27309.13	93921.77	5783.50	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.
W2	27304.40	93917.95	5780.00	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.
W3	27208.88	93840.75	5779.50	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.
W4	27201.63	93834.88	5775.63	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.
W5	27174.38	93805.42	5775.06	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.
W6	27143.34	93746.45	5777.76	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.
W7	27143.34	93585.23	5783.50	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.

HAPPY CANYON CREEK DROP STRUCTURE NO. 3 BANK GRADING POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
G1	27326.07	93919.34	5787.00	FINISHED GRADE EL.
G2	27306.20	93950.35	5787.00	FINISHED GRADE EL.
G3	27290.13	93942.45	5782.50	FINISHED GRADE EL.
G4	27195.58	93861.83	5780.00	FINISHED GRADE EL.
G5	27228.32	93816.93	5780.00	FINISHED GRADE EL.
G6	27270.93	93781.27	5780.00	FINISHED GRADE EL.
G7	27367.70	93861.41	5782.50	FINISHED GRADE EL.
G8	27322.50	93895.78	5782.50	FINISHED GRADE EL.
G9	27343.38	93895.03	5786.00	FINISHED GRADE EL.

HAPPY CANYON CREEK DROP STRUCTURE NO. 3 GROUTED BOULDER POINT DATA


POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
GB1	27168.76	93793.68	5778.19	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB2	27173.42	93802.52	5777.14	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB3	27201.27	93833.76	5777.14	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB4	27203.54	93835.78	5778.40	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB5	27234.88	93801.59	5772.49	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB6	27213.15	93778.09	5772.49	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.

HAPPY CANYON CREEK DROP STRUCTURE NO. 3 SOIL RIPRAP POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
SR1	27140.46	93759.22	5778.01	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR2	27168.09	93811.14	5777.07	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR3	27195.43	93840.70	5777.55	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR4	27201.78	93845.94	5779.67	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR5	27238.29	93805.27	5779.59	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR6	27234.88	93801.59	5778.14	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR7	27213.15	93778.09	5777.80	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR8	27199.57	93763.41	5777.80	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.

I:\115360-01 - Compare at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\ Zach.Grady

Print Date: 4/16/2019 9:03:18 AM  
 File Name: H115360-01DROP20Drop3 Point Data.dwg  
 Horizontal Scale: N.T.S. Vertical Scale: N.T.S.



6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

Sheet Revisions		
Date	Comments	Initials



**Manhard**  
 CONSULTING LTD

800 E. Arapaho Court, Suite 110, Centennial, CO 80112 ph: 303.721.0800 fax: 303.721.0400 manhard.com  
 Civil Engineers • Surveyors • Water Resource Engineers • Water & Wastewater Engineers  
 Construction Managers • Environmental Scientists • Landscape Architects • Planners

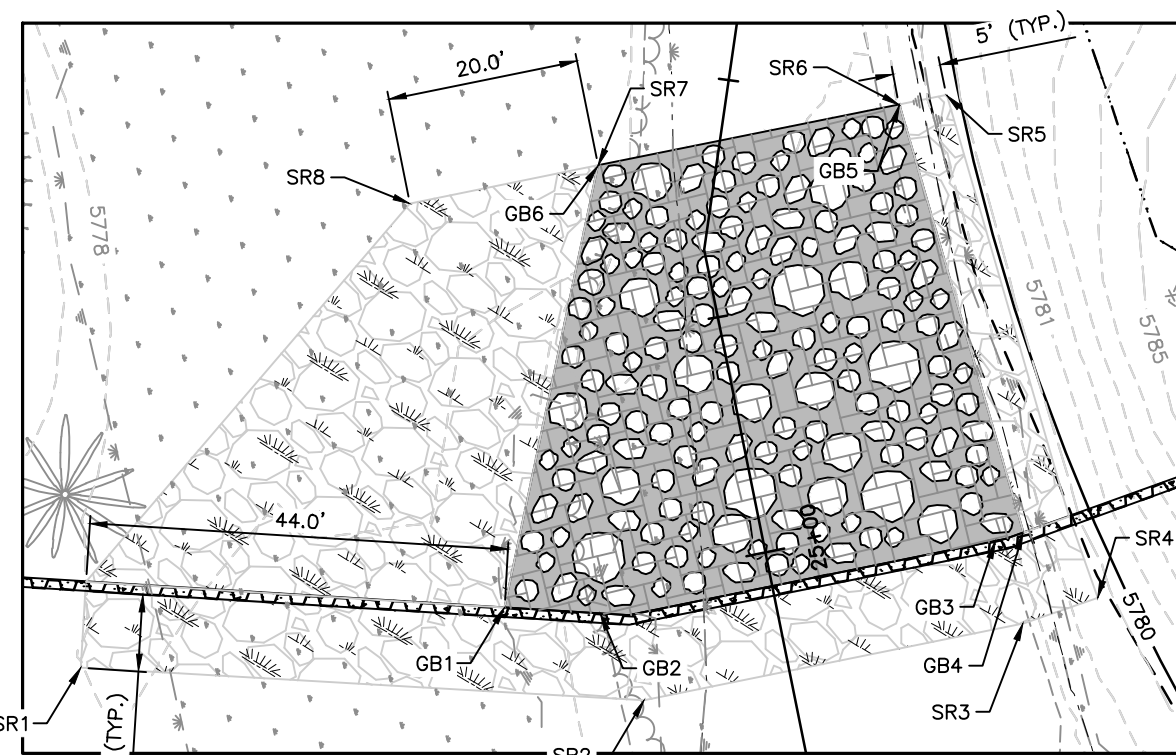
As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE DROP NO. 3 POINT DATA DETAIL		Project No./Code
No Revisions:	Designer: CDT	Structure Numbers	
Revised:	Detailer: ZJG		
Void:	Subset: Drainage	Sheets: DD-20 of 22	Sheet Number

NOTES:

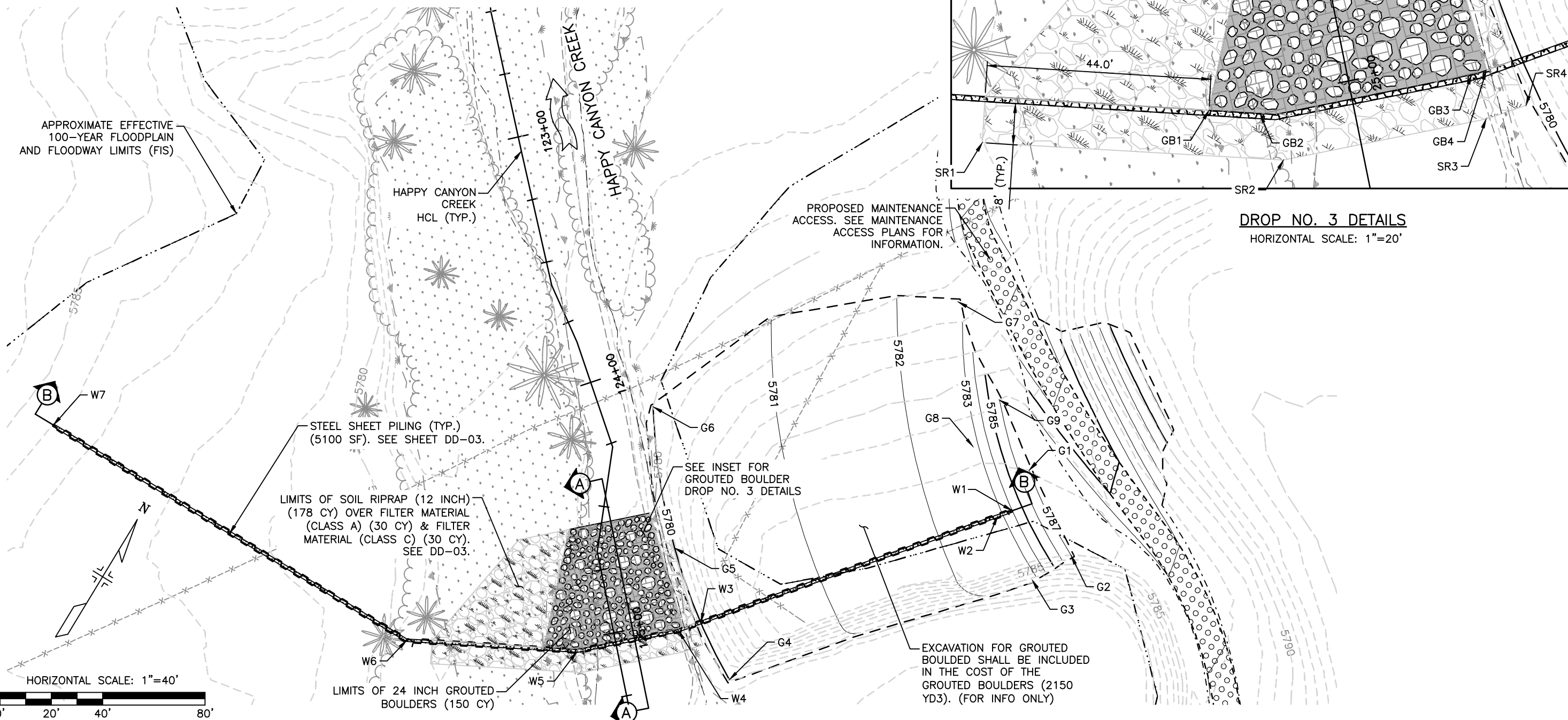
1. SEE SHEET DD-20 FOR DROP NO. 3 POINT DATA.
2. SEE SHEET DD-22 FOR SECTIONS A & B.
3. SEE SHEET DD-04 FOR SOIL RIPRAP DETAILS.
4. SEE SHEET DD-05 FOR GROUTED BOULDER DETAILS.
5. SEE UTILITY PLANS FOR ADDITIONAL INFORMATION
6. UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.

LEGEND

- TOP OF CUT
- TOE OF FILL
- [Symbol] WETLANDS
- [Symbol] SOIL RIPRAP (12 INCH)
- [Symbol] 24" GROUTED BOULDERS (BURIED)



**DROP NO. 3 DETAILS**  
HORIZONTAL SCALE: 1"=20'



I:\115360-01 - Compare at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\ Zach.Grady

Print Date: 4/16/2019 9:04:19 AM	
File Name: H115360-01DROP21Drop3 Plan.dwg	
Horizontal Scale: 1"=20'	Vertical Scale: N.T.S.
6300 South Syracuse Way, Suite 600 Centennial, CO 80111 tel 303.721.1440 fax 303.721.0832	

Sheet Revisions			
(R-X)	Date	Comments	Initials

**Manhard**  
CONSULTING LTD

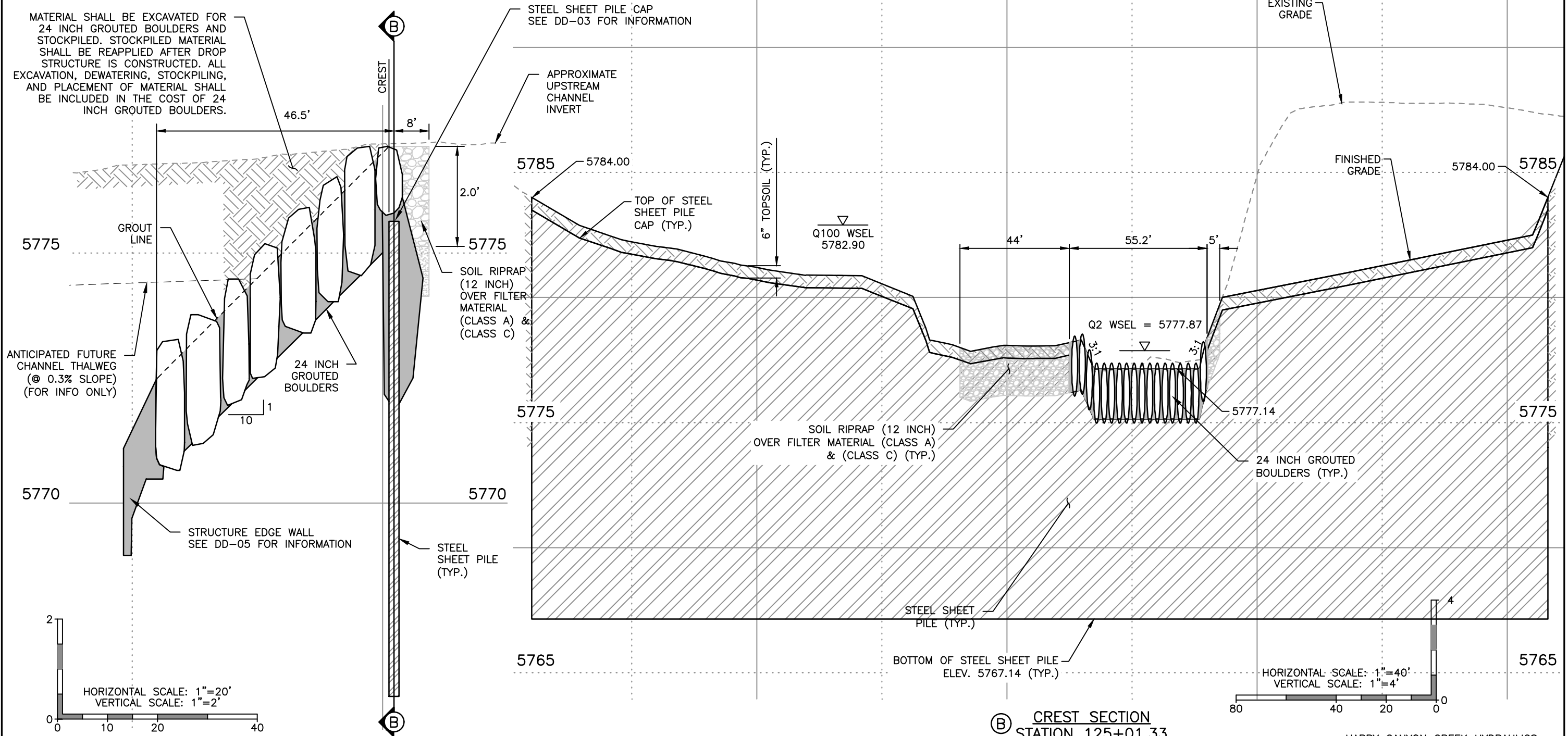
800 E. Arapahoe Court, Suite 110, Centennial, CO 80112 ph:303.708.0900 fax:303.708.0400 manhard.com  
Civil Engineers • Surveyors • Water Resource Engineers • Water & Wastewater Engineers  
Construction Managers • Environmental Scientists • Landscape Architects • Planners

As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE DROP NO. 3 PLAN		Project No./Code
No Revisions:	Designer: CDT	Structure Numbers	
Revised:	Detailer: ZJG		
Void:	Subset: Drainage	Sheets: DD-21 of 22	Sheet Number

NOTES

- UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.
- SEE UTILITY PLANS FOR ADDITIONAL INFORMATION.

MATERIAL SHALL BE EXCAVATED FOR 24 INCH GROUTED BOULDERS AND STOCKPILED. STOCKPILED MATERIAL SHALL BE REAPPLIED AFTER DROP STRUCTURE IS CONSTRUCTED. ALL EXCAVATION, DEWATERING, STOCKPILING, AND PLACEMENT OF MATERIAL SHALL BE INCLUDED IN THE COST OF 24 INCH GROUTED BOULDERS.



(A) GROUTED BOULDER DROP NO. 3 PROFILE  
STA 124+54.81 TO 125+09.33

DROP STRUCTURE NO. 3

HAPPY CANYON CREEK HYDRAULICS  
Q100= 8,303 C.F.S  
Q100 VELOCITY = 10.80 F.P.S  
FROUDE No.=0.77  
FOR INFO ONLY

I:\115360-01 - Compark at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\ Zach.Grady

Print Date: 4/16/2019 9:04:39 AM
File Name: H115360-01DROP22Drop3 Prof Sect.dwg
Horizontal Scale: As Noted Vertical Scale: As Noted
6300 South Syracuse Way, Suite 600 Centennial, CO 80111 tel 303.721.1440 fax 303.721.0832

Sheet Revisions		
Date	Comments	Initials



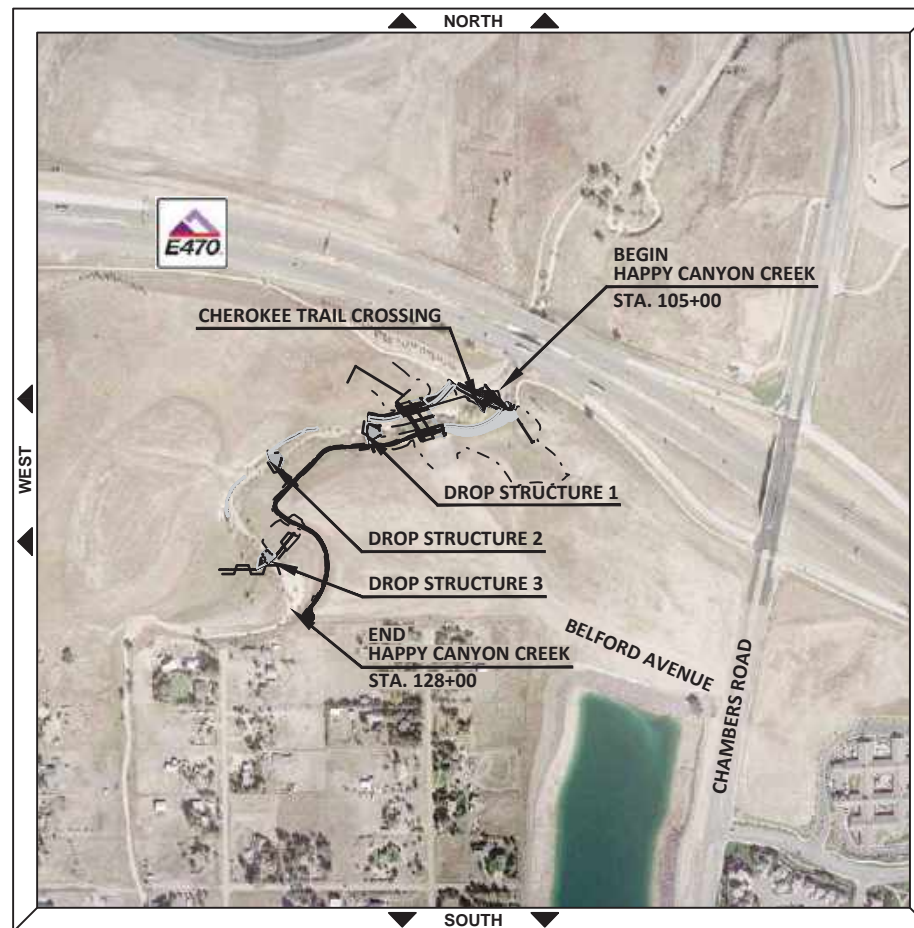
As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE DROP NO. 3 PROFILE/DETAILS		Project No./Code
No Revisions:	Designer: CDT	Structure Numbers	
Revised:	Detailer: ZJG		
Void:	Subset: Drainage	Sheets: DD-22 of 22	Sheet Number



**CONSTRUCTION PLANS**  
**CONSTRUCTION BEST MANAGEMENT PRACTICES**  
**BELFORD AVENUE BRIDGE AND HAPPY CANYON CREEK**  
**TOWN OF PARKER, COUNTY OF DOUGLAS, STATE OF COLORADO**

SCALE OF ORIGINAL DRAWINGS

ON PLAN      1" = 80'



**INDEX OF SHEETS**

SHEET NO.	SUBSET SHEETS	DESCRIPTION
83	EL-1	CBMP TITLE SHEET
84	ET-1	TABULATION OF EROSION CONTROL QUANTITIES
85-86	EI-1 TO EI-2	INITIAL CBMP PLAN
87-88	EN-1 TO EN-2	INTERIM CBMP PLAN
89-90	EF-1 TO EN-2	FINAL CBMP PLAN
91-125	ED-1 TO ED-35	CBMP STANDARD NOTES AND DETAILS

**TOWN OF PARKER APPROVALS**

THE TOWN OF PARKER REVIEW CONSTITUTES GENERAL COMPLIANCE WITH THE TOWNS STANDARDS AND APPROVED VARIANCES, SUBJECT TO THESE PLANS BEING STAMPED, SIGNED, AND DATED BY THE PROFESSIONAL ENGINEER OF RECORD. REVIEW BY THE TOWN DOES NOT CONSTITUTE APPROVAL OF THE PLAN DESIGN OR ACCURACY AND CORRECTNESS OF ENGINEERING CALCULATION. ERRORS IN THE DESIGN OR CALCULATIONS REMAIN THE RESPONSIBILITY OF THE REGISTERED PROFESSIONAL ENGINEER WHOSE STAMP AND SIGNATURE ARE AFFIXED TO THIS DOCUMENT.

THIS REVIEW DOES NOT CONSTITUTE APPROVAL OF ANY PRIVATE ON-SITE IMPROVEMENTS WHICH MAY BE SHOWN. CONSTRUCTION CANNOT COMMENCE UNTIL ALL REQUIRED DRAINAGE/TRAFFIC REPORT(S), FINAL DEVELOPMENT PLAN(S), SPECIAL REVIEW(S), GRADING PERMIT, AND/OR OTHER PERMITS ARE COMPLETE, APPROVED AND ON FILE WITH THE TOWN OF PARKER.

TOWN OF PARKER, PUBLIC WORKS DIRECTOR	DATE
TOWN OF PARKER, PUBLIC WORKS MANAGER – STORMWATER	DATE
TOWN OF PARKER, PUBLIC WORKS MANAGER – TRANSPORTATION	DATE

**BASIS OF BEARING:**

THE WEST LINE OF THE SOUTHWEST QUARTER OF SECTION 6, TOWNSHIP 6 SOUTH, RANGE 66 WEST OF THE SIXTH PRINCIPAL MERIDIAN BEING MONUMENTED AS SHOWN HEREON HAVING A BEARING OF NORTH 00°29'49" WEST, AS DETERMINED BY GPS OBSERVATION FROM NGS CONTROL POINTS IN THE COLORADO CENTRAL ZONE, STATE PLAN COORDINATE SYSTEM, TOWN OF PARKER, COUNTY OF DOUGLAS, STATE OF COLORADO.

**BENCHMARKS: (COMPARK SOUTH)**

**SOURCE BENCHMARKS:**  
 DOUGLAS COUNTY BM 1.115010  
 A DOUGLAS COUNTY GIS MONUMENT SET IN CONCRETE LOCATED APPROXIMATELY 130 FEET SOUTHWESTERLY OF THE CENTERLINE OF CHAMBERS ROAD AND 95 FEET NORTHWESTERLY OF THE CENTERLINE OF COMPARK BOULEVARD.  
 ELEVATION = 5752.84 (NAVD 88)

**SITE BENCHMARKS:**  
 A NO. 5 REBAR WITH 2" ALUMINUM CAP STAMPED "LS 28286, 2001" FOUND AT THE SOUTHWEST CORNER OF SECTION 6, T6S, R66W LOCATED ON THE WEST LINE OF FIRST STREET APPROXIMATELY 1000 FEET NORTH OF ELM AVENUE.  
 ELEVATION = 5845.51

A 2.5" IRON PIPE WITH 3.25" ALUMINUM CAP STAMPED "PLS 12405, 1997" FOUND AT THE SOUTHEAST CORNER OF SECTION 6, T6S, R66W LOCATED APPROXIMATELY 960 FEET NORTH OF THE CENTERLINE OF AVENTERRA PARKWAY AND APPROXIMATELY 1050 FEET WEST OF THE CENTERLINE OF CHAMBERS ROAD.  
 ELEVATION = 5808.06

Print Date: 3/13/2018 9:39:58 AM		As Constructed		BELFORD-HAPPY CANYON CREEK CBMP TITLE SHEET		Project No./Code
File Name: E115360-01TTL01ΔROP.dwg		No Revisions:				
Horizontal Scale: NTS      Vertical Scale: NTS		Revised:		Designer: CDT	Structure Numbers	
6300 South Syracuse Way, Suite 600 Centennial, CO 80111 tel 303.721.1440 fax 303.721.0832	(R-X) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Date	Comments	Initials	Detailer: KLT Subset: EROSION	Sheets: EL-1 of 1 Sheet Number 87

I:\115360-01 - Compark at Belford\CADD\Erosion\Drawings\Happy Cyn Creek Drop Structure\Scott.Dankenbring

**TABULATION OF EROSION CONTROL QUANTITIES**

DRAWING NUMBER	CHECK DAM (CD)	*CONCRETE WASHOUT STRUCTURE (CWA)	*VEHICLE TRACKING CONTROL (VTC)	*STABILIZED STAGING AREA (SSA)	SEEDING (NATIVE) (SMC)	MULCHING (WEED FREE STRAW) (SMC)	*CULVERT PROTECTION (CP)	DEWATERING (D)	*SEDIMENT CONTROL LOG (12 INCH) (SCL)	EROSION CONTROL BLANKET (STRAW/COCONUT) (ECB)	DIVERSION DITCH (DD)	CONSTRUCTION FENCE (CF)	SILT FENCE (SF)	#INLET PROTECTION AREA INLETS NOT IN PAVEMENT (IPAN)	##ROUGH CUT STREET CONTROL (RCSC)	TEMPORARY SEDIMENT BASIN (TSB)	TEMPORARY STREAM CONTROL (TSC)	(PTP)
	LF	EACH	EACH	SY	ACRE	ACRE	LF	LS	LF	SY	LF	LF	LF	EA	LF	EA	EA	
INITIAL (EI-1)	275	2	2	2300			40		1798		312	8838	1361				4	
INTERIM (EN-1)							60	1	1885					1	480	2		
FINAL (EF-1)					6.3	6.3				6180								
<b>PROJECT TOTALS</b>	<b>275</b>	<b>2</b>	<b>2</b>	<b>2300</b>	<b>6.3</b>	<b>6.3</b>	<b>100</b>	<b>1</b>	<b>3683</b>	<b>6180</b>	<b>312</b>	<b>8838</b>	<b>1361</b>	<b>1</b>	<b>480</b>	<b>2</b>	<b>4</b>	

1. THESE QUANTITIES HAVE BEEN TAKEN FORWARD TO THE SUMMARY OF APPROXIMATE QUANTITIES.
  2. FOR DETAILS, SEE CBMP STANDARD NOTES AND DETAILS.
  3. CHECK DAMS ARE NOT TO BE REMOVED UNLESS DIRECTED BY THE PROJECT ENGINEER.
  4. MULCH TACKIFIER IS REQUIRED AND IS INCLUDED IN THE COST OF MULCHING.
  5. SEE CBMP SHEETS FOR ADDITIONAL PLACEMENT INFORMATION.
  6. LOCATION OF STOCKPILES, INCLUDING TOPSOIL, IMPORTED AGGREGATES, EXCESS MATERIALS, STORAGE AND STAGING AREAS FOR EQUIPMENT FUEL, LUBRICANT, CHEMICAL (AND OTHER MATERIALS), WASTE STORAGE, BORROW AND DISPOSAL AREAS SHALL BE LOCATED PRIOR TO CONSTRUCTION WITH IN THE DEFINED LIMITS OF CONSTRUCTION BY THE PROJECT ENGINEER.
- \* THESE ITEMS SHALL BE PAID FOR AS PLACE AND REMOVE.  
 # THESE ITEMS SHALL BE PAID FOR AS INLET PROTECTION (EACH).  
 ## ROUGH CUT STREET CONTROL SHALL BE PAID FOR AS AGGREGATE BAG (LF)

ADDITIONAL SEDIMENT/EROSION CONTROL:  
 IT IS ESTIMATED THAT BLADING (120 HORSEPOWER), DOZING (100 HORSEPOWER), COMBINATION LOADER (125 HORSEPOWER) AND/OR BACKHOE (75 HORSEPOWER) AND/OR LABORER MAY BE REQUIRED FOR MISCELLANEOUS EROSION CONTROL WORK AS DIRECTED BY THE ENGINEER. WORK SHALL BE PAID FOR AS 208 SEDIMENT REMOVAL AND DISPOSAL (40 HRS). EROSION CONTROL MANAGEMENT WILL BE REQUIRED FOR THIS PROJECT AND SHALL BE PAID FOR AS 208 EROSION CONTROL MANAGEMENT (30 DAYS).

**WATER CONTROL NOTES – TEMPORARY STREAM CONTROL**

1. THE CONTRACTOR SHALL DEVELOP AND SUBMIT A WATER CONTROL PLAN TO THE TOWN OF PARKER FOR REVIEW AND APPROVAL TWO WEEKS PRIOR TO BEGINNING CONSTRUCTION. WATER CONTROL INCLUDES CHANNEL BASE FLOW, STORMWATER RUNOFF, AND GROUNDWATER. THE CONTRACTOR'S WATER CONTROL PLAN SHALL INCLUDE ALL MEANS AND METHODS NECESSARY IN CONVEYING A CLEAN WATER DIVERSION FOR WATER THROUGH AND FROM THE PROJECT SITE SO THAT THE WATER QUALITY OR PROPERTY DOWNSTREAM OF THE PROJECT LIMITS ARE NOT IMPACTED NEGATIVELY FROM THE PROJECT'S CONSTRUCTION ACTIVITIES.
2. THE CONTRACTOR'S MEANS AND METHODS INCLUDED IN THE CONTRACTOR'S APPROVED WATER CONTROL PLAN MAY INCLUDE, BUT ARE NOT LIMITED TO THE FOLLOWING: PLASTIC LINED DIVERSION DITCHES, TEMPORARY PIPING, HOSES, CUTOFF WALLS, CHECK DAMS, PUMPS, GENERATORS, SOUND PROOFING, TEMPORARY POWER, SHEET PILE, SHORING, SEDIMENT TRAPS, SEDIMENT BASINS, FILTER BAGS, REINFORCED ROCK BERMS, STREAM CROSSINGS, RIPRAP PADS, RIPRAP, CRUSHED ROCK AND ANY OTHER WATER CONTROL MEASURES NECESSARY AND APPROVED BY THE TOWN OF PARKER.
3. GIVEN THE NATURE OF THE PROJECT SITE'S TERRAIN AND SCOPE OF WORK, THE CONTRACTOR'S WATER CONTROL PLAN AND PROPOSAL SHALL ACCOUNT FOR THE NEED TO RELOCATE WATER CONTROL MEASURES AS NEEDED BASED ON THE CONTRACTOR'S ACTUAL CONSTRUCTION SEQUENCE AND SELECTED MEANS AND METHODS.
4. WATER QUALITY SHALL BE ONE OF THE CONTRACTOR'S PRIMARY CONCERNS. THE CONTRACTOR'S IMPLEMENTED WATER CONTROL PLAN WILL BE INSPECTED DAILY. IF FOR ANY REASON THE CONTRACTOR'S IMPLEMENTED WATER CONTROL PLAN NEEDS CORRECTIVE ACTION OR IF THE CONTRACTOR IS DIRECTED BY THE TOWN OF PARKER OR THE OWNER'S REPRESENTATIVE TO MAKE REPAIRS, THE CONTRACTOR SHALL MAKE SUCH CORRECTIONS IMMEDIATELY.
5. THE APPROXIMATE 2-YR DISCHARGE FOR HAPPY CANYON CREEK IS 309 CFS. THE AVERAGE BASE FLOW RATE IS UNKNOWN. THE ESTIMATED AVERAGE BASE FLOW RATE IS APPROXIMATELY 1 CFS.
6. ALL STREAM DIVERSION DITCHES NEED TO BE PLASTIC LINED AT A MINIMUM AS DIRECTED BY THE TOWN OF PARKER.
7. ALL TEMPORARY STREAM CROSSINGS SHALL BE COMPLETELY RIPRAP REINFORCED AND HAVE PLASTIC LINING UNDER THE RIPRAP. THE CONTRACTOR'S SELECTED STREAM CROSSING SHALL ACCOMMODATE PASSAGE FOR BASE FLOWS AND AT NO TIME SHALL CONTRACTORS' EQUIPMENT HAVE DIRECT CONTACT WITH ANY STREAM FLOW.
8. ALL INCIDENTAL WATER CONTROL ITEMS SHALL BE PAID FOR AS TEMPORARY STREAM CROSSING (EA).

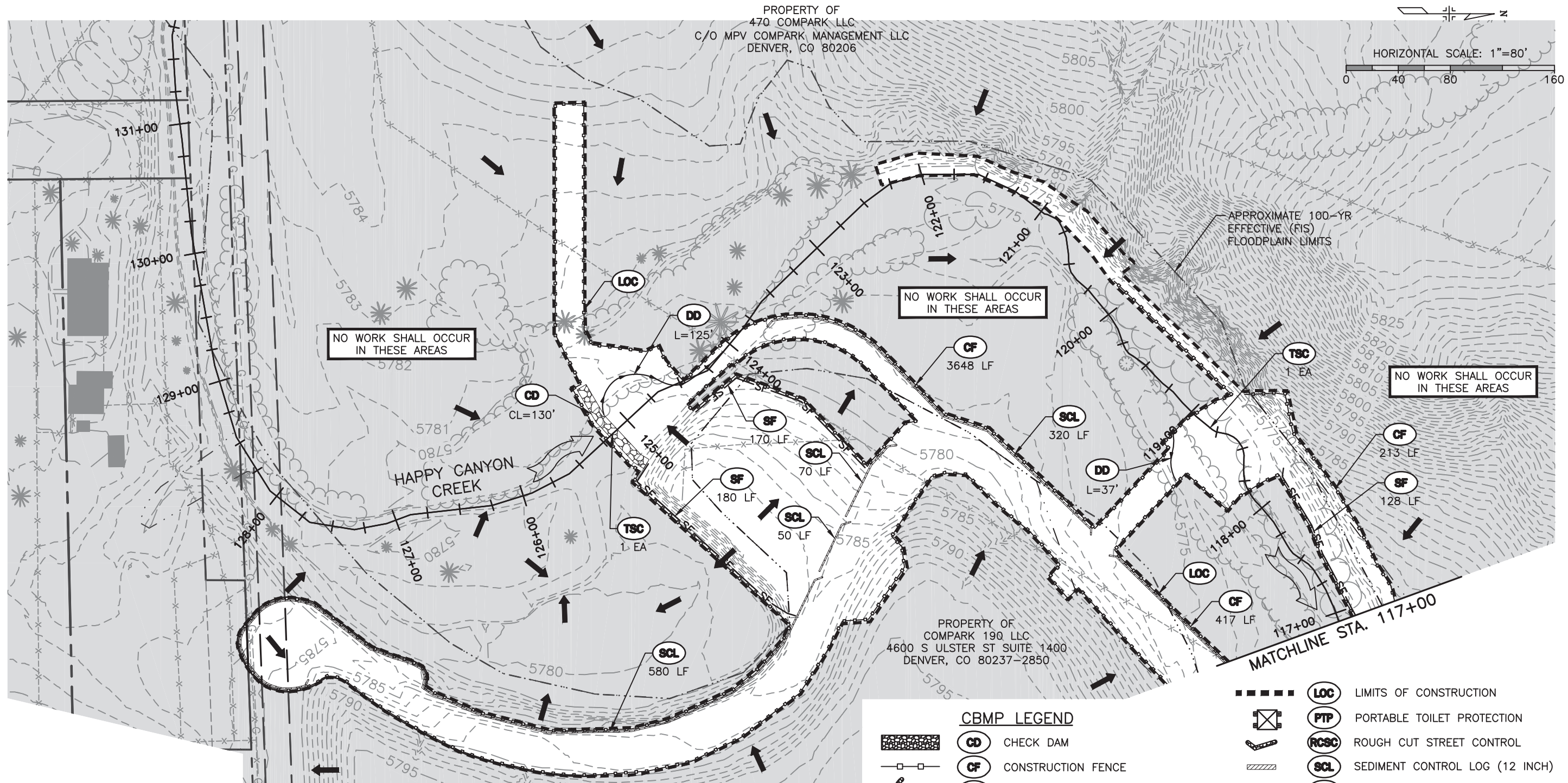
**CBMP LEGEND**

	<b>CD</b> CHECK DAM
	<b>CF</b> CONSTRUCTION FENCE
	<b>CP</b> CULVERT PROTECTION
	<b>CWA</b> CONCRETE WASHOUT AREA
	<b>D</b> DEWATERING
	<b>DD</b> DIVERSION DITCH
	<b>ECB</b> EROSION CONTROL BLANKET (STRAW/COCONUT)
	<b>IPAN</b> INLET PROTECTION FOR AREA INLETS NOT IN PAVEMENT
	<b>LOC</b> LIMITS OF CONSTRUCTION
	<b>PTP</b> PORTABLE TOILET PROTECTION
	<b>RCSC</b> ROUGH CUT STREET CONTROL
	<b>SCL</b> SEDIMENT CONTROL LOG (12 INCH)
	<b>SF</b> SILT FENCE
	<b>SMC</b> SEEDING MULCHING AND CRIMPING
	<b>SSA</b> STABILIZED STAGING AREA
	<b>TSB</b> TEMPORARY SEDIMENT BASIN
	<b>TSC</b> TEMPORARY STREAM CONTROL
	<b>VTC</b> VEHICLE TRACKING CONTROL

I:\115360-01 - Compark at Belford\CADD\Erosion\Drawings\Happy Cyn Creek Drop Structure\Scott.Dankenbring

Print Date: 3/13/2018 9:40:20 AM	Sheet Revisions	<p><b>Manhard CONSULTING LTD</b>                  8008 E. Arapahoe Court, Suite 110, Centennial, CO 80112 ph:303.721.0800 f:303.721.0400 manhard.com                  Civil Engineers • Surveyors • Water Resource Engineers • Water &amp; Wastewater Engineers                  Construction Managers • Environmental Scientists • Landscape Architects • Planners</p>	As Constructed	BELFORD-HAPPY CANYON CREEK TABULATION OF EROSION CONTROL QUANTITIES		Project No./Code
File Name: E115360-01TAB01ΔROP.dwg			Date	Comments	Initials	No Revisions:
Horizontal Scale: NTS	(R-X)			Revised:	Detailer: KLT	
Vertical Scale: NTS				Void:	Subset: EROSION	Sheets: ET-1 of 1
<p>6300 South Syracuse Way, Suite 600 Centennial, CO 80111 tel 303.721.1440 fax 303.721.0832</p>						Sheet Number 88

I:\115360-01 - Compark at Belford\CADD\Erosion\Drawings\Happy Cyn Creek Drop Structure\Chad.Twiss



**LEGEND**

---	TOP OF CUT
- - -	TOE OF FILL
---	LIMITS OF CONSTRUCTION
←	GENERAL FLOW DIRECTION
⊘	WETLANDS

- NOTES:**
- TEMPORARY CONSTRUCTION EASEMENTS SHALL NOT BE CLEARED AND GRUBBED UNLESS IT IS REQUIRED IN ORDER TO CONSTRUCT THE ROADWAY SECTION. THE CONTRACTOR SHALL USE PARTICULAR CARE TO MINIMIZE DAMAGE TO PLANTINGS WITHIN THE PROPERTY.
  - ALL DIRTY STREETS, CURBS, GUTTER, SIDEWALKS, LITTER AND OTHER CONSTRUCTION TRASH/DEBRIS, ETC. MUST BE THOROUGHLY CLEANED THROUGHOUT THE DAY AS THESE AREAS BECOME SOILED. NO EXCEPTIONS WILL BE MADE.
  - NO WORK SHALL OCCUR ON ANY AREA ADJACENT TO THE PROJECT OUTSIDE THE LIMITS OF CONSTRUCTION.

**CBMP LEGEND**

⊘	<b>CD</b> CHECK DAM	⊘	<b>LOC</b> LIMITS OF CONSTRUCTION
⊘	<b>CF</b> CONSTRUCTION FENCE	⊘	<b>PTP</b> PORTABLE TOILET PROTECTION
⊘	<b>CP</b> CULVERT PROTECTION	⊘	<b>RCSC</b> ROUGH CUT STREET CONTROL
⊘	<b>CWA</b> CONCRETE WASHOUT AREA	⊘	<b>SCL</b> SEDIMENT CONTROL LOG (12 INCH)
⊘	<b>D</b> DEWATERING	⊘	<b>SF</b> SILT FENCE
⊘	<b>DD</b> DIVERSION DITCH	⊘	<b>SMC</b> SEEDING MULCHING AND CRIMPING
⊘	<b>ECB</b> EROSION CONTROL BLANKET (STRAW/COCONUT)	⊘	<b>SSA</b> STABILIZED STAGING AREA
⊘	<b>PAN</b> INLET PROTECTION FOR AREA INLETS NOT IN PAVEMENT	⊘	<b>TSB</b> TEMPORARY SEDIMENT BASIN
		⊘	<b>TSC</b> TEMPORARY STREAM CONTROL (SEE WATER CONTROL NOTES ON ET-1)
		⊘	<b>VTC</b> VEHICLE TRACKING CONTROL

Print Date: 3/13/2018 11:36:22 AM  
 File Name: H115360-01DROP01?rosion-INI.dwg  
 Horizontal Scale: 1"=80' Vertical Scale: N.T.S.

**FELSBURG HOLT & ULLEVIG**  
 6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

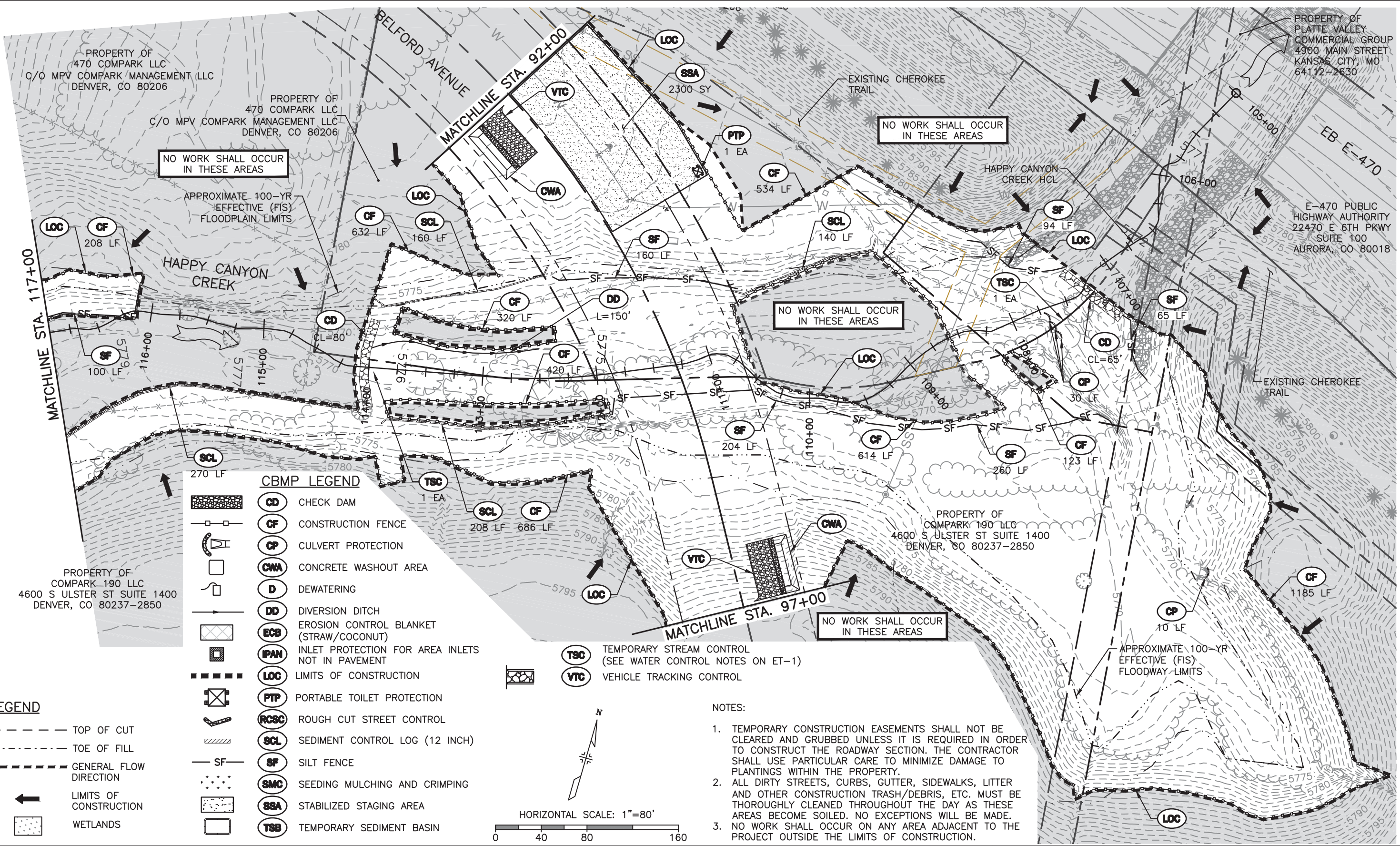
Sheet Revisions			
Date	Comments	Initials	

**Manhard CONSULTING LTD**

8008 E. Arapahoe Court, Suite 110, Centennial, CO 80112 ph: 303.708.0800 fax: 303.708.0400  
 Civil Engineers • Surveyors • Water Resource Engineers • Water & Wastewater Engineers  
 Construction Managers • Environmental Scientists • Landscape Architects • Planners

As Constructed	PEORIA & BELFORD INTERSECTION HAPPY CANYON CREEK DROP STRUCTURE INITIAL CBMP PLAN		Project No./Code
No Revisions:	Designer: CDT	Structure Numbers	
Revised:	Detailer: KLT		
Void:	Subset: Erosion	Sheets: El-1 of 2	Sheet Number 89

I:\115360-01 - Compark at Belford\CADD\Erosion\Drawings\Happy Cyn Creek Drop Structure\Chad.Twiss



NO WORK SHALL OCCUR IN THESE AREAS

NO WORK SHALL OCCUR IN THESE AREAS

NO WORK SHALL OCCUR IN THESE AREAS

**CBMP LEGEND**

- CD CHECK DAM
- CF CONSTRUCTION FENCE
- CP CULVERT PROTECTION
- CWA CONCRETE WASHOUT AREA
- D DEWATERING
- DD DIVERSION DITCH
- ECB EROSION CONTROL BLANKET (STRAW/COCONUT)
- IPAN INLET PROTECTION FOR AREA INLETS NOT IN PAVEMENT
- LOC LIMITS OF CONSTRUCTION
- PTP PORTABLE TOILET PROTECTION
- RCSC ROUGH CUT STREET CONTROL
- SCL SEDIMENT CONTROL LOG (12 INCH)
- SF SILT FENCE
- SMC SEEDING MULCHING AND CRIMPING
- SSA STABILIZED STAGING AREA
- TSB TEMPORARY SEDIMENT BASIN
- TSC TEMPORARY STREAM CONTROL (SEE WATER CONTROL NOTES ON ET-1)
- VTC VEHICLE TRACKING CONTROL

**LEGEND**

- TOP OF CUT
- TOE OF FILL
- GENERAL FLOW DIRECTION
- LIMITS OF CONSTRUCTION
- WETLANDS

**NOTES:**

1. TEMPORARY CONSTRUCTION EASEMENTS SHALL NOT BE CLEARED AND GRUBBED UNLESS IT IS REQUIRED IN ORDER TO CONSTRUCT THE ROADWAY SECTION. THE CONTRACTOR SHALL USE PARTICULAR CARE TO MINIMIZE DAMAGE TO PLANTINGS WITHIN THE PROPERTY.
2. ALL DIRTY STREETS, CURBS, GUTTER, SIDEWALKS, LITTER AND OTHER CONSTRUCTION TRASH/DEBRIS, ETC. MUST BE THOROUGHLY CLEANED THROUGHOUT THE DAY AS THESE AREAS BECOME SOILED. NO EXCEPTIONS WILL BE MADE.
3. NO WORK SHALL OCCUR ON ANY AREA ADJACENT TO THE PROJECT OUTSIDE THE LIMITS OF CONSTRUCTION.

Print Date: 3/13/2018 11:28:41 AM  
 File Name: H115360-01DROPO2?rosion-INI.dwg  
 Horizontal Scale: 1"=80' Vertical Scale: N.T.S.

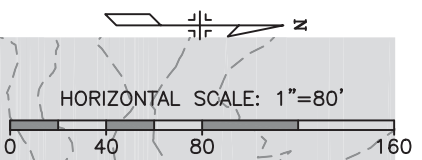
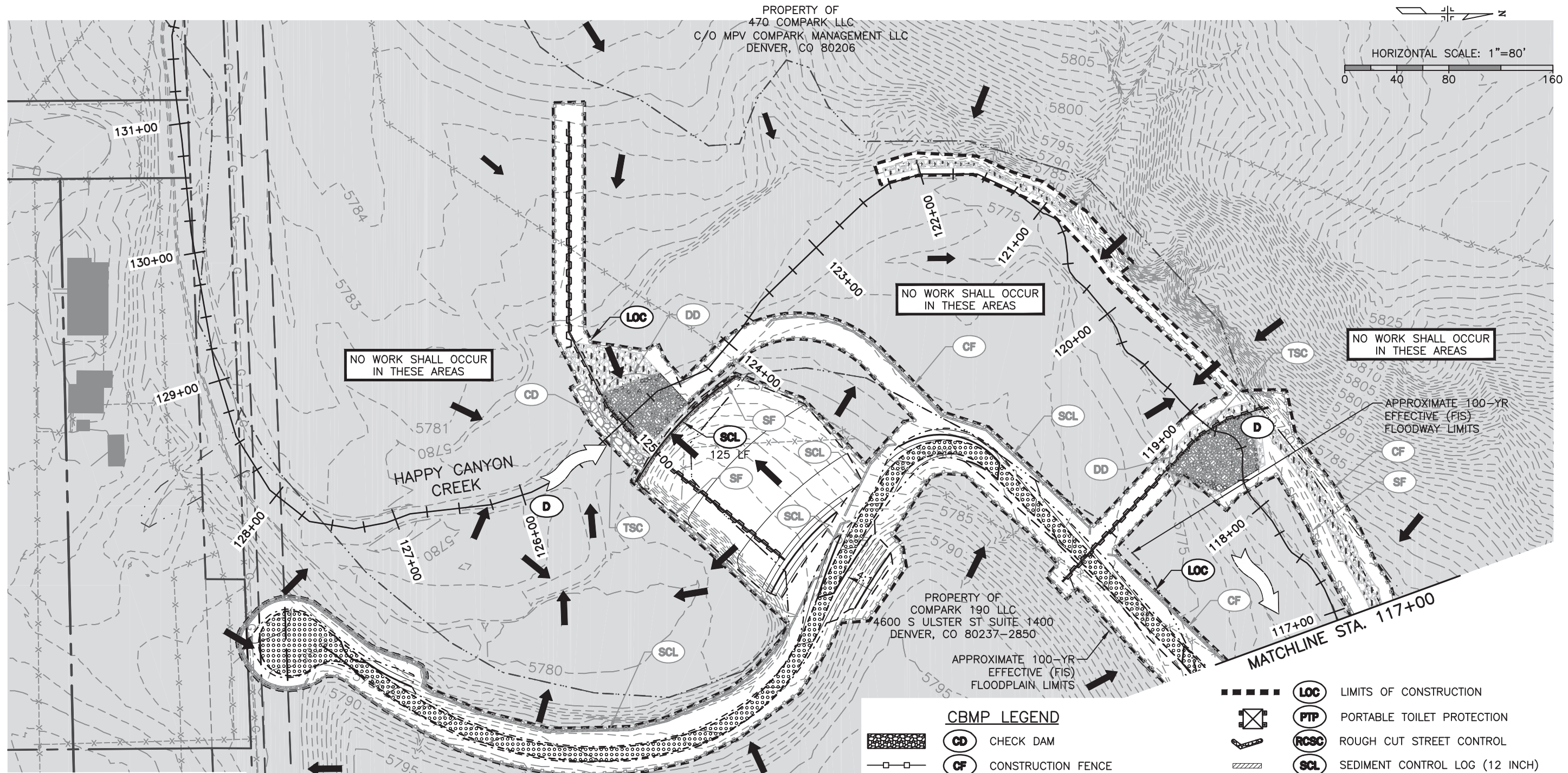
**FELSBURG HOLT & ULLEVIG**  
 6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

Sheet Revisions			
Date	Comments	Initials	



As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE INITIAL CBMP PLAN		Project No./Code
No Revisions:	Designer: CDT	Structure Numbers	Sheet Number 90
Revised:	Detailer: KLT		
Void:	Subset: Erosion	Sheets: EI-2 of 2	

I:\115360-01 - Compark at Belford\CADD\Erosion\Happy Cyn Creek Drop Structure\Chad.Twiss



**LEGEND**

- TOP OF CUT
- - - TOE OF FILL
- LIMITS OF CONSTRUCTION
- ← GENERAL FLOW DIRECTION
- WETLANDS

- NOTES:**
- TEMPORARY CONSTRUCTION EASEMENTS SHALL NOT BE CLEARED AND GRUBBED UNLESS IT IS REQUIRED IN ORDER TO CONSTRUCT THE ROADWAY SECTION. THE CONTRACTOR SHALL USE PARTICULAR CARE TO MINIMIZE DAMAGE TO PLANTINGS WITHIN THE PROPERTY.
  - \* EROSION CONTROL ITEMS INSTALLED IN THE INITIAL EROSION CONTROL PLAN SHALL REMAIN IN PLACE FOR INTERIM PHASES OF CONSTRUCTION AND SHALL BE REMOVED, MODIFIED OR REPLACED AT THE DIRECTION OF THE PROJECT ENGINEER. THESE ITEMS SHALL BE PAID FOR AS PLACE AND REMOVE.
  - NO WORK SHALL OCCUR ON ANY AREA ADJACENT TO THE PROJECT OUTSIDE THE LIMITS OF CONSTRUCTION.

**CBMP LEGEND**

	<b>CD</b> CHECK DAM		<b>LOC</b> LIMITS OF CONSTRUCTION
	<b>CF</b> CONSTRUCTION FENCE		<b>PTP</b> PORTABLE TOILET PROTECTION
	<b>CP</b> CULVERT PROTECTION		<b>RCSC</b> ROUGH CUT STREET CONTROL
	<b>CWA</b> CONCRETE WASHOUT AREA		<b>SCL</b> SEDIMENT CONTROL LOG (12 INCH)
	<b>D</b> DEWATERING		<b>SF</b> SILT FENCE
	<b>DD</b> DIVERSION DITCH		<b>SMC</b> SEEDING MULCHING AND CRIMPING
	<b>ECB</b> EROSION CONTROL BLANKET (STRAW/COCONUT)		<b>SSA</b> STABILIZED STAGING AREA
	<b>IPAN</b> INLET PROTECTION FOR AREA INLETS NOT IN PAVEMENT		<b>TSB</b> TEMPORARY SEDIMENT BASIN
			<b>TSC</b> TEMPORARY STREAM CONTROL (SEE WATER CONTROL NOTES SHEET ET-1)
			<b>VTC</b> VEHICLE TRACKING CONTROL

Print Date: 3/13/2018 11:33:46 AM  
 File Name: H115360-01DROP01?rosion-INT.dwg  
 Horizontal Scale: 1"=80' Vertical Scale: N.T.S.

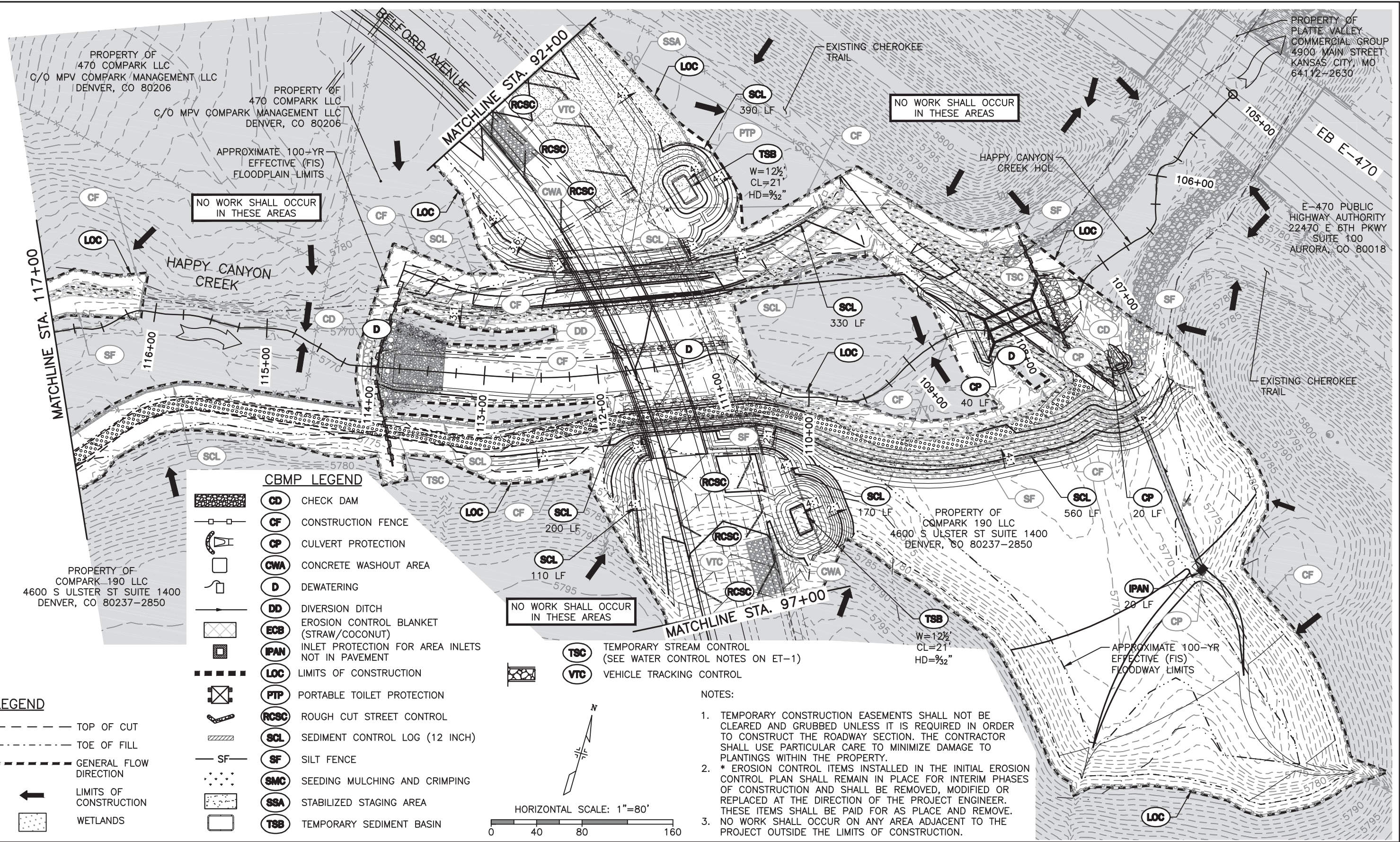
**FELSBURG HOLT & ULLEVIG**  
 6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

Sheet Revisions		
Date	Comments	Initials



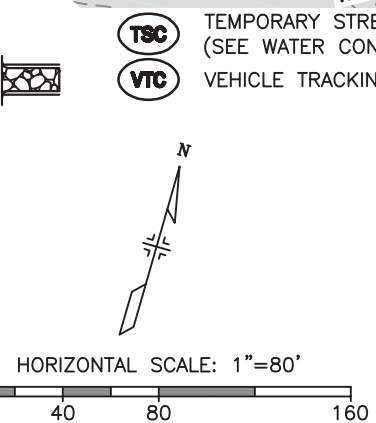
As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE INTERIM CBMP PLAN		Project No./Code
No Revisions:	Designer: CDT	Structure Numbers	
Revised:	Detailer: KLT		
Void:	Subset: Erosion	Sheets: EN-1 of 2	Sheet Number 91

I:\115360-01 - Compark at Belford\CADD\Erosion\Drawings\Happy Cyn Creek Drop Structure - Chad.Twiss



	CD	CHECK DAM
	CF	CONSTRUCTION FENCE
	CP	CULVERT PROTECTION
	CWA	CONCRETE WASHOUT AREA
	D	DEWATERING
	DD	DIVERSION DITCH
	ECB	EROSION CONTROL BLANKET (STRAW/COCONUT)
	IPAN	INLET PROTECTION FOR AREA INLETS NOT IN PAVEMENT
	LOC	LIMITS OF CONSTRUCTION
	PTP	PORTABLE TOILET PROTECTION
	RCSC	ROUGH CUT STREET CONTROL
	SCL	SEDIMENT CONTROL LOG (12 INCH)
	SF	SILT FENCE
	SMC	SEEDING MULCHING AND CRIMPING
	SSA	STABILIZED STAGING AREA
	TSB	TEMPORARY SEDIMENT BASIN

	TOP OF CUT
	TOE OF FILL
	GENERAL FLOW DIRECTION
	LIMITS OF CONSTRUCTION
	WETLANDS



- NOTES:
- TEMPORARY CONSTRUCTION EASEMENTS SHALL NOT BE CLEARED AND GRUBBED UNLESS IT IS REQUIRED IN ORDER TO CONSTRUCT THE ROADWAY SECTION. THE CONTRACTOR SHALL USE PARTICULAR CARE TO MINIMIZE DAMAGE TO PLANTINGS WITHIN THE PROPERTY.
  - \* EROSION CONTROL ITEMS INSTALLED IN THE INITIAL EROSION CONTROL PLAN SHALL REMAIN IN PLACE FOR INTERIM PHASES OF CONSTRUCTION AND SHALL BE REMOVED, MODIFIED OR REPLACED AT THE DIRECTION OF THE PROJECT ENGINEER. THESE ITEMS SHALL BE PAID FOR AS PLACE AND REMOVE. NO WORK SHALL OCCUR ON ANY AREA ADJACENT TO THE PROJECT OUTSIDE THE LIMITS OF CONSTRUCTION.

Print Date: 3/13/2018 11:42:17 AM  
 File Name: H115360-01DROP02?rosion-INT.dwg  
 Horizontal Scale: 1"=80' Vertical Scale: N.T.S.

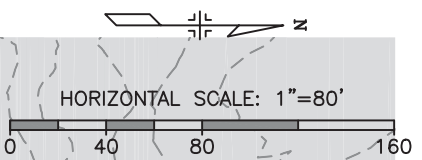
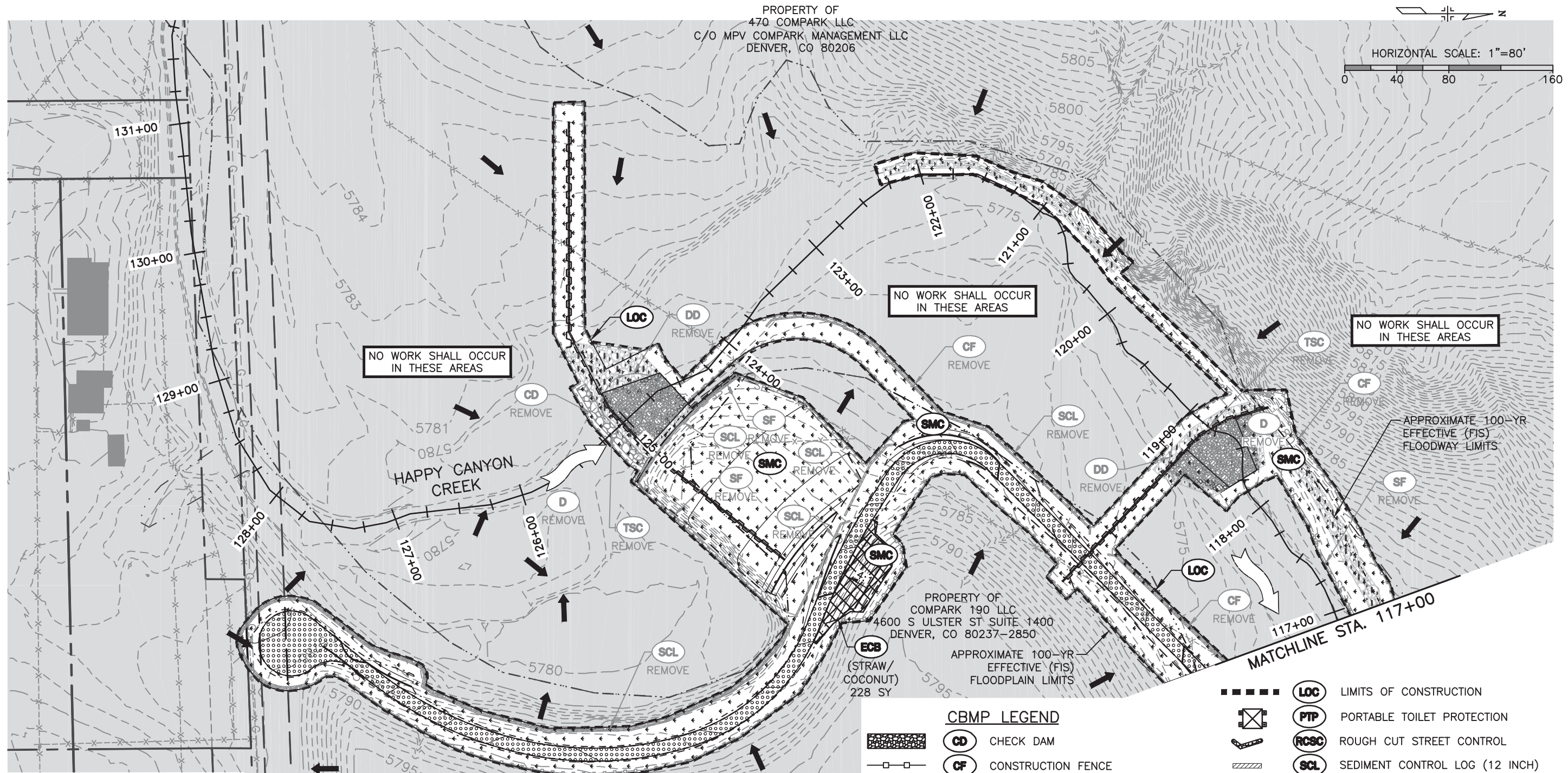
**FELSBURG HOLT & ULLEVIG**  
 6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

Date	Comments	Initials



As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE INTERIM CBMP PLAN		Project No./Code
No Revisions:	Designer: CDT	Structure Numbers	
Revised:	Detailer: KLT		
Void:	Subset: Erosion	Sheets: EN-2 of 2	Sheet Number 92

I:\115360-01 - Compark at Belford\CADD\Erosion\Happy Cyn Creek Drop Structure\Chad.Twiss



**LEGEND**

- TOP OF CUT
- - - TOE OF FILL
- LIMITS OF CONSTRUCTION
- ← GENERAL FLOW DIRECTION
- WETLANDS

- NOTES:**
- TEMPORARY CONSTRUCTION EASEMENTS SHALL NOT BE CLEARED AND GRUBBED UNLESS IT IS REQUIRED IN ORDER TO CONSTRUCT THE ROADWAY SECTION. THE CONTRACTOR SHALL USE PARTICULAR CARE TO MINIMIZE DAMAGE TO PLANTINGS WITHIN THE PROPERTY.
  - \* EROSION CONTROL ITEMS INSTALLED IN THE INITIAL EROSION CONTROL PLAN SHALL REMAIN IN PLACE FOR INTERIM PHASES OF CONSTRUCTION AND SHALL BE REMOVED, MODIFIED OR REPLACED AT THE DIRECTION OF THE PROJECT ENGINEER. THESE ITEMS SHALL BE PAID FOR AS PLACE AND REMOVE.
  - NO WORK SHALL OCCUR ON ANY AREA ADJACENT TO THE PROJECT OUTSIDE THE LIMITS OF CONSTRUCTION.

**CBMP LEGEND**

	<b>CD</b> CHECK DAM		<b>LOC</b> LIMITS OF CONSTRUCTION
	<b>CF</b> CONSTRUCTION FENCE		<b>PTP</b> PORTABLE TOILET PROTECTION
	<b>CP</b> CULVERT PROTECTION		<b>RCSC</b> ROUGH CUT STREET CONTROL
	<b>CWA</b> CONCRETE WASHOUT AREA		<b>SCL</b> SEDIMENT CONTROL LOG (12 INCH)
	<b>D</b> DEWATERING		<b>SF</b> SILT FENCE
	<b>DD</b> DIVERSION DITCH		<b>SMC</b> SEEDING MULCHING AND CRIMPING
	<b>ECB</b> EROSION CONTROL BLANKET (STRAW/COCONUT)		<b>SSA</b> STABILIZED STAGING AREA
	<b>IPAN</b> INLET PROTECTION FOR AREA INLETS NOT IN PAVEMENT		<b>TSB</b> TEMPORARY SEDIMENT BASIN
			<b>TSC</b> TEMPORARY STREAM CONTROL (SEE WATER CONTROL NOTES SHEET ET-1)
			<b>VTC</b> VEHICLE TRACKING CONTROL

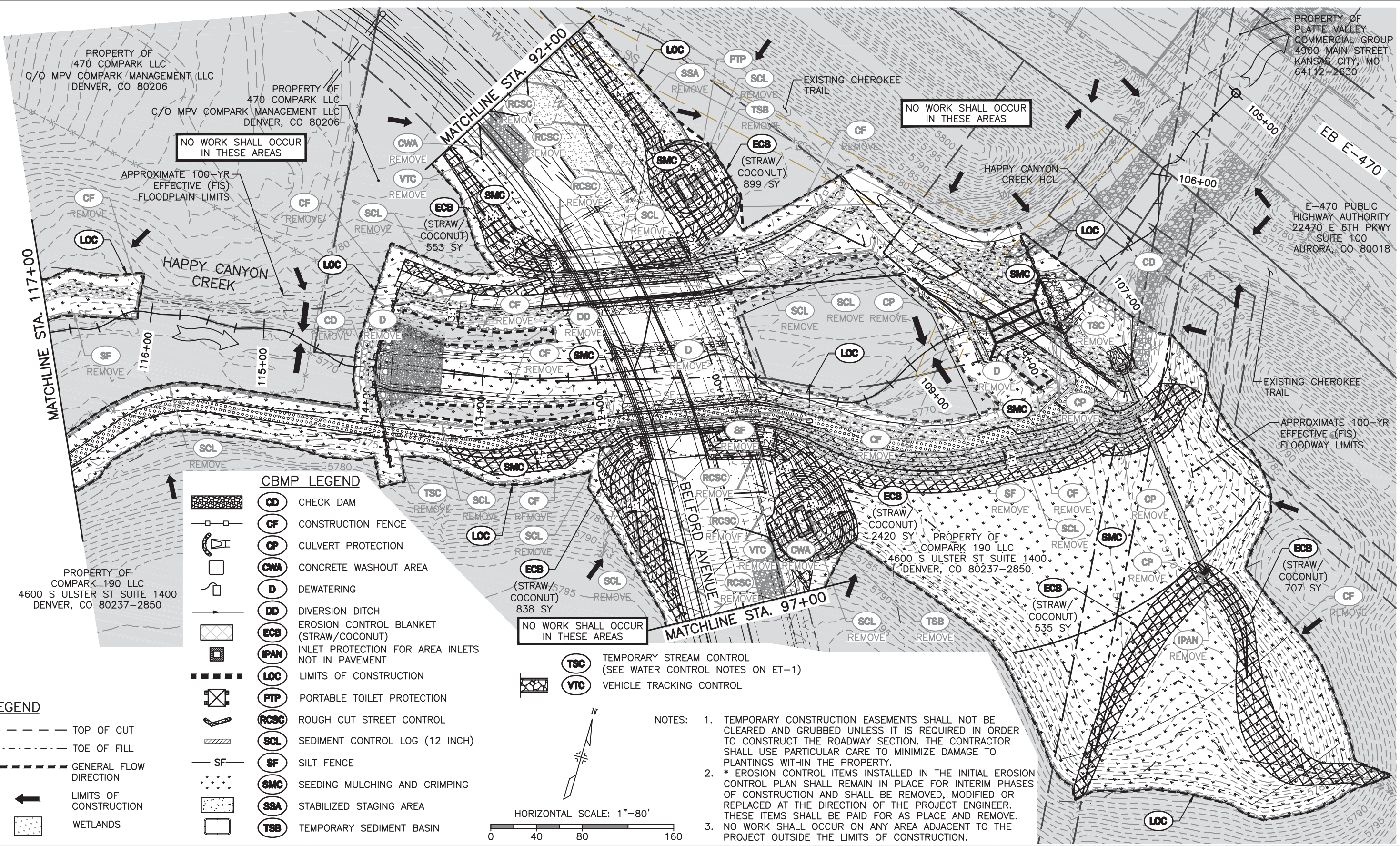
Print Date: 3/13/2018 11:38:31 AM  
 File Name: H115360-01DROP01?rosion-FIN.dwg  
 Horizontal Scale: 1"=80' Vertical Scale: N.T.S.

Sheet Revisions		
Date	Comments	Initials

8008 E. Arapahoe Court, Suite 110, Centennial, CO 80112 ph: 303.708.0900 fax: 303.708.0400 manhard.com  
 Civil Engineers • Surveyors • Water Resource Engineers • Water & Wastewater Engineers  
 Construction Managers • Environmental Scientists • Landscape Architects • Planners

As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE FINAL CBMP PLAN		Project No./Code
No Revisions:	Designer: CDT	Structure Numbers	
Revised:	Detailer: KLT		
Void:	Subset: Erosion	Sheets: EF-1 of 2	Sheet Number 93

I:\115360-01 - Compark at Belford\CADD\Erosion\Drawings\Happy Cyn Creek Drop Structure - Chad.Twiss



NO WORK SHALL OCCUR IN THESE AREAS

NO WORK SHALL OCCUR IN THESE AREAS

NO WORK SHALL OCCUR IN THESE AREAS

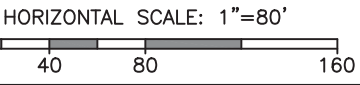
**CBMP LEGEND**

- CD** CHECK DAM
- CF** CONSTRUCTION FENCE
- CP** CULVERT PROTECTION
- CWA** CONCRETE WASHOUT AREA
- D** DEWATERING
- DD** DIVERSION DITCH
- ECB** EROSION CONTROL BLANKET (STRAW/COCONUT)
- IPAN** INLET PROTECTION FOR AREA INLETS NOT IN PAVEMENT
- LOC** LIMITS OF CONSTRUCTION
- PTP** PORTABLE TOILET PROTECTION
- RCSC** ROUGH CUT STREET CONTROL
- SCL** SEDIMENT CONTROL LOG (12 INCH)
- SF** SILT FENCE
- SMC** SEEDING MULCHING AND CRIMPING
- SSA** STABILIZED STAGING AREA
- TSB** TEMPORARY SEDIMENT BASIN

**LEGEND**

- TOP OF CUT
- TOE OF FILL
- GENERAL FLOW DIRECTION
- LIMITS OF CONSTRUCTION
- WETLANDS

- TSC** TEMPORARY STREAM CONTROL (SEE WATER CONTROL NOTES ON ET-1)
- VTC** VEHICLE TRACKING CONTROL



- NOTES:
- TEMPORARY CONSTRUCTION EASEMENTS SHALL NOT BE CLEARED AND GRUBBED UNLESS IT IS REQUIRED IN ORDER TO CONSTRUCT THE ROADWAY SECTION. THE CONTRACTOR SHALL USE PARTICULAR CARE TO MINIMIZE DAMAGE TO PLANTINGS WITHIN THE PROPERTY.
  - \* EROSION CONTROL ITEMS INSTALLED IN THE INITIAL EROSION CONTROL PLAN SHALL REMAIN IN PLACE FOR INTERIM PHASES OF CONSTRUCTION AND SHALL BE REMOVED, MODIFIED OR REPLACED AT THE DIRECTION OF THE PROJECT ENGINEER. THESE ITEMS SHALL BE PAID FOR AS PLACE AND REMOVE.
  - NO WORK SHALL OCCUR ON ANY AREA ADJACENT TO THE PROJECT OUTSIDE THE LIMITS OF CONSTRUCTION.

Print Date: 3/13/2018 11:31:12 AM  
 File Name: H115360-01DROPO2?rosion-FIN.dwg  
 Horizontal Scale: 1"=80' Vertical Scale: N.T.S.

**FELSBURG HOLT & ULLEVIG**  
 6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

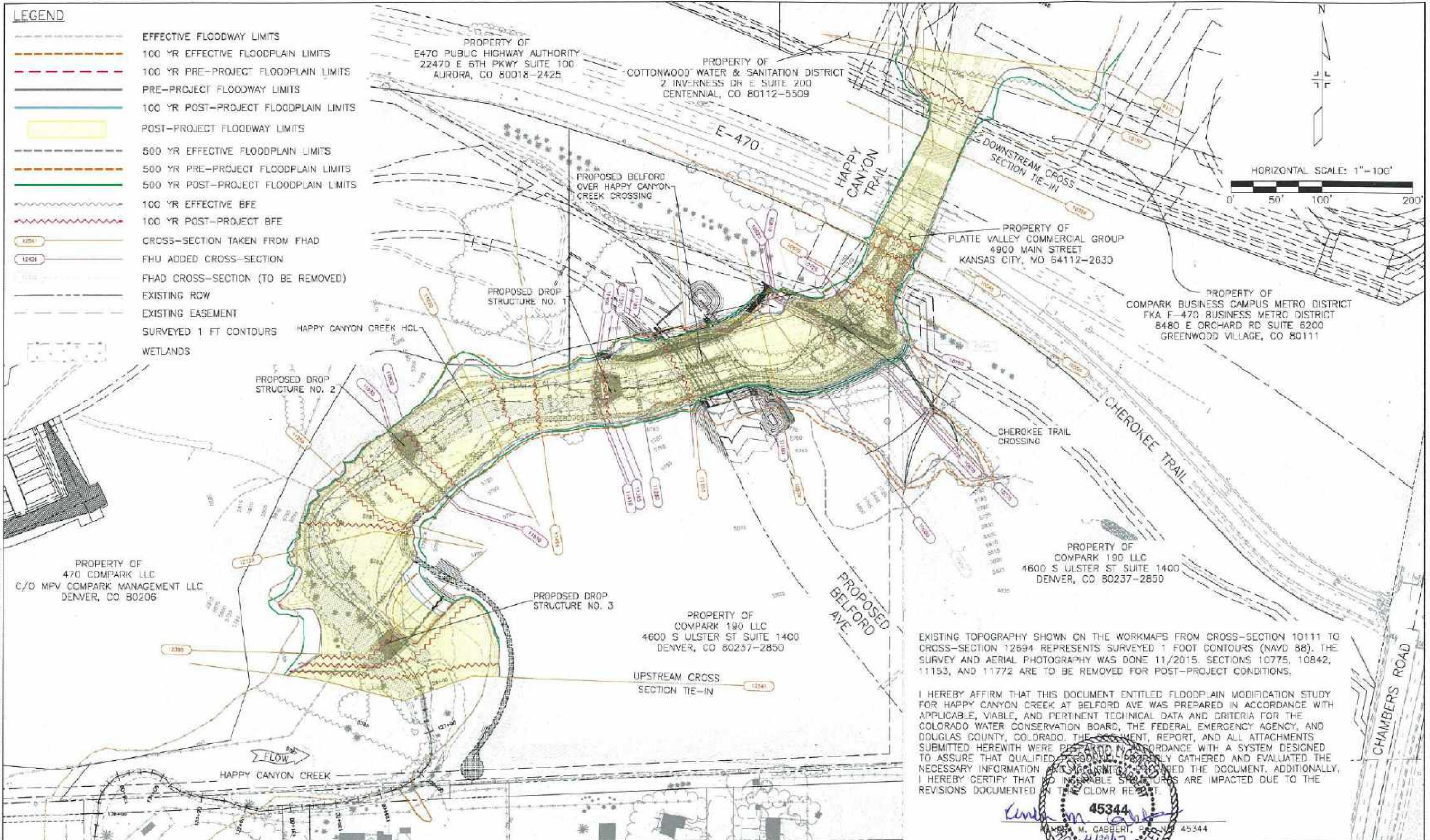
Sheet Revisions			
Date	Comments	Initials	

**Manhard CONSULTING LTD**

8008 E. Arapahoe Court, Suite 110, Centennial, CO 80112 ph: 303.708.0900 fax: 303.708.0400 manhard.com  
 Civil Engineers • Surveyors • Water Resources Engineers • Water & Wastewater Engineers  
 Construction Managers • Environmental Scientists • Landscape Architects • Planners

As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE FINAL CBMP PLAN		Project No./Code
No Revisions:	Designer: CDT	Structure Numbers	Sheet Number 94
Revised:	Detailer: KLT	Sheets: EF-2 of 2	
Void:	Subset: Erosion		

## **APPENDIX G. EFFECTIVE TIE-IN INFORMATION**



H:\115360-01 - Compark at Belford\CADD\Hydraulics\Drawings - Zach Grady

EXISTING TOPOGRAPHY SHOWN ON THE WORKMAPS FROM CROSS-SECTION 10111 TO CROSS-SECTION 12694 REPRESENTS SURVEYED 1 FOOT CONTOURS (NAVD 88). THE SURVEY AND AERIAL PHOTOGRAPHY WAS DONE 11/2015. SECTIONS 10775, 10842, 11153, AND 11772 ARE TO BE REMOVED FOR POST-PROJECT CONDITIONS.

I HEREBY AFFIRM THAT THIS DOCUMENT ENTITLED FLOODPLAIN MODIFICATION STUDY FOR HAPPY CANYON CREEK AT BELFORD AVE WAS PREPARED IN ACCORDANCE WITH APPLICABLE, VIABLE, AND PERTINENT TECHNICAL DATA AND CRITERIA FOR THE COLORADO WATER CONSERVATION BOARD, THE FEDERAL EMERGENCY AGENCY, AND DOUGLAS COUNTY, COLORADO. THE DOCUMENT, REPORT, AND ALL ATTACHMENTS SUBMITTED HERewith WERE PREPARED IN ACCORDANCE WITH A SYSTEM DESIGNED TO ASSURE THAT QUALIFIED PERSONNEL PROPERLY GATHERED AND EVALUATED THE NECESSARY INFORMATION AND PERMITTED TO SIGN THE DOCUMENT. ADDITIONALLY, I HEREBY CERTIFY THAT NO INSURABLE STRUCTURES ARE IMPACTED DUE TO THE REVISIONS DOCUMENTED IN THE CLOMR REPORT.

M. GABBERT, P.E. No. 45344

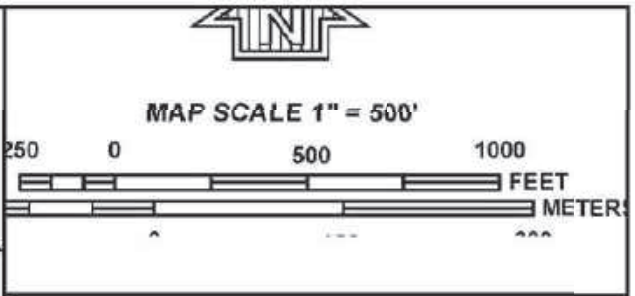
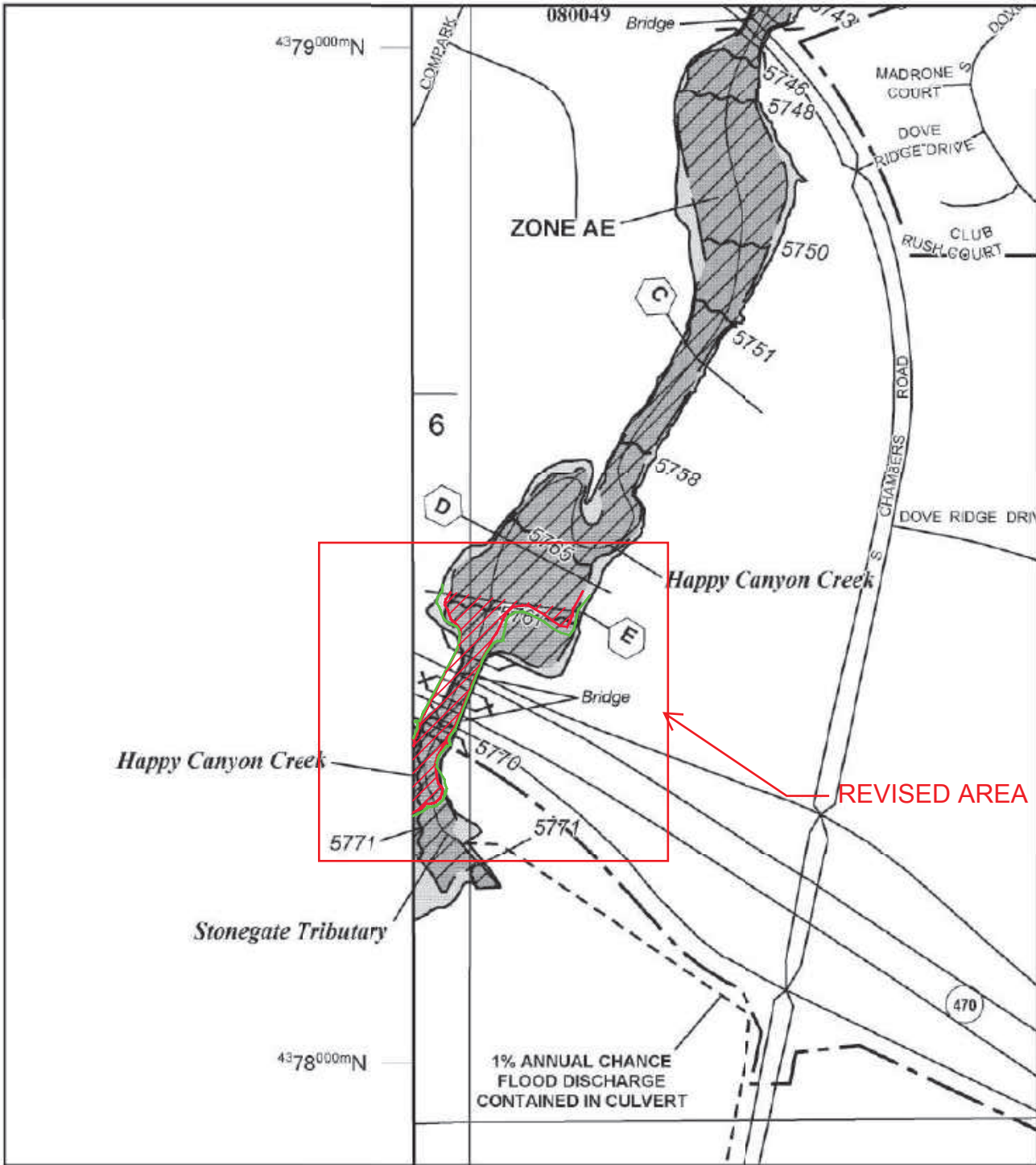
Print Date: 2/27/2018 10:43:41 AM  
 File Name: H115360-01FP-01 (Eff).dwg  
 Horizontal Scale: Vertical Scale:  
  
 6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

Sheet Revisions			
Date	Comments	Initials	

**Manhard**  
 CONSULTING LTD  
2000 E. Arapahoe Blvd Suite 110 Centennial, CO 80112 ph 303.720.0800 fax 303.720.0400 manhard.com  
 Civil Engineers • Surveyors • Water Resource Engineers • Water & Wastewater Engineers  
 Construction Managers • Environmental Scientists • Landscape Architects • Planners

As Constructed	BELFORD AVE HAPPY CANYON CREEK FLOODPLAIN MODIFICATION WORK MAP	
No Revisions:	Designer: CDT	Structure Numbers
Revised:	Detailer: ZJG	Sheets: 1 of 1
Void:	Subset:	

Project No./Code  
 Sheet Number



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0066G

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

**PANEL 66 OF 495**  
 (SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DOUGLAS COUNTY	08035C	0066	G
PARKER TOWN OF	08031C	0066	G

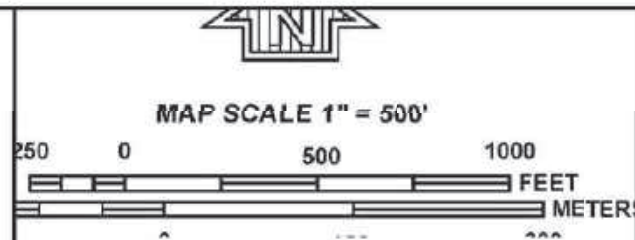
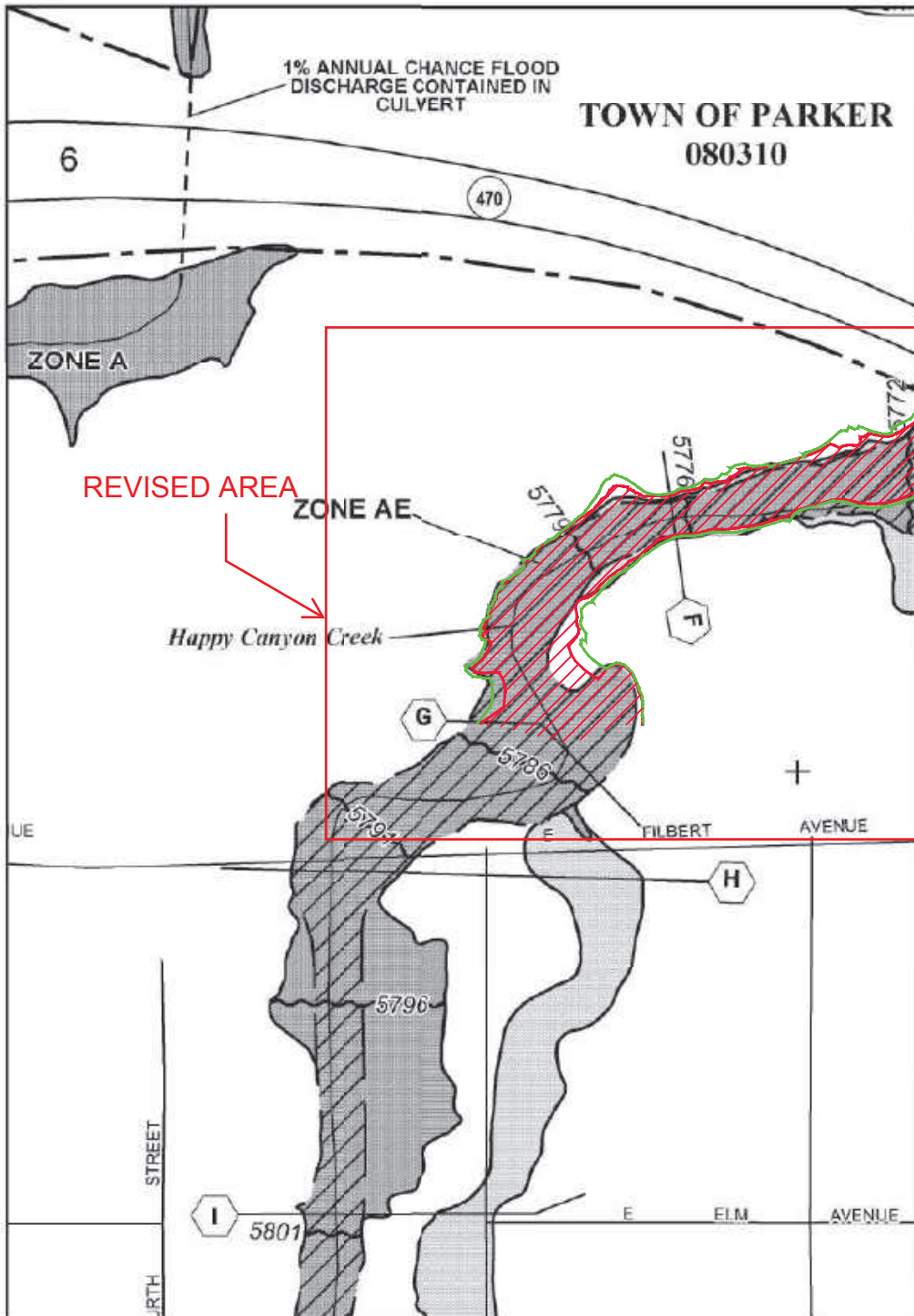
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.



**MAP NUMBER**  
**08035C0066G**  
**MAP REVISED**  
**MARCH 16, 2016**

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at [www.msc.fema.gov](http://www.msc.fema.gov)



**NATIONAL FLOOD INSURANCE PROGRAM**

PANEL 0062G

**FIRM**

FLOOD INSURANCE RATE MAP  
DOUGLAS COUNTY,  
COLORADO  
AND INCORPORATED AREAS

PANEL 62 OF 495  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

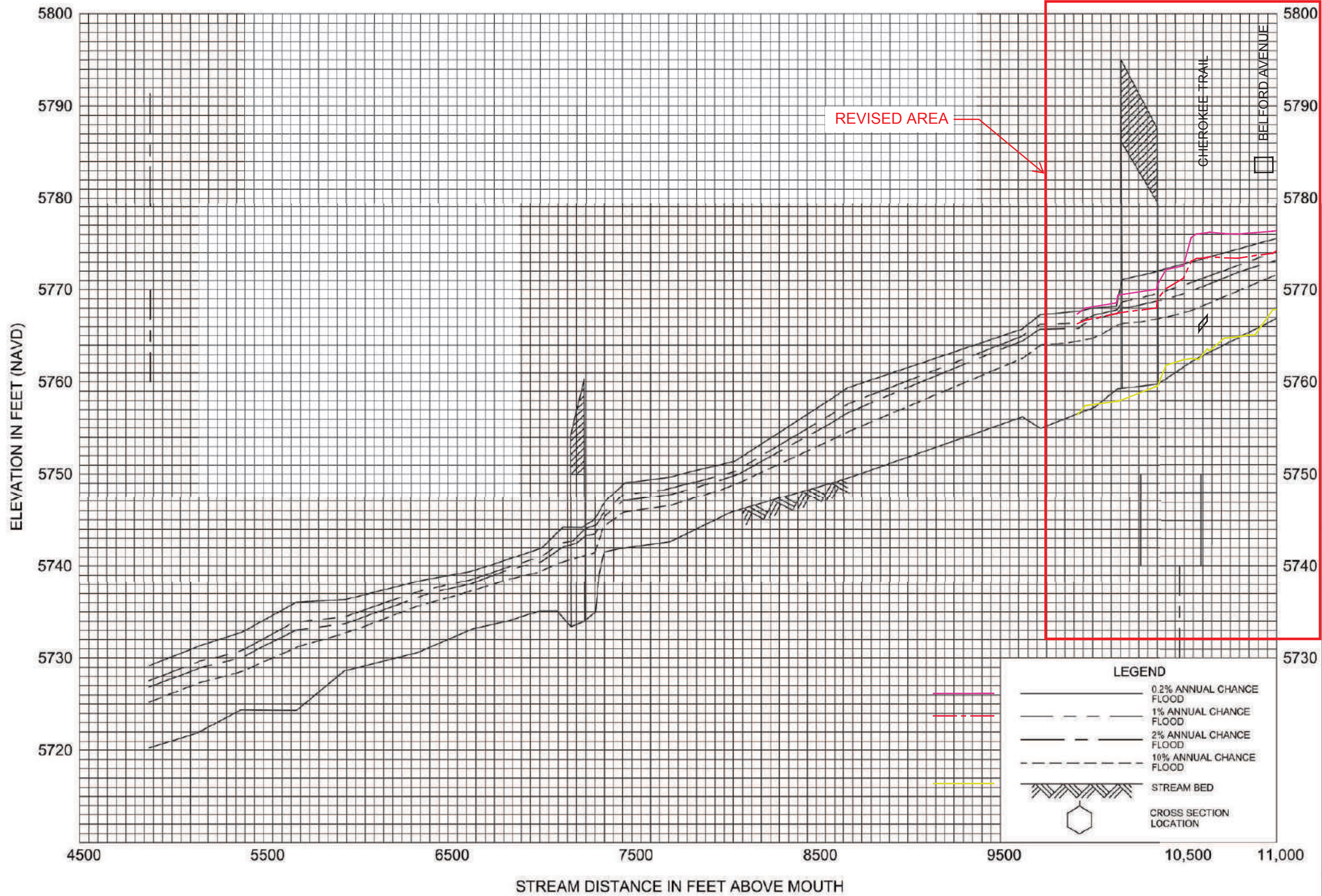
COMMUNITY	NUMBER	PANEL	SUFFIX
DOUGLAS COUNTY	080989	0062	G
LOUIS TREE, CITY OF	060310	0062	G
PARKER TOWN OF	060310	0062	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

**MAP NUMBER**  
08035C0062G  
**MAP REVISED**  
MARCH 16, 2016

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at [www.msc.fema.gov](http://www.msc.fema.gov)

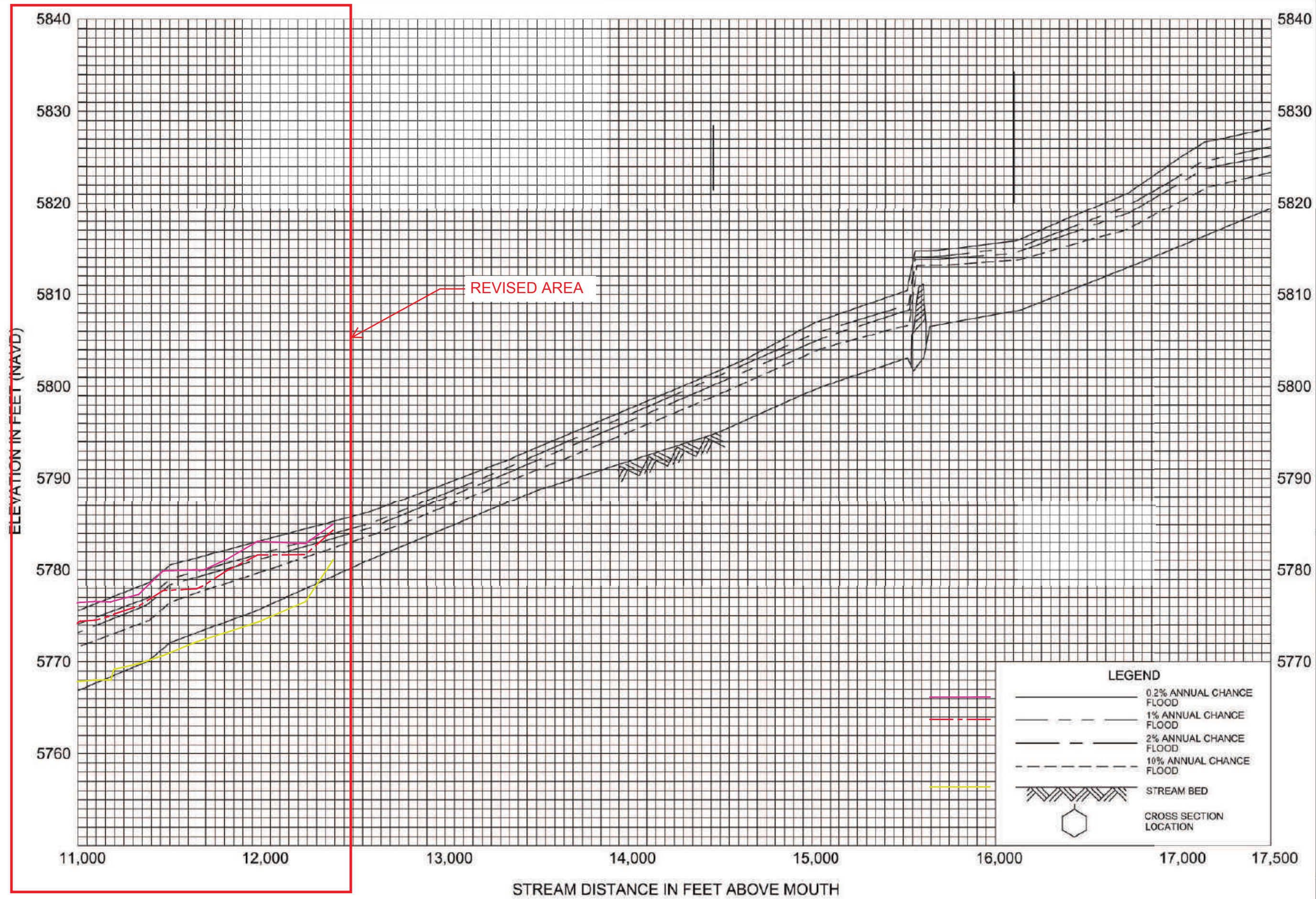


FLOOD PROFILES

HAPPY CANYON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO  
AND INCORPORATED AREAS



FLOOD PROFILES

HAPPY CANYON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO  
AND INCORPORATED AREAS

109P

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE <sup>1</sup>	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Happy Canyon Creek								
A	5,165	150	685	10.2	5,729.7	5,729.7	5,729.7	0.0
B	6,812	265	810	7.1	5,739.7	5,739.7	5,739.7	0.0
C	8,320	102	466	12.2	5,753.4	5,753.4	5,753.4	0.0
D	9,720	350	1,395	5.2	5,766.3	5,766.3	5,766.3	0.0
E	10,111	411	915	9.0	5,766.3	5,766.3	5,766.3	0.0
F	11,494	117	526	11.4	5,776.0	5,776.0	5,776.0	0.0
G	12,541	406	742	7.7	5,784.3	5,784.3	5,784.3	0.0
H	13,490	315	880	6.3	5,792.5	5,792.5	5,793.5	1.0 <sup>2</sup>
I	14,470	171	825	6.8	5,800.4	5,800.4	5,801.4	1.0 <sup>2</sup>
J	15,020	115	607	9.2	5,805.6	5,805.6	5,806.6	1.0 <sup>2</sup>
K	15,570	180	920	6.1	5,808.9	5,808.9	5,809.9	1.0 <sup>2</sup>
L	15,640	205	1,450	3.9	5,813.9	5,813.9	5,814.9	1.0 <sup>2</sup>
M	16,120	110	701	8.0	5,814.9	5,814.9	5,815.9	1.0 <sup>2</sup>
N	16,720	100	519	10.5	5,819.1	5,819.1	5,820.1	1.0 <sup>2</sup>
O	17,170	81	537	10.1	5,824.4	5,824.4	5,824.4	0.0
P	17,835	142	763	7.1	5,827.7	5,827.7	5,828.7	1.0 <sup>2</sup>
Q	18,230	136	498	8.7	5,831.2	5,831.2	5,831.2	0.0
R	18,310	107	977	5.6	5,836.2	5,836.2	5,837.2	1.0
S	19,020	99	509	10.8	5,837.7	5,837.7	5,838.2	0.5
T	19,604	72	540	10.2	5,841.4	5,841.4	5,841.6	0.2
U	19,918	113	716	7.7	5,845.3	5,845.3	5,845.3	0.0
V	20,104	148	803	5.1	5,851.2	5,851.2	5,851.2	0.0
W	20,571	128	423	9.8	5,854.0	5,854.0	5,854.1	0.1
X	20,972	103	437	9.5	5,859.0	5,859.0	5,859.0	0.0
Y	21,036	112	575	7.2	5,860.3	5,860.3	5,860.3	0.0

Area Revised

<sup>1</sup> Feet Above Mouth

<sup>2</sup> Encroachment Limited to Channel Banks; Elevation Increase May Be Less Than 1.0 Foot

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO  
AND INCORPORATED AREAS

FLOODWAY DATA

HAPPY CANYON CREEK



## UDFCD DLDMC Submittal - BFE Comparison Table

<b>Project Name :</b>	115360-01 Compark/Belford Avenue
<b>Flooding Source:</b>	Happy Canyon Creek
<b>Company:</b>	Felsburg Holt & Ullevig
<b>Completed By:</b>	ZJG

SOURCE DATA											COMPARISONS				
HYDRAULIC CROSS-SECTION INFO.						BASE FLOOD ELEVATIONS (NAVD)									
Effective Cross-Section ID (Letter)	Corrected Effective Cross-Section ID	Corrected Effective Stream Station	Existing Cross-Section ID	Proposed Cross-Section ID	Proposed Stream Station	EFFECTIVE	DUP. EFF.	COR. EFF.	EXISTING	PROPOSED	DUP. EFF vs. EFF.	COR. EFF. vs. EFF.	EX. vs. COR. EFF.	PP. vs. COR. EFF.	PP. vs. EFF.
						BFE	BFE	BFE	BFE	BFE	BFE	BFE	BFE	BFE	BFE
9920 (E)	10111	10111	10111	10111	10111	5766.3	5766.3	5766.3	5766.3	5766.3	0.0	0.0	0.0	0.0	0.0
-	10157	10157	10157	10157	10157	-	-	5766.7	5766.7	5766.7	-	-	0.0	0.0	-
-	10326	10326	10326	10326	10326	-	-	5767.4	5767.4	5767.4	-	-	0.0	0.0	-
-	10548	10548	10548	10548	10548	-	-	5769.0	5769.0	5769.0	-	-	0.0	0.0	-
-	10595	10597	10595	10595	10597	-	-	5770.1	5770.1	5770.2	-	-	0.0	0.0	-
-	10679	10691	10679	10679	10691	-	-	5771.2	5771.2	5771.2	-	-	0.0	0.0	-
-	10725	10735	10725	10725	10735	-	-	5772.8	5772.8	5773.1	-	-	0.0	0.3	-
-	-	-	-	10750	10764	-	-	-	-	5773.4	-	-	-	-	-
-	10775	10786	10775	-	-	-	-	5773.3	5773.3	-	-	-	0.0	-	-
-	-	-	-	10810	10823	-	-	-	-	5773.5	-	-	-	-	-
-	-	-	-	10819	10833	-	-	-	-	5773.6	-	-	-	-	-
-	-	-	-	10825	10838	-	-	-	-	5773.6	-	-	-	-	-
-	10842	10856	10842	-	-	-	-	5773.0	5773.0	-	-	-	0.0	-	-
-	10900	10922	10900	10900	10915	-	-	5773.3	5773.3	5773.5	-	-	0.0	0.2	-
-	10974	10995	10974	10974	10989	-	-	5773.0	5773.0	5773.4	-	-	0.0	0.4	-
-	11100	11050	11100	11100	11043	-	-	5772.9	5772.9	5773.6	-	-	0.0	0.6	-
-	11153	11187	11153	-	-	-	-	5774.0	5774.0	-	-	-	0.0	-	-
-	11180	11230	11180	11180	11215	-	-	5773.8	5773.8	5774.4	-	-	0.0	0.7	-
-	11280	11321	11280	11280	11312	-	-	5774.9	5774.9	5774.5	-	-	0.0	-0.3	-
-	11370	11424	11370	11370	11411	-	-	5775.3	5775.3	5774.9	-	-	0.0	-0.4	-
-	11385	11440	11385	11385	11426	-	-	5775.4	5775.4	5775.0	-	-	0.0	-0.5	-
-	11400	11458	11400	11400	11441	-	-	5775.6	5775.6	5775.2	-	-	0.0	-0.4	-
-	11410	11465	11410	11410	11447	-	-	5775.6	5775.6	5775.2	-	-	0.0	-0.4	-
11100 (F)	11494	11544	11494	11494	11526	5776.7	5776.7	5777.2	5777.2	5776.0	0.0	0.4	0.0	-1.1	-0.7
-	11620	11680	11620	11620	11662	-	-	5778.1	5778.1	5777.8	-	-	0.0	-0.3	-
-	11772	11836	11772	-	-	-	-	5778.2	5778.2	-	-	-	0.0	-	-
-	-	-	-	11800	11979	-	-	-	-	5777.9	-	-	-	-	-
-	-	-	-	11830	-	-	-	-	-	5778.2	-	-	-	-	-
-	-	-	-	11835	12011	-	-	-	-	5778.2	-	-	-	-	-
-	11959	12030	11959	11959	-	-	-	5779.9	5779.9	5779.9	-	-	0.0	-	-
-	12129	12213	12129	12129	12194	-	-	5781.6	5781.6	5781.6	-	-	0.0	0.0	-
-	12388	12478	12388	12388	12460	-	-	5781.6	5781.6	5781.7	-	-	0.0	0.1	-
12694 (G)	12541	12631	12541	12541	12613	5784.8	5784.8	5784.3	5784.3	5784.3	0.0	-0.5	0.0	-0.1	-0.5

-- = Not applicable or no direct comparison available  
 Information taken from Effective FIS and FIRM. Flows used were 100-yr from FIS (Q=5560 cfs @ E-470)



# UDFCD LOMC AGREEMENT TABLE

<b>PROJECT NAME:</b>	115360-01 Compark/Belford Avenue
<b>COMPANY:</b>	Felsburg Holt & Ullevig
<b>COMPLETED BY:</b>	ZJG

Community(ies): Town of Parker & Douglas County, CO  
 Flooding Source(s): Happy Canyon Creek

Page: 1 of 1  
 Date: 4/19/2019

Reference Location	Stream Station	Cross Section #	Channel Distance (ft)			Cumulative Channel Distance (ft)			Base Floodplain Width (ft)			Floodway Width (ft)			Comments
			Model	Map	% Difference	Model	Map	% Difference	Model	Map	Difference (ft)	Model	Map	Difference (ft)	
		10111	0	0	#DIV/0!	0	0	#DIV/0!	411	400	11	411	400	11	*
		10157	45	45	0%	45	45	0%	199	197	2	199	197	2	*
D/S XS - E-470 Bridge		10326	169	169	0%	214	214	0%	89	88	1	89	88	1	*
U/S XS - E-470 Bridge		10548	223	223	0%	437	437	0%	107	107	1	107	107	1	*
		10595	46	48	4%	484	486	0%	100	100	0	100	100	0	*
		10679	94	94	0%	578	580	0%	96	97	1	96	97	1	*
		10725	43	44	2%	620	623	1%	138	138	0	138	138	0	*
D/S XS - E-470 Trail Crossing		10750	29	29	0%	650	653	1%	188	190	2	188	190	2	*
U/S XS - E-470 Trail Crossing		10810	59	59	0%	708	711	0%	239	237	2	239	237	2	*
		10819	9	9	5%	717	721	1%	247	244	4	247	244	4	*
		10825	6	6	4%	723	727	0%	242	238	4	242	238	4	*
		10900	77	76	1%	800	803	0%	196	199	3	196	199	3	*
		10974	74	74	0%	874	877	0%	161	161	0	161	161	0	*
D/S XS - Belford Avenue		11100	54	54	0%	928	931	0%	154	154	0	154	154	0	*
U/S XS - Belford Avenue		11180	168	169	0%	1097	1100	0%	165	160	5	165	160	5	*
		11280	87	86	1%	1183	1186	0%	161	167	5	161	167	5	*
		11370	66	66	0%	1249	1252	0%	153	151	2	153	151	2	*
		11385	15	15	0%	1264	1267	0%	141	141	1	141	141	1	*
		11400	15	15	0%	1279	1282	0%	143	142	1	143	142	1	*
		11410	6	6	0%	1285	1288	0%	141	141	0	141	141	0	*
		11494	128	129	0%	1414	1416	0%	117	117	0	117	117	0	*
		11620	136	136	0%	1550	1552	0%	203	204	1	203	204	1	*
		11800	179	179	0%	1729	1732	0%	187	187	0	187	187	0	*
		11830	30	32	5%	1759	1763	0%	191	190	0	191	190	0	*
		11835	6	6	0%	1765	1769	0%	190	191	0	190	191	0	*
		11959	130	130	0%	1895	1899	0%	192	194	2	192	194	2	*
		12129	182	182	0%	2077	2082	0%	290	276	14	290	276	14	*
		12388	259	266	3%	2336	2347	0%	283	271	13	283	271	13	*
		12541	153	153	0%	2489	2500	0%	403	422	19	403	422	19	*
<b>ACCEPTABLE TOLERANCES =</b>			+/- 5% of Model			+/- 5% of Model			+/- 25 Feet						

\* - Floodway = Floodplain

## **APPENDIX H. PHOTOGRAPHS**



**Photo #1.**

Looking north towards the E-470 crossing.  
Photo taken from existing Cherokee Trail looking downstream.



**Photo #2.**

Photo taken from existing Cherokee Trail looking upstream to the south.



**Photo #3.**

Looking upstream towards the south. Photo taken from center of channel with Grandview Estates in the background. This location is approximately 500 feet upstream of the proposed Belford Avenue bridge crossing.



**Photo #4.**

Looking downstream to the north. Photo taken from center of channel with E-470 in the background. This photo was taken from the same location as Photo #3.



# Federal Emergency Management Agency

Washington, D.C. 20472

November 20, 2019

CERTIFIED MAIL  
RETURN RECEIPT REQUESTED

The Honorable Mike Waid  
Mayor, Town of Parker  
20120 East Main Street  
Parker, CO 80138

IN REPLY REFER TO:

Case No.: 19-08-0690R  
Community Name: Town of Parker, CO  
Community No.: 080310

104

Dear Mayor Waid:

We are providing our comments with the enclosed Conditional Letter of Map Revision (CLOMR) on a proposed project within your community that, if constructed as proposed, could revise the effective Flood Insurance Study (FIS) report and Flood Insurance Rate Map for your community.

If you have any questions regarding the floodplain management regulations for your community, the National Flood Insurance Program (NFIP) in general, or technical questions regarding this CLOMR, please contact the Director, Mitigation Division of the Federal Emergency Management Agency (FEMA) Regional Office in Denver, at (303) 235-4830, or the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP). Additional information about the NFIP is available on our website at <https://www.fema.gov/national-flood-insurance-program>.

Sincerely,

Patrick "Rick" F. Sacbibit, P.E., Branch Chief  
Engineering Services Branch  
Federal Insurance and Mitigation Administration

Enclosure:

Conditional Letter of Map Revision Comment Document

cc: Mr. Tom Williams, P.E.  
Director of Public Works/ Engineering  
Town of Parker

Ms. Terri Fead, P.E.  
Project Manager  
Mile High Flood District

Mr. Kevin Houck, P.E., CFM  
Chief, Watershed and Flood Protection Section  
Colorado Water Conservation Board

Ms. Kendra Gabbert, P.E.  
Felsburg Holt & Ullevig

Ms. Amie Drucker, P.E.  
Project Manager  
Manhard Consulting

Mr. Zachary Grady  
Felsburg Holt & Ullevig



**DEPARTMENT OF THE ARMY**  
CORPS OF ENGINEERS, OMAHA DISTRICT  
DENVER REGULATORY OFFICE, 9307 SOUTH WADSWORTH BOULEVARD  
LITTLETON, COLORADO 80128-6901

November 13, 2017

**SUBJECT:** Nationwide Permit Verification – Corps File No. NWO-2017-01897-DEN,  
Compark South Project, Douglas County, Colorado

Michael Vickers  
Belford South Metropolitan District  
8390 East Crescent Parkway, Suite 500  
Greenwood Village, CO 80111

Dear Mr. Vickers:

This letter is in reference to the proposed project located at approximately 39.553041°N, -104.821996°W, in Douglas County, Colorado. The work as described in your submittal will consist of constructing a road bridge crossing over Happy Canyon Creek, replacing an existing pedestrian bridge over Happy Canyon Creek, and installing three buried channel stabilization structures in Happy Canyon Creek, all in direct support of a residential development. This project will cause temporary impacts to 0.486 acre of Happy Canyon Creek and to 0.1657 acre of adjacent wetlands, and will cause permanent impacts to 0.049 acre of Happy Canyon Creek.

Based on the information provided, this office has determined that the work is authorized by the **Department of the Army Nationwide Permit (NWP) 29, Residential Developments**, found in the January 6, 2017, Federal Register. Enclosed is a fact sheet, which fully describes this Nationwide Permit and lists the General Conditions, and Colorado Regional Conditions, which must be adhered to for this authorization to remain valid. In addition, the following Special Conditions must be followed:

1. In order for this Nationwide Permit verification to be valid, 0.1657 acre of wetland shall be restored where impacted.
2. The created wetlands will be considered successful and self-sustaining when the following conditions have been met without intervention in the form of irrigation, removal of undesirable vegetation or replanting of desirable vegetation for a period of two consecutive years, as determined by the Corps of Engineers:
  - a) At least 80 % (determined by ocular estimate of herbaceous and shrub foliar cover) of the mitigation site is vegetated, with at least 50% of the total number of dominant species present will consist of species rated as facultative or wetter.
  - b) Those species shown on the Colorado Noxious Weed Inventory list-A shall be 100% eradicated. Those species shown on list-B shall be no more than 5% or less of the total cover in the mitigation area. The lists can be found at [http://www.colorado.gov/cs/Satellite/ag\\_Conservation/CBON/1251618874438](http://www.colorado.gov/cs/Satellite/ag_Conservation/CBON/1251618874438)
3. A mitigation monitoring report documenting growing season conditions shall be sent to the Denver Regulatory Office prior to December 31st of each year, for a period of at least three years, or until the Corps of Engineers determines that the 0.1657 acre of wetlands has successfully developed.

4. Annual reports shall be formatted per the attached Annual Mitigation Monitoring Report Formatting Requirements. If the authorized work has not yet started, please state so in the annual mitigation monitoring report.

Although an Individual Department of the Army permit will not be required for this work, this does not eliminate the requirement that any other applicable federal, state, tribal or local permits be obtained as required. Please be advised that deviations from the original plans and specifications of this project could require additional authorization from this office.

The applicant is responsible for all work accomplished in accordance with the terms and conditions of the nationwide permit. If a contractor or other authorized representative will be accomplishing the work authorized by the nationwide permit on behalf of the applicant, it is strongly recommended that they be provided a copy of this letter and the enclosed conditions so that they are aware of the limitations of the applicable nationwide permit. Any activity which fails to comply with all the terms and conditions of the nationwide permit will be considered unauthorized and subject to appropriate enforcement action.

**This verification will be valid until March 18, 2022. In compliance with General Condition 30, the enclosed "Certification of Completed Work" form (blue) must be signed and returned to this office upon completion of the authorized work and any required mitigation.**

If there are any questions please feel free to contact Angelle Greer at (303) 979-4120 or by e-mail at [Angelle.V.Greer@usace.army.mil](mailto:Angelle.V.Greer@usace.army.mil), and reference **Corps File No. NWO-2017-01897-DEN**.

Sincerely,



Aaron Eilers  
Chief, Denver Regulatory Office

Enclosure(s)

Nationwide Permit 29, Residential Developments  
Certification of Completed Work  
Annual Mitigation Monitoring Report Format Requirements

Copies Furnished:

Esa Crumb, ERO Resources Corporation, 1842 Clarkson Street, Denver, CO/80218



Public Works - Stormwater Division  
 20120 E. Mainstreet  
 Parker, Colorado 80138  
 303.840.9546

PERMIT #: \_\_\_\_\_

DATE: 03.15.2021

## FLOODPLAIN DEVELOPMENT PERMIT APPLICATION

### Applicant Information

Owner: Larry Jacobson	Contractor: TBD
Address: 8390 E. Crescent Parkway, Suite 300	Address: TBD
c/o CliftonLarsonAllen LLP Greenwood Village, CO 80111	TBD
Phone: N/A	Phone: TBD
Contact Name: Rick Moore, Manhard Consulting LTD	Contact Name: TBD
Contact Phone and Email: 303.531.3500 rmoore@manhard.com	Contact Phone and Email: TBD

### Project Information

Project Location/Directions: Located at Happy Canyon Creek south of E-470 and west of Chambers Road
<input checked="" type="checkbox"/> Bridge/Culvert <input type="checkbox"/> Utility Line <input type="checkbox"/> Substantial Improvement >50% <input type="checkbox"/> New Structure <input type="checkbox"/> Structure Addition <input type="checkbox"/> Manufactured (Mobile) Home <input checked="" type="checkbox"/> Non-Residential <input checked="" type="checkbox"/> Grading/Fill <input checked="" type="checkbox"/> Channelization <input type="checkbox"/> Levee <input checked="" type="checkbox"/> Trail Construction <input checked="" type="checkbox"/> Drainage Infrastructure Improvement
Project Description: New bridge for Belford Ave. over Happy Canyon Creek, trail improvements and channel grade control structures.

### Flood Hazard Data

Watercourse Name: Happy Canyon Creek	
The proposed project is in the:	<input checked="" type="checkbox"/> Floodway <input checked="" type="checkbox"/> Floodway Fringe
Flood Zone:	<input type="checkbox"/> A <input checked="" type="checkbox"/> AE <input checked="" type="checkbox"/> X (Shaded) <input type="checkbox"/> Other (Specify) _____
Base Flood (1% Annual Chance Flood) Elevation at project site: 5576	
Flood Insurance Rate Map Number: 08035C0062H & 08035C0066H	Effective: September 9, 2020
*Attach a copy of FIRM with approximate limits of proposed project shown	
Elevation required for lowest floor: N/A	Floodproofing: N/A

**Proposal Review Checklist**

<input type="checkbox"/> Yes/ <input type="checkbox"/> No	Site development plans are complete/attached and depict flood hazard data
If "No", Explain:	
<input type="checkbox"/> Yes/ <input type="checkbox"/> No	Engineering data and analysis is attached (Signed/Sealed by a Professional Engineer)
If "No", Explain:	
Yes/ <input type="checkbox"/> No	Floodway Certificate and data documents no increase in base flood elevation
If "No", Explain: N/A - Approved CLOMR from FEMA attached	
<input type="checkbox"/> Yes/ <input type="checkbox"/> No	Subdivision proposals minimize flood damage and protect utilities
If "No", Explain:	
Yes/ <input type="checkbox"/> No	Lowest floor elevations are two feet above the base (1% Annual Chance) flood level
If "No", Explain: N/A	
Yes/ <input type="checkbox"/> No	Manufactured homes address elevation and anchoring requirements
If "No", Explain: N/A	
<input type="checkbox"/> Yes/ <input type="checkbox"/> No	Floodproofing certification by a registered Professional Engineer or Architect
If "No", Explain:	

**Structure Information**

See Attached	Elevation in relation to mean sea level of lowest floor (including basement)*
See Attached	Elevation in relation to mean sea level to which structure has been floodproofed*
*If more than one structure, attach list with respective elevations	

**Applicant Signature**

Property Owner Name: _____	Title: _____
Property Owner Signature (Required): _____	Date: _____
Owner's Designated Agent: Name: _____	Company: _____
Owner's Designated Agent Signature: _____	Date: _____
<i>*Note: Applicant is responsible for obtaining all other applicable federal, state and local permits</i>	

**Permit Action**

Recommendation for approval	
Designated Town Authority: _____ Date: _____	
	<b>Permit Approved:</b> The information submitted for the proposed project was reviewed and is in compliance with Town floodplain regulations.
	<b>Permit Denied:</b> The proposed project does not meet Town floodplain regulations
	<b>Variance Granted:</b> A variance was granted from the base (1% Annual Chance) flood elevations established by FEMA consistent with variance requirements fo NFIP regulations Part 60.6 (variance action documentation is attached)
Floodplain Administrator's Signature: _____ Date: _____	
Comments: _____	





# Federal Emergency Management Agency

Washington, D.C. 20472

November 20, 2019

CERTIFIED MAIL  
RETURN RECEIPT REQUESTED

The Honorable Mike Waid  
Mayor, Town of Parker  
20120 East Main Street  
Parker, CO 80138

IN REPLY REFER TO:

Case No.: 19-08-0690R  
Community Name: Town of Parker, CO  
Community No.: 080310

104

Dear Mayor Waid:

We are providing our comments with the enclosed Conditional Letter of Map Revision (CLOMR) on a proposed project within your community that, if constructed as proposed, could revise the effective Flood Insurance Study (FIS) report and Flood Insurance Rate Map for your community.

If you have any questions regarding the floodplain management regulations for your community, the National Flood Insurance Program (NFIP) in general, or technical questions regarding this CLOMR, please contact the Director, Mitigation Division of the Federal Emergency Management Agency (FEMA) Regional Office in Denver, at (303) 235-4830, or the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP). Additional information about the NFIP is available on our website at <https://www.fema.gov/national-flood-insurance-program>.

Sincerely,

Patrick "Rick" F. Sacbibit, P.E., Branch Chief  
Engineering Services Branch  
Federal Insurance and Mitigation Administration

Enclosure:

Conditional Letter of Map Revision Comment Document

cc: Mr. Tom Williams, P.E.  
Director of Public Works/ Engineering  
Town of Parker

Ms. Terri Fead, P.E.  
Project Manager  
Mile High Flood District

Mr. Kevin Houck, P.E., CFM  
Chief, Watershed and Flood Protection Section  
Colorado Water Conservation Board

Ms. Kendra Gabbert, P.E.  
Felsburg Holt & Ullevig

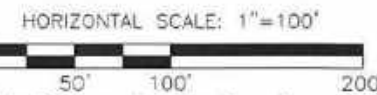
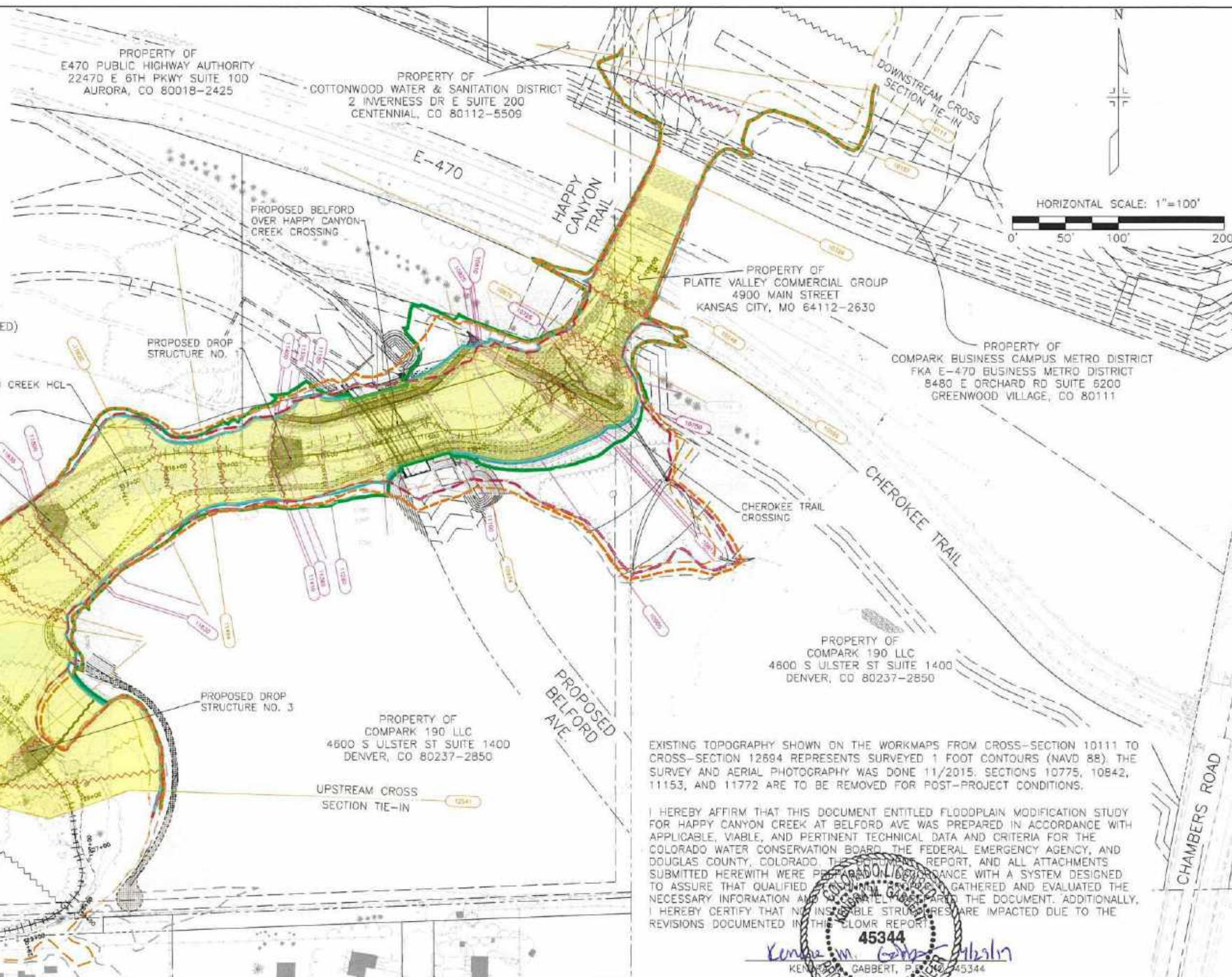
Ms. Amie Drucker, P.E.  
Project Manager  
Manhard Consulting

Mr. Zachary Grady  
Felsburg Holt & Ullevig



**LEGEND**

- FHAD FLOODWAY LIMITS
- 100 YR FHAD FLOODPLAIN LIMITS
- 100 YR PRE-PROJECT FLOODPLAIN LIMITS
- PRE-PROJECT FLOODWAY LIMITS
- 100 YR POST-PROJECT FLOODPLAIN LIMITS
- POST-PROJECT FLOODWAY LIMITS
- 500 YR FHAD FLOODPLAIN LIMITS
- 500 YR PRE-PROJECT FLOODPLAIN LIMITS
- 500 YR POST-PROJECT FLOODPLAIN LIMITS
- 100 YR FHAD BFE
- 100 YR POST-PROJECT BFE
- 2014 FHAD CROSS-SECTION
- FHU ADDED CROSS-SECTION
- 2014 FHAD CROSS-SECTION (TO BE REMOVED)
- EXISTING ROW
- EXISTING EASEMENT
- SURVEYED 1 FT CONTOURS
- WETLANDS



EXISTING TOPOGRAPHY SHOWN ON THE WORKMAPS FROM CROSS-SECTION 10111 TO CROSS-SECTION 12694 REPRESENTS SURVEYED 1 FOOT CONTOURS (NAVD 88). THE SURVEY AND AERIAL PHOTOGRAPHY WAS DONE 11/2015. SECTIONS 10775, 10842, 11153, AND 11772 ARE TO BE REMOVED FOR POST-PROJECT CONDITIONS.

I HEREBY AFFIRM THAT THIS DOCUMENT ENTITLED FLOODPLAIN MODIFICATION STUDY FOR HAPPY CANYON CREEK AT BELFORD AVE WAS PREPARED IN ACCORDANCE WITH APPLICABLE, VIABLE, AND PERTINENT TECHNICAL DATA AND CRITERIA FOR THE COLORADO WATER CONSERVATION BOARD, THE FEDERAL EMERGENCY AGENCY, AND DOUGLAS COUNTY, COLORADO. THE DOCUMENT REPORT, AND ALL ATTACHMENTS SUBMITTED HERewith WERE PREPARED IN CONFORMANCE WITH A SYSTEM DESIGNED TO ASSURE THAT QUALIFIED PERSONNEL GATHERED AND EVALUATED THE NECESSARY INFORMATION AND MATERIALS TO PREPARE THE DOCUMENT. ADDITIONALLY, I HEREBY CERTIFY THAT NO INSURANCE STRUCTURES ARE IMPACTED DUE TO THE REVISIONS DOCUMENTED IN THE FLOMR REPORT.

*Kenneth M. Gabbert*  
**45344**  
 KENNETH M. GABBERT, P.E. 45344

I:\115360-01\Compark et Belford\CADD\Hydraulics\Drawings\Zach.Grabdy

Print Date: 4/19/2019 9:21:25 AM  
 File Name: H115360-01FP-01 (FHAD).dwg  
 Horizontal Scale: Vertical Scale:  
  
 6300 South Syracuse Way, Suite 600  
 Centennial, CO 80111  
 tel 303.721.1440  
 fax 303.721.0832

Sheet Revisions		
Date	Comments	Initials

  
**Manhard CONSULTING LTD**  
8008 E. Arapahoe Court, Suite 110, Denver, CO 80112 | tel 303.738.0500 | fax 303.738.0500 | manhard.com  
Civil Engineers • Surveyors • Water Resource Engineers • Water & Wastewater Engineers  
 Construction Managers • Environmental Scientists • Landscape Architects • Planners

As Constructed  
 No Revisions:  
 Revised:  
 Void:

BELFORD AVE HAPPY CANYON CREEK FLOODPLAIN WORK MAP  
 Designer: CDT  
 Detailer: ZJG  
 Subset:  
 Structure Numbers  
 Sheets: 1 of 1

Project No./Code  
 Sheet Number