Department of Energy
Office of Legacy Management

August 21, 2008

Mr. Carl Spreng
Rocky Flats Cleanup Agreement Project Coordinator
Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, CO 80246-1530

SUBJECT: Original Landfill Seep #7 Drain Extension Design Dated August 12, 2008, and Tetra Tech Hydrologic Analysis Calculation Memorandum for Diversion Berms Dated August 19, 2008

Dear Mr. Spreng:

This correspondence is to transmit the enclosed subject drain extension design drawings and hydrologic analysis memorandum for Colorado Department of Public Health and Environment review and approval. Per your request, we are forwarding a copy of this letter and the enclosures to Vera Moritz, U.S. Environmental Protection Agency, Region 8.

The hydrologic analysis memorandum includes the berm profile drawings showing where each berm height will be raised to conform to the 1,000-year minimum height.

The Original Landfill Monitoring and Maintenance Plan modification we are preparing for submittal will include reference to the design drawing and the analysis, as approved. We are planning to start construction of the drain extension and addition of soil to raise the berm heights in early September 2008.

If you have any questions regarding the information in this correspondence or the enclosures, please contact me at (720) 377-9682 or Rick DiSalvo at (720) 377-9674.

Sincerely,

Scott R. Surovchak
LM Site Manager

RJD/abm

Enclosures

cc:
Vera Moritz, EPA
Rick DiSalvo, Stoller
Linda Kaiser, Stoller
Post Closure AR
rc-rocky.flats

TETRA TECH

4900 Pearl East Circle
Suite 300W
Tel 303.447.1823 Fax 300.447.1836
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Calculation Cover Sheet

Calc. No.: 1 **Discipline:** **No. of Sheets:** 139
Doc No.: **Hydrologic/Hydraulic Analyses**

Location: Rocky Flats

Project: 114-181750.107.1

Site: Original Landfill

Feature: Diversion Berms

Sources of Data:

Topographic Survey: Flatirons, Inc. – April 30 – May 14, 2007

Topographic Survey: Flatirons, Inc. – June 25-27, 2008

Appendix D – Landfill Engineering - Final Design Surface Water Management System Assessment of the OLF Final Design Analysis and Design Calculations Report – Kaiser Hill Company. May 2005

Sources of Formulae and References:

Hydrologic Analysis and Design by Richard H. McCuen. 1989. (Ref A)

HEC-RAS (River Analysis System) Version 4.0 Beta. Developed by the U.S. Army Corps of Engineers Hydrologic Engineering Center. www.hec.usace.army.mil

Preliminary Calc. ☐ **Final Calc.** ☒ **Supersedes Calc. No.**

Author:		8/19/08	**Checked by:**		8/19/08
	Name	**Date**		**Name**	**Date**
Approved by:		8/19/08		**Name**	**Date**
	Name	**Date**		**Name**	**Date**
				Name	**Date**

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Problem Statement:

This calculation memorandum addresses the minimum berm height requirements for the Original Landfill surface water control structures (diversion berms) that are required to convey the run-on to and run-off from the landfill footprint.

The Original Landfill (OLF) is located south of the former RFETS Buildings 440 and 460, along the north hillside of a ravine in the Woman Creek drainage area, extending from approximate elevation 6,040 feet at the top to elevation 5,950 feet at its base. Waste operations began in the early 1950s and continued through 1968. The OLF site footprint has a maximum length along the east-west direction of approximately 1,700 feet, and approximately 500 feet in the north-south direction, with an approximate area of 20 acres. Construction activities at the OLF were conducted in 2005 and included regrading, placement of a two-foot final cover and construction of the diversion berms.

Seven diversion berms were constructed with three of the berms conveying flow westward to the west perimeter channel while the remaining four berms convey flow eastward to the east perimeter channel. The perimeter channels ultimately convey run-on and run-off to Woman Creek. The *Landfill Monitoring and Maintenance Plan, RFETS Original Landfill* document states the following in section 3.4.2:

> "Areas of soil deposition that hinder the flow of surface water in a storm water channel will be removed to maintain the designed channel configuration of at least 2% grade and flow capacity as well as a berm height of 2 feet."

However, despite the two-foot parameter specified in the M&M Plan for the OLF, *Appendix D – Landfill Engineering - Final Design Surface Water Management System Assessment of the OLF Final Design Analysis and Design Calculations Report* specifies the following as a portion of the design criteria:

> "Collect and control surface water run-off from the landfill as a result of the 100-year, 24-hour storm event with freeboard capacity to handle the 1000-year, 24-hour storm event."

A survey of the OLF was conducted by Flatirons, Inc. between April 30, 2007 and May 14, 2007 to determine the channel heights and flow line slopes of the diversion berms. This 2007 survey data was used in this technical memorandum. The table below summarizes the berm height results of the survey.

BERM HEIGHT UNDER PARAMETER[3]

		2.0 FT. DESIGN	**1000-YR, 24-HR STORM EVENT**	
		< 2.0 FT	**FLOW DEPTH, FT**	**< 1000-YR**
WEST	BERM NO. 1	64%	1.60	25%
	BERM NO. 2	81%	1.75	58%
	BERM NO. 3	56%	1.64	28%
EAST	BERM NO. 4	69%	1.79	48%
	BERM NO. 5	86%	1.79	63%
	BERM NO. 6	82%	1.79	49%
	BERM NO. 7	62%	1.79	33%
	TOTAL	**73%**		**45%**

The 1,000-year, 24-hour storm event flow depths in the table above were obtained from Table D-3 of Appendix D of the OLF Final Design Analysis and Design Calculations Report.

In order to reduce the amount of construction required to raise approximately 45 percent of the total diversion berm length, site personnel proposed re-analyzing the diversion berms by using Flatirons, Inc.'s June 25-27, 2008 topographic survey data as well as sub-dividing the individual diversion berm drainage areas. Theoretically, the required berm height for the upstream portions would be shorter than the downstream portions thus reducing the cost of corrective construction activities. Original calculations by Kaiser Hill in 2005 estimated the peak flow for the diversion berm outlet and used this peak flow to determine the required berm height for the entire length of the individual diversion berm. This is common engineering practice. These analyses essentially duplicated the Kaiser Hill analyses with the exception being the use of existing topography and sub-dividing the drainage areas.

Method of Solution:

- Analyze for 1,000 yr., 24 hr. storm event.
- Analyze for 100 yr, 24 hr. storm event.
- Channel runoff shall be analyzed by creating sub-basins which will be approximately 200 feet along the diversion berm channel and extend upslope to next berm ridge.
- Use the Soil Conservation Service (SCS) to estimate peak flows for each sub-basin.
- Use HEC-RAS to estimate water surface profile for the estimated 100-year and 1,000-year peak flows.
- HEC-RAS runs to use cross-sections on 10-ft. centers from existing grades and contours.
- Check existing berm height against required berm height as estimated by HEC-RAS to meet the 1,000-yr, 24-hr storm event criteria.
- Difference between 100-yr, 24 hr. flow depth and 1,000-yr, 24-hr flow depth to be considered freeboard for the 100-yr. event.
- Identify berms which have heights too low to convey the estimated peak flow of the 1,000-yr storm event.

Assumptions:

Assumptions are referenced at the bottom of Table 1. Several assumptions utilize assumptions/results obtained from *Appendix D – Landfill Engineering - Final Design Surface Water Management System Assessment of the OLF Final Design Analysis and Design Calculations Report* such as the channel velocity in estimating the time of concentration and the class B retardant class for manning's coefficient.

Calculation:

Results of calculations are shown on the following tables, drawings and references.

Discussion and Conclusions/Recommendations:

The table below (also Table 25 of this calculation memorandum) summarizes the maximum flow depths of the various diversion berm sub-areas. The maximum flow depth as estimated through the HEC-RAS model analyses is equivalent to the minimum berm height requirement for the specified sub-basin.

BERM HEIGHT SUMMARY
ROCKY FLATS - ORIGINAL LANDFILL

Area ID		Maximum Flow Depth, ft	
		100-YR	1,000-YR
DB-1	A	1.37	1.48
	B	1.56	1.68
	C	1.35	1.46
DB-2	A	1.55	1.66
	B	1.58	1.69
	C	1.47	1.57
DB-3	A	1.51	1.62
	B	1.23	1.34
DB-4	A	1.24	1.33
	B	1.42	1.52
	C	1.20	1.29
	D	0.97	1.06
	E	1.00	1.06
DB-5	A	1.68	1.80
	B	1.56	1.67
	C	1.39	1.51
	D	1.28	1.39
	E	1.44	1.52
DB-6	A	1.87	2.01
	B	1.84	1.97
	C	1.44	1.55
	D	1.24	1.33
	E	1.14	1.21
DB-7	A	1.76	1.90
	B	1.56	1.67
	C	1.64	1.74
	D	1.36	1.47
	E	1.14	1.23

The table below (also Table 24 of this calculation memorandum) displays an overall summary of the berm sections not meeting the 1,000-year parameter.

BERM HEIGHT UNDER PARAMETER
ROCKY FLATS - ORIGINAL LANDFILL

		2.0 FT. DESIGN[2]	APPENDIX D[2]	EXISTING COND.[3]	
		< 2.0 FT	< 1000-YR	< 1000-YR	# of Sections[4]
WEST	BERM NO. 1	64%	25%	20.7%	1
	BERM NO. 2	81%	58%	57.5%	4
	BERM NO. 3	56%	28%	30.0%	2
EAST	BERM NO. 4	69%	48%	14.2%	3
	BERM NO. 5	86%	63%	16.0%	4
	BERM NO. 6	82%	49%	28.0%	5
	BERM NO. 7	62%	33%	15.4%	4
	TOTAL	**73%**	**45%**	**23.7%**	

Note:
1. Figures 2 – 8D show the sections of existing diversion berm which are lower than the estimated channel depth. The lengths were measured and shown above.
2. Percentages are based on the 2007 topographic survey by Flatirons, Inc.
3. Percentages are based on the 2008 topographic survey by Flatirons, Inc.
4. Number of different portions along the berm length that require additional berm height.

As shown, by dividing the drainage areas, the percentage of berm sections requiring construction to add channel height has been reduced from approximately 45 percent to 24 percent. The western diversion berms virtually remained unchanged as far as percentage but there was significant reduction in the eastern diversion berm sections.

TABLE 1 - HYDROLOGY CALCULATIONS
ROCKY FLATS - ORIGINAL LANDFILL
2008 DIVERSION BERM ANALYSES

Area ID		Subarea		Cumulative Area		Overland	Channel	Time of Concentration		Unit Peak	100-YR, 24-HR STORM EVENT		1000-YR, 24-HR STORM EVENT		Appendix D	% Change App. D to Existing Cond. Analyses		Channel Depth, ft	
		SF	ACRE	ACRE	MI^2	Flow Length, ft	Length, ft	Tc, sec.	Tc, hr	Discharge, q_u	Peak Discharge, cfs	Appendix D Estimation	Peak Discharge, cfs	Appendix D Estimation	Drainage Area	Drainage Area	1000 Peak	100-YR	1,000-YR
DB-1	A	23,184	0.53	1.88	0.003	-	120	231.57	0.064	1000	10.19	8.61	14.08	11.68	1.50	125%	121%	1.37	1.48
	B	34,931	0.80	1.35	0.002	-	200	183.57	0.051	1000	7.30		10.09					1.56	1.68
	C	23,795	0.55	0.55	0.001	70	200	103.57	0.029	1000	2.96		4.09					1.35	1.46
DB-2	A	25,054	0.58	2.31	0.004	-	172	277.47	0.077	1000	12.54	13.21	17.32	17.91	2.30	101%	97%	1.55	1.66
	B	30,101	0.69	1.74	0.003	-	200	208.67	0.058	1000	9.42		13.02					1.58	1.69
	C	45,648	1.05	1.05	0.002	160	187	128.67	0.036	1000	5.68		7.84					1.47	1.57
DB-3	A	32,580	0.75	1.51	0.002	-	205	218.57	0.061	1000	8.20	9.76	11.32	13.23	2.30	66%	86%	1.51	1.62
	B	33,322	0.76	0.76	0.001	168	200	136.57	0.038	1000	4.14		5.73					1.23	1.34
DB-4	A	11,892	0.27	1.51	0.002	-	165	407.89	0.113	1000	8.18	14.36	11.31	19.46	2.50	60%	58%	1.24	1.33
	B	12,900	0.30	1.24	0.002	-	200	341.89	0.095	1000	6.70		9.26					1.42	1.52
	C	14,351	0.33	0.94	0.001	-	200	261.89	0.073	1000	5.10		7.05					1.20	1.29
	D	14,555	0.33	0.61	0.001	-	200	181.89	0.051	1000	3.31		4.58					0.97	1.06
	E	12,096	0.28	0.28	0.000	65	200	101.89	0.028	1000	1.50		2.08					1.00	1.06
DB-5	A	15,749	0.36	2.38	0.004	-	165	424.72	0.118	1000	12.90	14.36	17.82	19.46	2.50	95%	92%	1.68	1.80
	B	22,090	0.51	2.02	0.003	-	200	358.72	0.100	1000	10.94		15.12					1.56	1.67
	C	22,964	0.53	1.51	0.002	-	200	278.72	0.077	1000	8.19		11.32					1.39	1.51
	D	22,231	0.51	0.99	0.002	-	200	198.72	0.055	1000	5.34		7.38					1.28	1.39
	E	20,691	0.47	0.47	0.001	115	200	118.72	0.033	1000	2.57		3.56					1.44	1.52
DB-6	A	31,809	0.73	2.77	0.004	-	253	460.93	0.128	950	14.27	14.36	19.72	19.46	2.50	111%	101%	1.87	2.01
	B	24,020	0.55	2.04	0.003	-	200	359.73	0.100	1000	11.07		15.30					1.84	1.97
	C	24,164	0.55	1.49	0.002	-	200	279.73	0.078	1000	8.08		11.17					1.44	1.55
	D	22,556	0.52	0.94	0.001	-	200	199.73	0.055	1000	5.08		7.02					1.24	1.33
	E	18,278	0.42	0.42	0.001	118	200	119.73	0.033	1000	2.27		3.14					1.14	1.21
DB-7	A	29,912	0.69	2.72	0.004	-	188	426.26	0.118	1000	14.74	14.36	20.37	19.46	2.50	109%	105%	1.76	1.90
	B	26,149	0.60	2.03	0.003	-	200	351.06	0.098	1000	11.02		15.23					1.56	1.67
	C	21,675	0.50	1.43	0.002	-	200	271.06	0.075	1000	7.77		10.74					1.64	1.74
	D	22,274	0.51	0.94	0.001	-	200	191.06	0.053	1000	5.07		7.01					1.36	1.47
	E	18,532	0.43	0.43	0.001	116	180	111.06	0.031	1000	2.30		3.18					1.14	1.23

A = Outlet (Downstream to Up)

Source:

Overland Velocity: $V=kS^{0.5}$			See Ref A.4: Equation 3-45
Assume k for short grass pasture			
18 percent slope			
Overland Velocity:	3.0	fps	See Ref A.5 (k = 0.70)
Channel Velocity:	2.5	fps	Ref B: Average for 1,000 storm event from Appendix D
Curve #:	86		Ref B: Appendix D assumption
S:	1.628		Ref A.6: Equation 7-30
100-YR, 24-HR:	5.0	in	Ref C: NOAA Atlass II Volume III Colorado
Runoff depth, Q_{100}:	3.467	in	Ref A.6: Equation 7-32a
1000-YR, 24-HR:	6.4	in	Ref B: Appendix D Estimation
Runoff depth, Q_{1000}:	4.791	in	Ref A.6: Equation 7-32a
Ia/P:	0.1		Ref A.9 for CN = 86, P = 5.0" and 6.4"
SCS Type II storm			Ref A.10

Description:

Column A	Diversion Berm ID
Column B	Sub-Basin ID
Column C	Area, sf as determined by AutoCAD, See Figure 1A, 1B
Column D	Area conversion
Column E	Cumalative Area, acreage of sub-basin plus upstream sub-basins
Column F	Area conversion for SCS Method
Column G	Length run-off travels prior to channelization
Column H	Length of channel to outlet of sub-basin
Column I	Ref A.4: Assuming overland and channel velocities of Appendix D (Kaiser Hill)
Column J	Time conversion for SCS method
Column K	Ref A.11
Column L	Ref A.9: Equation 7-38
Column M	Ref B: Appendix D estimation
Column N	Ref A.9: Equation 7-38
Column O	Ref B: Appendix D estimation
Column P	Ref B: Appendix D estimation
Column Q	Comparison of Appendix D to Existing Condition Analyses to see correlation
Column R	Comparison of Appendix D to Existing Condition Analyses to see correlation
Column S	HEC-RAS Result - See attached Tables
Column T	HEC-RAS Result - See attached Tables

TABLE 2 - HEC-RAS RESULTS
ROCKY FLATS - ORIGINAL LANDFILL
DIVERSION BERM NO. 1: 1000-YR STORM EVENT

River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #	Channel Depth, (ft)
54	4.09	6037.59	6038.75		6038.75	0.008474	0.56	7.33	12.69	0.13	1.16
53	4.09	6037.60	6038.64		6038.65	0.012377	0.63	6.45	12.36	0.15	1.04
52	4.09	6037.50	6038.51		6038.52	0.014347	0.67	6.14	12.27	0.17	1.01
51	4.09	6037.32	6038.36		6038.36	0.016708	0.72	5.66	11.15	0.18	1.04
50	4.09	6037.16	6038.16		6038.17	0.021520	0.81	5.05	10.12	0.20	1.00
49	4.09	6036.93	6037.95		6037.96	0.021590	0.82	4.99	9.83	0.20	1.02
48	4.09	6036.68	6037.76		6037.77	0.015993	0.73	5.64	10.67	0.18	1.08
47	4.09	6036.42	6037.64		6037.65	0.009934	0.60	6.78	11.83	0.14	1.22
46	4.09	6036.22	6037.56		6037.57	0.006442	0.52	7.88	12.42	0.11	1.34
45	4.09	6036.20	6037.50		6037.50	0.007368	0.55	7.46	11.99	0.12	1.30
44	4.09	6036.22	6037.41		6037.42	0.009894	0.61	6.71	11.47	0.14	1.19
43	4.09	6036.21	6037.28		6037.29	0.017570	0.75	5.48	10.68	0.18	1.07
42	4.09	6036.05	6037.10		6037.11	0.018078	0.75	5.45	10.77	0.19	1.05
41	4.09	6035.90	6036.92		6036.93	0.017268	0.73	5.57	10.97	0.18	1.02
40	4.09	6035.79	6036.73		6036.74	0.022644	0.81	5.03	10.44	0.21	0.94
39	4.09	6035.50	6036.51		6036.52	0.020778	0.79	5.16	10.44	0.20	1.01
38	4.09	6035.30	6036.33		6036.34	0.015547	0.71	5.77	11.11	0.17	1.03
37	4.09	6035.07	6036.22		6036.23	0.008139	0.57	7.22	12.51	0.13	1.15
36	4.09	6034.86	6036.15		6036.16	0.005618	0.49	8.43	13.21	0.11	1.29
35	4.09	6034.65	6036.11		6036.11	0.003741	0.42	9.68	13.72	0.09	1.46
34	10.09	6034.44	6035.98		6036.00	0.021450	1.03	9.75	13.15	0.21	1.54
33	10.09	6034.24	6035.75		6035.77	0.026184	1.12	9.05	12.77	0.23	1.51
32	10.09	6034.03	6035.51		6035.52	0.022058	1.04	9.67	13.40	0.22	1.48
31	10.09	6033.80	6035.31		6035.32	0.018082	0.97	10.38	13.79	0.20	1.51
30	10.09	6033.61	6035.14		6035.15	0.016647	0.94	10.71	14.04	0.19	1.53
29	10.09	6033.40	6034.99		6035.00	0.013722	0.88	11.47	14.40	0.17	1.59
28	10.09	6033.19	6034.87		6034.88	0.011065	0.82	12.30	14.56	0.16	1.68
27	10.09	6033.10	6034.75		6034.76	0.012660	0.86	11.71	14.24	0.17	1.65
26	10.09	6033.04	6034.60		6034.61	0.017004	0.94	10.75	14.25	0.19	1.56
25	10.09	6032.97	6034.40		6034.42	0.022697	1.05	9.61	13.55	0.22	1.43
24	10.09	6032.80	6034.15		6034.17	0.028995	1.12	9.03	13.79	0.24	1.35
23	10.09	6032.49	6033.86		6033.88	0.027299	1.10	9.20	13.78	0.24	1.37
22	10.09	6032.20	6033.62		6033.64	0.022015	1.04	9.72	13.62	0.22	1.42
21	10.09	6031.97	6033.41		6033.43	0.020103	0.99	10.14	14.16	0.21	1.44
20	10.09	6031.74	6033.23		6033.24	0.017715	0.93	10.90	15.24	0.19	1.49
19	10.09	6031.55	6033.07		6033.09	0.013860	0.86	11.75	15.42	0.17	1.52
18	10.09	6031.45	6032.92		6032.94	0.016428	0.89	11.31	15.80	0.19	1.47
17	10.09	6031.34	6032.74		6032.75	0.020950	0.99	10.19	14.84	0.21	1.40
16	10.09	6031.17	6032.49		6032.51	0.030337	1.15	8.75	13.40	0.25	1.32
15	10.09	6030.80	6032.23		6032.25	0.022568	1.04	9.71	13.88	0.22	1.43
14	14.08	6030.45	6031.90		6031.93	0.040950	1.43	9.85	13.60	0.30	1.45
13	14.08	6029.99	6031.44		6031.48	0.049234	1.55	9.09	12.75	0.32	1.45
12	14.08	6029.45	6030.93		6030.97	0.053596	1.64	8.58	11.71	0.34	1.48
11	14.08	6028.91	6030.31		6030.36	0.070050	1.81	7.76	11.14	0.38	1.40
10	14.08	6028.32	6029.49		6029.56	0.090660	2.02	6.97	10.36	0.43	1.17
9	14.08	6027.75	6028.89		6028.93	0.045278	1.52	9.29	12.70	0.31	1.14
8	14.08	6027.20	6028.57		6028.59	0.025369	1.17	12.05	15.79	0.24	1.37
7	14.08	6027.02	6028.30		6028.32	0.027964	1.13	12.42	18.46	0.24	1.28
6	14.08	6026.80	6028.09		6028.11	0.017572	0.95	14.82	20.27	0.20	1.29
5	14.08	6026.58	6027.90		6027.91	0.022012	1.01	13.89	20.44	0.22	1.32
4	14.08	6026.47	6027.62		6027.64	0.034595	1.15	12.29	21.18	0.27	1.15
3	14.08	6026.36	6027.09		6027.13	0.082039	1.54	9.15	19.41	0.39	0.73
2	14.08	6025.19	6026.03	6025.85	6026.09	0.134960	1.83	7.68	18.20	0.50	0.84
1	14.08	6022.95	6023.39	6023.39	6023.52	0.660590	2.83	4.97	20.23	1.01	0.44

Abbreviations:
River Sta River Station
Q Total Total Discharge
Min Ch El Minimum Channel Elevation (Thalweg)
W.S. Elev Water Surface Elevation
Crit W.S. Critical Water Surface Elevation
E.G. Elev Energy Grade Elevation
E.G. Slope Energy Grade Slope
Vel Chnl Channel Velocity

TABLE 3 - HEC-RAS RESULTS
ROCKY FLATS - ORIGINAL LANDFILL
DIVERSION BERM NO. 1: 100-YR STORM EVENT

River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #	Channel Depth, (ft)
54	2.96	6037.59	6038.67		6038.67	0.008201	0.46	6.40	11.88	0.11	1.08
53	2.96	6037.60	6038.57		6038.58	0.012275	0.53	5.57	11.50	0.13	0.97
52	2.96	6037.50	6038.44		6038.44	0.014398	0.56	5.29	11.40	0.14	0.94
51	2.96	6037.32	6038.28		6038.29	0.016680	0.61	4.88	10.35	0.16	0.96
50	2.96	6037.16	6038.09		6038.10	0.021572	0.68	4.34	9.34	0.18	0.93
49	2.96	6036.93	6037.87		6037.88	0.021866	0.69	4.28	9.10	0.18	0.94
48	2.96	6036.68	6037.68		6037.69	0.016632	0.62	4.80	9.88	0.16	1.00
47	2.96	6036.42	6037.56		6037.56	0.010052	0.51	5.80	10.90	0.12	1.14
46	2.96	6036.22	6037.48		6037.48	0.006217	0.43	6.86	11.53	0.10	1.26
45	2.96	6036.20	6037.41		6037.42	0.007059	0.45	6.51	11.13	0.10	1.21
44	2.96	6036.22	6037.33		6037.34	0.009504	0.51	5.84	10.63	0.12	1.11
43	2.96	6036.21	6037.21		6037.21	0.017417	0.63	4.73	9.86	0.16	1.00
42	2.96	6036.05	6037.03		6037.03	0.017910	0.63	4.70	9.96	0.16	0.98
41	2.96	6035.90	6036.85		6036.86	0.017144	0.61	4.81	10.23	0.16	0.95
40	2.96	6035.79	6036.65		6036.66	0.023280	0.69	4.29	9.65	0.18	0.86
39	2.96	6035.50	6036.43		6036.43	0.021536	0.67	4.39	9.61	0.18	0.93
38	2.96	6035.30	6036.24		6036.24	0.016955	0.62	4.81	10.14	0.16	0.94
37	2.96	6035.07	6036.12		6036.12	0.009108	0.49	6.00	11.41	0.12	1.05
36	2.96	6034.86	6036.05		6036.05	0.006020	0.42	7.06	12.03	0.10	1.19
35	2.96	6034.65	6036.00		6036.00	0.003896	0.36	8.22	12.67	0.08	1.35
34	7.30	6034.44	6035.88		6035.89	0.021516	0.87	8.38	12.15	0.18	1.44
33	7.30	6034.24	6035.64		6035.65	0.026270	0.94	7.75	11.71	0.20	1.40
32	7.30	6034.03	6035.40		6035.41	0.022370	0.88	8.28	12.38	0.19	1.37
31	7.30	6033.80	6035.20		6035.21	0.018395	0.82	8.90	12.82	0.17	1.40
30	7.30	6033.61	6035.02		6035.03	0.017172	0.80	9.14	13.03	0.17	1.41
29	7.30	6033.40	6034.87		6034.88	0.013809	0.74	9.85	13.34	0.15	1.47
28	7.30	6033.19	6034.75		6034.76	0.010812	0.68	10.68	13.56	0.14	1.56
27	7.30	6033.10	6034.64		6034.64	0.012389	0.72	10.16	13.26	0.14	1.54
26	7.30	6033.04	6034.49		6034.50	0.016345	0.79	9.28	13.04	0.16	1.45
25	7.30	6032.97	6034.30		6034.31	0.022695	0.88	8.28	12.58	0.19	1.33
24	7.30	6032.80	6034.04		6034.06	0.029128	0.95	7.68	12.55	0.21	1.24
23	7.30	6032.49	6033.76		6033.77	0.027210	0.93	7.84	12.52	0.21	1.27
22	7.30	6032.20	6033.52		6033.53	0.022126	0.87	8.35	12.59	0.19	1.32
21	7.30	6031.97	6033.31		6033.32	0.020394	0.84	8.68	13.09	0.18	1.34
20	7.30	6031.74	6033.12		6033.13	0.017465	0.78	9.33	13.88	0.17	1.38
19	7.30	6031.55	6032.97		6032.98	0.013486	0.72	10.19	14.35	0.15	1.42
18	7.30	6031.45	6032.82		6032.83	0.016067	0.75	9.77	14.64	0.16	1.37
17	7.30	6031.34	6032.64		6032.65	0.020646	0.83	8.82	13.79	0.18	1.30
16	7.30	6031.17	6032.39		6032.40	0.030833	0.98	7.48	12.36	0.22	1.22
15	7.30	6030.80	6032.12		6032.13	0.023295	0.88	8.26	12.77	0.19	1.32
14	10.19	6030.45	6031.79		6031.81	0.040991	1.20	8.47	12.57	0.26	1.34
13	10.19	6029.99	6031.34		6031.36	0.049701	1.31	7.79	11.75	0.28	1.35
12	10.19	6029.45	6030.82		6030.85	0.053371	1.38	7.40	10.87	0.29	1.37
11	10.19	6028.91	6030.21		6030.24	0.070851	1.53	6.66	10.32	0.34	1.30
10	10.19	6028.32	6029.40		6029.44	0.091064	1.70	6.01	9.65	0.38	1.08
9	10.19	6027.75	6028.79		6028.82	0.044621	1.26	8.09	11.99	0.27	1.04
8	10.19	6027.20	6028.47		6028.49	0.025028	0.97	10.55	15.12	0.20	1.27
7	10.19	6027.02	6028.21		6028.23	0.027859	0.95	10.76	17.30	0.21	1.19
6	10.19	6026.80	6028.00		6028.01	0.016895	0.78	13.00	19.13	0.17	1.20
5	10.19	6026.58	6027.81		6027.82	0.020834	0.83	12.23	19.25	0.18	1.23
4	10.19	6026.47	6027.54		6027.56	0.033513	0.94	10.80	20.17	0.23	1.07
3	10.19	6026.36	6027.02		6027.05	0.086502	1.29	7.87	18.67	0.35	0.66
2	10.19	6025.19	6025.99	6025.78	6026.03	0.122566	1.46	6.96	17.79	0.41	0.80
1	10.19	6022.95	6023.34	6023.34	6023.44	0.861070	2.58	3.95	18.75	0.99	0.39

Abbreviations:
River Sta River Station
Q Total Total Discharge
Min Ch El Minimum Channel Elevation (Thalweg)
W.S. Elev Water Surface Elevation
Crit W.S. Critical Water Surface Elevation
E.G. Elev Energy Grade Elevation
E.G. Slope Energy Grade Slope
Vel Chnl Channel Velocity

TABLE 4 - HEC-RAS RESULTS
ROCKY FLATS - ORIGINAL LANDFILL
DIVERSION BERM NO. 2: 1000-YR STORM EVENT

River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #	Channel Depth, (ft)
57	7.84	6018.30	6019.03		6019.10	0.143376	2.15	3.66	9.47	0.60	0.73
56	7.84	6017.48	6018.36		6018.39	0.041375	1.38	5.67	10.67	0.33	0.88
55	7.84	6017.00	6018.02		6018.04	0.030727	1.18	6.64	13.01	0.29	1.02
54	7.84	6016.58	6017.64		6017.67	0.045139	1.42	5.51	10.71	0.35	1.06
53	7.84	6016.28	6017.37		6017.39	0.018704	1.09	7.30	11.96	0.24	1.09
52	7.84	6015.99	6017.10		6017.13	0.037393	1.41	5.58	9.98	0.32	1.11
51	7.84	6015.69	6016.79		6016.81	0.027909	1.25	6.31	10.79	0.28	1.10
50	7.84	6015.40	6016.55		6016.57	0.021052	1.16	6.79	10.77	0.25	1.15
49	7.84	6015.10	6016.31		6016.34	0.025660	1.22	6.42	10.20	0.27	1.21
48	7.84	6014.80	6016.07		6016.10	0.022803	1.20	6.53	10.24	0.26	1.27
47	7.84	6014.60	6015.88		6015.90	0.017488	1.05	7.50	11.33	0.23	1.28
46	7.84	6014.34	6015.75		6015.76	0.011232	0.88	8.92	12.58	0.18	1.41
45	7.84	6014.18	6015.65		6015.66	0.008251	0.79	9.96	13.51	0.16	1.47
44	7.84	6014.07	6015.58		6015.59	0.006498	0.71	10.98	13.98	0.14	1.51
43	7.84	6013.95	6015.52		6015.53	0.005283	0.66	11.91	14.56	0.13	1.57
42	7.84	6013.94	6015.47		6015.47	0.006237	0.70	11.22	14.34	0.14	1.53
41	7.84	6013.95	6015.39		6015.40	0.008411	0.78	10.09	13.81	0.16	1.44
40	7.84	6013.97	6015.29		6015.30	0.012360	0.88	8.87	13.41	0.19	1.32
39	7.84	6013.82	6015.18		6015.19	0.009531	0.80	9.79	14.10	0.17	1.36
38	7.84	6013.67	6015.10		6015.11	0.008042	0.76	10.38	14.36	0.16	1.43
37	13.02	6013.50	6014.92		6014.95	0.025631	1.33	9.77	13.71	0.28	1.42
36	13.02	6013.20	6014.68		6014.70	0.024521	1.32	9.87	13.59	0.27	1.48
35	13.02	6012.94	6014.48		6014.50	0.016882	1.16	11.22	14.63	0.23	1.54
34	13.02	6012.72	6014.34		6014.36	0.012468	1.05	12.40	15.31	0.20	1.62
33	13.02	6012.60	6014.19		6014.21	0.017345	1.17	11.13	14.61	0.23	1.59
32	13.02	6012.49	6013.97		6014.00	0.027568	1.40	9.32	12.82	0.29	1.48
31	13.02	6012.30	6013.65		6013.69	0.034722	1.57	8.33	12.12	0.32	1.35
30	13.02	6011.90	6013.31		6013.35	0.033241	1.50	8.69	12.40	0.32	1.41
29	13.02	6011.54	6013.07		6013.09	0.019628	1.26	10.38	13.49	0.25	1.53
28	13.02	6011.31	6012.91		6012.93	0.013372	1.07	12.14	14.39	0.21	1.60
27	13.02	6011.16	6012.80		6012.82	0.009619	0.95	13.70	15.54	0.18	1.64
26	13.02	6011.03	6012.72		6012.73	0.008145	0.86	15.06	17.04	0.16	1.69
25	13.02	6010.98	6012.63		6012.64	0.009391	0.92	14.19	16.36	0.17	1.65
24	13.02	6010.90	6012.52		6012.53	0.012084	1.00	13.01	15.93	0.20	1.62
23	13.02	6010.87	6012.39		6012.41	0.012792	1.01	12.90	16.57	0.20	1.52
22	13.02	6010.80	6012.26		6012.27	0.014826	1.05	12.42	16.93	0.21	1.46
21	13.02	6010.73	6012.07		6012.09	0.023395	1.26	10.39	15.73	0.27	1.34
20	13.02	6010.50	6011.84		6011.86	0.022377	1.24	10.53	15.65	0.26	1.34
19	13.02	6010.20	6011.66		6011.68	0.015273	1.09	11.98	15.79	0.22	1.46
18	13.02	6009.90	6011.52		6011.53	0.013612	1.04	12.49	15.76	0.21	1.62
17	17.32	6009.70	6011.31		6011.34	0.025947	1.42	12.20	15.74	0.28	1.61
16	17.32	6009.50	6011.03		6011.06	0.029827	1.51	11.50	15.42	0.30	1.53
15	17.32	6009.28	6010.69		6010.73	0.037269	1.61	10.77	15.20	0.34	1.41
14	17.32	6008.90	6010.31		6010.35	0.039011	1.63	10.62	15.18	0.34	1.41
13	17.32	6008.52	6009.95		6009.98	0.033147	1.53	11.31	15.76	0.32	1.43
12	17.32	6008.19	6009.66		6009.69	0.025559	1.39	12.48	16.58	0.28	1.47
11	17.32	6007.97	6009.41		6009.44	0.026173	1.37	12.60	17.33	0.28	1.44
10	17.32	6007.75	6009.03		6009.08	0.050291	1.73	10.02	15.96	0.38	1.28
9	17.32	6007.20	6008.44		6008.50	0.067182	1.94	8.92	14.80	0.44	1.24
8	17.32	6006.55	6007.77		6007.83	0.067782	2.00	8.65	13.79	0.45	1.22
7	17.32	6005.85	6007.23		6007.28	0.045541	1.80	9.65	13.32	0.37	1.38
6	17.32	6005.30	6006.75		6006.81	0.049037	1.87	9.27	12.70	0.39	1.45
5	17.32	6004.79	6006.26		6006.31	0.048682	1.86	9.33	12.84	0.38	1.47
4	17.32	6004.30	6005.76		6005.82	0.050308	1.91	9.06	12.22	0.39	1.46
3	17.32	6003.74	6005.31		6005.36	0.042003	1.82	9.54	12.09	0.36	1.57
2	17.32	6003.27	6004.93	6004.34	6004.98	0.034656	1.69	10.26	12.54	0.33	1.66
1	17.32	6002.80	6003.86	6003.86	6004.13	0.383501	4.17	4.15	7.90	1.01	1.06

Abbreviations:

River Sta	River Station
Q Total	Total Discharge
Min Ch El	Minimum Channel Elevation (Thalweg)
W.S. Elev	Water Surface Elevation
Crit W.S.	Critical Water Surface Elevation
E.G. Elev	Energy Grade Elevation
E.G. Slope	Energy Grade Slope
Vel Chnl	Channel Velocity

TABLE 5 - HEC-RAS RESULTS
ROCKY FLATS - ORIGINAL LANDFILL
DIVERSION BERM NO. 2: 100-YR STORM EVENT

River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #	Channel Depth, (ft)
57	5.68	6018.30	6018.97		6019.02	0.152996	1.81	3.13	8.76	0.53	0.67
56	5.68	6017.48	6018.30		6018.32	0.039568	1.14	5.00	10.11	0.29	0.82
55	5.68	6017.00	6017.95		6017.96	0.031476	0.99	5.74	12.15	0.25	0.95
54	5.68	6016.58	6017.56		6017.59	0.045220	1.20	4.74	9.90	0.31	0.98
53	5.68	6016.28	6017.29		6017.31	0.018497	0.90	6.40	11.39	0.20	1.01
52	5.68	6015.99	6017.03		6017.05	0.037937	1.16	4.88	9.43	0.28	1.04
51	5.68	6015.69	6016.71		6016.73	0.027805	1.04	5.49	10.07	0.25	1.02
50	5.68	6015.40	6016.47		6016.48	0.021268	0.96	5.92	10.10	0.22	1.07
49	5.68	6015.10	6016.23		6016.25	0.024787	1.01	5.61	9.55	0.23	1.13
48	5.68	6014.80	6015.99		6016.00	0.023777	1.00	5.69	9.58	0.23	1.19
47	5.68	6014.60	6015.78		6015.79	0.017991	0.89	6.41	10.54	0.20	1.18
46	5.68	6014.34	6015.65		6015.65	0.011254	0.74	7.69	11.69	0.16	1.31
45	5.68	6014.18	6015.55		6015.56	0.008433	0.66	8.61	12.51	0.14	1.37
44	5.68	6014.07	6015.48		6015.48	0.006491	0.60	9.55	13.33	0.12	1.41
43	5.68	6013.95	6015.42		6015.42	0.005242	0.55	10.42	14.02	0.11	1.47
42	5.68	6013.94	6015.36		6015.37	0.006200	0.58	9.77	13.64	0.12	1.42
41	5.68	6013.95	6015.29		6015.30	0.008342	0.65	8.72	12.83	0.14	1.34
40	5.68	6013.97	6015.19		6015.20	0.012765	0.75	7.56	12.39	0.17	1.22
39	5.68	6013.82	6015.08		6015.09	0.009889	0.68	8.35	13.10	0.15	1.26
38	5.68	6013.67	6014.99		6015.00	0.008094	0.64	8.89	13.17	0.14	1.32
37	9.42	6013.50	6014.82		6014.84	0.025512	1.12	8.41	12.68	0.24	1.32
36	9.42	6013.20	6014.57		6014.59	0.024109	1.10	8.54	12.61	0.24	1.37
35	9.42	6012.94	6014.38		6014.39	0.016866	0.96	9.80	13.63	0.20	1.44
34	9.42	6012.72	6014.24		6014.25	0.012898	0.87	10.84	14.61	0.18	1.52
33	9.42	6012.60	6014.09		6014.10	0.017279	0.97	9.69	13.43	0.20	1.49
32	9.42	6012.49	6013.87		6013.89	0.026637	1.16	8.13	11.94	0.25	1.38
31	9.42	6012.30	6013.55		6013.58	0.035715	1.30	7.23	11.27	0.28	1.25
30	9.42	6011.90	6013.21		6013.23	0.033326	1.26	7.49	11.54	0.28	1.31
29	9.42	6011.54	6012.96		6012.98	0.020447	1.05	8.98	12.60	0.22	1.42
28	9.42	6011.31	6012.80		6012.81	0.013203	0.89	10.60	13.76	0.18	1.49
27	9.42	6011.16	6012.69		6012.70	0.009627	0.78	12.03	14.93	0.15	1.53
26	9.42	6011.03	6012.61		6012.61	0.007927	0.71	13.24	16.40	0.14	1.58
25	9.42	6010.98	6012.52		6012.53	0.009096	0.75	12.49	15.74	0.15	1.54
24	9.42	6010.90	6012.42		6012.43	0.011695	0.82	11.43	15.23	0.17	1.52
23	9.42	6010.87	6012.30		6012.31	0.012317	0.83	11.34	15.58	0.17	1.43
22	9.42	6010.80	6012.17		6012.18	0.014425	0.86	10.91	15.94	0.18	1.37
21	9.42	6010.73	6011.98		6011.99	0.024102	1.04	9.05	14.70	0.23	1.25
20	9.42	6010.50	6011.74		6011.75	0.024148	1.05	8.98	14.45	0.23	1.24
19	9.42	6010.20	6011.55		6011.56	0.015800	0.92	10.29	14.72	0.19	1.35
18	9.42	6009.90	6011.40		6011.42	0.013594	0.88	10.76	14.65	0.18	1.50
17	12.54	6009.70	6011.21		6011.23	0.025268	1.18	10.60	14.61	0.24	1.51
16	12.54	6009.50	6010.93		6010.96	0.029598	1.25	10.03	14.37	0.26	1.43
15	12.54	6009.28	6010.59		6010.62	0.037241	1.35	9.30	14.18	0.29	1.31
14	12.54	6008.90	6010.21		6010.23	0.038916	1.37	9.15	14.08	0.30	1.31
13	12.54	6008.52	6009.84		6009.87	0.033442	1.29	9.74	14.68	0.28	1.32
12	12.54	6008.19	6009.56		6009.58	0.025069	1.16	10.82	15.39	0.24	1.37
11	12.54	6007.97	6009.31		6009.33	0.025534	1.14	10.96	16.15	0.24	1.34
10	12.54	6007.75	6008.94		6008.97	0.050582	1.46	8.60	14.74	0.34	1.19
9	12.54	6007.20	6008.36		6008.40	0.067267	1.63	7.68	13.72	0.38	1.16
8	12.54	6006.55	6007.67		6007.72	0.069642	1.69	7.40	12.82	0.39	1.12
7	12.54	6005.85	6007.13		6007.16	0.045873	1.51	8.30	12.39	0.33	1.28
6	12.54	6005.30	6006.65		6006.69	0.048717	1.57	8.01	11.80	0.33	1.35
5	12.54	6004.79	6006.15		6006.19	0.049394	1.57	8.00	11.90	0.34	1.36
4	12.54	6004.30	6005.65		6005.69	0.051032	1.61	7.77	11.32	0.34	1.35
3	12.54	6003.74	6005.19		6005.23	0.042197	1.53	8.19	11.17	0.31	1.45
2	12.54	6003.27	6004.82	6004.21	6004.85	0.034204	1.41	8.88	11.66	0.29	1.55
1	12.54	6002.80	6003.73	6003.73	6003.97	0.505364	3.89	3.22	6.96	1.01	0.93

Abbreviations:

River Sta	River Station
Q Total	Total Discharge
Min Ch El	Minimum Channel Elevation (Thalweg)
W.S. Elev	Water Surface Elevation
Crit W.S.	Critical Water Surface Elevation
E.G. Elev	Energy Grade Elevation
E.G. Slope	Energy Grade Slope
Vel Chnl	Channel Velocity

TABLE 6 - HEC-RAS RESULTS
ROCKY FLATS - ORIGINAL LANDFILL
DIVERSION BERM NO. 3: 1000-YR STORM EVENT

River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude #	Channel
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		Depth, (ft)
41	5.73	5990.67	5991.55		5991.57	0.031645	1.02	5.64	11.47	0.26	0.88
40	5.73	5990.20	5991.24		5991.26	0.033134	1.05	5.34	10.50	0.26	1.04
39	5.73	5989.80	5990.84		5990.87	0.044594	1.28	4.60	8.98	0.31	1.04
38	5.73	5989.32	5990.57		5990.58	0.019077	0.93	6.19	9.90	0.21	1.25
37	5.73	5989.80	5990.45		5990.46	0.008961	0.41	7.74	10.77	0.13	0.65
36	5.73	5989.35	5990.34		5990.35	0.013181	0.66	6.87	10.16	0.17	0.99
35	5.73	5989.97	5990.16		5990.18	0.024422	0.29	5.38	9.01	0.17	0.19
34	5.73	5988.97	5989.89		5989.91	0.030056	0.96	5.13	8.95	0.25	0.92
33	5.73	5989.00	5989.62		5989.64	0.024222	0.67	5.41	9.22	0.21	0.62
32	5.73	5988.14	5989.43		5989.44	0.016706	0.89	6.53	10.25	0.20	1.29
31	5.73	5987.99	5989.27		5989.28	0.016391	0.88	6.58	10.33	0.19	1.28
30	5.73	5987.84	5989.10		5989.11	0.017881	0.90	6.42	10.37	0.20	1.26
29	5.73	5987.69	5988.92		5988.93	0.017039	0.88	6.58	10.68	0.20	1.23
28	5.73	5987.50	5988.76		5988.77	0.015745	0.84	6.83	11.03	0.19	1.26
27	5.73	5987.32	5988.62		5988.63	0.013176	0.79	7.28	11.35	0.17	1.30
26	5.73	5987.18	5988.50		5988.51	0.011899	0.76	7.56	11.54	0.17	1.32
25	5.73	5987.09	5988.37		5988.38	0.014226	0.82	7.04	11.04	0.18	1.28
24	5.73	5987.00	5988.19		5988.20	0.021783	0.95	6.04	10.36	0.22	1.19
23	5.73	5986.79	5987.97		5987.98	0.022489	0.97	5.93	10.12	0.22	1.18
22	5.73	5986.48	5987.82		5987.82	0.011430	0.76	7.60	11.34	0.16	1.34
21	11.32	5986.17	5987.57		5987.60	0.034304	1.36	8.40	11.93	0.29	1.40
20	11.32	5985.82	5987.20		5987.23	0.039073	1.43	8.14	12.23	0.30	1.38
19	11.32	5985.47	5986.79		5986.82	0.043178	1.46	8.09	13.09	0.32	1.32
18	11.32	5985.13	5986.44		5986.46	0.030825	1.23	9.14	13.71	0.27	1.31
17	11.32	5984.81	5986.14		5986.16	0.029207	1.20	9.33	13.87	0.26	1.33
16	11.32	5984.50	5985.84		5985.86	0.030656	1.24	9.24	13.96	0.27	1.34
15	11.32	5984.18	5985.51		5985.53	0.033036	1.28	8.88	13.44	0.28	1.33
14	11.32	5983.86	5985.13		5985.17	0.041346	1.40	8.13	12.75	0.31	1.27
13	11.32	5983.45	5984.71		5984.74	0.045653	1.45	7.99	13.21	0.32	1.26
12	11.32	5983.00	5984.27		5984.30	0.041289	1.36	8.38	13.77	0.31	1.27
11	11.32	5982.63	5983.92		5983.95	0.033818	1.27	8.97	14.08	0.28	1.29
10	11.32	5982.25	5983.57		5983.60	0.035382	1.32	8.76	13.73	0.29	1.32
9	11.32	5981.86	5983.25		5983.27	0.028876	1.25	9.27	13.55	0.26	1.39
8	11.32	5981.48	5983.06		5983.07	0.014300	0.96	11.99	15.19	0.19	1.58
7	11.32	5981.32	5982.94		5982.95	0.011771	0.87	13.02	16.16	0.17	1.62
6	11.32	5981.22	5982.82		5982.83	0.012472	0.89	12.75	16.02	0.18	1.60
5	11.32	5981.12	5982.68		5982.70	0.014590	0.95	12.02	15.52	0.19	1.56
4	11.32	5980.98	5982.53		5982.54	0.015041	0.95	11.76	15.04	0.19	1.55
3	11.32	5980.84	5982.39		5982.40	0.012866	0.88	12.57	15.83	0.18	1.55
2	11.32	5980.72	5982.28		5982.29	0.012042	0.87	12.95	16.24	0.17	1.56
1	11.32	5981.00	5981.70	5981.70	5981.91	0.465864	2.68	3.12	7.40	0.88	0.70

Abbreviations:
River Sta River Station
Q Total Total Discharge
Min Ch El Minimum Channel Elevation (Thalweg)
W.S. Elev Water Surface Elevation
Crit W.S. Critical Water Surface Elevation
E.G. Elev Energy Grade Elevation
E.G. Slope Energy Grade Slope
Vel Chnl Channel Velocity

TABLE 7 - HEC-RAS RESULTS
ROCKY FLATS - ORIGINAL LANDFILL
DIVERSION BERM NO. 3: 100-YR STORM EVENT

River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #	Channel Depth, (ft)
41	4.14	5990.67	5991.49		5991.50	0.031901	0.84	4.92	11.09	0.22	0.82
40	4.14	5990.20	5991.16		5991.17	0.033741	0.88	4.55	9.64	0.23	0.96
39	4.14	5989.80	5990.76		5990.78	0.046867	1.10	3.88	8.23	0.28	0.96
38	4.14	5989.32	5990.48		5990.48	0.019511	0.79	5.28	9.14	0.18	1.16
37	4.14	5989.80	5990.35		5990.36	0.008598	0.32	6.76	10.07	0.11	0.55
36	4.14	5989.35	5990.25		5990.26	0.012620	0.54	5.99	9.49	0.14	0.90
35	4.14	5989.97	5990.07		5990.09	0.024767	0.18	4.66	8.35	0.14	0.10
34	4.14	5988.97	5989.81		5989.82	0.030231	0.80	4.40	8.29	0.22	0.84
33	4.14	5989.00	5989.53		5989.55	0.024525	0.54	4.63	8.52	0.18	0.53
32	4.14	5988.14	5989.34		5989.35	0.016702	0.75	5.62	9.52	0.17	1.20
31	4.14	5987.99	5989.18		5989.18	0.016319	0.74	5.67	9.59	0.17	1.19
30	4.14	5987.84	5989.01		5989.02	0.017877	0.76	5.52	9.60	0.18	1.17
29	4.14	5987.69	5988.83		5988.84	0.017049	0.74	5.66	9.90	0.17	1.14
28	4.14	5987.50	5988.67		5988.68	0.015914	0.71	5.86	10.25	0.17	1.17
27	4.14	5987.32	5988.53		5988.53	0.013153	0.66	6.27	10.53	0.15	1.21
26	4.14	5987.18	5988.41		5988.41	0.011690	0.64	6.55	10.73	0.14	1.23
25	4.14	5987.09	5988.28		5988.29	0.013982	0.68	6.10	10.28	0.16	1.19
24	4.14	5987.00	5988.10		5988.11	0.022173	0.80	5.17	9.58	0.19	1.10
23	4.14	5986.79	5987.87		5987.88	0.023864	0.83	5.00	9.34	0.20	1.08
22	4.14	5986.48	5987.71		5987.72	0.011736	0.64	6.48	10.47	0.14	1.23
21	8.20	5986.17	5987.47		5987.49	0.034744	1.14	7.21	11.07	0.25	1.30
20	8.20	5985.82	5987.11		5987.13	0.038185	1.19	7.03	11.19	0.26	1.29
19	8.20	5985.47	5986.70		5986.72	0.042787	1.22	6.99	12.12	0.27	1.23
18	8.20	5985.13	5986.35		5986.37	0.031042	1.04	7.97	13.20	0.23	1.22
17	8.20	5984.81	5986.05		5986.06	0.029568	1.02	8.09	13.23	0.23	1.24
16	8.20	5984.50	5985.74		5985.76	0.030717	1.05	7.96	13.11	0.23	1.24
15	8.20	5984.18	5985.42		5985.44	0.033090	1.08	7.69	12.66	0.24	1.24
14	8.20	5983.86	5985.05		5985.07	0.040342	1.17	7.08	11.94	0.27	1.19
13	8.20	5983.45	5984.62		5984.64	0.045427	1.22	6.89	12.20	0.28	1.17
12	8.20	5983.00	5984.18		5984.20	0.041592	1.15	7.20	12.75	0.27	1.18
11	8.20	5982.63	5983.83		5983.85	0.033753	1.07	7.73	13.04	0.24	1.20
10	8.20	5982.25	5983.47		5983.49	0.036877	1.13	7.43	12.63	0.25	1.22
9	8.20	5981.86	5983.14		5983.16	0.030312	1.06	7.84	12.39	0.23	1.28
8	8.20	5981.48	5982.95		5982.96	0.014117	0.80	10.33	13.93	0.16	1.47
7	8.20	5981.32	5982.83		5982.83	0.011655	0.73	11.26	14.99	0.15	1.51
6	8.20	5981.22	5982.71		5982.71	0.012423	0.75	11.02	14.90	0.15	1.49
5	8.20	5981.12	5982.57		5982.58	0.014646	0.80	10.35	14.39	0.17	1.45
4	8.20	5980.98	5982.42		5982.43	0.015134	0.80	10.13	14.00	0.17	1.44
3	8.20	5980.84	5982.28		5982.29	0.012983	0.74	10.83	14.77	0.16	1.44
2	8.20	5980.72	5982.17		5982.18	0.012128	0.73	11.15	15.10	0.15	1.45
1	8.20	5981.00	5981.60	5981.60	5981.78	0.616746	2.42	2.41	6.47	0.87	0.60

Abbreviations:
River Sta River Station
Q Total Total Discharge
Min Ch El Minimum Channel Elevation (Thalweg)
W.S. Elev Water Surface Elevation
Crit W.S. Critical Water Surface Elevation
E.G. Elev Energy Grade Elevation
E.G. Slope Energy Grade Slope
Vel Chnl Channel Velocity

TABLE 8 - HEC-RAS RESULTS
ROCKY FLATS - ORIGINAL LANDFILL
DIVERSION BERM NO. 4: 1000-YR STORM EVENT

River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #	Channel Depth, (ft)
99	2.08	6033.55	6034.61		6034.61	0.003234	0.41	5.10	8.94	0.10	1.06
98	2.08	6033.97	6034.57		6034.57	0.004813	0.42	4.91	11.67	0.12	0.60
97	2.08	6033.86	6034.53		6034.53	0.003780	0.39	5.32	11.99	0.10	0.67
96	2.08	6033.73	6034.49		6034.50	0.003142	0.36	5.71	12.36	0.09	0.76
95	2.08	6033.60	6034.46		6034.46	0.004643	0.43	4.83	10.87	0.11	0.86
94	2.08	6033.56	6034.38		6034.39	0.011055	0.64	3.25	7.93	0.17	0.82
93	2.08	6033.40	6034.23		6034.24	0.020629	0.84	2.49	6.22	0.23	0.83
92	2.08	6033.24	6034.03		6034.04	0.019686	0.80	2.59	6.67	0.23	0.79
91	2.08	6033.06	6033.82		6033.83	0.020569	0.82	2.54	6.60	0.23	0.76
90	2.08	6032.90	6033.58		6033.60	0.027518	0.95	2.28	6.92	0.27	0.68
89	2.08	6032.70	6033.31		6033.32	0.027452	0.86	2.42	7.30	0.26	0.61
88	2.08	6032.41	6033.05		6033.07	0.024350	0.83	2.52	7.85	0.25	0.64
87	2.08	6032.16	6032.73		6032.74	0.043187	0.99	2.10	7.25	0.32	0.57
86	2.08	6031.60	6032.64		6032.65	0.003836	0.41	5.10	10.62	0.10	1.04
85	2.08	6031.57	6032.58		6032.59	0.010629	0.66	3.17	6.81	0.17	1.01
84	2.08	6031.51	6032.46		6032.47	0.013937	0.72	2.89	6.63	0.19	0.95
83	2.08	6031.45	6032.28		6032.29	0.021364	0.83	2.50	6.38	0.23	0.83
82	2.08	6031.40	6032.00		6032.01	0.039807	0.97	2.15	7.19	0.31	0.60
81	2.08	6031.00	6031.53		6031.55	0.054777	1.10	1.89	6.61	0.36	0.53
80	2.08	6030.56	6031.27		6031.28	0.016159	0.70	2.99	8.37	0.21	0.71
79	4.58	6030.16	6031.07		6031.08	0.020413	0.92	4.97	10.85	0.24	0.91
78	4.58	6029.94	6030.90		6030.91	0.014750	0.82	5.58	11.37	0.21	0.96
77	4.58	6029.80	6030.77		6030.78	0.012811	0.78	5.89	11.67	0.19	0.97
76	4.58	6029.67	6030.63		6030.64	0.014175	0.80	5.76	11.88	0.20	0.96
75	4.58	6029.52	6030.44		6030.46	0.024781	0.94	4.86	11.92	0.26	0.92
74	4.58	6029.30	6030.20		6030.21	0.024705	0.98	4.68	10.78	0.26	0.90
73	4.58	6029.06	6029.98		6029.99	0.020053	0.91	5.02	11.02	0.24	0.92
72	4.58	6028.80	6029.77		6029.79	0.019894	0.90	5.07	11.18	0.24	0.97
71	4.58	6028.64	6029.57		6029.58	0.021253	0.94	4.87	10.63	0.24	0.93
70	4.58	6028.40	6029.36		6029.37	0.020035	0.92	4.98	10.74	0.24	0.96
69	4.58	6028.23	6029.18		6029.19	0.016448	0.87	5.26	10.65	0.22	0.95
68	4.58	6028.05	6029.01		6029.02	0.017419	0.88	5.19	10.81	0.22	0.96
67	4.58	6027.88	6028.83		6028.85	0.017778	0.88	5.19	10.90	0.23	0.95
66	4.58	6027.72	6028.65		6028.66	0.019071	0.90	5.08	10.94	0.23	0.93
65	4.58	6027.55	6028.44		6028.46	0.022945	0.96	4.75	10.60	0.25	0.89
64	4.58	6027.33	6028.23		6028.24	0.020004	0.92	4.98	10.81	0.24	0.90
63	4.58	6027.12	6028.02		6028.03	0.021329	0.95	4.84	10.71	0.25	0.90
62	4.58	6026.90	6027.79		6027.81	0.024812	1.00	4.57	10.17	0.26	0.89
61	4.58	6026.65	6027.57		6027.59	0.018915	0.91	5.02	10.49	0.23	0.92
60	4.58	6026.39	6027.45		6027.45	0.009626	0.72	6.33	11.29	0.17	1.06
59	7.05	6026.14	6027.30		6027.32	0.017689	1.02	6.90	11.55	0.23	1.16
58	7.05	6025.93	6027.12		6027.14	0.018651	1.04	6.79	11.54	0.24	1.19
57	7.05	6025.75	6026.94		6026.96	0.016849	1.00	7.05	11.74	0.23	1.19
56	7.05	6025.57	6026.80		6026.81	0.013080	0.91	7.76	12.35	0.20	1.23
55	7.05	6025.40	6026.69		6026.70	0.009597	0.81	8.74	13.19	0.17	1.29
54	7.05	6025.32	6026.59		6026.60	0.010419	0.83	8.50	13.06	0.18	1.27
53	7.05	6025.24	6026.48		6026.49	0.012225	0.85	8.26	13.75	0.19	1.24
52	7.05	6025.15	6026.36		6026.37	0.010541	0.80	8.85	14.69	0.18	1.21
51	7.05	6025.06	6026.26		6026.27	0.011424	0.83	8.45	13.87	0.19	1.20
50	7.05	6024.95	6026.14		6026.15	0.012312	0.88	8.07	13.36	0.20	1.19
49	7.05	6024.85	6026.01		6026.02	0.013895	0.94	7.56	12.74	0.21	1.16
48	7.05	6024.75	6025.84		6025.86	0.019461	1.04	6.78	12.16	0.24	1.09
47	7.05	6024.54	6025.65		6025.66	0.019100	1.03	6.85	12.06	0.24	1.11
46	7.05	6024.33	6025.46		6025.48	0.018202	1.03	6.88	11.71	0.24	1.13
45	7.05	6024.12	6025.26		6025.28	0.021553	1.11	6.37	10.95	0.26	1.14
44	7.05	6023.90	6025.04		6025.06	0.022733	1.16	6.10	10.53	0.26	1.14
43	7.05	6023.66	6024.81		6024.83	0.024646	1.16	6.08	10.78	0.27	1.15
42	7.05	6023.42	6024.57		6024.59	0.022844	1.12	6.28	11.05	0.26	1.15
41	7.05	6023.18	6024.35		6024.37	0.022000	1.13	6.25	10.57	0.26	1.17
40	7.05	6022.93	6024.15		6024.16	0.019038	1.07	6.59	10.81	0.24	1.22

39	9.26	6022.67	6023.91		6023.94	0.026180	1.27	7.30	11.84	0.28	1.24
38	9.26	6022.42	6023.65		6023.67	0.026649	1.26	7.33	12.14	0.29	1.23
37	9.26	6022.16	6023.40		6023.42	0.024251	1.21	7.62	12.48	0.27	1.24
36	9.26	6021.93	6023.17		6023.19	0.021979	1.17	7.89	12.65	0.26	1.24
35	9.26	6021.69	6022.97		6022.99	0.018574	1.10	8.43	13.16	0.24	1.28
34	9.26	6021.46	6022.82		6022.83	0.012826	0.95	9.70	14.15	0.20	1.36
33	9.26	6021.28	6022.71		6022.72	0.009868	0.87	10.69	14.84	0.18	1.43
32	9.26	6021.20	6022.60		6022.62	0.011097	0.91	10.19	14.33	0.19	1.40
31	9.26	6021.13	6022.47		6022.49	0.014456	1.01	9.21	13.57	0.22	1.34
30	9.26	6021.05	6022.28		6022.31	0.024335	1.23	7.54	12.16	0.27	1.23
29	9.26	6020.78	6022.00		6022.03	0.030781	1.35	6.88	11.57	0.31	1.22
28	9.26	6020.45	6021.71		6021.74	0.027681	1.31	7.05	11.34	0.29	1.26
27	9.26	6020.12	6021.45		6021.48	0.024235	1.27	7.31	11.14	0.28	1.33
26	9.26	6019.81	6021.24		6021.26	0.019611	1.18	7.82	11.36	0.25	1.43
25	9.26	6019.64	6021.06		6021.08	0.016571	1.13	8.24	11.66	0.23	1.42
24	9.26	6019.46	6020.91		6020.93	0.014125	1.02	9.09	12.84	0.21	1.45
23	9.26	6019.29	6020.80		6020.81	0.009436	0.86	10.72	14.36	0.18	1.51
22	9.26	6019.20	6020.72		6020.73	0.008258	0.83	11.18	14.87	0.17	1.52
21	9.26	6019.17	6020.63		6020.64	0.009893	0.87	10.61	14.52	0.18	1.46
20	9.26	6019.14	6020.51		6020.52	0.012761	0.95	9.73	14.20	0.20	1.37
19	11.31	6019.10	6020.29		6020.32	0.032682	1.41	8.04	13.38	0.32	1.19
18	11.31	6018.76	6019.98		6020.00	0.029674	1.36	8.35	13.53	0.30	1.22
17	11.31	6018.44	6019.67		6019.70	0.031117	1.36	8.33	13.97	0.31	1.23
16	11.31	6018.12	6019.42		6019.44	0.021713	1.19	9.48	14.72	0.26	1.30
15	11.31	6017.90	6019.22		6019.24	0.017097	1.13	10.30	15.17	0.24	1.32
14	11.31	6017.71	6019.04		6019.07	0.017930	1.15	9.85	13.99	0.24	1.33
13	11.31	6017.53	6018.82		6018.85	0.026379	1.35	8.39	12.47	0.29	1.29
12	11.31	6017.25	6018.37		6018.43	0.074708	2.04	5.54	9.60	0.47	1.12
11	11.31	6016.41	6017.41		6017.50	0.117896	2.39	4.73	9.25	0.59	1.00
10	11.31	6015.24	6016.20		6016.29	0.123548	2.35	4.81	9.89	0.59	0.96
9	11.31	6014.07	6014.99		6015.07	0.120621	2.29	4.94	10.44	0.59	0.92
8	11.31	6012.90	6013.81		6013.89	0.116123	2.26	5.01	10.49	0.58	0.91
7	11.31	6011.50	6012.32		6012.43	0.188174	2.69	4.20	9.72	0.72	0.82
6	11.31	6009.91	6010.82		6010.90	0.126931	2.32	4.88	10.54	0.60	0.91
5	11.31	6008.31	6009.15	6009.07	6009.28	0.215852	2.91	3.90	9.48	0.77	0.84
4	11.31	6006.30	6007.34	6007.20	6007.45	0.156671	2.64	4.29	8.79	0.67	1.04
3	11.31	6003.86	6005.09	6005.03	6005.29	0.311618	3.61	3.14	6.28	0.89	1.23
2	11.31	6001.10	6002.05	6002.01	6002.25	0.296142	3.55	3.18	6.66	0.91	0.95
1	11.31	5997.83	5998.69	5998.69	5998.91	0.377762	3.77	3.00	6.95	1.01	0.86

Abbreviations:

River Sta	River Station
Q Total	Total Discharge
Min Ch El	Minimum Channel Elevation (Thalweg)
W.S. Elev	Water Surface Elevation
Crit W.S.	Critical Water Surface Elevation
E.G. Elev	Energy Grade Elevation
E.G. Slope	Energy Grade Slope
Vel Chnl	Channel Velocity

TABLE 9 - HEC-RAS RESULTS
ROCKY FLATS - ORIGINAL LANDFILL
DIVERSION BERM NO. 4: 100-YR STORM EVENT

River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #	Channel Depth, (ft)
99	1.50	6033.55	6034.55		6034.55	0.002913	0.33	4.55	8.46	0.08	1.00
98	1.50	6033.97	6034.51		6034.51	0.004902	0.36	4.22	11.01	0.10	0.54
97	1.50	6033.86	6034.47		6034.47	0.003771	0.33	4.61	11.29	0.09	0.61
96	1.50	6033.73	6034.43		6034.44	0.003036	0.30	4.98	11.63	0.08	0.70
95	1.50	6033.60	6034.40		6034.40	0.004576	0.36	4.20	10.28	0.10	0.80
94	1.50	6033.56	6034.33		6034.33	0.011075	0.53	2.81	7.38	0.15	0.77
93	1.50	6033.40	6034.17		6034.18	0.020122	0.70	2.15	5.74	0.20	0.77
92	1.50	6033.24	6033.97		6033.98	0.019433	0.67	2.23	6.19	0.20	0.73
91	1.50	6033.06	6033.77		6033.78	0.019968	0.68	2.21	6.16	0.20	0.71
90	1.50	6032.90	6033.53		6033.54	0.027562	0.79	1.96	6.39	0.23	0.63
89	1.50	6032.70	6033.27		6033.28	0.025957	0.71	2.13	6.89	0.22	0.57
88	1.50	6032.41	6033.02		6033.02	0.024372	0.68	2.22	7.48	0.22	0.61
87	1.50	6032.16	6032.66		6032.68	0.053374	0.90	1.67	6.46	0.31	0.50
86	1.50	6031.60	6032.58		6032.58	0.003771	0.34	4.40	9.84	0.09	0.98
85	1.50	6031.57	6032.51		6032.52	0.010379	0.55	2.74	6.31	0.15	0.94
84	1.50	6031.51	6032.40		6032.40	0.013587	0.60	2.50	6.12	0.17	0.89
83	1.50	6031.45	6032.23		6032.24	0.020609	0.69	2.17	5.94	0.20	0.78
82	1.50	6031.40	6031.95		6031.96	0.039537	0.81	1.85	6.67	0.27	0.55
81	1.50	6031.00	6031.49		6031.50	0.055751	0.93	1.61	6.11	0.32	0.49
80	1.50	6030.56	6031.21		6031.21	0.017515	0.60	2.49	7.66	0.19	0.65
79	3.31	6030.16	6031.00		6031.01	0.020890	0.78	4.24	10.08	0.21	0.84
78	3.31	6029.94	6030.83		6030.84	0.014733	0.69	4.80	10.53	0.18	0.89
77	3.31	6029.80	6030.70		6030.70	0.012478	0.65	5.12	10.89	0.17	0.90
76	3.31	6029.67	6030.57		6030.58	0.013737	0.66	5.02	11.10	0.17	0.90
75	3.31	6029.52	6030.38		6030.39	0.024378	0.79	4.17	10.82	0.23	0.86
74	3.31	6029.30	6030.13		6030.15	0.024864	0.82	4.01	9.98	0.23	0.83
73	3.31	6029.06	6029.91		6029.92	0.020030	0.77	4.32	10.22	0.21	0.85
72	3.31	6028.80	6029.71		6029.71	0.020081	0.76	4.34	10.33	0.21	0.91
71	3.31	6028.64	6029.50		6029.51	0.021266	0.79	4.17	9.76	0.21	0.86
70	3.31	6028.40	6029.29		6029.30	0.020119	0.78	4.25	9.81	0.21	0.89
69	3.31	6028.23	6029.11		6029.12	0.016139	0.73	4.55	9.87	0.19	0.88
68	3.31	6028.05	6028.94		6028.95	0.017499	0.74	4.47	10.04	0.20	0.89
67	3.31	6027.88	6028.77		6028.77	0.017606	0.74	4.48	10.13	0.20	0.89
66	3.31	6027.72	6028.58		6028.59	0.018952	0.75	4.38	10.15	0.20	0.86
65	3.31	6027.55	6028.38		6028.39	0.022890	0.81	4.09	9.84	0.22	0.83
64	3.31	6027.33	6028.16		6028.17	0.019677	0.77	4.32	10.07	0.21	0.83
63	3.31	6027.12	6027.96		6027.96	0.021543	0.79	4.19	9.98	0.21	0.84
62	3.31	6026.90	6027.72		6027.73	0.025131	0.85	3.91	9.42	0.23	0.82
61	3.31	6026.65	6027.49		6027.50	0.020465	0.78	4.22	9.74	0.21	0.84
60	3.31	6026.39	6027.36		6027.36	0.009928	0.61	5.39	10.43	0.15	0.97
59	5.10	6026.14	6027.21		6027.23	0.017601	0.86	5.95	10.69	0.20	1.07
58	5.10	6025.93	6027.03		6027.04	0.018883	0.88	5.83	10.71	0.21	1.10
57	5.10	6025.75	6026.86		6026.87	0.016940	0.84	6.04	10.82	0.20	1.11
56	5.10	6025.57	6026.71		6026.72	0.013033	0.76	6.69	11.47	0.18	1.14
55	5.10	6025.40	6026.60		6026.61	0.009343	0.67	7.61	12.33	0.15	1.20
54	5.10	6025.32	6026.50		6026.51	0.010089	0.69	7.41	12.22	0.16	1.18
53	5.10	6025.24	6026.39		6026.40	0.012006	0.71	7.16	12.79	0.17	1.15
52	5.10	6025.15	6026.28		6026.29	0.010171	0.66	7.71	13.66	0.16	1.13
51	5.10	6025.06	6026.18		6026.18	0.011134	0.69	7.39	13.13	0.16	1.12
50	5.10	6024.95	6026.06		6026.07	0.012080	0.72	7.08	12.75	0.17	1.11
49	5.10	6024.85	6025.93		6025.94	0.014056	0.77	6.64	12.15	0.18	1.08
48	5.10	6024.75	6025.76		6025.77	0.019990	0.87	5.85	11.57	0.21	1.01
47	5.10	6024.54	6025.56		6025.58	0.019359	0.87	5.89	11.27	0.21	1.02
46	5.10	6024.33	6025.38		6025.39	0.018046	0.86	5.94	10.88	0.20	1.05
45	5.10	6024.12	6025.18		6025.19	0.020857	0.92	5.54	10.16	0.22	1.06
44	5.10	6023.90	6024.96		6024.98	0.023027	0.96	5.32	9.89	0.23	1.06
43	5.10	6023.66	6024.72		6024.74	0.024601	0.97	5.24	9.99	0.24	1.06
42	5.10	6023.42	6024.49		6024.50	0.023125	0.95	5.38	10.23	0.23	1.07
41	5.10	6023.18	6024.26		6024.28	0.022244	0.95	5.36	9.79	0.23	1.08
40	5.10	6022.93	6024.06		6024.07	0.019052	0.90	5.65	9.96	0.21	1.13
39	6.70	6022.67	6023.82		6023.84	0.026194	1.06	6.30	11.03	0.25	1.15

38	6.70	6022.42	6023.56		6023.58	0.027146	1.07	6.27	11.23	0.25	1.14
37	6.70	6022.16	6023.31		6023.32	0.024264	1.02	6.57	11.59	0.24	1.15
36	6.70	6021.93	6023.07		6023.09	0.022266	0.99	6.77	11.73	0.23	1.14
35	6.70	6021.69	6022.87		6022.88	0.018958	0.93	7.20	12.15	0.21	1.18
34	6.70	6021.46	6022.72		6022.73	0.012880	0.80	8.34	13.13	0.18	1.26
33	6.70	6021.28	6022.61		6022.62	0.009727	0.72	9.27	13.82	0.16	1.33
32	6.70	6021.20	6022.51		6022.51	0.010887	0.76	8.84	13.37	0.16	1.31
31	6.70	6021.13	6022.38		6022.39	0.014108	0.84	7.99	12.59	0.19	1.25
30	6.70	6021.05	6022.20		6022.21	0.024117	1.03	6.52	11.31	0.24	1.15
29	6.70	6020.78	6021.92		6021.94	0.030679	1.13	5.94	10.71	0.27	1.14
28	6.70	6020.45	6021.62		6021.64	0.028253	1.11	6.05	10.52	0.26	1.17
27	6.70	6020.12	6021.36		6021.38	0.024439	1.07	6.28	10.35	0.24	1.24
26	6.70	6019.81	6021.14		6021.16	0.019735	0.99	6.74	10.46	0.22	1.33
25	6.70	6019.64	6020.96		6020.98	0.016753	0.94	7.12	10.63	0.20	1.32
24	6.70	6019.46	6020.81		6020.82	0.013938	0.85	7.84	11.83	0.19	1.35
23	6.70	6019.29	6020.70		6020.71	0.009127	0.72	9.33	13.37	0.15	1.41
22	6.70	6019.20	6020.62		6020.63	0.008153	0.69	9.77	13.89	0.14	1.42
21	6.70	6019.17	6020.53		6020.54	0.009586	0.72	9.26	13.65	0.15	1.36
20	6.70	6019.14	6020.42		6020.43	0.012539	0.79	8.47	13.35	0.18	1.28
19	8.18	6019.10	6020.21		6020.23	0.032989	1.18	6.93	12.44	0.28	1.11
18	8.18	6018.76	6019.89		6019.91	0.029407	1.13	7.22	12.61	0.26	1.13
17	8.18	6018.44	6019.58		6019.60	0.031291	1.14	7.16	12.94	0.27	1.14
16	8.18	6018.12	6019.32		6019.34	0.021925	1.00	8.16	13.78	0.23	1.20
15	8.18	6017.90	6019.12		6019.14	0.017551	0.95	8.86	14.35	0.21	1.22
14	8.18	6017.71	6018.95		6018.96	0.017858	0.96	8.51	13.06	0.21	1.24
13	8.18	6017.53	6018.72		6018.74	0.026290	1.13	7.22	11.56	0.25	1.19
12	8.18	6017.25	6018.29		6018.33	0.074270	1.71	4.79	8.94	0.41	1.04
11	8.18	6016.41	6017.33		6017.39	0.121727	2.02	4.04	8.52	0.52	0.92
10	8.18	6015.24	6016.13		6016.19	0.119472	1.95	4.19	9.22	0.51	0.89
9	8.18	6014.07	6014.92		6014.98	0.123102	1.94	4.22	9.67	0.52	0.85
8	8.18	6012.90	6013.74		6013.80	0.113668	1.88	4.35	9.82	0.50	0.84
7	8.18	6011.50	6012.26		6012.34	0.195994	2.29	3.58	9.06	0.64	0.76
6	8.18	6009.91	6010.76		6010.82	0.121255	1.90	4.29	9.96	0.51	0.85
5	8.18	6008.31	6009.08	6008.98	6009.18	0.234844	2.46	3.33	8.63	0.70	0.77
4	8.18	6006.30	6007.29	6007.10	6007.36	0.143805	2.14	3.83	8.37	0.56	0.99
3	8.18	6003.86	6004.96	6004.88	6005.14	0.386145	3.36	2.44	5.06	0.85	1.10
2	8.18	6001.10	6002.02	6001.90	6002.14	0.238461	2.75	2.97	6.45	0.71	0.92
1	8.18	5997.83	5998.59	5998.59	5998.78	0.500989	3.52	2.32	6.12	1.01	0.76

Abbreviations:

River Sta	River Station
Q Total	Total Discharge
Min Ch El	Minimum Channel Elevation (Thalweg)
W.S. Elev	Water Surface Elevation
Crit W.S.	Critical Water Surface Elevation
E.G. Elev	Energy Grade Elevation
E.G. Slope	Energy Grade Slope
Vel Chnl	Channel Velocity

TABLE 10 - HEC-RAS RESULTS
ROCKY FLATS - ORIGINAL LANDFILL
DIVERSION BERM NO. 5: 1000-YR STORM EVENT

River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #	Channel Depth, (ft)
99	3.56	6014.64	6015.38		6015.41	0.047346	1.21	2.94	8.01	0.35	0.74
98	3.56	6014.20	6015.03		6015.05	0.028019	1.02	3.51	8.70	0.28	0.83
97	3.56	6013.95	6014.78		6014.79	0.023917	0.94	3.80	9.13	0.26	0.83
96	3.56	6013.70	6014.51		6014.53	0.027705	0.98	3.63	9.07	0.27	0.81
95	3.56	6013.41	6014.23		6014.25	0.028646	1.01	3.51	8.73	0.28	0.82
94	3.56	6013.13	6013.92		6013.94	0.033431	1.05	3.39	8.84	0.30	0.79
93	3.56	6012.80	6013.58		6013.60	0.032469	1.06	3.37	8.51	0.30	0.78
92	3.56	6012.40	6013.48		6013.49	0.005407	0.55	6.47	11.28	0.13	1.08
91	3.56	6012.00	6013.45		6013.46	0.001987	0.39	9.24	12.88	0.08	1.45
90	3.56	6011.92	6013.44		6013.44	0.001169	0.31	11.54	15.17	0.06	1.52
89	3.56	6012.06	6013.43		6013.43	0.001512	0.32	11.05	16.61	0.07	1.37
88	3.56	6012.21	6013.40		6013.41	0.003633	0.46	7.73	13.07	0.11	1.19
87	3.56	6012.24	6013.36		6013.36	0.005343	0.54	6.64	11.94	0.13	1.12
86	3.56	6012.25	6013.29		6013.30	0.007837	0.62	5.70	10.85	0.15	1.04
85	3.56	6012.25	6013.17		6013.19	0.018865	0.89	4.02	8.72	0.23	0.92
84	3.56	6012.07	6012.97		6012.98	0.021758	0.95	3.76	8.22	0.25	0.90
83	3.56	6011.85	6012.73		6012.75	0.025287	0.99	3.59	8.19	0.26	0.88
82	3.56	6011.62	6012.44		6012.46	0.033471	1.10	3.25	7.88	0.30	0.82
81	3.56	6011.29	6012.12		6012.13	0.029786	1.03	3.44	8.35	0.28	0.83
80	3.56	6010.96	6011.95		6011.96	0.010738	0.70	5.08	10.33	0.18	0.99
79	7.38	6010.63	6011.78		6011.80	0.021018	1.09	6.79	11.78	0.25	1.15
78	7.38	6010.41	6011.56		6011.58	0.022156	1.10	6.71	11.90	0.26	1.15
77	7.38	6010.19	6011.35		6011.36	0.021739	1.10	6.73	11.82	0.26	1.16
76	7.38	6009.97	6011.15		6011.16	0.018448	1.04	7.12	12.05	0.24	1.18
75	7.38	6009.77	6010.97		6010.98	0.017866	1.03	7.18	12.00	0.23	1.20
74	7.38	6009.58	6010.79		6010.81	0.016767	1.00	7.35	12.12	0.23	1.21
73	7.38	6009.39	6010.64		6010.65	0.014939	0.96	7.68	12.41	0.22	1.25
72	7.38	6009.24	6010.48		6010.49	0.017338	1.02	7.26	12.01	0.23	1.24
71	7.38	6009.08	6010.30		6010.32	0.018157	1.11	6.71	11.04	0.24	1.22
70	7.38	6008.93	6010.11		6010.13	0.020118	1.11	6.67	11.15	0.25	1.18
69	7.38	6008.75	6009.92		6009.93	0.018940	1.08	6.87	11.44	0.24	1.17
68	7.38	6008.58	6009.72		6009.74	0.020525	1.08	6.84	11.80	0.25	1.14
67	7.38	6008.38	6009.49		6009.51	0.025138	1.15	6.40	11.67	0.27	1.11
66	7.38	6008.12	6009.24		6009.26	0.023997	1.16	6.38	11.14	0.27	1.12
65	7.38	6007.86	6009.00		6009.02	0.023954	1.16	6.35	10.98	0.27	1.14
64	7.38	6007.61	6008.76		6008.78	0.024154	1.17	6.30	10.84	0.27	1.15
63	7.38	6007.36	6008.53		6008.55	0.022324	1.17	6.36	10.77	0.26	1.17
62	7.38	6007.11	6008.32		6008.34	0.019204	1.11	6.70	10.90	0.24	1.21
61	7.38	6006.87	6008.15		6008.17	0.015837	1.01	7.30	11.35	0.22	1.28
60	7.38	6006.64	6008.03		6008.04	0.010570	0.87	8.46	12.19	0.18	1.39
59	11.32	6006.42	6007.87		6007.89	0.020210	1.24	9.15	12.62	0.26	1.45
58	11.32	6006.20	6007.68		6007.70	0.018024	1.19	9.53	12.82	0.24	1.48
57	11.32	6006.03	6007.50		6007.53	0.017116	1.17	9.66	13.00	0.24	1.47
56	11.32	6005.86	6007.32		6007.35	0.018974	1.20	9.41	12.89	0.25	1.46
55	11.32	6005.70	6007.13		6007.15	0.020212	1.24	9.13	12.55	0.26	1.43
54	11.32	6005.54	6006.93		6006.95	0.019356	1.21	9.34	12.97	0.25	1.39
53	11.32	6005.40	6006.73		6006.76	0.019629	1.21	9.37	13.16	0.25	1.33
52	11.32	6005.23	6006.51		6006.54	0.023941	1.29	8.79	13.04	0.28	1.28
51	11.32	6004.98	6006.28		6006.30	0.023204	1.27	8.93	13.28	0.27	1.30
50	11.32	6004.73	6006.04		6006.07	0.024137	1.28	8.87	13.43	0.28	1.31
49	11.32	6004.48	6005.78		6005.81	0.028702	1.37	8.25	12.76	0.30	1.30
48	11.32	6004.19	6005.50		6005.53	0.026806	1.33	8.50	13.04	0.29	1.31
47	11.32	6003.91	6005.25		6005.28	0.023367	1.27	8.95	13.38	0.27	1.34
46	11.32	6003.66	6005.05		6005.07	0.018368	1.16	9.77	13.93	0.24	1.39
45	11.32	6003.48	6004.87		6004.89	0.018269	1.15	9.87	14.24	0.24	1.39
44	11.32	6003.31	6004.69		6004.71	0.018183	1.16	9.80	14.17	0.24	1.38
43	11.32	6003.13	6004.50		6004.52	0.018910	1.18	9.62	13.70	0.25	1.37
42	11.32	6002.91	6004.31		6004.33	0.019284	1.18	9.56	13.67	0.25	1.40
41	11.32	6002.69	6004.13		6004.15	0.017601	1.15	9.84	13.68	0.24	1.44
40	11.32	6002.47	6003.98		6004.00	0.013465	1.04	10.84	14.25	0.21	1.51

39	15.12	6002.24	6003.79		6003.82	0.022645	1.36	11.09	14.44	0.27	1.55
38	15.12	6002.02	6003.55		6003.58	0.024715	1.41	10.71	14.14	0.29	1.53
37	15.12	6001.79	6003.30		6003.33	0.025097	1.42	10.64	14.05	0.29	1.51
36	15.12	6001.55	6003.05		6003.08	0.025485	1.43	10.56	13.97	0.29	1.50
35	15.12	6001.29	6002.80		6002.83	0.025612	1.44	10.50	13.80	0.29	1.51
34	15.12	6001.03	6002.50		6002.54	0.032719	1.59	9.52	12.94	0.33	1.47
33	15.12	6000.70	6002.17		6002.21	0.033000	1.60	9.48	12.89	0.33	1.47
32	15.12	6000.42	6001.84		6001.88	0.032436	1.57	9.65	13.35	0.32	1.42
31	15.12	6000.11	6001.50		6001.54	0.035376	1.62	9.34	13.16	0.34	1.39
30	15.12	5999.74	6001.11		6001.16	0.040570	1.72	8.81	13.11	0.36	1.37
29	15.12	5999.30	6000.69		6000.74	0.042305	1.72	8.77	12.84	0.37	1.39
28	15.12	5998.86	6000.31		6000.35	0.034854	1.62	9.32	13.09	0.34	1.45
27	15.12	5998.51	6000.00		6000.04	0.027838	1.49	10.16	13.55	0.30	1.49
26	15.12	5998.22	5999.75		5999.78	0.023772	1.39	10.85	14.18	0.28	1.53
25	15.12	5997.90	5999.56		5999.58	0.016024	1.21	12.53	15.24	0.23	1.66
24	15.12	5997.73	5999.40		5999.43	0.015652	1.19	12.68	15.30	0.23	1.67
23	15.12	5997.60	5999.24		5999.26	0.017739	1.26	12.04	14.71	0.24	1.64
22	15.12	5997.49	5999.04		5999.07	0.020594	1.34	11.32	14.28	0.26	1.55
21	15.12	5997.27	5998.85		5998.87	0.018369	1.25	12.05	15.17	0.25	1.58
20	15.12	5997.04	5998.68		5998.71	0.015397	1.17	12.90	15.82	0.23	1.64
19	17.82	5996.81	5998.51		5998.54	0.017637	1.29	13.83	16.28	0.25	1.70
18	17.82	5996.62	5998.35		5998.37	0.015674	1.23	14.50	16.76	0.23	1.73
17	17.82	5996.45	5998.20		5998.22	0.015232	1.22	14.65	16.84	0.23	1.75
16	17.82	5996.28	5998.05		5998.08	0.013722	1.19	15.01	16.91	0.22	1.77
15	17.82	5996.12	5997.92		5997.94	0.013996	1.19	14.96	16.68	0.22	1.80
14	17.82	5995.97	5997.77		5997.80	0.014966	1.22	14.64	16.52	0.23	1.80
13	17.82	5995.82	5997.62		5997.64	0.015815	1.25	14.24	16.05	0.23	1.80
12	17.82	5995.68	5997.46		5997.49	0.014610	1.26	14.19	15.66	0.23	1.78
11	17.82	5995.59	5997.31		5997.34	0.015690	1.26	14.10	15.45	0.23	1.72
10	17.82	5995.49	5997.14		5997.17	0.018988	1.34	13.34	15.49	0.25	1.65
9	17.82	5995.34	5996.94		5996.97	0.020521	1.37	12.98	15.39	0.26	1.60
8	17.82	5995.16	5996.73		5996.76	0.021650	1.38	12.87	15.82	0.27	1.57
7	17.82	5994.97	5996.49		5996.52	0.026168	1.47	12.13	15.83	0.30	1.52
6	17.82	5994.75	5996.20		5996.23	0.031712	1.58	11.25	15.12	0.32	1.45
5	17.82	5994.47	5995.87		5995.91	0.033449	1.58	11.29	15.92	0.33	1.40
4	17.82	5994.18	5995.43		5995.48	0.055342	1.88	9.48	15.03	0.42	1.25
3	17.82	5993.65	5994.06	5994.04	5994.16	0.321443	2.26	6.94	26.34	0.85	0.41
2	17.82	5991.19	5992.24	5992.18	5992.39	0.263168	3.11	5.73	13.72	0.85	1.05
1	17.82	5988.13	5989.07	5989.07	5989.31	0.365365	3.91	4.56	9.82	1.01	0.94

Abbreviations:

River Sta	River Station
Q Total	Total Discharge
Min Ch El	Minimum Channel Elevation (Thalweg)
W.S. Elev	Water Surface Elevation
Crit W.S.	Critical Water Surface Elevation
E.G. Elev	Energy Grade Elevation
E.G. Slope	Energy Grade Slope
Vel Chnl	Channel Velocity

TABLE 11 - HEC-RAS RESULTS
ROCKY FLATS - ORIGINAL LANDFILL
DIVERSION BERM NO. 5: 100-YR STORM EVENT

River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #	Channel Depth, (ft)
99	2.57	6014.64	6015.33		6015.35	0.046600	1.01	2.55	7.46	0.30	0.69
98	2.57	6014.20	6014.98		6014.99	0.028084	0.84	3.07	8.15	0.24	0.78
97	2.57	6013.95	6014.72		6014.73	0.024407	0.79	3.24	8.44	0.23	0.77
96	2.57	6013.70	6014.46		6014.47	0.027546	0.82	3.12	8.41	0.24	0.76
95	2.57	6013.41	6014.17		6014.19	0.028614	0.84	3.04	8.10	0.24	0.76
94	2.57	6013.13	6013.86		6013.88	0.033811	0.88	2.90	8.17	0.26	0.73
93	2.57	6012.80	6013.51		6013.52	0.037212	0.93	2.76	7.70	0.27	0.71
92	2.57	6012.40	6013.40		6013.41	0.005408	0.46	5.58	10.53	0.11	1.00
91	2.57	6012.00	6013.37		6013.38	0.001804	0.31	8.23	12.15	0.07	1.37
90	2.57	6011.92	6013.36		6013.36	0.001041	0.25	10.36	14.38	0.05	1.44
89	2.57	6012.06	6013.35		6013.35	0.001393	0.26	9.79	15.61	0.06	1.29
88	2.57	6012.21	6013.33		6013.33	0.003458	0.38	6.76	12.22	0.09	1.12
87	2.57	6012.24	6013.29		6013.29	0.005146	0.44	5.79	11.15	0.11	1.05
86	2.57	6012.25	6013.22		6013.23	0.007602	0.52	4.96	10.12	0.13	0.97
85	2.57	6012.25	6013.11		6013.12	0.018771	0.74	3.47	8.11	0.20	0.86
84	2.57	6012.07	6012.90		6012.91	0.021613	0.79	3.24	7.64	0.21	0.83
83	2.57	6011.85	6012.67		6012.68	0.025016	0.83	3.10	7.60	0.23	0.82
82	2.57	6011.62	6012.38		6012.39	0.034162	0.93	2.77	7.30	0.26	0.76
81	2.57	6011.29	6012.05		6012.06	0.032041	0.89	2.88	7.69	0.26	0.76
80	2.57	6010.96	6011.87		6011.88	0.011406	0.60	4.27	9.47	0.16	0.91
79	5.34	6010.63	6011.69		6011.71	0.021114	0.91	5.84	10.97	0.22	1.06
78	5.34	6010.41	6011.48		6011.50	0.022254	0.93	5.76	11.01	0.23	1.07
77	5.34	6010.19	6011.26		6011.27	0.022003	0.93	5.75	10.85	0.22	1.07
76	5.34	6009.97	6011.06		6011.07	0.018360	0.87	6.12	11.07	0.21	1.09
75	5.34	6009.77	6010.88		6010.89	0.017932	0.86	6.18	11.13	0.20	1.11
74	5.34	6009.58	6010.71		6010.72	0.016703	0.84	6.34	11.26	0.20	1.13
73	5.34	6009.39	6010.55		6010.56	0.014662	0.80	6.66	11.56	0.19	1.16
72	5.34	6009.24	6010.40		6010.41	0.016822	0.84	6.32	11.24	0.20	1.16
71	5.34	6009.08	6010.22		6010.23	0.018523	0.91	5.87	10.22	0.21	1.14
70	5.34	6008.93	6010.03		6010.04	0.020020	0.92	5.80	10.39	0.22	1.10
69	5.34	6008.75	6009.83		6009.85	0.019124	0.90	5.96	10.69	0.21	1.08
68	5.34	6008.58	6009.64		6009.65	0.020361	0.90	5.91	10.99	0.22	1.06
67	5.34	6008.38	6009.41		6009.42	0.025291	0.97	5.50	10.80	0.24	1.03
66	5.34	6008.12	6009.16		6009.18	0.024044	0.97	5.50	10.37	0.24	1.04
65	5.34	6007.86	6008.92		6008.93	0.023962	0.98	5.47	10.20	0.23	1.06
64	5.34	6007.61	6008.68		6008.69	0.023971	0.98	5.45	10.08	0.24	1.07
63	5.34	6007.36	6008.45		6008.46	0.022683	0.97	5.49	10.02	0.23	1.09
62	5.34	6007.11	6008.23		6008.25	0.020082	0.93	5.73	10.11	0.22	1.12
61	5.34	6006.87	6008.05		6008.07	0.016428	0.86	6.20	10.47	0.20	1.18
60	5.34	6006.64	6007.92		6007.93	0.010989	0.74	7.21	11.28	0.16	1.28
59	8.19	6006.42	6007.76		6007.78	0.020255	1.04	7.88	11.71	0.22	1.34
58	8.19	6006.20	6007.57		6007.59	0.017790	0.99	8.25	11.92	0.21	1.37
57	8.19	6006.03	6007.40		6007.42	0.017273	0.98	8.37	12.09	0.21	1.37
56	8.19	6005.86	6007.22		6007.23	0.018886	1.01	8.11	11.97	0.22	1.36
55	8.19	6005.70	6007.02		6007.04	0.019896	1.04	7.91	11.67	0.22	1.32
54	8.19	6005.54	6006.83		6006.84	0.019226	1.01	8.10	12.11	0.22	1.29
53	8.19	6005.40	6006.64		6006.65	0.019292	1.01	8.13	12.30	0.22	1.24
52	8.19	6005.23	6006.42		6006.44	0.023890	1.08	7.60	12.22	0.24	1.19
51	8.19	6004.98	6006.18		6006.20	0.023359	1.06	7.70	12.44	0.24	1.20
50	8.19	6004.73	6005.95		6005.97	0.023864	1.07	7.63	12.34	0.24	1.22
49	8.19	6004.48	6005.68		6005.70	0.028753	1.15	7.10	11.83	0.26	1.20
48	8.19	6004.19	6005.40		6005.42	0.027122	1.12	7.28	12.07	0.26	1.21
47	8.19	6003.91	6005.15		6005.17	0.023325	1.07	7.67	12.26	0.24	1.24
46	8.19	6003.66	6004.95		6004.96	0.018317	0.97	8.43	12.95	0.21	1.29
45	8.19	6003.48	6004.77		6004.78	0.018122	0.96	8.53	13.25	0.21	1.29
44	8.19	6003.31	6004.59		6004.60	0.018729	0.97	8.44	13.25	0.21	1.28
43	8.19	6003.13	6004.40		6004.41	0.019045	0.99	8.28	12.74	0.22	1.27
42	8.19	6002.91	6004.21		6004.22	0.019709	1.00	8.18	12.68	0.22	1.30
41	8.19	6002.69	6004.02		6004.03	0.018415	0.98	8.36	12.72	0.21	1.33
40	8.19	6002.47	6003.86		6003.88	0.013634	0.88	9.28	13.16	0.19	1.39

39	10.94	6002.24	6003.68		6003.70	0.022533	1.14	9.56	13.39	0.24	1.44
38	10.94	6002.02	6003.44		6003.46	0.024718	1.19	9.23	13.13	0.25	1.42
37	10.94	6001.79	6003.19		6003.22	0.025019	1.19	9.17	13.04	0.25	1.40
36	10.94	6001.55	6002.94		6002.96	0.025452	1.20	9.11	13.00	0.25	1.39
35	10.94	6001.29	6002.69		6002.71	0.025436	1.21	9.07	12.84	0.25	1.40
34	10.94	6001.03	6002.39		6002.42	0.032844	1.34	8.19	12.02	0.29	1.36
33	10.94	6000.70	6002.07		6002.10	0.032635	1.33	8.20	11.99	0.28	1.37
32	10.94	6000.42	6001.74		6001.77	0.032122	1.31	8.36	12.48	0.28	1.32
31	10.94	6000.11	6001.40		6001.43	0.034885	1.35	8.10	12.29	0.29	1.29
30	10.94	5999.74	6001.02		6001.05	0.041435	1.43	7.64	12.21	0.32	1.28
29	10.94	5999.30	6000.59		6000.63	0.042260	1.45	7.55	11.90	0.32	1.29
28	10.94	5998.86	6000.21		6000.24	0.035629	1.36	8.02	12.14	0.30	1.35
27	10.94	5998.51	5999.89		5999.92	0.027970	1.25	8.74	12.57	0.26	1.38
26	10.94	5998.22	5999.64		5999.66	0.024055	1.17	9.32	13.18	0.25	1.42
25	10.94	5997.90	5999.45		5999.46	0.016150	1.01	10.82	14.21	0.20	1.55
24	10.94	5997.73	5999.29		5999.30	0.015357	1.00	10.99	14.22	0.20	1.56
23	10.94	5997.60	5999.12		5999.14	0.017636	1.05	10.44	13.86	0.21	1.52
22	10.94	5997.49	5998.93		5998.95	0.021425	1.12	9.77	13.61	0.23	1.44
21	10.94	5997.27	5998.73		5998.75	0.019071	1.06	10.28	14.19	0.22	1.46
20	10.94	5997.04	5998.56		5998.58	0.015685	0.99	11.03	14.62	0.20	1.52
19	12.90	5996.81	5998.39		5998.41	0.017715	1.08	11.90	15.09	0.22	1.58
18	12.90	5996.62	5998.23		5998.24	0.015657	1.03	12.49	15.56	0.20	1.61
17	12.90	5996.45	5998.07		5998.09	0.015113	1.02	12.66	15.64	0.20	1.62
16	12.90	5996.28	5997.93		5997.95	0.013959	0.99	12.98	15.70	0.19	1.65
15	12.90	5996.12	5997.79		5997.81	0.013863	1.00	12.95	15.49	0.19	1.67
14	12.90	5995.97	5997.65		5997.67	0.014732	1.02	12.68	15.35	0.20	1.68
13	12.90	5995.82	5997.50		5997.51	0.015358	1.04	12.40	14.97	0.20	1.68
12	12.90	5995.68	5997.35		5997.36	0.014874	1.04	12.40	14.81	0.20	1.67
11	12.90	5995.59	5997.20		5997.21	0.015338	1.05	12.34	14.76	0.20	1.61
10	12.90	5995.49	5997.03		5997.04	0.018768	1.11	11.63	14.79	0.22	1.54
9	12.90	5995.34	5996.83		5996.85	0.020308	1.14	11.33	14.73	0.23	1.49
8	12.90	5995.16	5996.62		5996.64	0.021645	1.15	11.19	15.12	0.24	1.46
7	12.90	5994.97	5996.38		5996.41	0.025982	1.23	10.50	14.77	0.26	1.41
6	12.90	5994.75	5996.09		5996.12	0.031317	1.32	9.74	14.09	0.28	1.34
5	12.90	5994.47	5995.77		5995.80	0.032806	1.32	9.76	14.68	0.29	1.30
4	12.90	5994.18	5995.36		5995.40	0.049145	1.51	8.54	14.26	0.34	1.18
3	12.90	5993.65	5994.00	5993.97	5994.09	0.423936	1.97	5.53	24.44	0.83	0.35
2	12.90	5991.19	5992.20	5992.07	5992.30	0.216272	2.44	5.29	13.04	0.68	1.01
1	12.90	5988.13	5988.96	5988.96	5989.16	0.485087	3.67	3.51	8.53	1.01	0.83

Abbreviations:

River Sta River Station
Q Total Total Discharge
Min Ch El Minimum Channel Elevation (Thalweg)
W.S. Elev Water Surface Elevation
Crit W.S. Critical Water Surface Elevation
E.G. Elev Energy Grade Elevation
E.G. Slope Energy Grade Slope
Vel Chnl Channel Velocity

TABLE 12 - HEC-RAS RESULTS
ROCKY FLATS - ORIGINAL LANDFILL
DIVERSION BERM NO. 6: 1000-YR STORM EVENT

River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #	Channel Depth, (ft)
108	3.14	5995.84	5996.48		5996.51	0.064407	1.29	2.43	7.55	0.40	0.64
107	3.14	5995.25	5996.14		5996.15	0.022108	0.93	3.38	7.63	0.25	0.89
106	3.14	5995.02	5995.90		5995.91	0.025981	0.99	3.18	7.41	0.27	0.88
105	3.14	5994.80	5995.60		5995.62	0.031427	1.13	2.88	7.15	0.30	0.80
104	3.14	5994.52	5995.29		5995.32	0.029617	1.23	2.79	7.13	0.30	0.77
103	3.14	5994.20	5995.01		5995.02	0.028764	1.08	2.97	7.17	0.28	0.81
102	3.14	5993.89	5994.71		5994.74	0.028820	1.18	2.78	6.72	0.29	0.82
101	3.14	5993.59	5994.41		5994.43	0.032144	1.04	3.01	7.57	0.29	0.82
100	3.14	5993.29	5994.15		5994.17	0.021592	0.98	3.30	8.09	0.25	0.86
99	3.14	5993.03	5994.02		5994.03	0.009851	0.67	4.71	9.94	0.17	0.99
98	3.14	5992.77	5993.98		5993.98	0.002383	0.39	8.15	13.08	0.09	1.21
97	3.14	5992.98	5993.93		5993.94	0.009960	0.65	4.82	10.34	0.17	0.95
96	3.14	5992.87	5993.81		5993.82	0.012766	0.73	4.33	9.47	0.19	0.94
95	3.14	5992.70	5993.71		5993.72	0.008801	0.65	4.87	9.63	0.16	1.01
94	3.14	5992.55	5993.63		5993.63	0.007830	0.63	5.01	9.39	0.15	1.08
93	3.14	5992.51	5993.54		5993.55	0.009864	0.68	4.59	8.98	0.17	1.03
92	3.14	5992.50	5993.41		5993.42	0.016808	0.84	3.75	8.11	0.22	0.91
91	3.14	5992.36	5993.14		5993.16	0.046263	1.22	2.58	6.85	0.35	0.78
90	3.14	5991.80	5992.49		5992.53	0.092226	1.60	1.97	5.76	0.48	0.69
89	3.14	5991.25	5992.31		5992.32	0.008521	0.65	4.87	9.32	0.16	1.06
88	7.02	5990.89	5992.19		5992.20	0.013463	0.97	7.27	11.03	0.21	1.30
87	7.02	5990.77	5992.04		5992.06	0.015899	1.01	6.96	10.89	0.22	1.27
86	7.02	5990.66	5991.84		5991.86	0.025077	1.20	5.85	9.88	0.28	1.18
85	7.02	5990.42	5991.55		5991.58	0.030399	1.30	5.42	9.44	0.30	1.13
84	7.02	5990.12	5991.22		5991.24	0.035792	1.34	5.24	9.85	0.32	1.10
83	7.02	5989.83	5990.85		5990.88	0.036060	1.34	5.25	10.02	0.33	1.02
82	7.02	5989.45	5990.50		5990.52	0.035477	1.34	5.25	9.88	0.32	1.05
81	7.02	5989.08	5990.23		5990.25	0.020593	1.11	6.33	10.81	0.25	1.15
80	7.02	5988.75	5990.08		5990.10	0.011997	0.90	7.81	11.76	0.19	1.33
79	7.02	5988.67	5989.95		5989.96	0.014660	0.95	7.36	11.82	0.21	1.28
78	7.02	5988.60	5989.78		5989.80	0.019704	1.05	6.66	11.55	0.24	1.18
77	7.02	5988.46	5989.56		5989.58	0.023413	1.12	6.28	11.36	0.26	1.10
76	7.02	5988.21	5989.36		5989.38	0.017834	1.02	6.89	11.66	0.23	1.15
75	7.02	5987.96	5989.21		5989.22	0.014269	0.94	7.44	11.90	0.21	1.25
74	7.02	5987.78	5989.08		5989.09	0.011916	0.89	7.89	12.04	0.19	1.30
73	7.02	5987.70	5988.95		5988.96	0.014021	0.94	7.46	11.83	0.21	1.25
72	7.02	5987.62	5988.77		5988.79	0.022707	1.12	6.26	10.97	0.26	1.15
71	7.02	5987.43	5988.49		5988.52	0.032162	1.27	5.51	10.35	0.31	1.06
70	7.02	5987.10	5988.18		5988.20	0.030062	1.24	5.66	10.54	0.30	1.08
69	7.02	5986.77	5987.93		5987.94	0.021544	1.10	6.40	11.13	0.26	1.16
68	11.17	5986.35	5987.56		5987.61	0.047547	1.68	6.67	11.12	0.38	1.21
67	11.17	5985.88	5987.07		5987.12	0.050545	1.70	6.58	11.26	0.39	1.19
66	11.17	5985.40	5986.74		5986.77	0.024704	1.30	8.57	12.76	0.28	1.34
65	11.17	5985.19	5986.52		5986.54	0.020332	1.20	9.35	13.74	0.26	1.33
64	11.17	5984.98	5986.31		5986.34	0.021406	1.24	9.04	13.10	0.26	1.33
63	11.17	5984.77	5986.00		5986.04	0.042745	1.61	6.92	11.23	0.36	1.23
62	11.17	5984.31	5985.55		5985.59	0.046016	1.68	6.64	10.69	0.38	1.24
61	11.17	5983.85	5985.14		5985.18	0.036861	1.54	7.24	11.27	0.34	1.29
60	11.17	5983.44	5984.81		5984.84	0.030074	1.44	7.75	11.44	0.31	1.37
59	11.17	5983.13	5984.53		5984.56	0.027038	1.40	7.99	11.38	0.29	1.40
58	11.17	5982.82	5984.28		5984.31	0.022832	1.31	8.51	11.81	0.27	1.46
57	11.17	5982.58	5984.08		5984.10	0.018122	1.25	9.01	12.10	0.25	1.50
56	11.17	5982.41	5983.89		5983.91	0.021047	1.26	8.84	12.14	0.26	1.48
55	11.17	5982.23	5983.67		5983.69	0.022055	1.27	8.79	12.43	0.27	1.44
54	11.17	5982.03	5983.47		5983.49	0.018375	1.20	9.30	12.92	0.25	1.44
53	11.17	5981.83	5983.30		5983.32	0.016770	1.14	9.82	13.36	0.23	1.47
52	11.17	5981.63	5983.16		5983.17	0.012437	1.08	10.44	13.54	0.21	1.53
51	11.17	5981.48	5983.03		5983.04	0.013585	1.10	10.14	12.77	0.21	1.55
50	11.17	5981.35	5982.87		5982.90	0.017027	1.19	9.42	12.08	0.24	1.52
49	11.17	5981.22	5982.64		5982.67	0.029355	1.46	7.65	10.78	0.31	1.42

48	15.30	5980.71	5982.17		5982.25	0.056973	2.23	6.95	9.62	0.43	1.46
47	15.30	5980.10	5981.57		5981.64	0.065604	2.23	6.88	9.44	0.46	1.47
46	15.30	5979.49	5981.05		5981.11	0.043386	2.01	7.71	9.92	0.38	1.56
45	15.30	5979.06	5980.73		5980.77	0.026630	1.54	9.91	11.86	0.30	1.67
44	15.30	5978.85	5980.48		5980.51	0.024803	1.52	10.09	12.04	0.29	1.63
43	15.30	5978.63	5980.22		5980.26	0.026865	1.55	9.89	12.34	0.30	1.59
42	15.30	5978.36	5979.97		5980.00	0.023583	1.46	10.52	13.08	0.28	1.61
41	15.30	5978.06	5979.77		5979.80	0.017645	1.30	11.79	13.56	0.25	1.71
40	15.30	5977.80	5979.63		5979.65	0.012513	1.15	13.33	14.34	0.21	1.83
39	15.30	5977.63	5979.50		5979.52	0.013183	1.16	13.21	14.48	0.21	1.87
38	15.30	5977.58	5979.35		5979.38	0.016453	1.25	12.26	14.23	0.24	1.77
37	15.30	5977.50	5979.16		5979.19	0.021615	1.37	11.14	13.76	0.27	1.66
36	15.30	5977.33	5978.95		5978.98	0.019864	1.33	11.47	13.93	0.26	1.62
35	15.30	5977.10	5978.77		5978.80	0.016890	1.30	11.82	13.91	0.24	1.67
34	15.30	5976.87	5978.61		5978.63	0.016216	1.25	12.25	14.02	0.24	1.74
33	15.30	5976.69	5978.45		5978.48	0.015699	1.23	12.47	14.33	0.23	1.76
32	15.30	5976.51	5978.31		5978.33	0.013650	1.16	13.18	14.84	0.22	1.80
31	15.30	5976.34	5978.19		5978.21	0.010922	1.08	14.20	15.31	0.20	1.85
30	15.30	5976.19	5978.09		5978.11	0.008994	1.00	15.26	15.82	0.18	1.90
29	15.30	5976.04	5978.01		5978.02	0.007516	0.93	16.37	16.23	0.16	1.97
28	19.72	5975.90	5977.91		5977.93	0.012118	1.19	16.61	16.46	0.21	2.01
27	19.72	5975.90	5977.76		5977.79	0.016033	1.30	15.18	16.33	0.24	1.86
26	19.72	5975.82	5977.56		5977.60	0.023625	1.50	13.15	15.27	0.28	1.74
25	19.72	5975.64	5977.29		5977.33	0.029908	1.63	12.09	14.79	0.32	1.65
24	19.72	5975.35	5976.99		5977.03	0.028882	1.60	12.32	15.13	0.31	1.64
23	19.72	5975.05	5976.74		5976.77	0.023366	1.48	13.36	15.76	0.28	1.69
22	19.72	5974.79	5976.55		5976.57	0.016761	1.33	14.84	15.88	0.24	1.76
21	19.72	5974.57	5976.38		5976.41	0.016973	1.33	14.77	15.87	0.24	1.81
20	19.72	5974.36	5976.20		5976.23	0.018688	1.40	14.11	15.21	0.26	1.84
19	19.72	5974.18	5976.00		5976.04	0.019987	1.43	13.83	15.26	0.26	1.82
18	19.72	5974.00	5975.79		5975.82	0.022772	1.47	13.41	15.57	0.28	1.79
17	19.72	5973.84	5975.55		5975.59	0.024684	1.49	13.19	15.96	0.29	1.71
16	19.72	5973.67	5975.33		5975.36	0.020908	1.39	14.18	16.92	0.27	1.66
15	19.72	5973.50	5975.10		5975.14	0.023982	1.45	13.62	16.99	0.29	1.60
14	19.72	5973.30	5974.83		5974.87	0.030354	1.57	12.56	16.57	0.32	1.53
13	19.72	5973.04	5974.52		5974.56	0.031567	1.58	12.49	16.87	0.32	1.48
12	19.72	5972.72	5974.23		5974.27	0.026650	1.48	13.33	17.49	0.30	1.51
11	19.72	5972.40	5974.02		5974.04	0.019001	1.31	15.03	18.37	0.25	1.62
10	19.72	5972.10	5973.82		5973.85	0.020062	1.36	14.49	17.30	0.26	1.72
9	19.72	5971.90	5973.62		5973.65	0.019842	1.40	14.04	15.82	0.26	1.72
8	19.72	5971.60	5973.43		5973.46	0.017127	1.33	14.79	16.11	0.25	1.83
7	19.72	5971.40	5973.25		5973.28	0.019525	1.39	14.15	15.89	0.26	1.85
6	19.72	5971.28	5973.03		5973.06	0.025053	1.50	13.18	16.17	0.29	1.75
5	19.72	5971.13	5972.74		5972.78	0.030905	1.58	12.50	16.57	0.32	1.61
4	19.72	5971.00	5972.19		5972.28	0.092811	2.38	8.28	13.52	0.54	1.19
3	19.72	5970.01	5970.65	5970.61	5970.77	0.282719	2.81	7.02	20.98	0.86	0.64
2	19.72	5967.55	5968.19		5968.28	0.221004	2.42	8.13	25.17	0.75	0.64
1	19.72	5964.39	5965.24	5965.24	5965.46	0.369301	3.74	5.27	12.42	1.01	0.85

Abbreviations:

River Sta River Station
Q Total Total Discharge
Min Ch El Minimum Channel Elevation (Thalweg)
W.S. Elev Water Surface Elevation
Crit W.S. Critical Water Surface Elevation
E.G. Elev Energy Grade Elevation
E.G. Slope Energy Grade Slope
Vel Chnl Channel Velocity

TABLE 13 - HEC-RAS RESULTS
ROCKY FLATS - ORIGINAL LANDFILL
DIVERSION BERM NO. 6: 100-YR STORM EVENT

River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #	Channel Depth, (ft)
108	2.27	5995.84	5996.43		5996.45	0.069347	1.12	2.03	6.91	0.36	0.59
107	2.27	5995.25	5996.08		5996.08	0.022024	0.78	2.91	7.06	0.21	0.83
106	2.27	5995.02	5995.83		5995.85	0.026303	0.83	2.72	6.86	0.23	0.81
105	2.27	5994.80	5995.55		5995.56	0.031183	0.94	2.48	6.63	0.26	0.75
104	2.27	5994.52	5995.24		5995.25	0.030021	1.01	2.40	6.62	0.26	0.72
103	2.27	5994.20	5994.95		5994.96	0.028569	0.90	2.58	6.70	0.25	0.75
102	2.27	5993.89	5994.66		5994.67	0.029239	0.97	2.41	6.21	0.25	0.77
101	2.27	5993.59	5994.36		5994.37	0.031393	0.87	2.61	7.05	0.25	0.77
100	2.27	5993.29	5994.09		5994.10	0.023706	0.82	2.79	7.42	0.22	0.80
99	2.27	5993.03	5993.95		5993.95	0.010329	0.56	4.02	9.07	0.15	0.92
98	2.27	5992.77	5993.91		5993.91	0.002204	0.31	7.22	12.33	0.07	1.14
97	2.27	5992.98	5993.86		5993.87	0.010067	0.55	4.13	9.56	0.15	0.88
96	2.27	5992.87	5993.74		5993.75	0.013226	0.62	3.67	8.68	0.17	0.87
95	2.27	5992.70	5993.64		5993.64	0.008838	0.54	4.20	8.94	0.14	0.94
94	2.27	5992.55	5993.56		5993.56	0.007567	0.52	4.37	8.77	0.13	1.01
93	2.27	5992.51	5993.47		5993.48	0.009495	0.57	4.01	8.38	0.14	0.96
92	2.27	5992.50	5993.35		5993.36	0.016257	0.69	3.27	7.57	0.19	0.85
91	2.27	5992.36	5993.09		5993.11	0.043693	1.00	2.28	6.43	0.29	0.73
90	2.27	5991.80	5992.42		5992.45	0.106456	1.42	1.60	5.19	0.45	0.62
89	2.27	5991.25	5992.22		5992.23	0.009040	0.55	4.09	8.54	0.14	0.97
88	5.08	5990.89	5992.10		5992.11	0.013809	0.80	6.33	10.41	0.18	1.21
87	5.08	5990.77	5991.95		5991.96	0.015699	0.84	6.03	10.15	0.19	1.18
86	5.08	5990.66	5991.75		5991.77	0.025292	1.01	5.02	9.16	0.24	1.09
85	5.08	5990.42	5991.47		5991.49	0.030570	1.09	4.66	8.76	0.26	1.05
84	5.08	5990.12	5991.14		5991.16	0.035802	1.13	4.50	9.06	0.28	1.02
83	5.08	5989.83	5990.78		5990.80	0.036486	1.12	4.52	9.38	0.29	0.95
82	5.08	5989.45	5990.42		5990.44	0.035775	1.13	4.51	9.16	0.28	0.97
81	5.08	5989.08	5990.15		5990.16	0.021860	0.94	5.42	10.02	0.22	1.07
80	5.08	5988.75	5989.99		5990.00	0.011695	0.75	6.79	10.96	0.17	1.24
79	5.08	5988.67	5989.86		5989.87	0.014329	0.80	6.38	10.96	0.18	1.19
78	5.08	5988.60	5989.70		5989.71	0.019617	0.88	5.75	10.71	0.21	1.10
77	5.08	5988.46	5989.48		5989.49	0.023709	0.94	5.39	10.52	0.23	1.02
76	5.08	5988.21	5989.27		5989.29	0.018251	0.86	5.90	10.86	0.21	1.06
75	5.08	5987.96	5989.11		5989.12	0.014333	0.79	6.40	11.06	0.18	1.15
74	5.08	5987.78	5988.99		5989.00	0.011662	0.74	6.85	11.22	0.17	1.21
73	5.08	5987.70	5988.86		5988.87	0.013770	0.79	6.47	11.03	0.18	1.16
72	5.08	5987.62	5988.69		5988.70	0.022571	0.94	5.39	10.13	0.23	1.07
71	5.08	5987.43	5988.42		5988.43	0.032168	1.07	4.74	9.60	0.27	0.99
70	5.08	5987.10	5988.09		5988.11	0.031132	1.05	4.82	9.75	0.26	0.99
69	5.08	5986.77	5987.84		5987.85	0.022326	0.94	5.43	10.24	0.23	1.07
68	8.08	5986.35	5987.48		5987.51	0.047261	1.40	5.75	10.32	0.33	1.13
67	8.08	5985.88	5986.98		5987.01	0.051815	1.44	5.60	10.35	0.35	1.10
66	8.08	5985.40	5986.65		5986.66	0.024535	1.09	7.39	11.84	0.24	1.25
65	8.08	5985.19	5986.42		5986.44	0.020439	1.00	8.07	12.88	0.22	1.23
64	8.08	5984.98	5986.22		5986.23	0.021186	1.03	7.82	12.22	0.23	1.24
63	8.08	5984.77	5985.91		5985.94	0.042775	1.36	5.95	10.42	0.32	1.14
62	8.08	5984.31	5985.46		5985.49	0.046186	1.42	5.71	9.92	0.33	1.15
61	8.08	5983.85	5985.04		5985.07	0.037941	1.31	6.18	10.42	0.30	1.19
60	8.08	5983.44	5984.71		5984.73	0.030135	1.21	6.67	10.60	0.27	1.27
59	8.08	5983.13	5984.43		5984.45	0.026771	1.17	6.91	10.57	0.26	1.30
58	8.08	5982.82	5984.18		5984.20	0.022529	1.09	7.40	11.04	0.23	1.36
57	8.08	5982.58	5983.98		5984.00	0.018762	1.03	7.84	11.25	0.22	1.40
56	8.08	5982.41	5983.78		5983.80	0.020736	1.06	7.65	11.27	0.23	1.37
55	8.08	5982.23	5983.57		5983.59	0.021805	1.06	7.60	11.56	0.23	1.34
54	8.08	5982.03	5983.37		5983.38	0.018745	1.01	8.03	12.00	0.22	1.34
53	8.08	5981.83	5983.20		5983.21	0.016553	0.95	8.49	12.41	0.20	1.37
52	8.08	5981.63	5983.05		5983.07	0.012894	0.89	9.10	12.64	0.18	1.42
51	8.08	5981.48	5982.92		5982.93	0.014128	0.92	8.80	12.07	0.19	1.44
50	8.08	5981.35	5982.76		5982.78	0.016880	0.99	8.14	11.26	0.21	1.41
49	8.08	5981.22	5982.53		5982.56	0.029977	1.24	6.54	9.98	0.27	1.31

48	11.07	5980.71	5982.08		5982.13	0.056799	1.82	6.11	9.00	0.37	1.37
47	11.07	5980.10	5981.47		5981.52	0.065018	1.85	5.98	8.80	0.40	1.37
46	11.07	5979.49	5980.94		5980.99	0.044364	1.67	6.69	9.24	0.33	1.45
45	11.07	5979.06	5980.62		5980.64	0.026256	1.29	8.58	11.05	0.26	1.56
44	11.07	5978.85	5980.37		5980.39	0.024549	1.26	8.80	11.25	0.25	1.52
43	11.07	5978.63	5980.11		5980.13	0.027085	1.29	8.57	11.55	0.26	1.48
42	11.07	5978.36	5979.85		5979.87	0.024745	1.23	9.02	12.09	0.25	1.49
41	11.07	5978.06	5979.65		5979.66	0.017743	1.09	10.13	12.59	0.21	1.59
40	11.07	5977.80	5979.50		5979.52	0.012401	0.96	11.57	13.38	0.18	1.70
39	11.07	5977.63	5979.38		5979.39	0.012740	0.96	11.49	13.40	0.18	1.75
38	11.07	5977.58	5979.23		5979.25	0.016144	1.04	10.63	13.23	0.20	1.65
37	11.07	5977.50	5979.04		5979.06	0.021668	1.15	9.59	12.79	0.23	1.54
36	11.07	5977.33	5978.84		5978.86	0.019978	1.12	9.89	13.02	0.23	1.51
35	11.07	5977.10	5978.65		5978.67	0.017852	1.09	10.15	12.89	0.22	1.55
34	11.07	5976.87	5978.48		5978.50	0.016291	1.05	10.53	13.00	0.21	1.61
33	11.07	5976.69	5978.32		5978.34	0.015864	1.04	10.69	13.26	0.20	1.63
32	11.07	5976.51	5978.18		5978.19	0.013791	0.98	11.31	13.76	0.19	1.67
31	11.07	5976.34	5978.06		5978.07	0.011150	0.91	12.22	14.25	0.17	1.72
30	11.07	5976.19	5977.96		5977.97	0.009131	0.84	13.18	14.80	0.16	1.77
29	11.07	5976.04	5977.88		5977.88	0.007439	0.78	14.21	15.33	0.14	1.84
28	14.27	5975.90	5977.77		5977.79	0.011804	0.98	14.50	15.56	0.18	1.87
27	14.27	5975.90	5977.64		5977.65	0.015670	1.08	13.18	15.22	0.20	1.74
26	14.27	5975.82	5977.44		5977.46	0.023408	1.26	11.37	14.20	0.25	1.62
25	14.27	5975.64	5977.17		5977.20	0.029887	1.37	10.41	13.72	0.28	1.53
24	14.27	5975.35	5976.87		5976.90	0.029014	1.35	10.58	13.98	0.27	1.52
23	14.27	5975.05	5976.61		5976.64	0.024258	1.25	11.42	14.82	0.25	1.56
22	14.27	5974.79	5976.42		5976.44	0.017085	1.11	12.81	15.17	0.21	1.63
21	14.27	5974.57	5976.25		5976.27	0.017093	1.12	12.76	14.97	0.21	1.68
20	14.27	5974.36	5976.07		5976.09	0.018422	1.17	12.22	14.16	0.22	1.71
19	14.27	5974.18	5975.88		5975.90	0.019611	1.19	12.00	14.17	0.23	1.70
18	14.27	5974.00	5975.67		5975.69	0.022401	1.23	11.60	14.43	0.24	1.67
17	14.27	5973.84	5975.44		5975.46	0.024454	1.25	11.40	14.82	0.25	1.60
16	14.27	5973.67	5975.21		5975.23	0.020557	1.16	12.30	15.80	0.23	1.54
15	14.27	5973.50	5974.99		5975.02	0.023769	1.21	11.79	15.87	0.25	1.49
14	14.27	5973.30	5974.72		5974.75	0.030195	1.32	10.83	15.36	0.28	1.42
13	14.27	5973.04	5974.41		5974.44	0.031888	1.33	10.73	15.67	0.28	1.37
12	14.27	5972.72	5974.12		5974.14	0.027387	1.25	11.38	16.21	0.26	1.40
11	14.27	5972.40	5973.89		5973.91	0.019557	1.11	12.88	17.15	0.23	1.49
10	14.27	5972.10	5973.69		5973.71	0.020759	1.15	12.37	16.13	0.23	1.59
9	14.27	5971.90	5973.49		5973.51	0.019620	1.18	12.09	14.54	0.23	1.59
8	14.27	5971.60	5973.31		5973.33	0.016840	1.11	12.82	14.99	0.21	1.71
7	14.27	5971.40	5973.13		5973.15	0.018975	1.16	12.29	14.74	0.22	1.73
6	14.27	5971.28	5972.91		5972.93	0.024760	1.25	11.38	14.88	0.25	1.63
5	14.27	5971.13	5972.64		5972.66	0.030748	1.32	10.77	15.34	0.28	1.51
4	14.27	5971.00	5972.12		5972.18	0.083687	1.93	7.40	12.77	0.45	1.12
3	14.27	5970.01	5970.58	5970.53	5970.68	0.344902	2.52	5.67	19.23	0.82	0.57
2	14.27	5967.55	5968.16		5968.22	0.184064	1.89	7.55	24.57	0.60	0.61
1	14.27	5964.39	5965.13	5965.13	5965.33	0.515260	3.56	4.01	10.82	1.03	0.74

Abbreviations:

River Sta River Station
Q Total Total Discharge
Min Ch El Minimum Channel Elevation (Thalweg)
W.S. Elev Water Surface Elevation
Crit W.S. Critical Water Surface Elevation
E.G. Elev Energy Grade Elevation
E.G. Slope Energy Grade Slope
Vel Chnl Channel Velocity

TABLE 14 - HEC-RAS RESULTS
ROCKY FLATS - ORIGINAL LANDFILL
DIVERSION BERM NO. 7: 1000-YR STORM EVENT

River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #	Channel Depth, (ft)
99	3.18	5977.40	5978.03		5978.07	0.096858	1.62	1.97	6.20	0.49	0.63
98	3.18	5976.70	5977.43		5977.45	0.043165	1.19	2.67	6.94	0.34	0.73
97	3.18	5976.30	5977.10		5977.11	0.027632	1.02	3.12	7.59	0.28	0.80
96	3.18	5975.96	5976.88		5976.89	0.017338	0.85	3.74	8.06	0.22	0.92
95	3.18	5975.79	5976.71		5976.72	0.017672	0.85	3.73	8.17	0.22	0.92
94	3.18	5975.63	5976.49		5976.51	0.025424	0.97	3.28	7.77	0.26	0.86
93	3.18	5975.44	5976.18		5976.20	0.038555	1.11	2.86	7.54	0.32	0.74
92	3.18	5975.08	5975.82		5975.84	0.034045	1.04	3.07	8.24	0.30	0.74
91	3.18	5974.72	5975.45		5975.47	0.037467	1.08	2.96	8.05	0.31	0.73
90	3.18	5974.36	5975.12		5975.13	0.031026	1.02	3.12	8.27	0.29	0.76
89	3.18	5974.00	5974.79		5974.81	0.033632	1.06	2.99	7.61	0.30	0.79
88	3.18	5973.66	5974.59		5974.60	0.014035	0.77	4.13	8.84	0.20	0.93
87	3.18	5973.50	5974.44		5974.45	0.016980	0.85	3.75	7.97	0.22	0.94
86	3.18	5973.35	5974.23		5974.24	0.024535	0.97	3.28	7.52	0.26	0.88
85	3.18	5973.11	5973.98		5973.99	0.024418	0.97	3.29	7.54	0.26	0.87
84	3.18	5972.86	5973.72		5973.74	0.027759	1.02	3.12	7.31	0.27	0.86
83	3.18	5972.60	5973.46		5973.47	0.024784	0.96	3.31	7.78	0.26	0.86
82	3.18	5972.33	5973.24		5973.25	0.018805	0.87	3.64	8.03	0.23	0.91
81	3.18	5972.06	5973.13		5973.14	0.007718	0.63	5.06	9.54	0.15	1.07
80	3.18	5971.85	5973.08		5973.09	0.003341	0.46	6.97	11.19	0.10	1.23
79	7.01	5971.72	5972.99		5973.00	0.013863	0.94	7.45	11.70	0.21	1.27
78	7.01	5971.59	5972.85		5972.86	0.014686	0.96	7.31	11.64	0.21	1.26
77	7.01	5971.43	5972.69		5972.71	0.017043	1.03	6.84	10.98	0.23	1.26
76	7.01	5971.22	5972.53		5972.54	0.015700	1.00	7.03	11.06	0.22	1.31
75	7.01	5971.00	5972.40		5972.42	0.010533	0.87	8.05	11.60	0.18	1.40
74	7.01	5970.88	5972.31		5972.32	0.008443	0.81	8.70	11.81	0.17	1.43
73	7.01	5970.83	5972.22		5972.23	0.009128	0.82	8.53	11.95	0.17	1.39
72	7.01	5970.78	5972.12		5972.13	0.011076	0.87	8.04	11.99	0.19	1.34
71	7.01	5970.69	5972.00		5972.01	0.014275	0.95	7.35	11.54	0.21	1.31
70	7.01	5970.54	5971.85		5971.86	0.015669	1.00	7.03	11.02	0.22	1.31
69	7.01	5970.39	5971.69		5971.71	0.014542	0.99	7.07	10.78	0.21	1.30
68	7.01	5970.25	5971.54		5971.56	0.015910	1.02	6.89	10.70	0.22	1.29
67	7.01	5970.10	5971.38		5971.40	0.016992	1.04	6.76	10.61	0.23	1.28
66	7.01	5969.96	5971.18		5971.20	0.022176	1.15	6.12	10.12	0.26	1.22
65	7.01	5969.77	5970.92		5970.95	0.029081	1.26	5.56	9.76	0.29	1.15
64	7.01	5969.49	5970.65		5970.68	0.025559	1.20	5.85	10.06	0.28	1.16
63	7.01	5969.21	5970.42		5970.44	0.021822	1.13	6.23	10.46	0.26	1.21
62	7.01	5968.93	5970.26		5970.27	0.012528	0.92	7.65	11.53	0.20	1.33
61	7.01	5968.76	5970.16		5970.17	0.008934	0.80	8.72	12.45	0.17	1.40
60	7.01	5968.61	5970.08		5970.09	0.006802	0.73	9.61	12.90	0.15	1.47
59	10.74	5968.45	5969.97		5969.98	0.015279	1.10	9.76	12.95	0.22	1.52
58	10.74	5968.34	5969.82		5969.83	0.014752	1.08	9.95	13.40	0.22	1.48
57	10.74	5968.23	5969.66		5969.68	0.017695	1.14	9.39	13.17	0.24	1.43
56	10.74	5968.10	5969.42		5969.45	0.029472	1.38	7.77	12.03	0.30	1.32
55	10.74	5967.84	5969.13		5969.16	0.030053	1.39	7.72	12.01	0.31	1.29
54	10.74	5967.53	5968.85		5968.88	0.025165	1.30	8.26	12.48	0.28	1.32
53	10.74	5967.21	5968.65		5968.67	0.017569	1.16	9.29	12.74	0.24	1.44
52	10.74	5966.98	5968.48		5968.50	0.016160	1.13	9.51	12.67	0.23	1.50
51	10.74	5966.83	5968.30		5968.32	0.019680	1.21	8.85	12.25	0.25	1.47
50	10.74	5966.69	5968.07		5968.10	0.026306	1.35	7.93	11.60	0.29	1.38
49	10.74	5966.45	5967.77		5967.80	0.032747	1.46	7.34	11.24	0.32	1.32
48	10.74	5966.14	5967.42		5967.46	0.035462	1.52	7.05	10.81	0.33	1.28
47	10.74	5965.84	5967.07		5967.11	0.035264	1.55	6.95	10.81	0.33	1.23
46	10.74	5965.53	5966.75		5966.78	0.031081	1.45	7.39	10.96	0.31	1.22
45	10.74	5965.23	5966.28		5966.33	0.067410	1.91	5.64	10.00	0.45	1.05
44	10.74	5964.30	5966.04		5966.06	0.013929	0.90	11.35	15.87	0.18	1.74
43	10.74	5964.60	5965.84		5965.87	0.025115	1.34	8.00	11.68	0.28	1.24
42	10.74	5964.30	5965.50		5965.54	0.043904	1.62	6.64	10.95	0.37	1.20
41	10.74	5963.85	5965.01		5965.05	0.055229	1.76	6.12	10.66	0.41	1.16
40	10.74	5963.31	5964.57		5964.60	0.036465	1.51	7.13	11.36	0.34	1.26

39	15.23	5962.76	5964.14		5964.19	0.045296	1.79	8.51	12.32	0.38	1.38
38	15.23	5962.40	5963.72		5963.76	0.040671	1.70	8.95	12.94	0.36	1.32
37	15.23	5962.00	5963.35		5963.39	0.033724	1.57	9.70	13.80	0.33	1.35
36	15.23	5961.55	5963.12		5963.15	0.017403	1.23	12.41	15.72	0.24	1.57
35	15.23	5961.30	5962.97		5962.99	0.013504	1.11	13.75	16.61	0.21	1.67
34	15.23	5961.25	5962.80		5962.83	0.020612	1.30	11.73	15.33	0.26	1.55
33	15.23	5961.20	5962.52		5962.56	0.035466	1.49	10.24	16.56	0.33	1.32
32	15.23	5960.92	5962.15		5962.18	0.038923	1.54	9.89	16.24	0.35	1.23
31	15.23	5960.53	5961.76		5961.80	0.037859	1.47	9.98	16.24	0.33	1.23
30	15.23	5960.14	5961.40		5961.43	0.034646	1.49	10.25	16.23	0.33	1.26
29	15.23	5959.79	5961.10		5961.13	0.025910	1.32	11.51	17.46	0.29	1.31
28	15.23	5959.54	5960.86		5960.88	0.023697	1.27	11.98	18.08	0.28	1.32
27	15.23	5959.30	5960.64		5960.66	0.020663	1.21	12.57	18.41	0.26	1.34
26	15.23	5959.05	5960.42		5960.45	0.023185	1.28	11.94	17.62	0.27	1.37
25	15.23	5958.78	5960.18		5960.21	0.023715	1.32	11.53	16.36	0.28	1.40
24	15.23	5958.50	5959.98		5960.00	0.019198	1.22	12.48	17.02	0.25	1.48
23	15.23	5958.26	5959.79		5959.82	0.017675	1.20	12.71	16.70	0.24	1.53
22	15.23	5958.09	5959.60		5959.63	0.020262	1.27	11.97	15.92	0.26	1.51
21	15.23	5957.92	5959.37		5959.40	0.025414	1.40	10.89	14.90	0.29	1.45
20	15.23	5957.70	5959.09		5959.13	0.030070	1.48	10.29	14.69	0.31	1.39
19	20.37	5957.27	5958.72		5958.77	0.040228	1.78	11.45	15.44	0.36	1.45
18	20.37	5956.90	5958.36		5958.41	0.032867	1.66	12.25	15.73	0.33	1.46
17	20.37	5956.46	5958.06		5958.10	0.029732	1.61	12.69	15.89	0.32	1.60
16	20.37	5956.10	5957.79		5957.83	0.023729	1.49	13.68	16.16	0.29	1.69
15	20.37	5955.81	5957.59		5957.62	0.018708	1.37	14.82	16.49	0.26	1.78
14	20.37	5955.52	5957.42		5957.44	0.016264	1.32	15.45	16.43	0.24	1.90
13	20.37	5955.39	5957.25		5957.28	0.017199	1.35	15.06	16.06	0.25	1.86
12	20.37	5955.25	5957.06		5957.09	0.019874	1.43	14.29	15.71	0.26	1.81
11	20.37	5955.11	5956.81		5956.85	0.029057	1.65	12.36	14.53	0.31	1.70
10	20.37	5954.83	5956.52		5956.56	0.029603	1.66	12.27	14.46	0.32	1.69
9	20.37	5954.54	5956.21		5956.26	0.031054	1.69	12.02	14.20	0.32	1.67
8	20.37	5954.25	5955.89		5955.94	0.033195	1.74	11.70	13.91	0.33	1.64
7	20.37	5953.90	5955.54		5955.59	0.036251	1.82	11.20	13.34	0.35	1.64
6	20.37	5953.54	5955.17		5955.22	0.036982	1.82	11.22	13.65	0.35	1.63
5	20.37	5953.18	5954.77		5954.82	0.042240	1.90	10.72	13.48	0.38	1.59
4	20.37	5952.75	5954.31		5954.37	0.048290	2.01	10.14	12.95	0.40	1.56
3	20.37	5952.30	5953.86		5953.92	0.042349	1.92	10.62	13.35	0.38	1.56
2	20.37	5951.77	5952.90	5952.80	5953.09	0.219814	3.48	5.85	10.24	0.81	1.13
1	20.37	5948.98	5949.97	5949.97	5950.31	0.357637	4.69	4.35	6.43	1.00	0.99

Abbreviations:

River Sta	River Station
Q Total	Total Discharge
Min Ch El	Minimum Channel Elevation (Thalweg)
W.S. Elev	Water Surface Elevation
Crit W.S.	Critical Water Surface Elevation
E.G. Elev	Energy Grade Elevation
E.G. Slope	Energy Grade Slope
Vel Chnl	Channel Velocity

TABLE 15 - HEC-RAS RESULTS
ROCKY FLATS - ORIGINAL LANDFILL
DIVERSION BERM NO. 7: 100-YR STORM EVENT

River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #	Channel Depth, (ft)
99	2.30	5977.40	5977.99		5978.02	0.098462	1.33	1.72	5.82	0.43	0.59
98	2.30	5976.70	5977.38		5977.40	0.042557	0.99	2.32	6.50	0.29	0.68
97	2.30	5976.30	5977.03		5977.04	0.029652	0.87	2.65	7.02	0.25	0.73
96	2.30	5975.96	5976.82		5976.83	0.017119	0.71	3.23	7.49	0.19	0.86
95	2.30	5975.79	5976.64		5976.65	0.017399	0.71	3.24	7.62	0.19	0.85
94	2.30	5975.63	5976.43		5976.44	0.025154	0.81	2.84	7.22	0.23	0.80
93	2.30	5975.44	5976.13		5976.14	0.038009	0.93	2.47	7.02	0.28	0.69
92	2.30	5975.08	5975.77		5975.78	0.034279	0.87	2.64	7.63	0.26	0.69
91	2.30	5974.72	5975.40		5975.42	0.037268	0.90	2.55	7.48	0.27	0.68
90	2.30	5974.36	5975.06		5975.07	0.031363	0.86	2.69	7.68	0.25	0.70
89	2.30	5974.00	5974.73		5974.74	0.035075	0.91	2.54	7.00	0.27	0.73
88	2.30	5973.66	5974.53		5974.53	0.013949	0.65	3.56	8.21	0.17	0.87
87	2.30	5973.50	5974.37		5974.38	0.016580	0.71	3.26	7.43	0.19	0.87
86	2.30	5973.35	5974.17		5974.18	0.024352	0.81	2.83	7.00	0.22	0.82
85	2.30	5973.11	5973.92		5973.93	0.023997	0.81	2.85	7.03	0.22	0.81
84	2.30	5972.86	5973.66		5973.67	0.028275	0.86	2.67	6.74	0.24	0.80
83	2.30	5972.60	5973.39		5973.40	0.025890	0.82	2.81	7.18	0.23	0.79
82	2.30	5972.33	5973.16		5973.17	0.020390	0.76	3.04	7.34	0.21	0.83
81	2.30	5972.06	5973.04		5973.04	0.008588	0.54	4.23	8.77	0.14	0.98
80	2.30	5971.85	5972.99		5972.99	0.003457	0.39	5.95	10.40	0.09	1.14
79	5.07	5971.72	5972.90		5972.91	0.013892	0.79	6.41	10.86	0.18	1.18
78	5.07	5971.59	5972.76		5972.77	0.014832	0.81	6.27	10.78	0.19	1.17
77	5.07	5971.43	5972.60		5972.61	0.017332	0.87	5.85	10.15	0.20	1.17
76	5.07	5971.22	5972.43		5972.44	0.016017	0.84	6.01	10.20	0.19	1.21
75	5.07	5971.00	5972.30		5972.31	0.010673	0.73	6.94	10.77	0.16	1.30
74	5.07	5970.88	5972.21		5972.22	0.008175	0.67	7.58	11.01	0.14	1.33
73	5.07	5970.83	5972.13		5972.13	0.008915	0.68	7.42	11.17	0.15	1.30
72	5.07	5970.78	5972.03		5972.04	0.011038	0.73	6.95	11.15	0.16	1.25
71	5.07	5970.69	5971.90		5971.91	0.014212	0.80	6.32	10.63	0.18	1.21
70	5.07	5970.54	5971.75		5971.77	0.015488	0.84	6.06	10.20	0.19	1.21
69	5.07	5970.39	5971.61		5971.62	0.014601	0.83	6.14	10.04	0.19	1.22
68	5.07	5970.25	5971.45		5971.46	0.015909	0.85	5.96	9.96	0.19	1.20
67	5.07	5970.10	5971.29		5971.30	0.016672	0.87	5.86	9.87	0.20	1.19
66	5.07	5969.96	5971.10		5971.11	0.021897	0.96	5.30	9.44	0.22	1.14
65	5.07	5969.77	5970.84		5970.86	0.029208	1.06	4.78	9.03	0.26	1.07
64	5.07	5969.49	5970.57		5970.58	0.025771	1.01	5.02	9.32	0.24	1.08
63	5.07	5969.21	5970.32		5970.34	0.022871	0.96	5.27	9.63	0.23	1.11
62	5.07	5968.93	5970.16		5970.17	0.012919	0.78	6.51	10.64	0.18	1.23
61	5.07	5968.76	5970.05		5970.06	0.009149	0.68	7.45	11.54	0.15	1.29
60	5.07	5968.61	5969.97		5969.98	0.006811	0.61	8.27	11.99	0.13	1.36
59	7.77	5968.45	5969.86		5969.88	0.014940	0.92	8.48	12.08	0.19	1.41
58	7.77	5968.34	5969.72		5969.73	0.014654	0.90	8.64	12.52	0.19	1.38
57	7.77	5968.23	5969.56		5969.57	0.017350	0.95	8.14	12.26	0.21	1.33
56	7.77	5968.10	5969.33		5969.35	0.029541	1.16	6.69	11.15	0.26	1.23
55	7.77	5967.84	5969.03		5969.05	0.030359	1.17	6.62	11.11	0.27	1.19
54	7.77	5967.53	5968.75		5968.77	0.026269	1.11	7.00	11.50	0.25	1.22
53	7.77	5967.21	5968.54		5968.55	0.017800	0.98	7.97	11.83	0.21	1.33
52	7.77	5966.98	5968.38		5968.39	0.015894	0.94	8.24	11.79	0.20	1.40
51	7.77	5966.83	5968.20		5968.22	0.019366	1.01	7.66	11.40	0.22	1.37
50	7.77	5966.69	5967.97		5967.99	0.025838	1.13	6.87	10.77	0.25	1.28
49	7.77	5966.45	5967.68		5967.70	0.032454	1.22	6.35	10.46	0.28	1.23
48	7.77	5966.14	5967.34		5967.36	0.034433	1.26	6.15	10.08	0.28	1.20
47	7.77	5965.84	5966.99		5967.01	0.036534	1.28	6.05	10.12	0.29	1.15
46	7.77	5965.53	5966.66		5966.68	0.030150	1.20	6.45	10.29	0.27	1.13
45	7.77	5965.23	5966.19		5966.23	0.071570	1.63	4.78	9.34	0.40	0.96
44	7.77	5964.30	5965.94		5965.95	0.013814	0.76	9.82	14.79	0.16	1.64
43	7.77	5964.60	5965.75		5965.77	0.025175	1.12	6.95	10.85	0.25	1.15
42	7.77	5964.30	5965.42		5965.45	0.043466	1.35	5.74	10.17	0.32	1.12
41	7.77	5963.85	5964.92		5964.95	0.056319	1.48	5.24	9.87	0.36	1.07
40	7.77	5963.31	5964.47		5964.50	0.037884	1.28	6.05	10.47	0.30	1.16

39	11.02	5962.76	5964.04		5964.08	0.045083	1.50	7.34	11.46	0.33	1.28
38	11.02	5962.40	5963.62		5963.65	0.040507	1.43	7.73	12.08	0.31	1.22
37	11.02	5962.00	5963.24		5963.27	0.034247	1.32	8.32	12.82	0.29	1.24
36	11.02	5961.55	5963.01		5963.03	0.017600	1.03	10.74	14.73	0.21	1.46
35	11.02	5961.30	5962.86		5962.88	0.012957	0.92	12.03	15.53	0.18	1.56
34	11.02	5961.25	5962.70		5962.72	0.019656	1.07	10.29	14.35	0.22	1.45
33	11.02	5961.20	5962.44		5962.46	0.035366	1.25	8.84	15.36	0.29	1.24
32	11.02	5960.92	5962.06		5962.08	0.038937	1.29	8.52	15.06	0.30	1.14
31	11.02	5960.53	5961.67		5961.70	0.037804	1.24	8.59	15.06	0.29	1.14
30	11.02	5960.14	5961.31		5961.33	0.034656	1.25	8.83	15.07	0.29	1.17
29	11.02	5959.79	5961.01		5961.03	0.025843	1.11	9.92	16.22	0.25	1.22
28	11.02	5959.54	5960.76		5960.78	0.023734	1.07	10.31	16.78	0.24	1.22
27	11.02	5959.30	5960.54		5960.56	0.020862	1.02	10.83	17.21	0.23	1.24
26	11.02	5959.05	5960.32		5960.34	0.023469	1.08	10.23	16.31	0.24	1.27
25	11.02	5958.78	5960.08		5960.10	0.024075	1.11	9.88	15.20	0.24	1.30
24	11.02	5958.50	5959.87		5959.88	0.019393	1.03	10.70	15.76	0.22	1.37
23	11.02	5958.26	5959.69		5959.70	0.017607	1.01	10.96	15.52	0.21	1.43
22	11.02	5958.09	5959.50		5959.52	0.020087	1.07	10.33	14.76	0.22	1.41
21	11.02	5957.92	5959.27		5959.29	0.025417	1.17	9.39	13.87	0.25	1.35
20	11.02	5957.70	5958.99		5959.01	0.030359	1.25	8.79	13.42	0.27	1.29
19	14.74	5957.27	5958.62		5958.65	0.040389	1.50	9.85	14.34	0.32	1.35
18	14.74	5956.90	5958.25		5958.28	0.033164	1.40	10.56	14.73	0.29	1.35
17	14.74	5956.46	5957.93		5957.96	0.030470	1.36	10.81	14.62	0.28	1.47
16	14.74	5956.10	5957.67		5957.69	0.024246	1.26	11.70	14.97	0.25	1.57
15	14.74	5955.81	5957.46		5957.48	0.019012	1.16	12.72	15.37	0.22	1.65
14	14.74	5955.52	5957.28		5957.30	0.016140	1.10	13.35	15.28	0.21	1.76
13	14.74	5955.39	5957.12		5957.14	0.016950	1.13	13.04	14.94	0.21	1.73
12	14.74	5955.25	5956.93		5956.96	0.019648	1.19	12.37	14.63	0.23	1.68
11	14.74	5955.11	5956.69		5956.72	0.028967	1.38	10.66	13.50	0.27	1.58
10	14.74	5954.83	5956.40		5956.43	0.029311	1.39	10.60	13.43	0.28	1.57
9	14.74	5954.54	5956.10		5956.13	0.030812	1.42	10.41	13.34	0.28	1.56
8	14.74	5954.25	5955.77		5955.81	0.033407	1.45	10.14	13.26	0.29	1.52
7	14.74	5953.90	5955.42		5955.46	0.036278	1.52	9.69	12.58	0.31	1.52
6	14.74	5953.54	5955.06		5955.09	0.036478	1.52	9.71	12.71	0.31	1.52
5	14.74	5953.18	5954.66		5954.70	0.042069	1.59	9.26	12.56	0.33	1.48
4	14.74	5952.75	5954.20		5954.24	0.048032	1.69	8.75	12.03	0.35	1.45
3	14.74	5952.30	5953.74		5953.78	0.044473	1.63	9.03	12.32	0.34	1.44
2	14.74	5951.77	5952.85	5952.68	5952.97	0.185453	2.75	5.37	9.81	0.65	1.08
1	14.74	5948.98	5949.81	5949.81	5950.11	0.491121	4.34	3.40	6.05	1.02	0.83

Abbreviations:

River Sta	River Station
Q Total	Total Discharge
Min Ch El	Minimum Channel Elevation (Thalweg)
W.S. Elev	Water Surface Elevation
Crit W.S.	Critical Water Surface Elevation
E.G. Elev	Energy Grade Elevation
E.G. Slope	Energy Grade Slope
Vel Chnl	Channel Velocity

Table 16
HEC-RAS Input

	Manning's (n)	
	100-YR	**1,000-YR**
DB-1	0.189	0.1669
DB-2	0.1587	0.1401
DB-3	0.1796	0.1585
DB-4	0.1533	0.1354
DB-5	0.1533	0.1354
DB-6	0.1533	0.1354
DB-7	0.1533	0.1354

Notes:
1) See Ref B for Manning's values for Class B retardant.
2) Ref. B includese Appendix D of the May 2005 Kaiser Hill Final Design Report.
3) Values from this table have been inputted into the HEC-RAS model. Portions of the model output are found in Ref. D.

TABLE 17 - HEC-RAS CHANNEL DEPTH SUMMARY
ROCKY FLATS - ORIGINAL LANDFILL
DIVERSION BERM NO. 1

Station	1,000-YR Channel Depth, ft		100-YR Channel Depth, ft		Freeboard, ft	
Sub-Basin C						
54	1.16		1.08		0.08	
53	1.04		0.97		0.07	
52	1.01		0.94		0.07	
51	1.04		0.96		0.08	
50	1.00		0.93		0.07	
49	1.02		0.94		0.08	
48	1.08		1.00		0.08	
47	1.22		1.14		0.08	
46	1.34		1.26		0.08	
45	1.30		1.21		0.09	
44	1.19		1.11		0.08	
43	1.07		1.00		0.07	
42	1.05		0.98		0.07	
41	1.02		0.95		0.07	
40	0.94		0.86		0.08	
39	1.01		0.93		0.08	
38	1.03		0.94		0.09	
37	1.15		1.05		0.10	
36	1.29	**1.12**	1.19	**1.04**	0.10	**AVG. DEPTH**
35	1.46	**1.46**	1.35	**1.35**	0.11	**MAX. DEPTH**
Sub-Basin B						
34	1.54		1.44		0.10	
33	1.51		1.40		0.11	
32	1.48		1.37		0.11	
31	1.51		1.40		0.11	
30	1.53		1.41		0.12	
29	1.59		1.47		0.12	
28	1.68		1.56		0.12	
27	1.65		1.54		0.11	
26	1.56		1.45		0.11	
25	1.43		1.33		0.10	
24	1.35		1.24		0.11	
23	1.37		1.27		0.10	
22	1.42		1.32		0.10	
21	1.44		1.34		0.10	
20	1.49		1.38		0.11	
19	1.52		1.42		0.10	
18	1.47		1.37		0.10	
17	1.40		1.30		0.10	
16	1.32	**1.48**	1.22	**1.38**	0.10	**AVG. DEPTH**
15	1.43	**1.68**	1.32	**1.56**	0.11	**MAX. DEPTH**
Sub-Basin A						
14	1.45		1.34		0.11	
13	1.45		1.35		0.10	

12	1.48		1.37		0.11	
11	1.40		1.30		0.10	
10	1.17		1.08		0.09	
9	1.14		1.04		0.10	
8	1.37		1.27		0.10	
7	1.28		1.19		0.09	
6	1.29		1.20		0.09	
5	1.32		1.23		0.09	
4	1.15		1.07		0.08	
3	0.73		0.66		0.07	
2	0.84	**1.18**	0.80	**1.09**	0.04	**AVG. DEPTH**
1	0.44	**1.48**	0.39	**1.37**	0.05	**MAX. DEPTH**

Note:
Figures 2 - 8D show the sections of existing diversion berm which are lower than the estimated channel depth.

TABLE 18 - HEC-RAS CHANNEL DEPTH SUMMARY
ROCKY FLATS - ORIGINAL LANDFILL
DIVERSION BERM NO. 2

Station	1,000-YR Channel Depth, ft		100-YR Channel Depth, ft		Freeboard, ft	
Sub-Basin C						
57	0.73		0.67		0.06	
56	0.88		0.82		0.06	
55	1.02		0.95		0.07	
54	1.06		0.98		0.08	
53	1.09		1.01		0.08	
52	1.11		1.04		0.07	
51	1.10		1.02		0.08	
50	1.15		1.07		0.08	
49	1.21		1.13		0.08	
48	1.27		1.19		0.08	
47	1.28		1.18		0.10	
46	1.41		1.31		0.10	
45	1.47		1.37		0.10	
44	1.51		1.41		0.10	
43	1.57		1.47		0.10	
42	1.53		1.42		0.11	
41	1.44		1.34		0.10	
40	1.32		1.22		0.10	
39	1.36	**1.25**	1.26	**1.16**	0.10	**AVG. DEPTH**
38	1.43	**1.57**	1.32	**1.47**	0.11	**MAX. DEPTH**
Sub-Basin B						
37	1.42		1.32		0.10	
36	1.48		1.37		0.11	
35	1.54		1.44		0.10	
34	1.62		1.52		0.10	
33	1.59		1.49		0.10	
32	1.48		1.38		0.10	
31	1.35		1.25		0.10	
30	1.41		1.31		0.10	
29	1.53		1.42		0.11	
28	1.60		1.49		0.11	
27	1.64		1.53		0.11	
26	1.69		1.58		0.11	
25	1.65		1.54		0.11	
24	1.62		1.52		0.10	
23	1.52		1.43		0.09	
22	1.46		1.37		0.09	
21	1.34		1.25		0.09	
20	1.34		1.24		0.10	
19	1.46	**1.52**	1.35	**1.42**	0.11	**AVG. DEPTH**
18	1.62	**1.69**	1.50	**1.58**	0.12	**MAX. DEPTH**
Sub-Basin A						
17	1.61		1.51		0.10	
16	1.53		1.43		0.10	

15	1.41		1.31		0.10	
14	1.41		1.31		0.10	
13	1.43		1.32		0.11	
12	1.47		1.37		0.10	
11	1.44		1.34		0.10	
10	1.28		1.19		0.09	
9	1.24		1.16		0.08	
8	1.22		1.12		0.10	
7	1.38		1.28		0.10	
6	1.45		1.35		0.10	
5	1.47		1.36		0.11	
4	1.46		1.35		0.11	
3	1.57		1.45		0.12	
2	1.66	**1.42**	1.55	**1.31**	0.11	**AVG. DEPTH**
1	1.06	**1.66**	0.93	**1.55**	0.13	**MAX. DEPTH**

Note:
Figures 2 - 8D show the sections of existing diversion berm which are lower than the estimated channel depth.

TABLE 19 - HEC-RAS CHANNEL DEPTH SUMMARY
ROCKY FLATS - ORIGINAL LANDFILL
DIVERSION BERM NO. 3

Station	1,000-YR Channel Depth, ft		100-YR Channel Depth, ft		Freeboard, ft	
Sub-Basin B						
41	0.88		0.82		0.06	
40	1.04		0.96		0.08	
39	1.04		0.96		0.08	
38	1.25		1.16		0.09	
37	0.65		0.55		0.10	
36	0.99		0.90		0.09	
35	0.19		0.10		0.09	
34	0.92		0.84		0.08	
33	0.62		0.53		0.09	
32	1.29		1.20		0.09	
31	1.28		1.19		0.09	
30	1.26		1.17		0.09	
29	1.23		1.14		0.09	
28	1.26		1.17		0.09	
27	1.30		1.21		0.09	
26	1.32		1.23		0.09	
25	1.28		1.19		0.09	
24	1.19		1.10		0.09	
23	1.18	**1.08**	1.08	**0.99**	0.10	**AVG. DEPTH**
22	1.34	**1.34**	1.23	**1.23**	0.11	**MAX. DEPTH**
Sub-Basin A						
21	1.40		1.30		0.10	
20	1.38		1.29		0.09	
19	1.32		1.23		0.09	
18	1.31		1.22		0.09	
17	1.33		1.24		0.09	
16	1.34		1.24		0.10	
15	1.33		1.24		0.09	
14	1.27		1.19		0.08	
13	1.26		1.17		0.09	
12	1.27		1.18		0.09	
11	1.29		1.20		0.09	
10	1.32		1.22		0.10	
9	1.39		1.28		0.11	
8	1.58		1.47		0.11	
7	1.62		1.51		0.11	
6	1.60		1.49		0.11	
5	1.56		1.45		0.11	
4	1.55		1.44		0.11	
3	1.55		1.44		0.11	
2	1.56	**1.38**	1.45	**1.28**	0.11	**AVG. DEPTH**
1	0.70	**1.62**	0.60	**1.51**	0.10	**MAX. DEPTH**

Note:

Figures 2 - 8D show the sections of existing diversion berm which are lower than the estimated channel depth.

TABLE 20 - HEC-RAS CHANNEL DEPTH SUMMARY
ROCKY FLATS - ORIGINAL LANDFILL
DIVERSION BERM NO. 4

Station	1,000-YR Channel Depth, ft		100-YR Channel Depth, ft		Freeboard, ft	
Sub-Basin E						
99	1.06		1.00		0.06	
98	0.60		0.54		0.06	
97	0.67		0.61		0.06	
96	0.76		0.70		0.06	
95	0.86		0.80		0.06	
94	0.82		0.77		0.05	
93	0.83		0.77		0.06	
92	0.79		0.73		0.06	
91	0.76		0.71		0.05	
90	0.68		0.63		0.05	
89	0.61		0.57		0.04	
88	0.64		0.61		0.03	
87	0.57		0.50		0.07	
86	1.04		0.98		0.06	
85	1.01		0.94		0.07	
84	0.95		0.89		0.06	
83	0.83		0.78		0.05	
82	0.60		0.55		0.05	
81	0.53	**0.77**	0.49	**0.71**	0.04	**AVG. DEPTH**
80	0.71	**1.06**	0.65	**1.00**	0.06	**MAX. DEPTH**
Sub-Basin D						
79	0.91		0.84		0.07	
78	0.96		0.89		0.07	
77	0.97		0.90		0.07	
76	0.96		0.90		0.06	
75	0.92		0.86		0.06	
74	0.90		0.83		0.07	
73	0.92		0.85		0.07	
72	0.97		0.91		0.06	
71	0.93		0.86		0.07	
70	0.96		0.89		0.07	
69	0.95		0.88		0.07	
68	0.96		0.89		0.07	
67	0.95		0.89		0.06	
66	0.93		0.86		0.07	
65	0.89		0.83		0.06	
64	0.90		0.83		0.07	
63	0.90		0.84		0.06	
62	0.89		0.82		0.07	
61	0.92	**0.94**	0.84	**0.87**	0.08	**AVG. DEPTH**
60	1.06	**1.06**	0.97	**0.97**	0.09	**MAX. DEPTH**
Sub-Basin C						
59	1.16		1.07		0.09	
58	1.19		1.10		0.09	

57	1.19		1.11		0.08	
56	1.23		1.14		0.09	
55	1.29		1.20		0.09	
54	1.27		1.18		0.09	
53	1.24		1.15		0.09	
52	1.21		1.13		0.08	
51	1.20		1.12		0.08	
50	1.19		1.11		0.08	
49	1.16		1.08		0.08	
48	1.09		1.01		0.08	
47	1.11		1.02		0.09	
46	1.13		1.05		0.08	
45	1.14		1.06		0.08	
44	1.14		1.06		0.08	
43	1.15		1.06		0.09	
42	1.15		1.07		0.08	
41	1.17	**1.18**	1.08	**1.10**	0.09	**AVG. DEPTH**
40	1.22	**1.29**	1.13	**1.20**	0.09	**MAX. DEPTH**
Sub-Basin B						
39	1.24		1.15		0.09	
38	1.23		1.14		0.09	
37	1.24		1.15		0.09	
36	1.24		1.14		0.10	
35	1.28		1.18		0.10	
34	1.36		1.26		0.10	
33	1.43		1.33		0.10	
32	1.40		1.31		0.09	
31	1.34		1.25		0.09	
30	1.23		1.15		0.08	
29	1.22		1.14		0.08	
28	1.26		1.17		0.09	
27	1.33		1.24		0.09	
26	1.43		1.33		0.10	
25	1.42		1.32		0.10	
24	1.45		1.35		0.10	
23	1.51		1.41		0.10	
22	1.52		1.42		0.10	
21	1.46	**1.34**	1.36	**1.25**	0.10	**AVG. DEPTH**
20	1.37	**1.52**	1.28	**1.42**	0.09	**MAX. DEPTH**
Sub-Basin A						
19	1.19		1.11		0.08	
18	1.22		1.13		0.09	
17	1.23		1.14		0.09	
16	1.30		1.20		0.10	
15	1.32		1.22		0.10	
14	1.33		1.24		0.09	
13	1.29		1.19		0.10	
12	1.12		1.04		0.08	
11	1.00		0.92		0.08	
10	0.96		0.89		0.07	
9	0.92		0.85		0.07	
8	0.91		0.84		0.07	

7	0.82		0.76		0.06	
6	0.91		0.85		0.06	
5	0.84		0.77		0.07	
4	1.04		0.99		0.05	
3	1.23		1.10		0.13	
2	0.95	**1.08**	0.92	**1.00**	0.03	**AVG. DEPTH**
1	0.86	**1.33**	0.76	**1.24**	0.10	**MAX. DEPTH**

Note:
Figures 2 - 8D show the sections of existing diversion berm which are lower than the estimated channel depth.

TABLE 21 - HEC-RAS CHANNEL DEPTH SUMMARY
ROCKY FLATS - ORIGINAL LANDFILL
DIVERSION BERM NO. 5

Station	1,000-YR Channel Depth, ft		100-YR Channel Depth, ft		Freeboard, ft	
Sub-Basin E						
99	0.74		0.69		0.05	
98	0.83		0.78		0.05	
97	0.83		0.77		0.06	
96	0.81		0.76		0.05	
95	0.82		0.76		0.06	
94	0.79		0.73		0.06	
93	0.78		0.71		0.07	
92	1.08		1.00		0.08	
91	1.45		1.37		0.08	
90	1.52		1.44		0.08	
89	1.37		1.29		0.08	
88	1.19		1.12		0.07	
87	1.12		1.05		0.07	
86	1.04		0.97		0.07	
85	0.92		0.86		0.06	
84	0.90		0.83		0.07	
83	0.88		0.82		0.06	
82	0.82		0.76		0.06	
81	0.83	**0.99**	0.76	**0.92**	0.07	**AVG. DEPTH**
80	0.99	**1.52**	0.91	**1.44**	0.08	**MAX. DEPTH**
Sub-Basin D						
79	1.15		1.06		0.09	
78	1.15		1.07		0.08	
77	1.16		1.07		0.09	
76	1.18		1.09		0.09	
75	1.20		1.11		0.09	
74	1.21		1.13		0.08	
73	1.25		1.16		0.09	
72	1.24		1.16		0.08	
71	1.22		1.14		0.08	
70	1.18		1.10		0.08	
69	1.17		1.08		0.09	
68	1.14		1.06		0.08	
67	1.11		1.03		0.08	
66	1.12		1.04		0.08	
65	1.14		1.06		0.08	
64	1.15		1.07		0.08	
63	1.17		1.09		0.08	
62	1.21		1.12		0.09	
61	1.28	**1.19**	1.18	**1.11**	0.10	**AVG. DEPTH**
60	1.39	**1.39**	1.28	**1.28**	0.11	**MAX. DEPTH**
Sub-Basin C						
59	1.45		1.34		0.11	
58	1.48		1.37		0.11	

57	1.47		1.37		0.10	
56	1.46		1.36		0.10	
55	1.43		1.32		0.11	
54	1.39		1.29		0.10	
53	1.33		1.24		0.09	
52	1.28		1.19		0.09	
51	1.30		1.20		0.10	
50	1.31		1.22		0.09	
49	1.30		1.20		0.10	
48	1.31		1.21		0.10	
47	1.34		1.24		0.10	
46	1.39		1.29		0.10	
45	1.39		1.29		0.09	
44	1.38		1.28		0.09	
43	1.37		1.27		0.10	
42	1.40		1.30		0.10	
41	1.44	**1.39**	1.33	**1.29**	0.11	**AVG. DEPTH**
40	1.51	**1.51**	1.39	**1.39**	0.12	**MAX. DEPTH**
Sub-Basin B						
39	1.55		1.44		0.11	
38	1.53		1.42		0.11	
37	1.51		1.40		0.11	
36	1.50		1.39		0.11	
35	1.51		1.40		0.11	
34	1.47		1.36		0.11	
33	1.47		1.37		0.10	
32	1.42		1.32		0.10	
31	1.39		1.29		0.10	
30	1.37		1.28		0.09	
29	1.39		1.29		0.10	
28	1.45		1.35		0.10	
27	1.49		1.38		0.11	
26	1.53		1.42		0.11	
25	1.66		1.55		0.11	
24	1.67		1.56		0.11	
23	1.64		1.52		0.12	
22	1.55		1.44		0.11	
21	1.58	**1.52**	1.46	**1.41**	0.12	**AVG. DEPTH**
20	1.64	**1.67**	1.52	**1.56**	0.12	**MAX. DEPTH**
Sub-Basin A						
19	1.70		1.58		0.12	
18	1.73		1.61		0.12	
17	1.75		1.62		0.13	
16	1.77		1.65		0.12	
15	1.80		1.67		0.13	
14	1.80		1.68		0.12	
13	1.80		1.68		0.12	
12	1.78		1.67		0.11	
11	1.72		1.61		0.11	
10	1.65		1.54		0.11	
9	1.60		1.49		0.11	
8	1.57		1.46		0.11	

7	1.52		1.41		0.11	
6	1.45		1.34		0.11	
5	1.40		1.30		0.10	
4	1.25		1.18		0.07	
3	0.41		0.35		0.06	
2	1.05	**1.51**	1.01	**1.40**	0.04	**AVG. DEPTH**
1	0.94	**1.80**	0.83	**1.68**	0.11	**MAX. DEPTH**

Note:
Figures 2 - 8D show the sections of existing diversion berm which are lower than the estimated channel depth.

TABLE 22 - HEC-RAS CHANNEL DEPTH SUMMARY
ROCKY FLATS - ORIGINAL LANDFILL
DIVERSION BERM NO. 6

Station	1,000-YR Channel Depth, ft		100-YR Channel Depth, ft		Freeboard, ft	
Sub-Basin E						
108	0.64		0.59		0.05	
107	0.89		0.83		0.06	
106	0.88		0.81		0.07	
105	0.80		0.75		0.05	
104	0.77		0.72		0.05	
103	0.81		0.75		0.06	
102	0.82		0.77		0.05	
101	0.82		0.77		0.05	
100	0.86		0.8		0.06	
99	0.99		0.92		0.07	
98	1.21		1.14		0.07	
97	0.95		0.88		0.07	
96	0.94		0.87		0.07	
95	1.01		0.94		0.07	
94	1.08		1.01		0.07	
93	1.03		0.96		0.07	
92	0.91		0.85		0.06	
91	0.78		0.73		0.05	
90	0.69	**0.90**	0.62	**0.83**	0.07	**AVG. DEPTH**
89	1.06	**1.21**	0.97	**1.14**	0.09	**MAX. DEPTH**
Sub-Basin D						
88	1.30		1.21		0.09	
87	1.27		1.18		0.09	
86	1.18		1.09		0.09	
85	1.13		1.05		0.08	
84	1.10		1.02		0.08	
83	1.02		0.95		0.07	
82	1.05		0.97		0.08	
81	1.15		1.07		0.08	
80	1.33		1.24		0.09	
79	1.28		1.19		0.09	
78	1.18		1.1		0.08	
77	1.10		1.02		0.08	
76	1.15		1.06		0.09	
75	1.25		1.15		0.10	
74	1.30		1.21		0.09	
73	1.25		1.16		0.09	
72	1.15		1.07		0.08	
71	1.06		0.99		0.07	
70	1.08	**1.17**	0.99	**1.09**	0.09	**AVG. DEPTH**
69	1.16	**1.33**	1.07	**1.24**	0.09	**MAX. DEPTH**
Sub-Basin C						
68	1.21		1.13		0.08	
67	1.19		1.1		0.09	

66	1.34		1.25		0.09	
65	1.33		1.23		0.10	
64	1.33		1.24		0.09	
63	1.23		1.14		0.09	
62	1.24		1.15		0.09	
61	1.29		1.19		0.10	
60	1.37		1.27		0.10	
59	1.40		1.3		0.10	
58	1.46		1.36		0.10	
57	1.50		1.4		0.10	
56	1.48		1.37		0.11	
55	1.44		1.34		0.10	
54	1.44		1.34		0.13	
53	1.47		1.37		0.16	
52	1.53		1.42		0.11	
51	1.55		1.44		0.11	
50	1.52	**1.39**	1.41	**1.29**	0.11	**AVG. DEPTH**
49	1.42	**1.55**	1.31	**1.44**	0.11	**MAX. DEPTH**
Sub-Basin B						
48	1.46		1.37		0.09	
47	1.47		1.37		0.10	
46	1.56		1.45		0.11	
45	1.67		1.56		0.11	
44	1.63		1.52		0.11	
43	1.59		1.48		0.11	
42	1.61		1.49		0.12	
41	1.71		1.59		0.12	
40	1.83		1.7		0.13	
39	1.87		1.75		0.12	
38	1.77		1.65		0.12	
37	1.66		1.54		0.12	
36	1.62		1.51		0.11	
35	1.67		1.55		0.12	
34	1.74		1.61		0.13	
33	1.76		1.63		0.13	
32	1.80		1.67		0.13	
31	1.85		1.72		0.13	
30	1.90	**1.72**	1.77	**1.59**	0.13	**AVG. DEPTH**
29	1.97	**1.97**	1.84	**1.84**	0.13	**MAX. DEPTH**
Sub-Basin A						
28	2.01		1.87		0.14	
27	1.86		1.74		0.12	
26	1.74		1.62		0.12	
25	1.65		1.53		0.12	
24	1.64		1.52		0.12	
23	1.69		1.56		0.13	
22	1.76		1.63		0.13	
21	1.81		1.68		0.13	
20	1.84		1.71		0.13	
19	1.82		1.7		0.12	
18	1.79		1.67		0.12	
17	1.71		1.6		0.11	

16	1.66		1.54		0.12	
15	1.60		1.49		0.11	
14	1.53		1.42		0.11	
13	1.48		1.37		0.11	
12	1.51		1.4		0.11	
11	1.62		1.49		0.13	
10	1.72		1.59		0.13	
9	1.72		1.59		0.13	
8	1.83		1.71		0.12	
7	1.85		1.73		0.12	
6	1.75		1.63		0.12	
5	1.61		1.51		0.10	
4	1.19		1.12		0.07	
3	0.64		0.57		0.07	
2	0.64	**1.59**	0.61	**1.48**	0.03	**AVG. DEPTH**
1	0.85	**2.01**	0.74	**1.87**	0.11	**MAX. DEPTH**

Note:
Figures 2 - 8D show the sections of existing diversion berm which are lower than the estimated channel depth.

TABLE 23 - HEC-RAS CHANNEL DEPTH SUMMARY
ROCKY FLATS - ORIGINAL LANDFILL
DIVERSION BERM NO. 7

Station	1,000-YR Channel Depth, ft		100-YR Channel Depth, ft		Freeboard, ft	
Sub-Basin E						
99	0.63		0.59		0.04	
98	0.73		0.68		0.05	
97	0.80		0.73		0.07	
96	0.92		0.86		0.06	
95	0.92		0.85		0.07	
94	0.86		0.80		0.06	
93	0.74		0.69		0.05	
92	0.74		0.69		0.05	
91	0.73		0.68		0.05	
90	0.76		0.70		0.06	
89	0.79		0.73		0.06	
88	0.93		0.87		0.06	
87	0.94		0.87		0.07	
86	0.88		0.82		0.06	
85	0.87		0.81		0.06	
84	0.86		0.80		0.06	
83	0.86		0.79		0.07	
82	0.91		0.83		0.08	
81	1.07	**0.86**	0.98	**0.80**	0.09	**AVG. DEPTH**
80	1.23	**1.23**	1.14	**1.14**	0.09	**MAX. DEPTH**
Sub-Basin D						
79	1.27		1.18		0.09	
78	1.26		1.17		0.09	
77	1.26		1.17		0.09	
76	1.31		1.21		0.10	
75	1.40		1.30		0.10	
74	1.43		1.33		0.10	
73	1.39		1.30		0.09	
72	1.34		1.25		0.09	
71	1.31		1.21		0.10	
70	1.31		1.21		0.10	
69	1.30		1.22		0.08	
68	1.29		1.20		0.09	
67	1.28		1.19		0.09	
66	1.22		1.14		0.08	
65	1.15		1.07		0.08	
64	1.16		1.08		0.08	
63	1.21		1.11		0.10	
62	1.33		1.23		0.10	
61	1.40	**1.30**	1.29	**1.21**	0.11	**AVG. DEPTH**
60	1.47	**1.47**	1.36	**1.36**	0.11	**MAX. DEPTH**
Sub-Basin C						
59	1.52		1.41		0.11	
58	1.48		1.38		0.10	

57	1.43		1.33		0.10	
56	1.32		1.23		0.09	
55	1.29		1.19		0.10	
54	1.32		1.22		0.10	
53	1.44		1.33		0.11	
52	1.50		1.40		0.10	
51	1.47		1.37		0.10	
50	1.38		1.28		0.10	
49	1.32		1.23		0.09	
48	1.28		1.20		0.08	
47	1.23		1.15		0.08	
46	1.22		1.13		-0.08	
45	1.05		0.96		0.78	
44	1.74		1.64		-0.40	
43	1.24		1.15		0.09	
42	1.20		1.12		0.08	
41	1.16	**1.34**	1.07	**1.25**	0.09	**AVG. DEPTH**
40	1.26	**1.74**	1.16	**1.64**	0.10	**MAX. DEPTH**
Sub-Basin B						
39	1.38		1.28		0.10	
38	1.32		1.22		0.10	
37	1.35		1.24		0.11	
36	1.57		1.46		0.11	
35	1.67		1.56		0.11	
34	1.55		1.45		0.10	
33	1.32		1.24		0.08	
32	1.23		1.14		0.09	
31	1.23		1.14		0.09	
30	1.26		1.17		0.09	
29	1.31		1.22		0.09	
28	1.32		1.22		0.10	
27	1.34		1.24		0.10	
26	1.37		1.27		0.10	
25	1.40		1.30		0.10	
24	1.48		1.37		0.11	
23	1.53		1.43		0.10	
22	1.51		1.41		0.10	
21	1.45	**1.40**	1.35	**1.30**	0.10	**AVG. DEPTH**
20	1.39	**1.67**	1.29	**1.56**	0.10	**MAX. DEPTH**
Sub-Basin A						
19	1.45		1.35		0.10	
18	1.46		1.35		0.11	
17	1.60		1.47		0.13	
16	1.69		1.57		0.12	
15	1.78		1.65		0.13	
14	1.90		1.76		0.14	
13	1.86		1.73		0.13	
12	1.81		1.68		0.13	
11	1.70		1.58		0.12	
10	1.69		1.57		0.12	
9	1.67		1.56		0.11	
8	1.64		1.52		0.12	

7	1.64		1.52		0.12	
6	1.63		1.52		0.11	
5	1.59		1.48		0.11	
4	1.56		1.45		0.11	
3	1.56		1.44		0.12	
2	1.13	**1.60**	1.08	**1.48**	0.05	**AVG. DEPTH**
1	0.99	**1.90**	0.83	**1.76**	0.16	**MAX. DEPTH**

Note:
Figures 2 - 8D show the sections of existing diversion berm which are lower than the estimated channel depth.

TABLE 24 - BERM HEIGHT UNDER PARAMETER
ROCKY FLATS - ORIGINAL LANDFILL

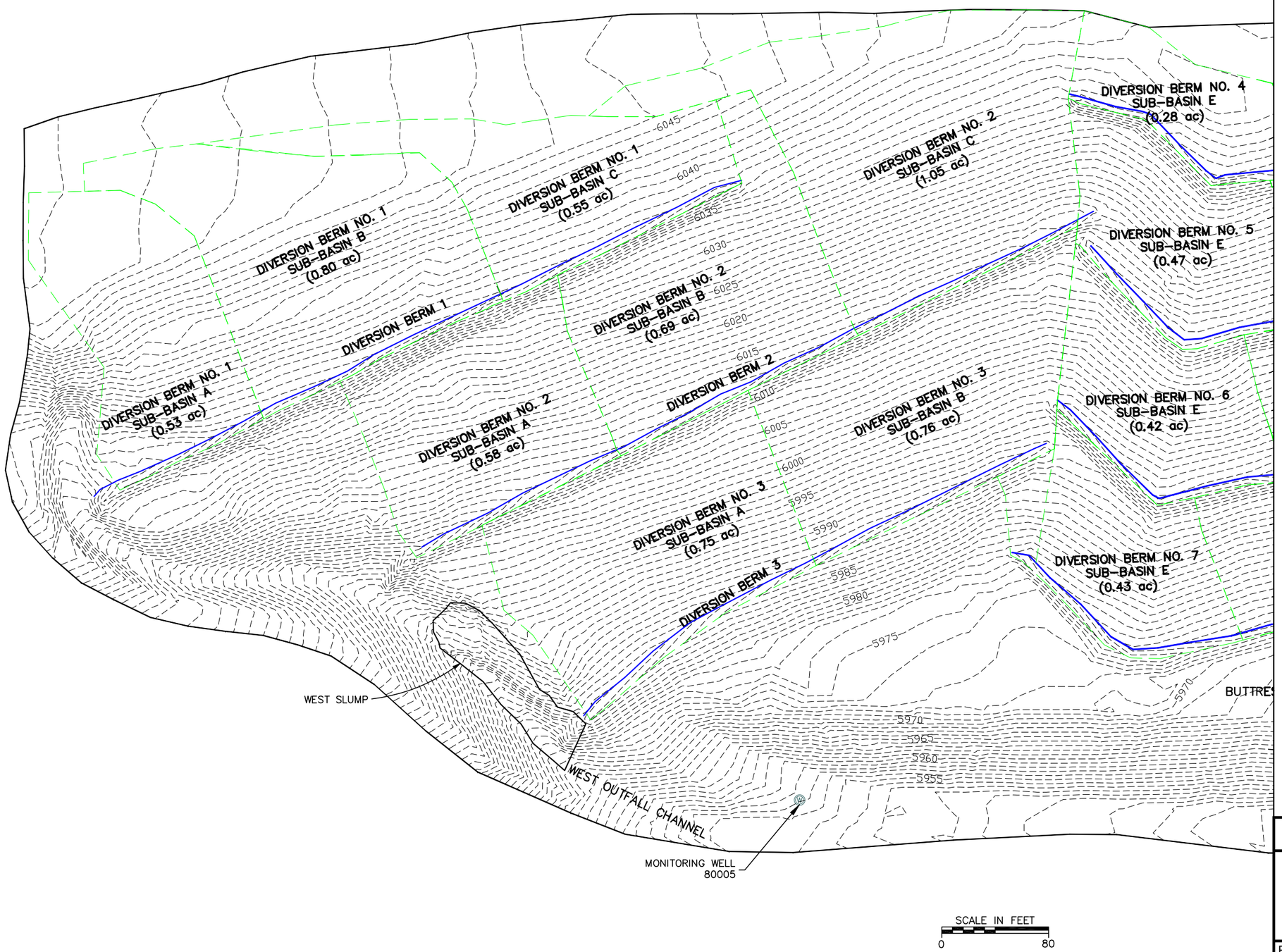
		2.0 FT. DESIGN[2]	APPENDIX D[2]	EXISTING COND.[3]	
		< 2.0 FT	< 1000-YR	< 1000-YR	# of Sections[4]
WEST	BERM NO. 1	64%	25%	20.7%	1
	BERM NO. 2	81%	58%	57.5%	4
	BERM NO. 3	56%	28%	30.0%	2
EAST	BERM NO. 4	69%	48%	14.2%	3
	BERM NO. 5	86%	63%	16.0%	4
	BERM NO. 6	82%	49%	28.0%	5
	BERM NO. 7	62%	33%	15.4%	4
	TOTAL	**73%**	**45%**	**23.7%**	

Note:
1. Figures 2 - 8D show the sections of existing diversion berm which are lower than the estimated channel depth. The lengths were measured and shown above.
2. Percentages are based on the 2007 topographic survey by Flatirons, Inc.
3. Percentages are based on the 2008 topographic survey by Flatirons, Inc.
4. Number of different portions along the berm length that require additional berm height.

TABLE 25 - BERM HEIGHT SUMMARY
ROCKY FLATS - ORIGINAL LANDFILL

Area ID		Max. Flow Depth, ft	
		100-YR	1,000-YR
DB-1	A	1.37	1.48
	B	1.56	1.68
	C	1.35	1.46
DB-2	A	1.55	1.66
	B	1.58	1.69
	C	1.47	1.57
DB-3	A	1.51	1.62
	B	1.23	1.34
DB-4	A	1.24	1.33
	B	1.42	1.52
	C	1.20	1.29
	D	0.97	1.06
	E	1.00	1.06
DB-5	A	1.68	1.80
	B	1.56	1.67
	C	1.39	1.51
	D	1.28	1.39
	E	1.44	1.52
DB-6	A	1.87	2.01
	B	1.84	1.97
	C	1.44	1.55
	D	1.24	1.33
	E	1.14	1.21
DB-7	A	1.76	1.90
	B	1.56	1.67
	C	1.64	1.74
	D	1.36	1.47
	E	1.14	1.23

Note:
1) Maximum flow depth is the minimum berm height required for the particular sub-basin.



ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 1A
WEST DIVERSION BERMS
PLAN

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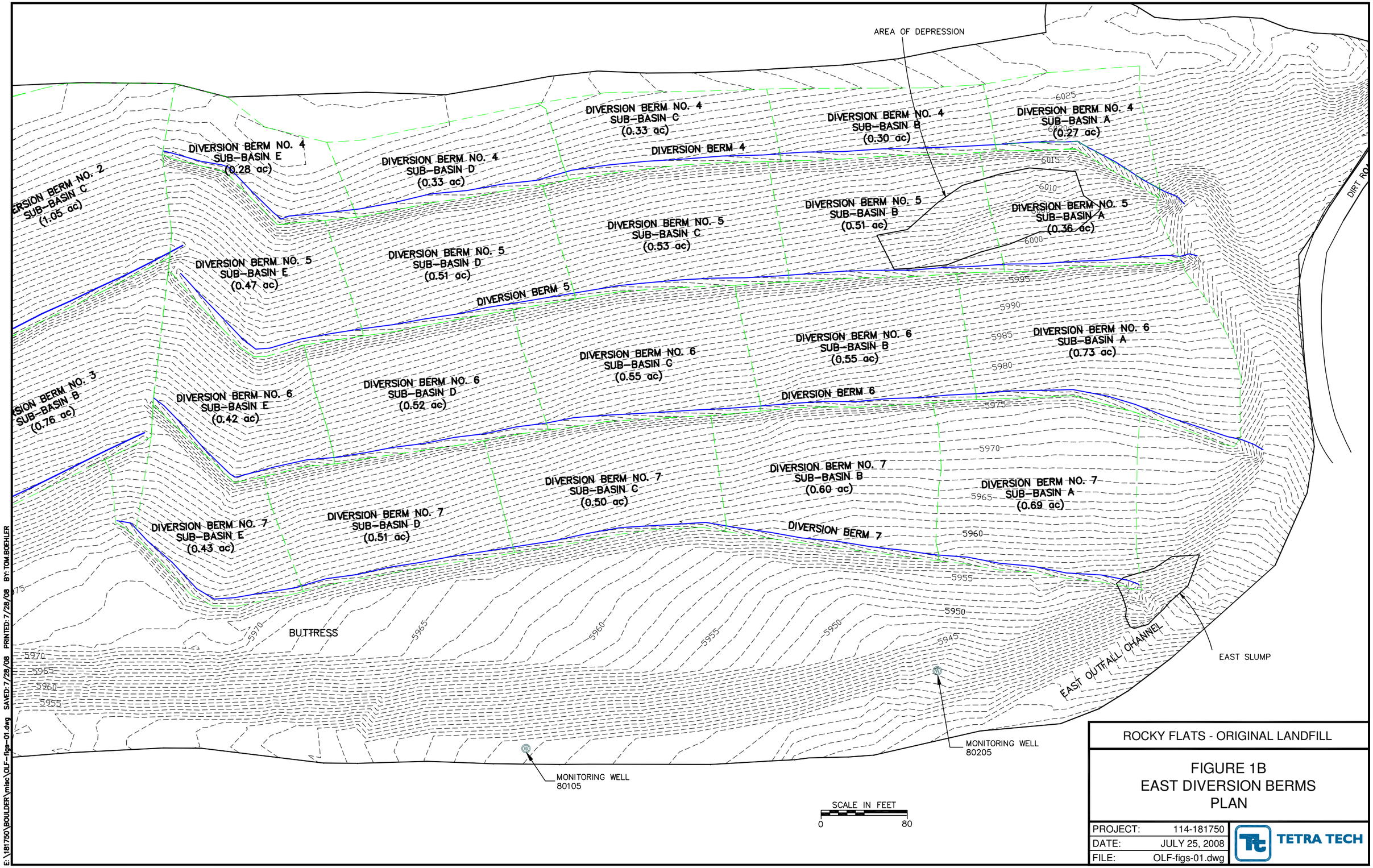

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 1B
EAST DIVERSION BERMS
PLAN

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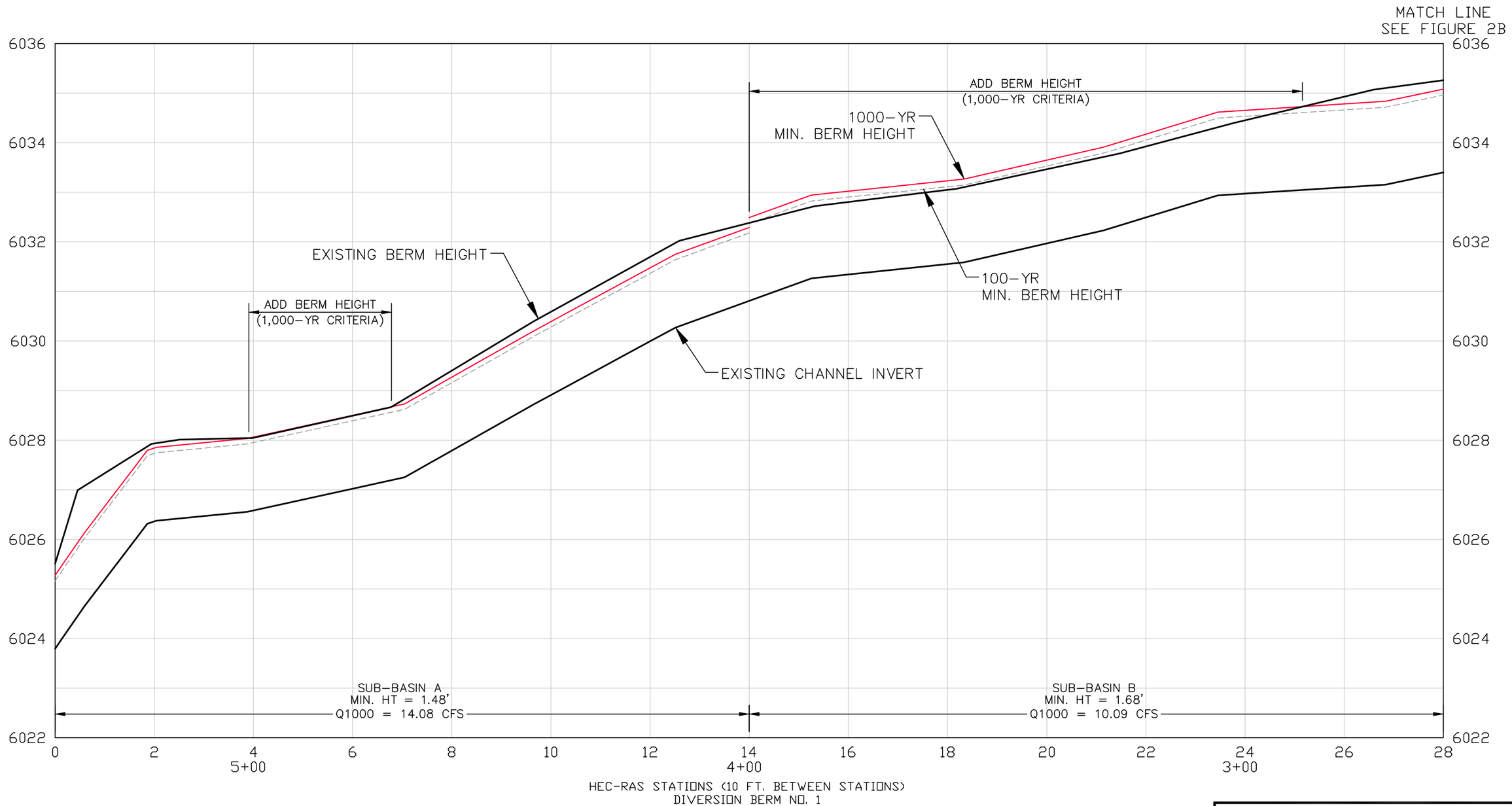

LEGEND:

- EXISTING BERM HEIGHT
- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 2A
DIVERSION BERM NO. 1
PROFILE

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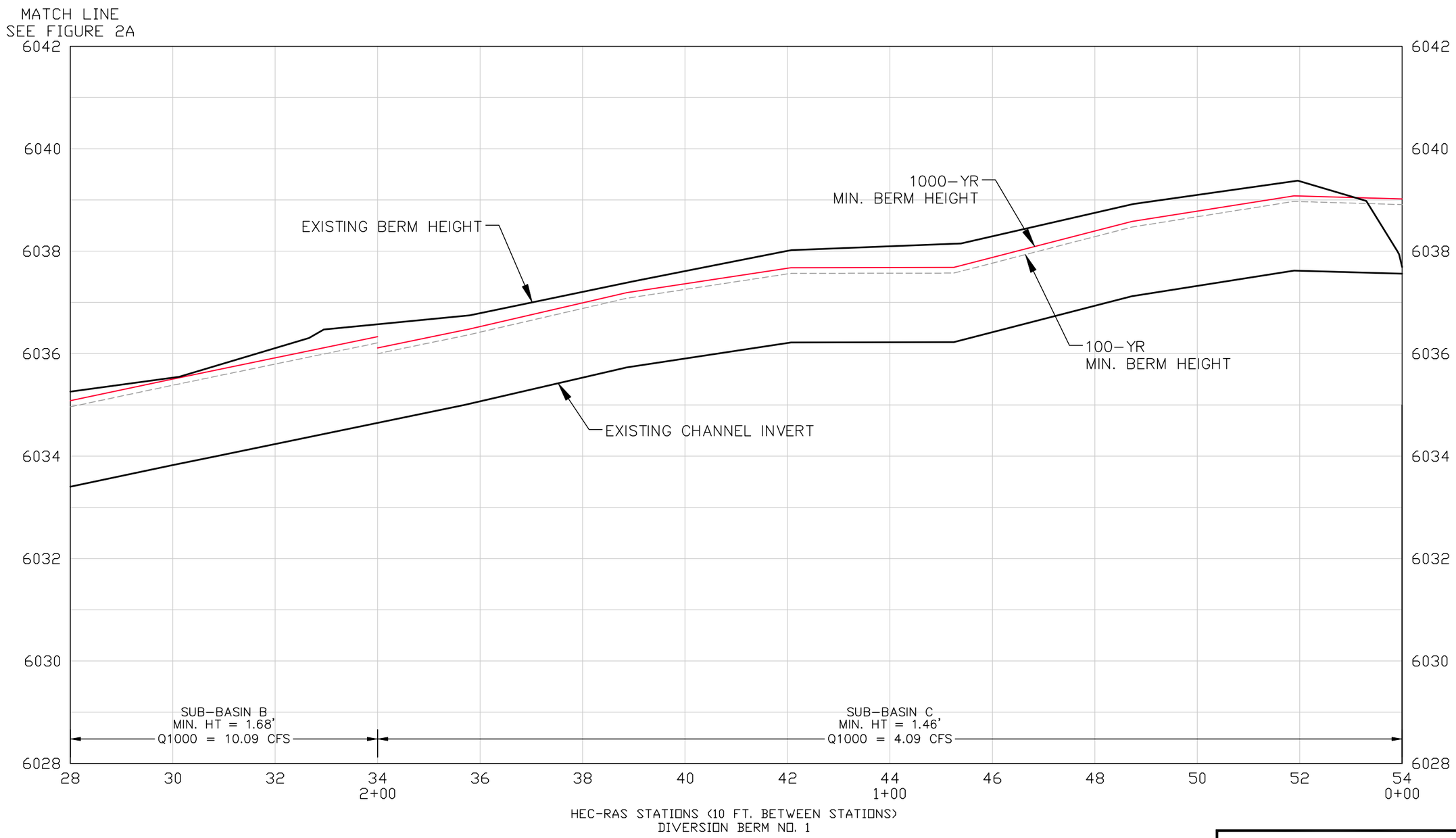

LEGEND:

- EXISTING BERM HEIGHT
- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 2B
DIVERSION BERM NO. 1
PROFILE

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DATE:	JULY 25, 2008
FILE:	OLF-figs-01.dwg

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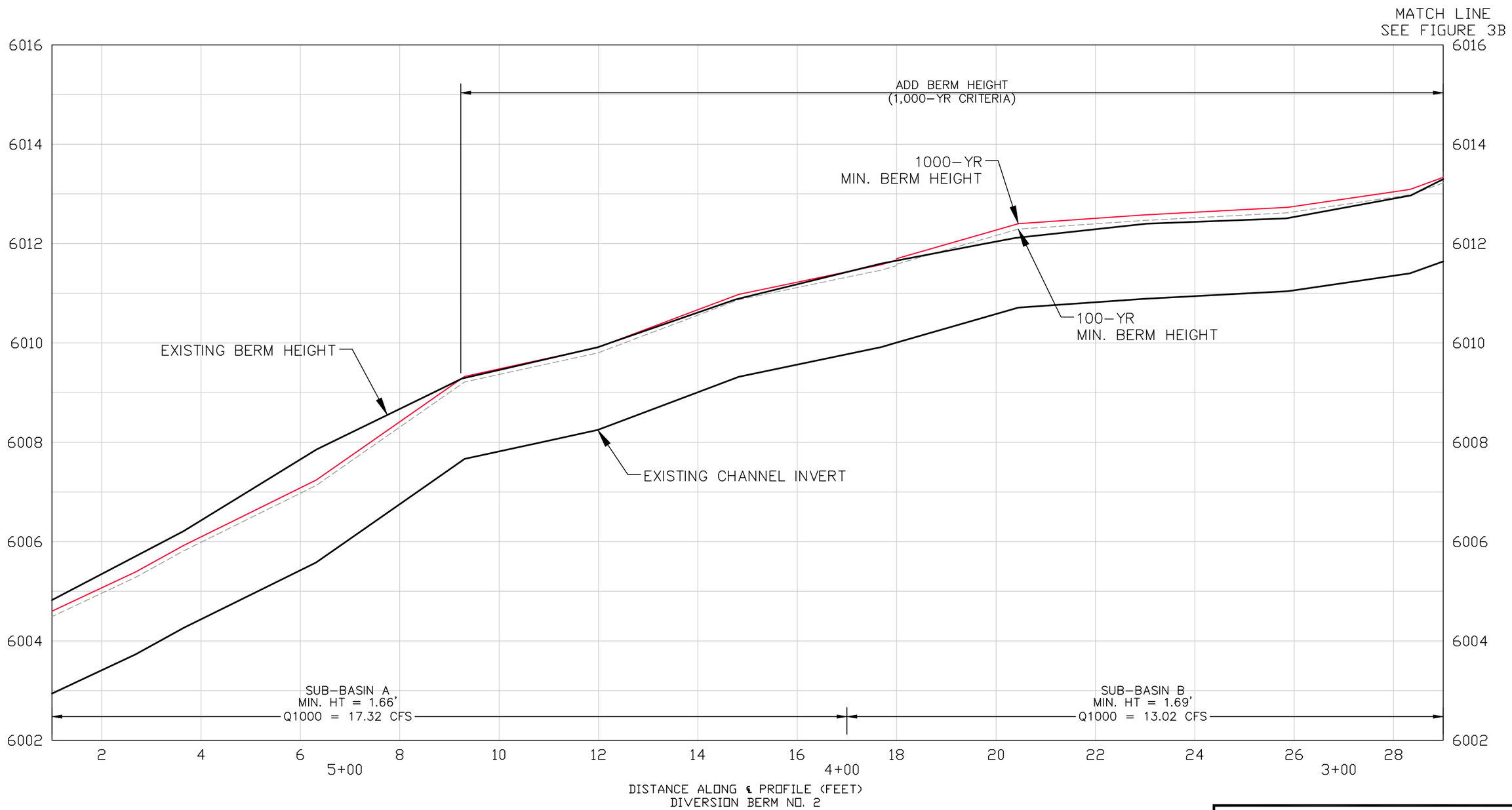

LEGEND:

- EXISTING BERM HEIGHT
- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 3A
DIVERSION BERM NO. 2
PROFILE

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DATE:	JULY 25, 2008
FILE:	OLF-figs-01.dwg

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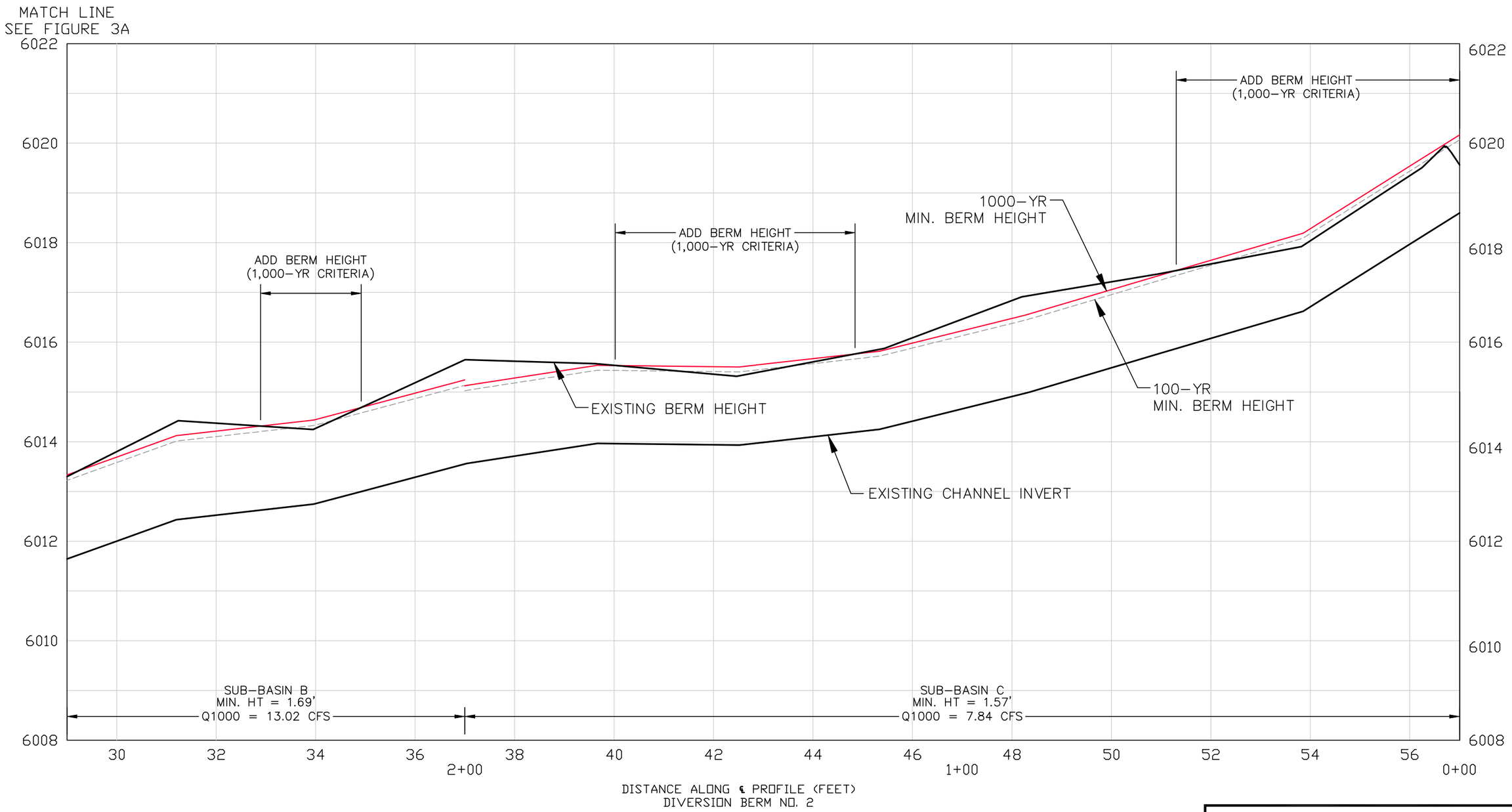

LEGEND:

- EXISTING BERM HEIGHT
- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 3B
DIVERSION BERM NO. 2
PROFILE

PROJECT:	114-181750
DATE:	JULY 25, 2008
FILE:	OLF-figs-01.dwg

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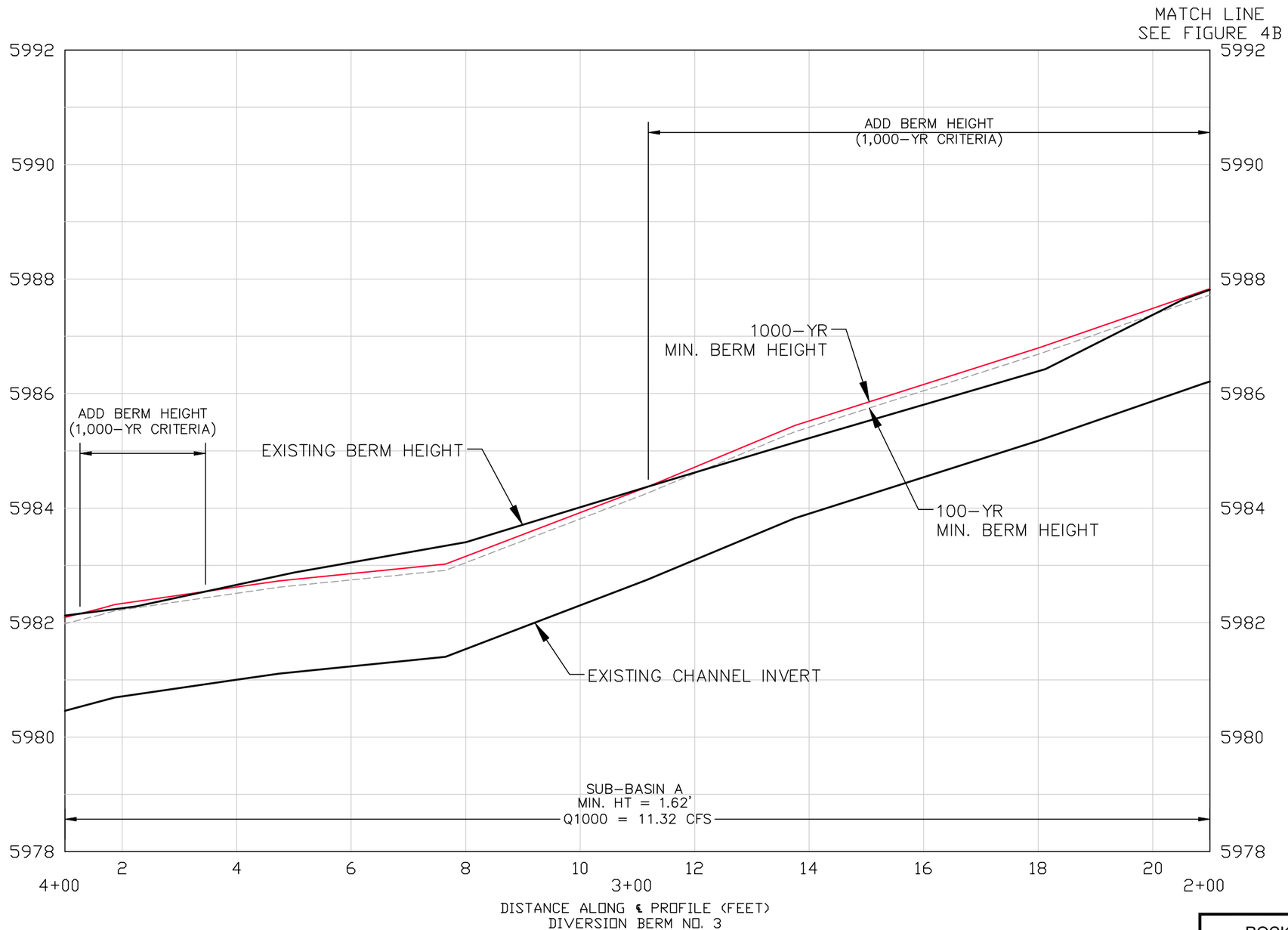

LEGEND:

- EXISTING BERM HEIGHT
- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 4A
DIVERSION BERM NO. 3
PROFILE

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FILE:	OLF-figs-01.dwg

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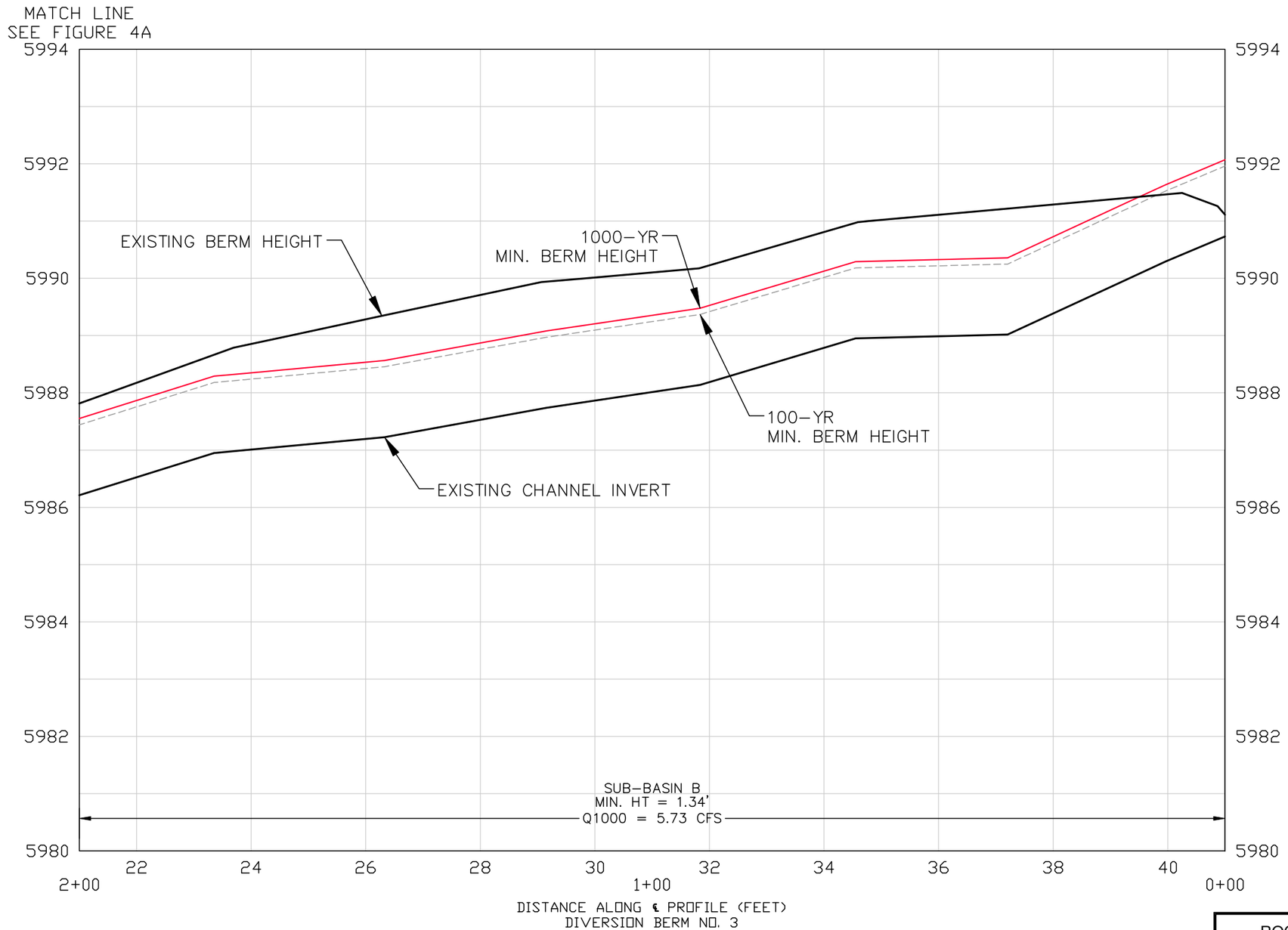

LEGEND:

- EXISTING BERM HEIGHT
- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 4B
DIVERSION BERM NO. 3
PROFILE

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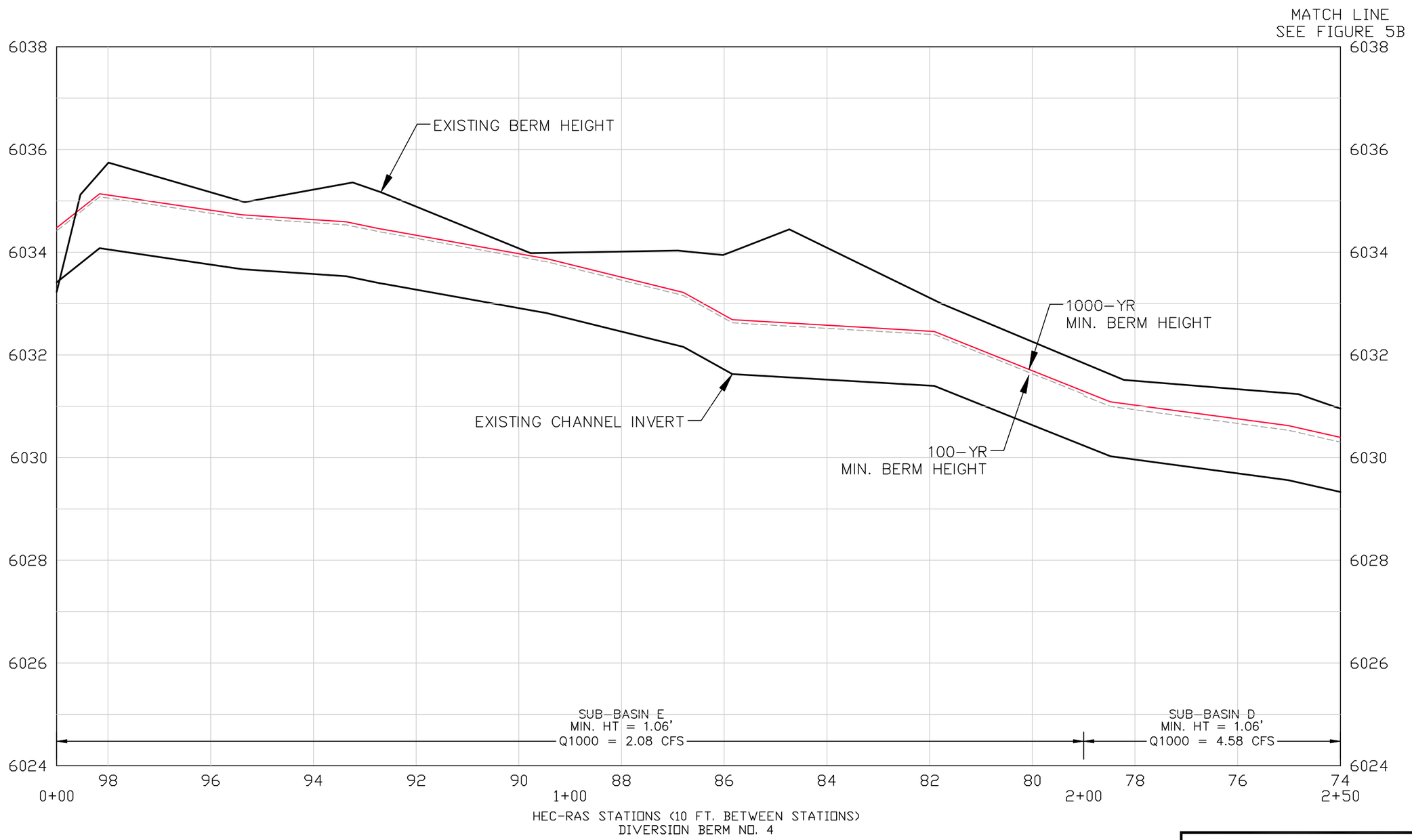

LEGEND:

- EXISTING BERM HEIGHT
- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 5A
DIVERSION BERM NO. 4
PROFILE

PROJECT:	114-181750
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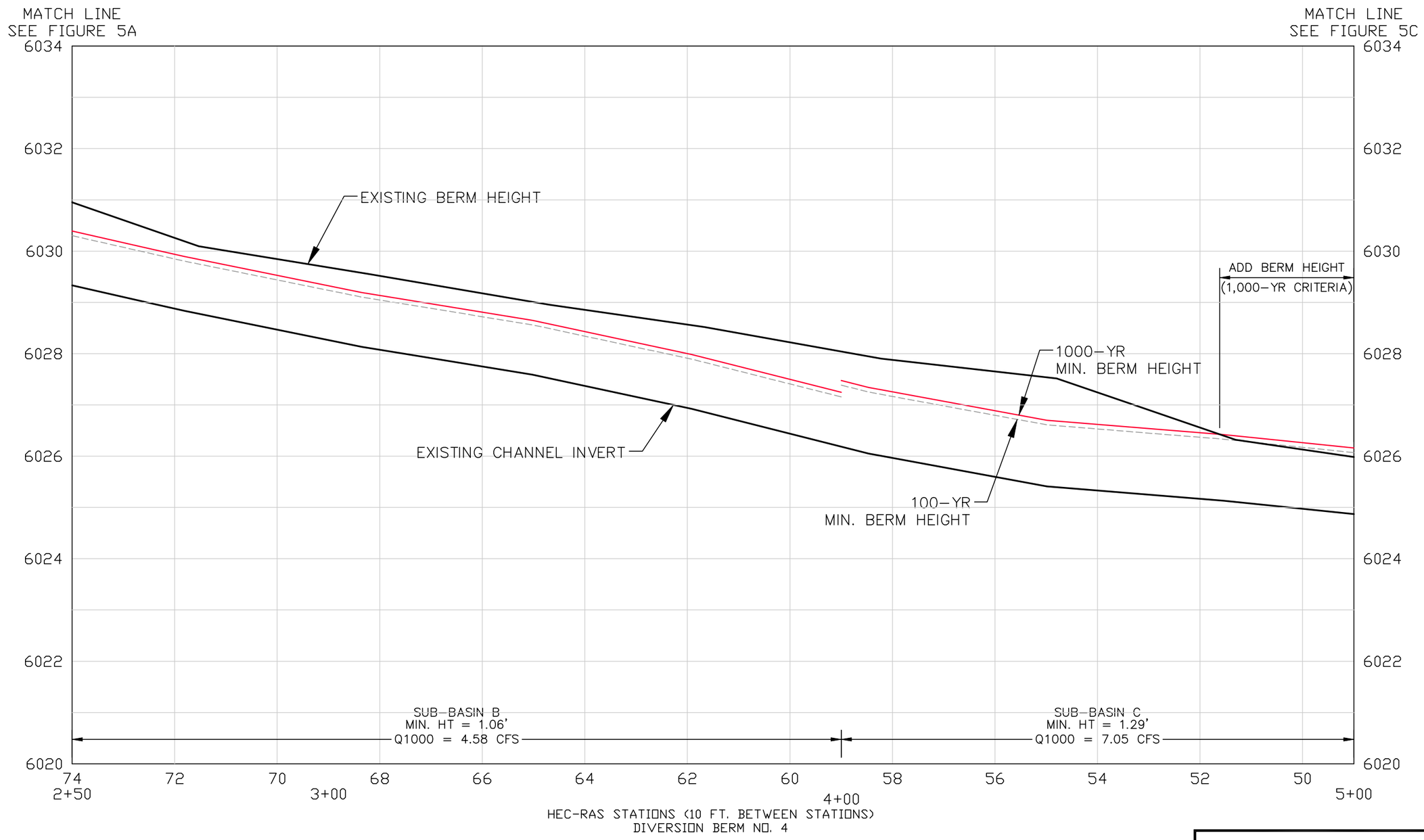

LEGEND:

- EXISTING BERM HEIGHT
- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 5B
DIVERSION BERM NO. 4
PROFILE

PROJECT:	114-181750
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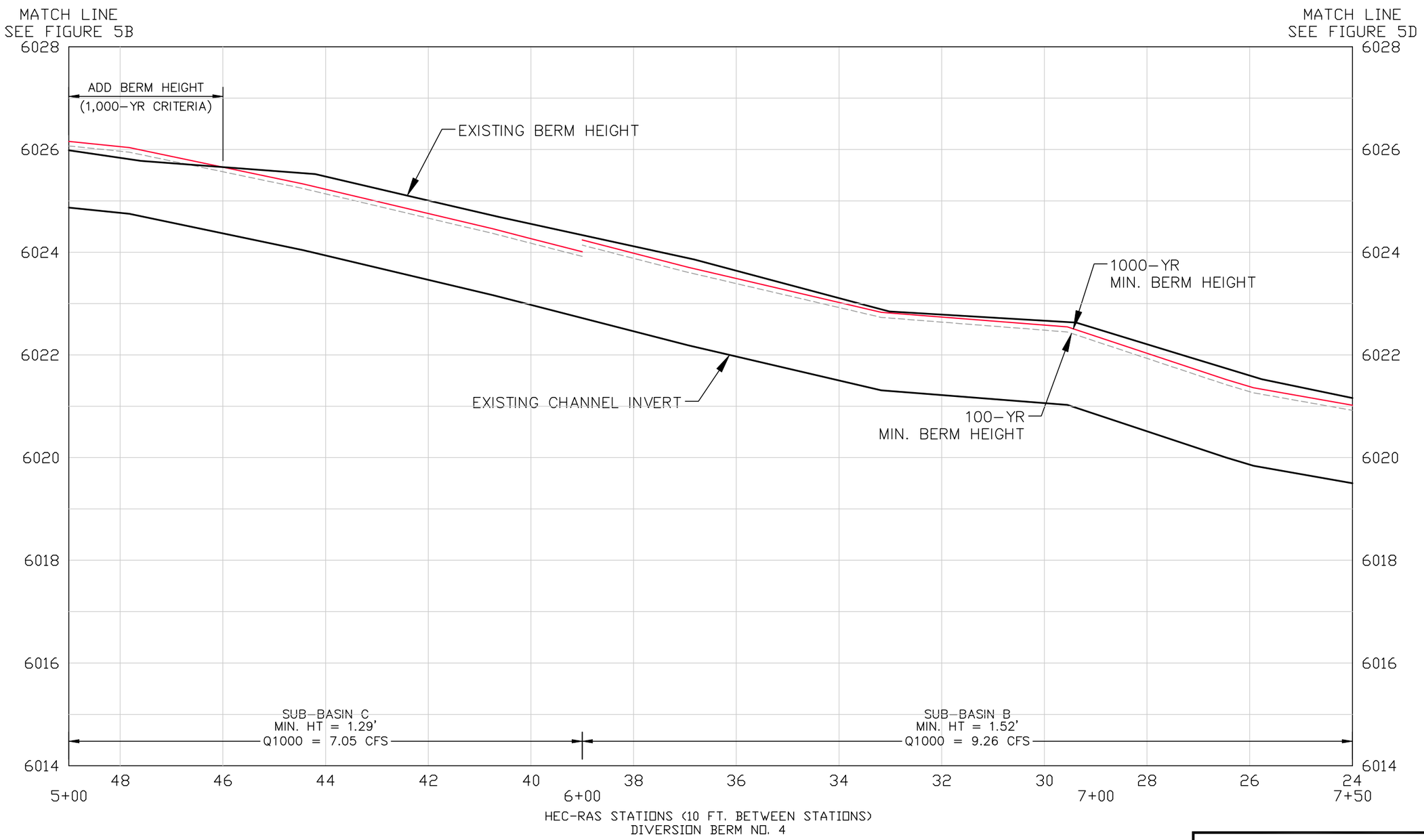

LEGEND:

- EXISTING BERM HEIGHT
- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 5C
DIVERSION BERM NO. 4
PROFILE

PROJECT:	114-181750
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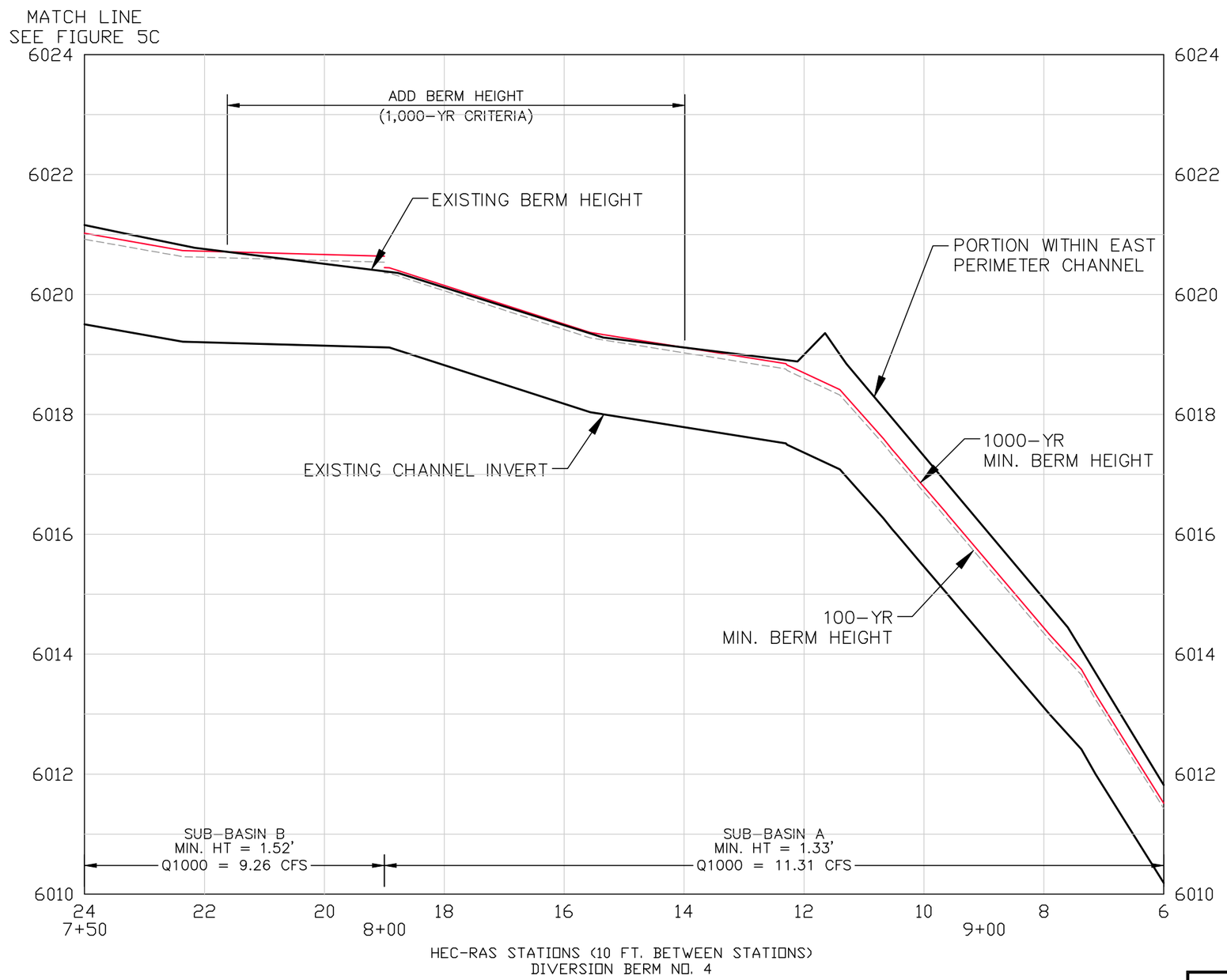

LEGEND:

- EXISTING BERM HEIGHT
- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 5D
DIVERSION BERM NO. 4
PROFILE

PROJECT:	114-181750
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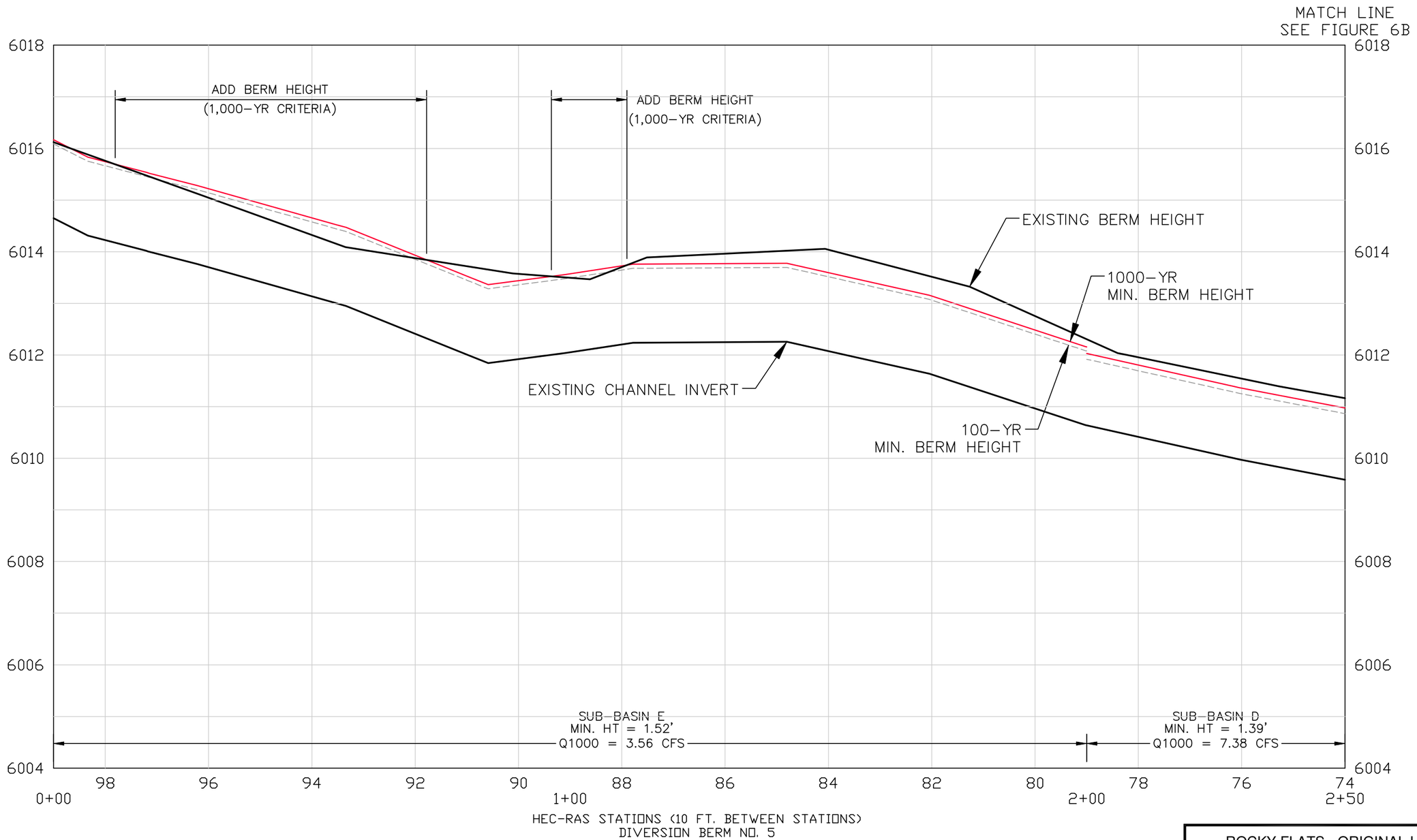

LEGEND:

- EXISTING BERM HEIGHT
- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 6A
DIVERSION BERM NO. 5
PROFILE

PROJECT:	114-181750
DATE:	JULY 25, 2008
FILE:	OLF-figs-01.dwg

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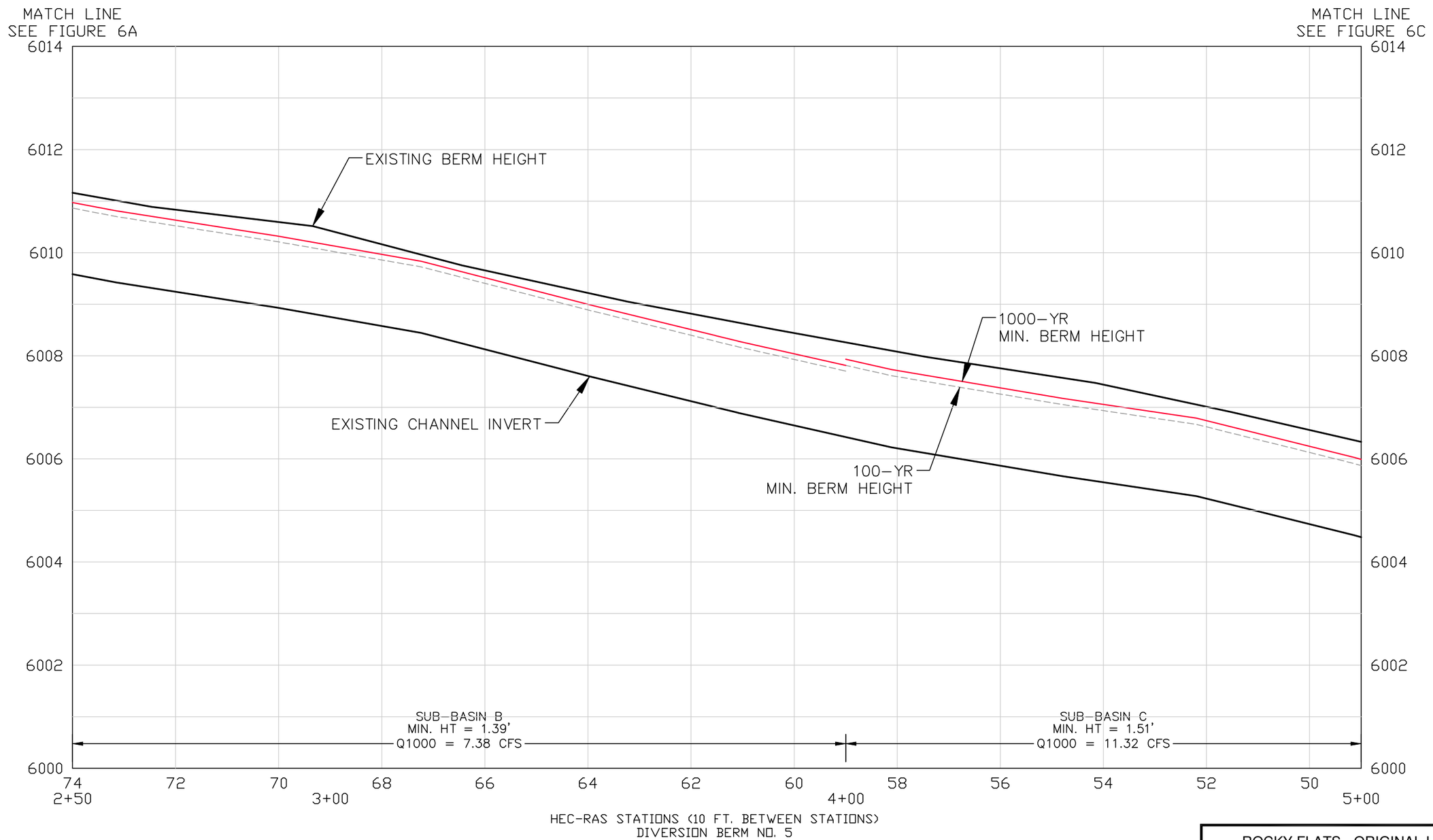

LEGEND:

- EXISTING BERM HEIGHT
- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 6B
DIVERSION BERM NO. 5
PROFILE

PROJECT:	114-181750
DATE:	JULY 25, 2008
FILE:	OLF-figs-01.dwg

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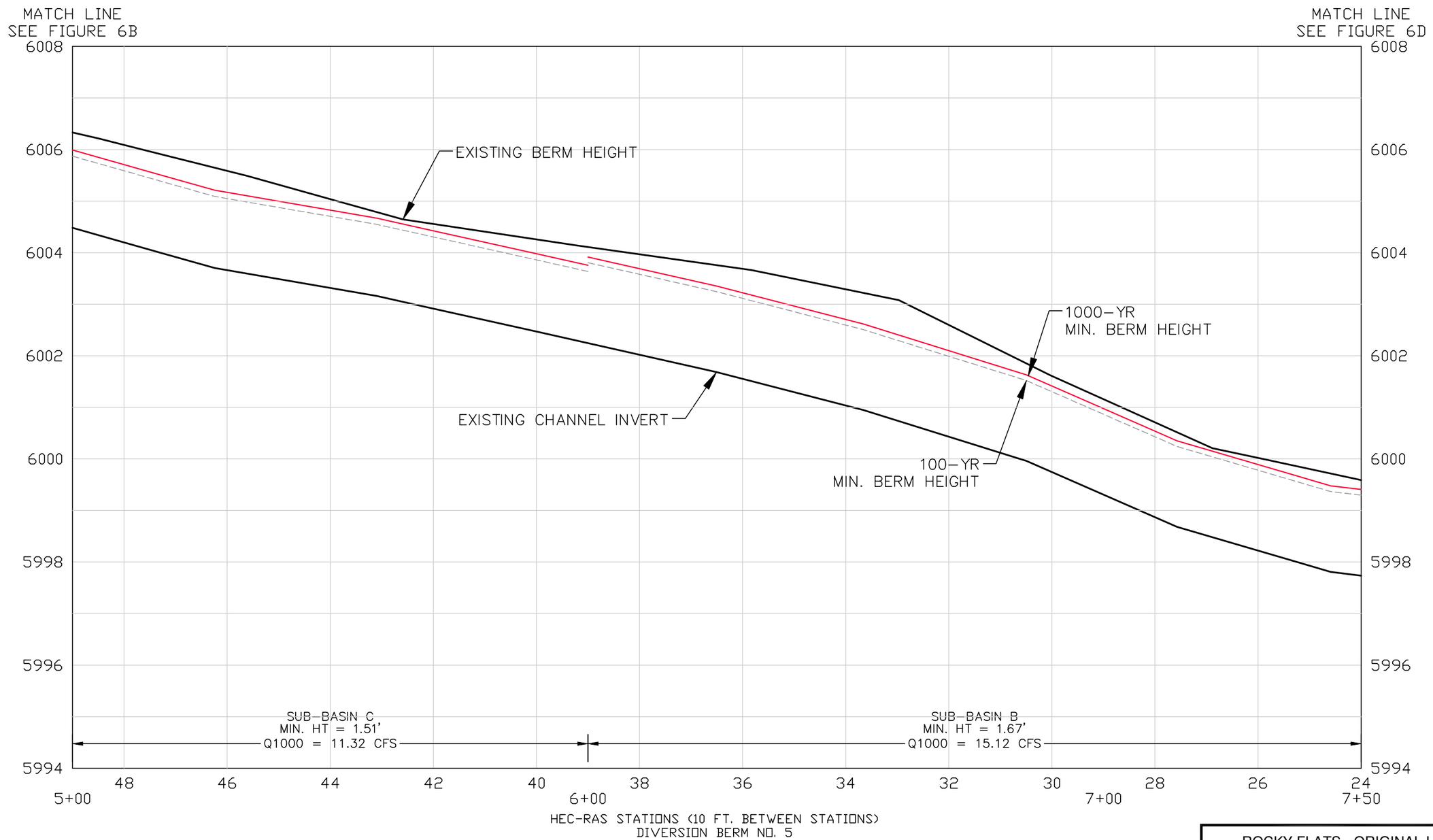

LEGEND:

- EXISTING BERM HEIGHT
- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 6C
DIVERSION BERM NO. 5
PROFILE

PROJECT:	114-181750
DATE:	JULY 25, 2008
FILE:	OLF-figs-01.dwg

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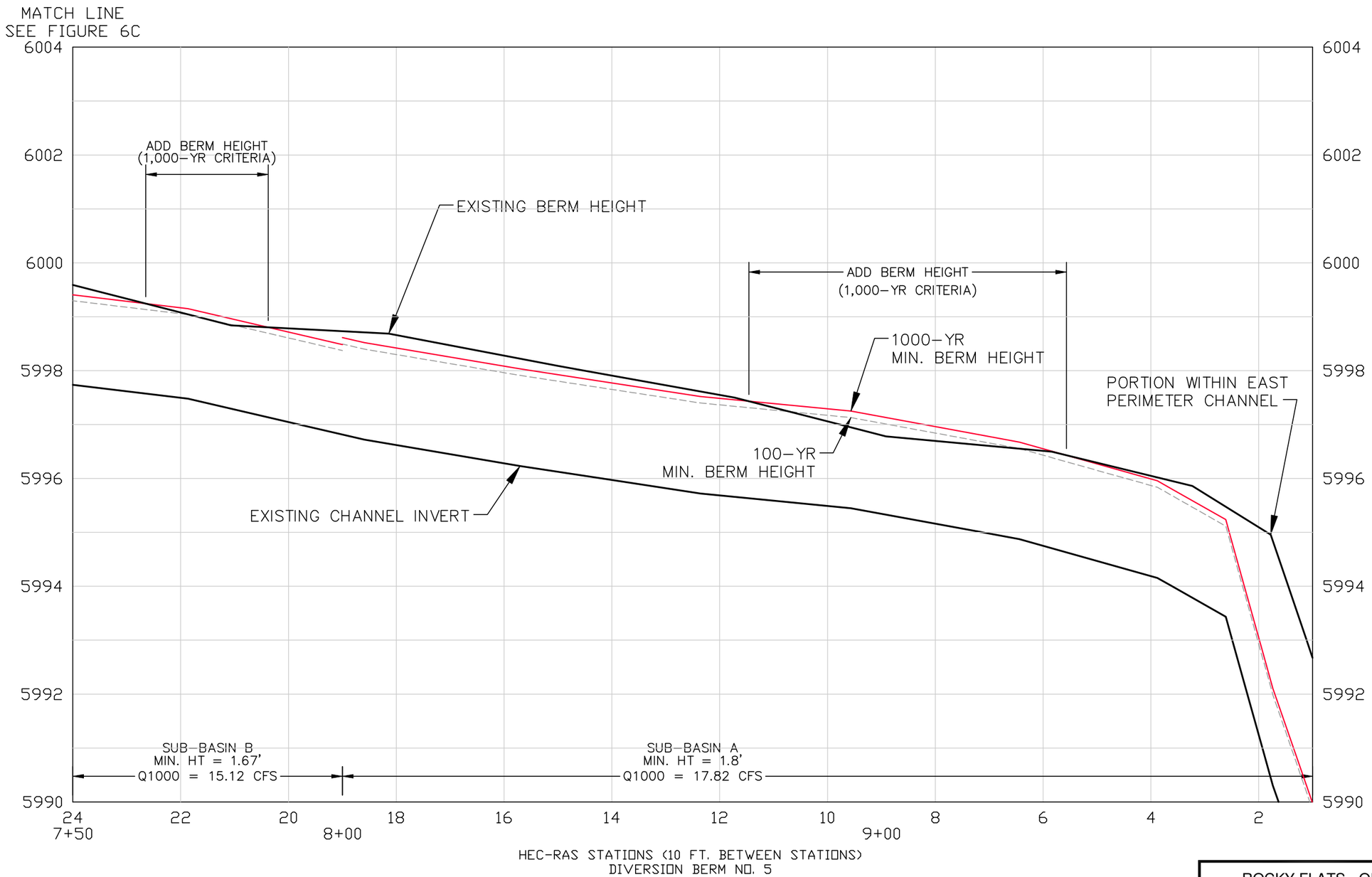

LEGEND:

- EXISTING BERM HEIGHT
- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 6D
DIVERSION BERM NO. 5
PROFILE

PROJECT:	114-181750
DATE:	JULY 25, 2008
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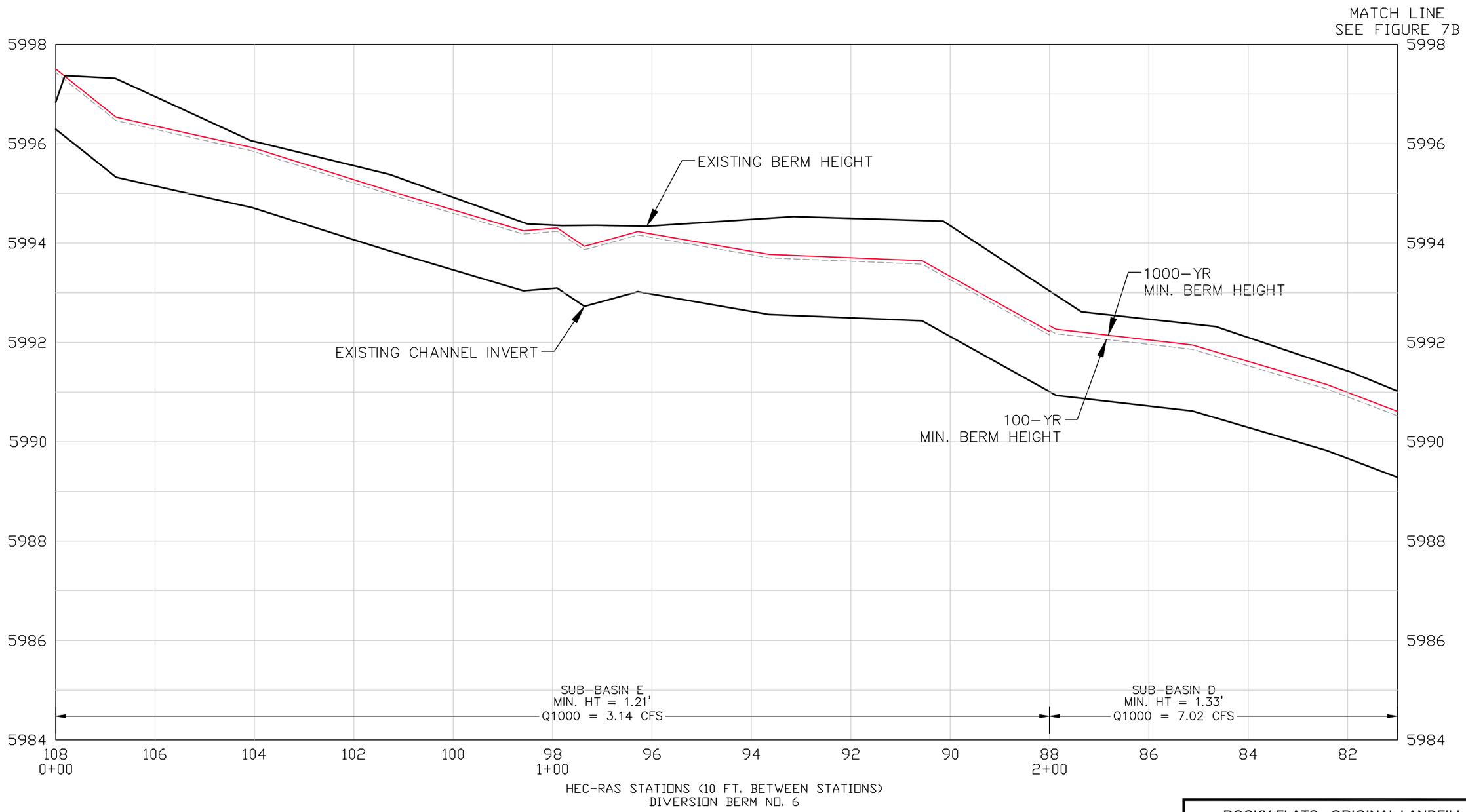

LEGEND:

- EXISTING BERM HEIGHT
- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 7A
DIVERSION BERM NO. 6
PROFILE

PROJECT:	114-181750
DATE:	JULY 25, 2008
FILE:	OLF-figs-01.dwg

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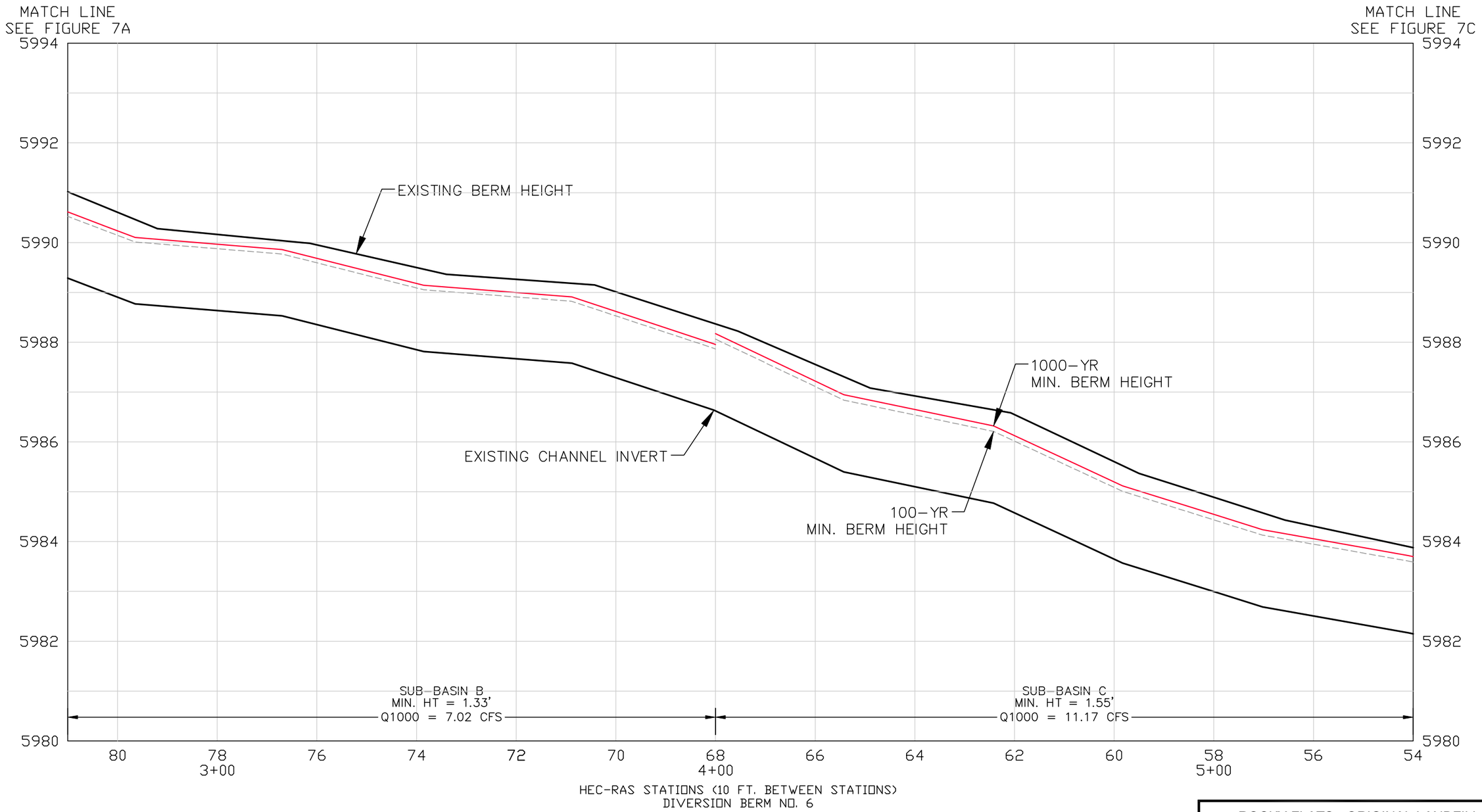

LEGEND:

- EXISTING BERM HEIGHT
- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 7B
DIVERSION BERM NO. 6
PROFILE

PROJECT:	114-181750
DATE:	JULY 25, 2008
FILE:	OLF-figs-01.dwg

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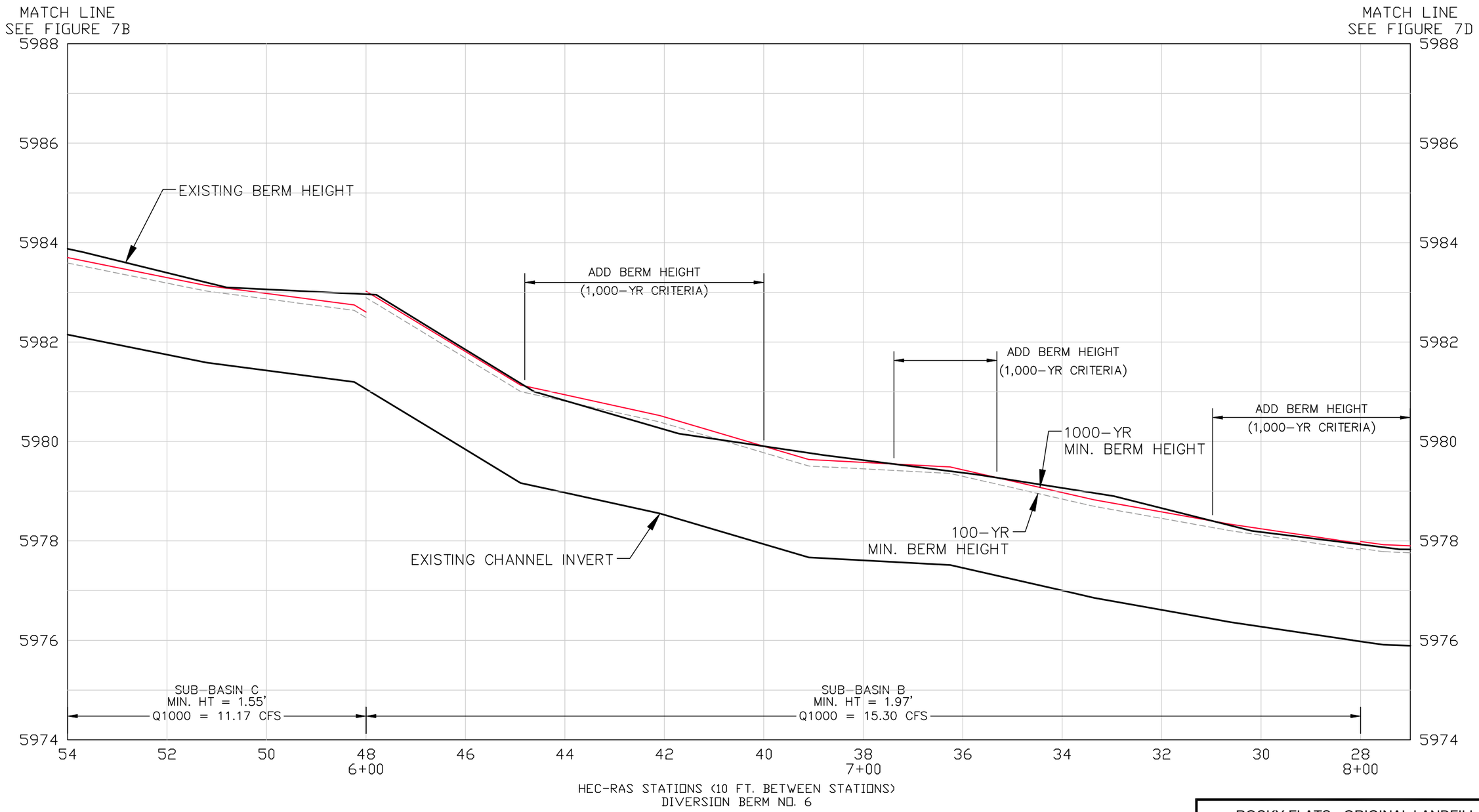

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- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 7C
DIVERSION BERM NO. 6
PROFILE

PROJECT:	114-181750
DATE:	JULY 25, 2008
FILE:	OLF-figs-01.dwg

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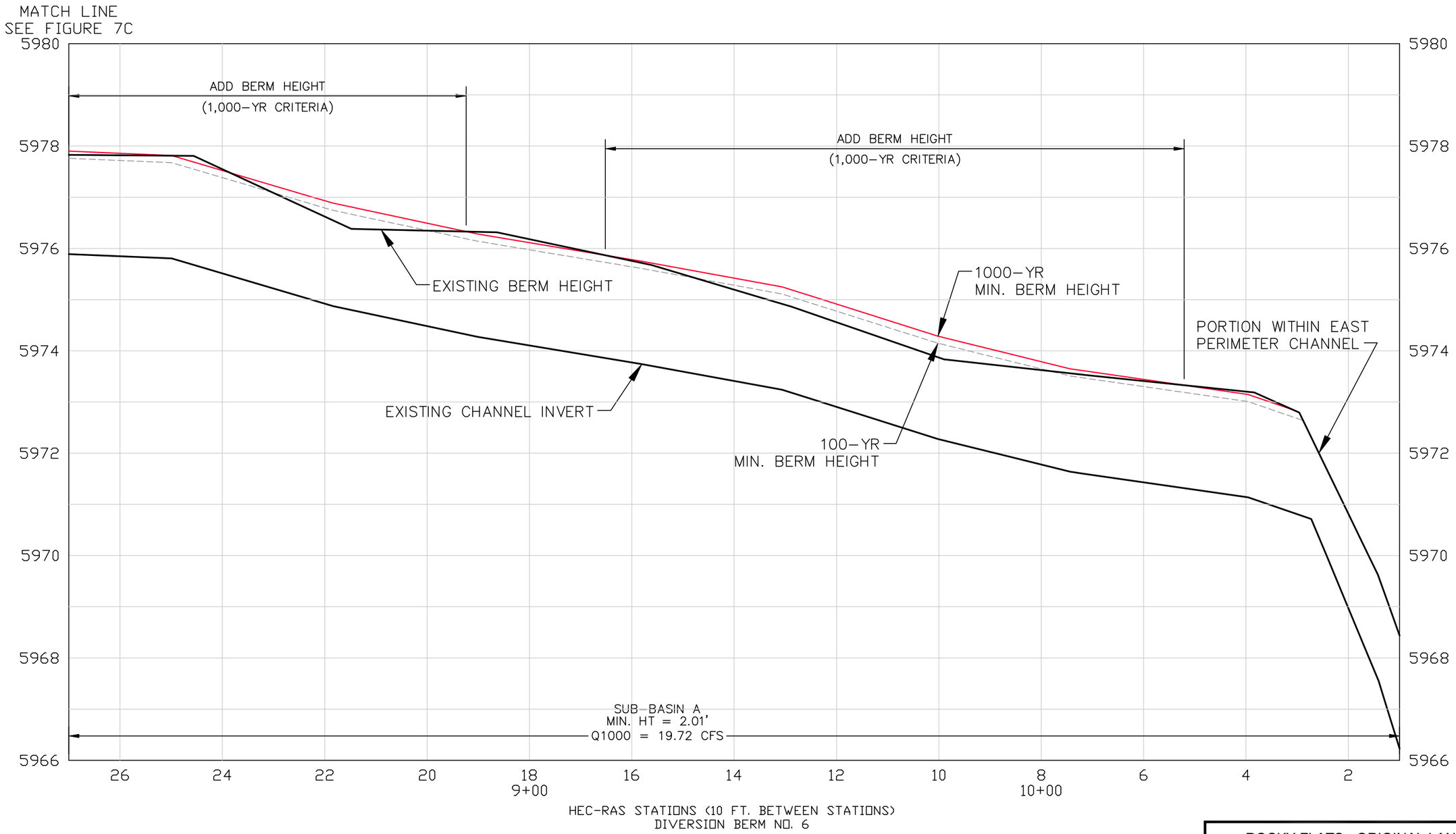

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- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 7D
DIVERSION BERM NO. 6
PROFILE

PROJECT:	114-181750
DATE:	JULY 25, 2008
FILE:	OLF-figs-01.dwg

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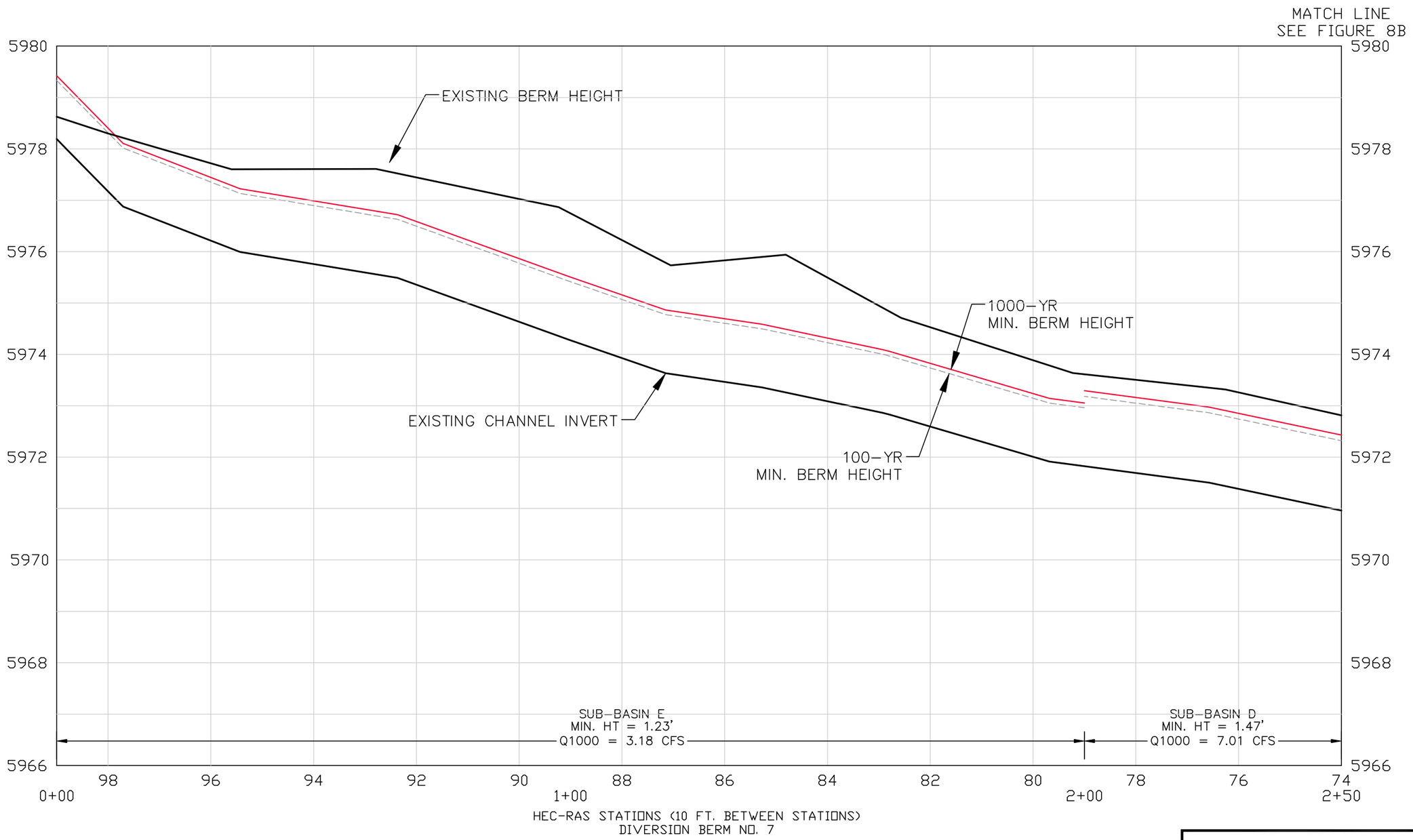

LEGEND:

- EXISTING BERM HEIGHT
- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 8A
DIVERSION BERM NO. 7
PROFILE

PROJECT:	114-181750
DATE:	JULY 25, 2008
FILE:	OLF-figs-01.dwg

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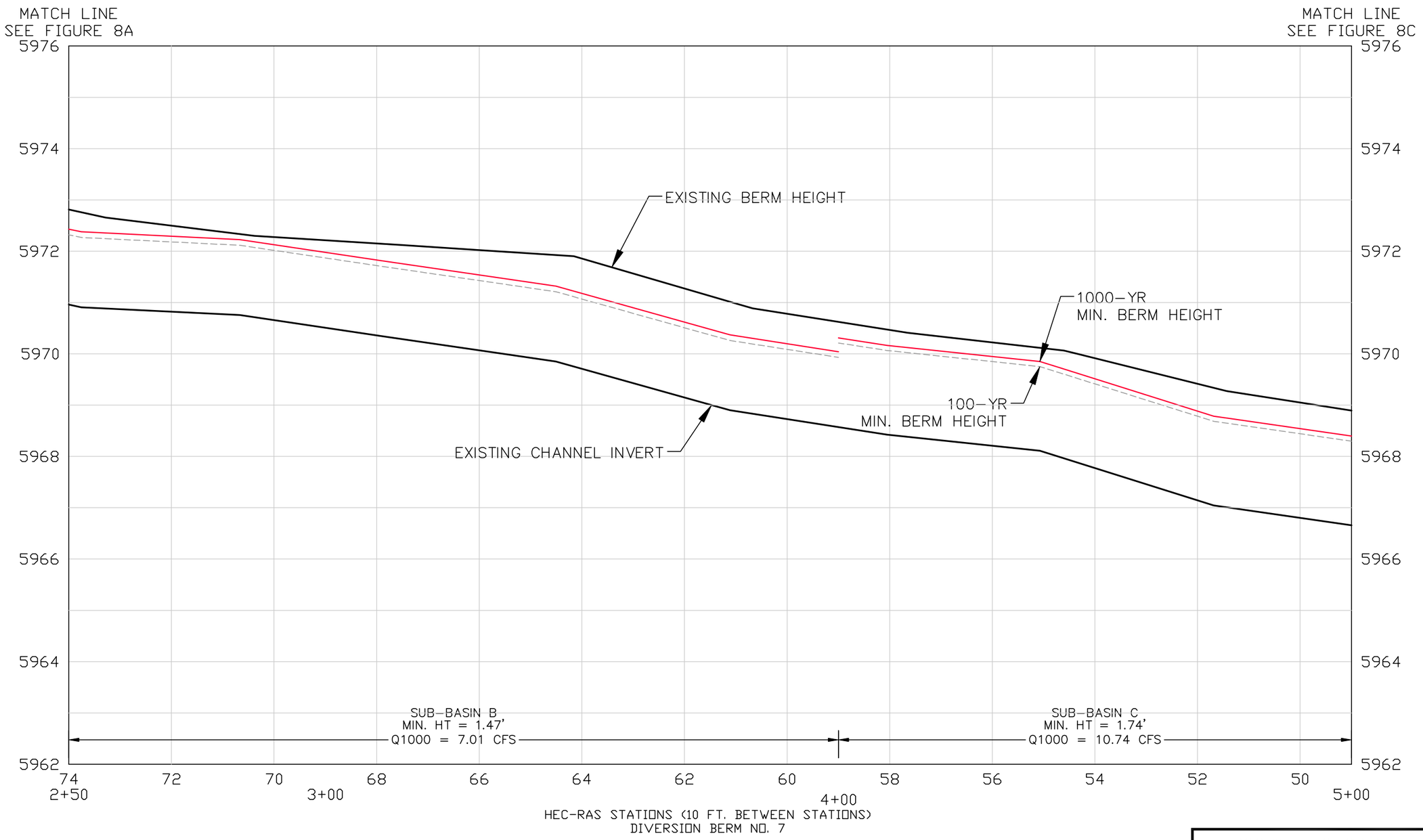

LEGEND:

- EXISTING BERM HEIGHT
- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 8B
DIVERSION BERM NO. 7
PROFILE

PROJECT:	114-181750
DATE:	JULY 25, 2008
FILE:	OLF-figs-01.dwg

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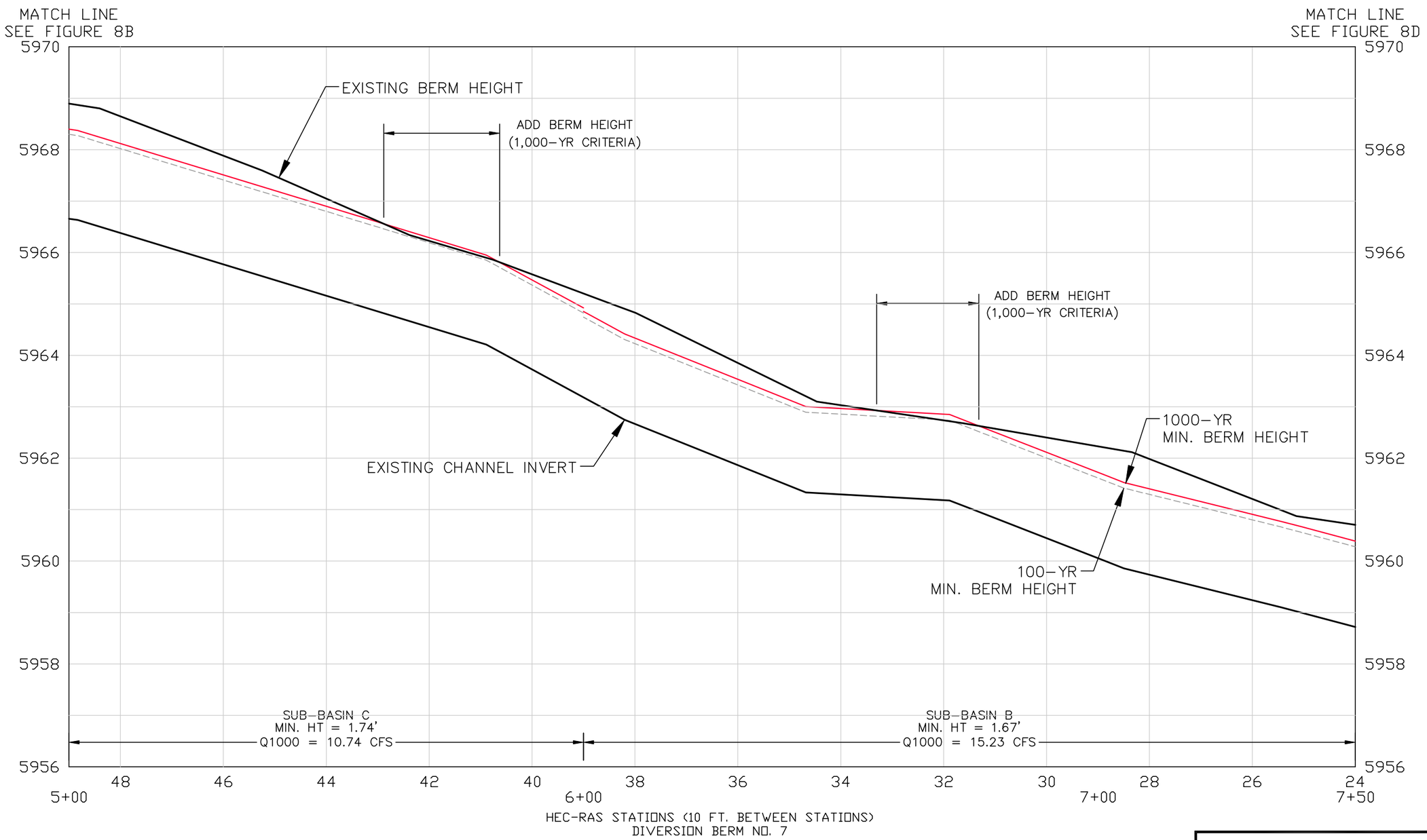

LEGEND:

- EXISTING BERM HEIGHT
- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 8C
DIVERSION BERM NO. 7
PROFILE

PROJECT:	114-181750
DATE:	JULY 25, 2008
FILE:	OLF-figs-01.dwg

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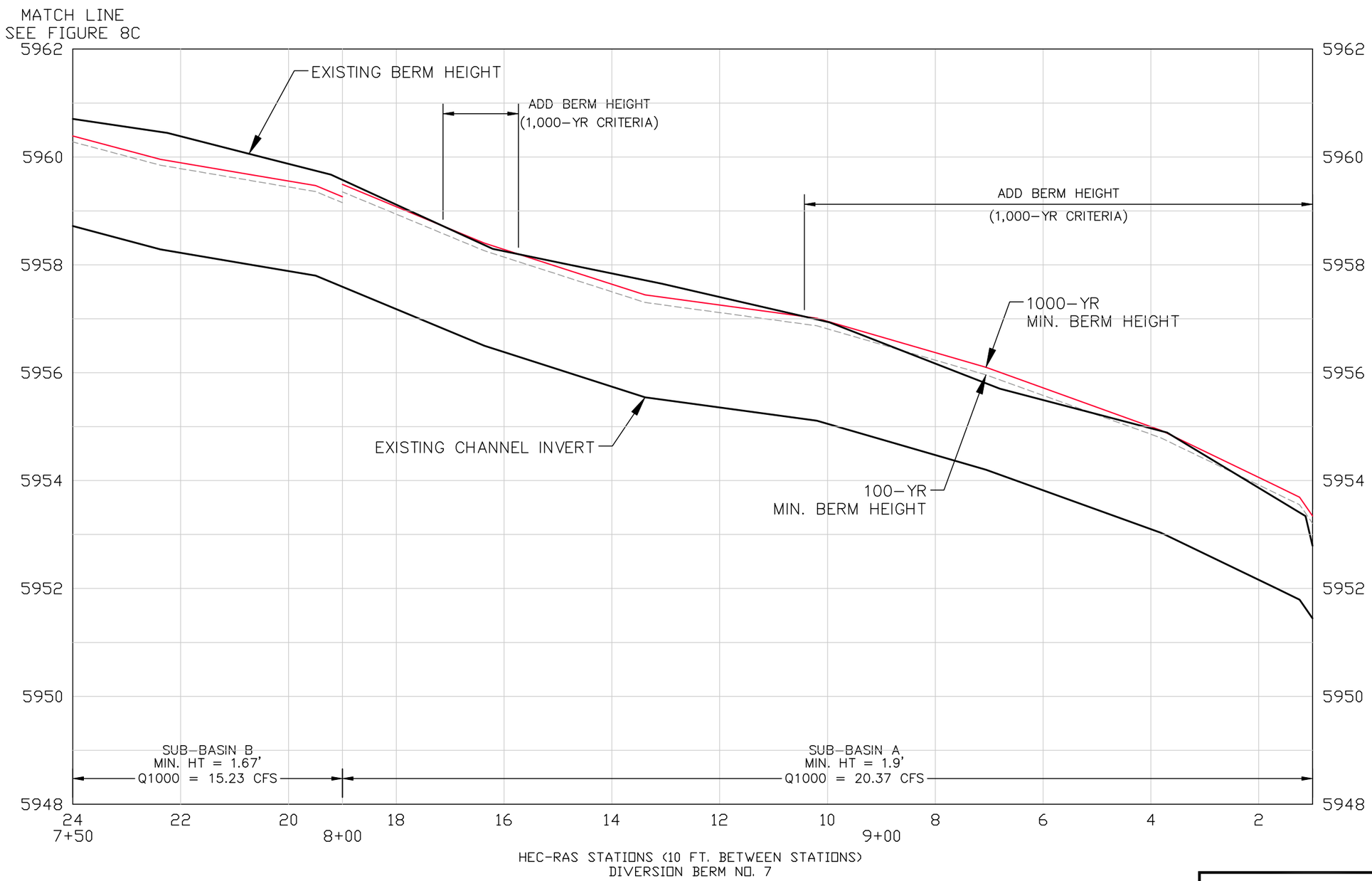

LEGEND:

- EXISTING BERM HEIGHT
- 1000-YR MINIMUM BERM HEIGHT
- 100-YR MINIMUM BERM HEIGHT
- EXISTING CHANNEL INVERT

HORIZONTAL SCALE IN FEET: 0 – 20

VERTICAL SCALE IN FEET: 0 – 2

VERTICAL EXAGGERATION = 10X

ROCKY FLATS - ORIGINAL LANDFILL

FIGURE 8D
DIVERSION BERM NO. 7
PROFILE

PROJECT:	114-181750
DATE:	JULY 25, 2008
FILE:	OLF-figs-01.dwg

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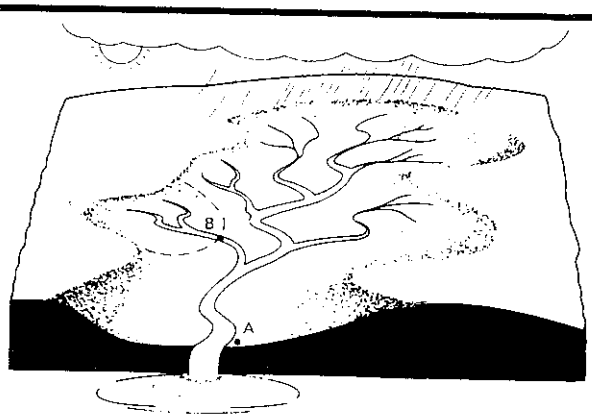
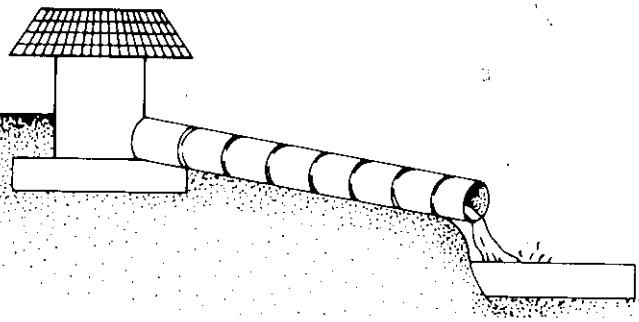


HYDROLOGIC ANALYSIS AND DESIGN

RICHARD H. McCUEN



REF A.2

Hydrologic Analysis and Design

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Englewood Cliffs, New Jersey / 07632

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 REF A.4

however, given the relatively small drainage areas used in calibrating the models, the coefficients probably reflect significant portions of overland flow travel time.

The SCS Lag Formula. The Soil Conservation Service (SCS) provided an equation for estimating the watershed lag, which was defined as the time in hours from the center of mass of the excess rainfall to the peak discharge; they also indicate that the time of concentration equals 1.67 times the lag. Equation 3-39 is intended for use on watersheds where overland flow dominates and was developed for nonurban watersheds. The SCS recommends that the lag equation be used for homogeneous watersheds 2000 acres and less. Two graphs were provided by SCS in TR-55 (1975) for correcting the lag formula for use in urban areas. One factor is based on the percentage of imperviousness and curve number and the other on the percentage of the hydraulic length modified and the curve number. The method primarily reflects overland flow. The runoff curve number CN can be obtained from Table 7-6.

Velocity Methods. The velocity methods are based on the concept that the travel time (T_t) is a function of the length of flow (L) and the velocity (V):

$$T_t = \frac{L}{V} \tag{3-42}$$

in which T_t, L, and V have units of seconds, feet, and ft/sec, respectively. The travel time is computed for the principal flow path. Where the principal flow path consists of segments that have different slopes or land cover, the principal flow path should be divided into segments and Eq. 3-42 used for each flow segment. The time of concentration is then the sum of the travel times:

$$t_c = \sum_{i=1}^{k} T_{ti} = \sum_{i=1}^{k} \frac{L_i}{V_i} \tag{3-43}$$

in which k is the number of segments and the subscript i refers to the flow segment.

The velocity of Eq. 3-42 is a function of the type of flow (overland, sheet, rill and gully flow, channel flow, pipe flow), the roughness of the flow path, and the slope of the flow path. Some methods also include a rainfall index such as the 2-year, 24-hr rainfall depth. Flow velocities in pipes and open channels can be computed using Manning's equation:

$$V = \frac{1.49}{n} R_h^{2/3} S^{0.5} \tag{3-44}$$

in which V is the velocity (ft/sec), n is the roughness coefficient, R_h is the hydraulic radius (feet), and S is the slope (ft/ft). A number of methods have been developed for estimating the velocity. Overland flow or sheet flow can be estimated using a relationship between the velocity and the slope:

$$V = kS^{0.5} \tag{3-45}$$

in which V is the velocity (ft/sec) and S is the slope (percent). The value of k is a function of the land cover, with values for five land covers (forest, trash fallow, short grass pasture, cultivated, and nearly bare) given in Table 3-12. These are also shown in Fig. 3-13.

REF A.5

TABLE 3-12 Coefficients of velocity versus slope relationship for estimating travel times with the velocity method

k	Land Use/Flow Regime
0.25	Forest with heavy ground litter; hay meadow (overlow flow)
0.50	Trash fallow or minimum tillage cultivation; contour or strip cropped; woodland (overland flow)
0.70	Short grass pasture (overland flow)
0.90	Cultivated straight row (overland flow)
1.00	Nearly bare and untilled (overland flow); alluvial fans in western mountain regions
1.50	Grassed waterway
2.00	Paved area (sheet flow); small upland gullies

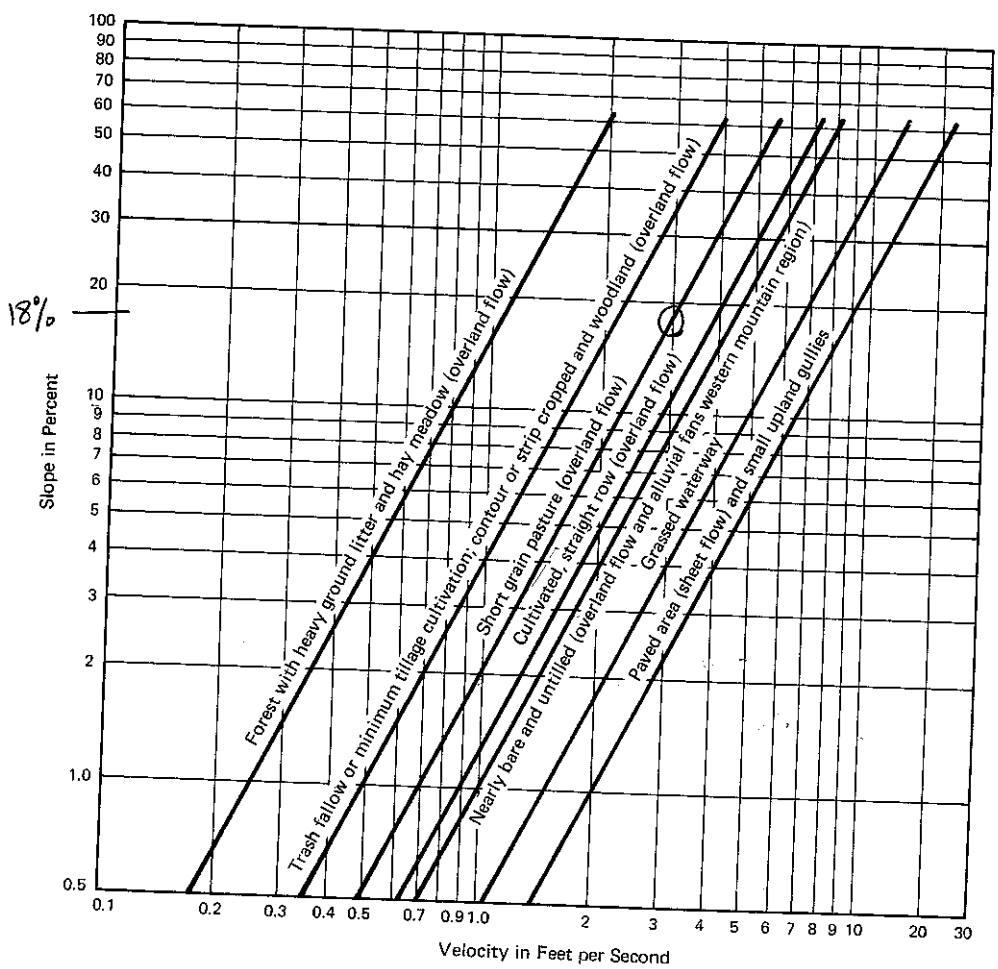

Fig. 3-13 Velocities for upland method of estimating T_0.

REF A.6

30% (i.e., $f \leq 0.3$). This decision was made because the model used to compute the ΔCN values assumed that the runoff from the unconnected areas was evenly distributed over the previous area (i.e., over F_p). For large values of f, this assumption may not be valid in practice. Also, for large values of f the time in which the excess water will be detained on the pervious surface would be small, and therefore, there would be little additional infiltration.

Example 7-7. To illustrate the use of Fig. 7-7, consider the case of a drainage area having 25% imperviousness, a pervious area CN of 61, and 50% of the imperviousness is unconnected. Enter the right-hand side of Fig. 7-7 using 25% imperviousness and move up the graph to the point on the line corresponding to 50% unconnected. Then move from this point horizontally to the left-hand side of the figure until the horizontal line intersects the interpolated line corresponding to the pervious area CN of 61. From this intersection move down to the abscissa and read off the value of the composite CN. In this case, the composite CN would be 68. If credit were not given for unconnected imperviousness, the percent of imperviousness could be entered on the vertical axis at the center of the graph and the composite CN found using the pervious area CN. For 25% imperviousness and a pervious area CN of 61 the composite CN would equal 70, which means that disconnecting 50% of the impervious cover allows for the CN to be reduced by 2.

7.6 Examples: Estimating Runoff Volumes

As indicated previously, the CN was developed for use with Eq. 7-26. Thus there was a need to relate S, which was the unknown of Eq. 7-26, and the runoff CN. An empirical analysis led to the following relationship:

$$S = \frac{1000}{\text{CN}} - 10 \tag{7-30}$$

Equations 7-26 and 7-30 can be used to estimate Q when the values of P and CN are available. It is important to note the following constraint on Eq. 7-26:

$$P \geq 0.2S \tag{7-31}$$

When $P < 0.2S$, it is necessary to assume that $Q = 0$.

In addition to Eqs. 7-26, 7-30, and 7-31, the runoff volume can be determined using either Fig. 7-8 or Table 7-8. The use of Fig. 7-8 suffers from the problem of interpolation; that is, the accuracy of Q is limited by the degree to which the figure can be interpolated.

Because of their importance to the material that follows, it is probably worthwhile summarizing the method for estimating the runoff depth (i.e., volume). Given a depth of rainfall P in inches, the runoff depth Q can be estimated by

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S} \qquad \text{for } P \geq 0.2S \tag{7-32a}$$

REF A.7

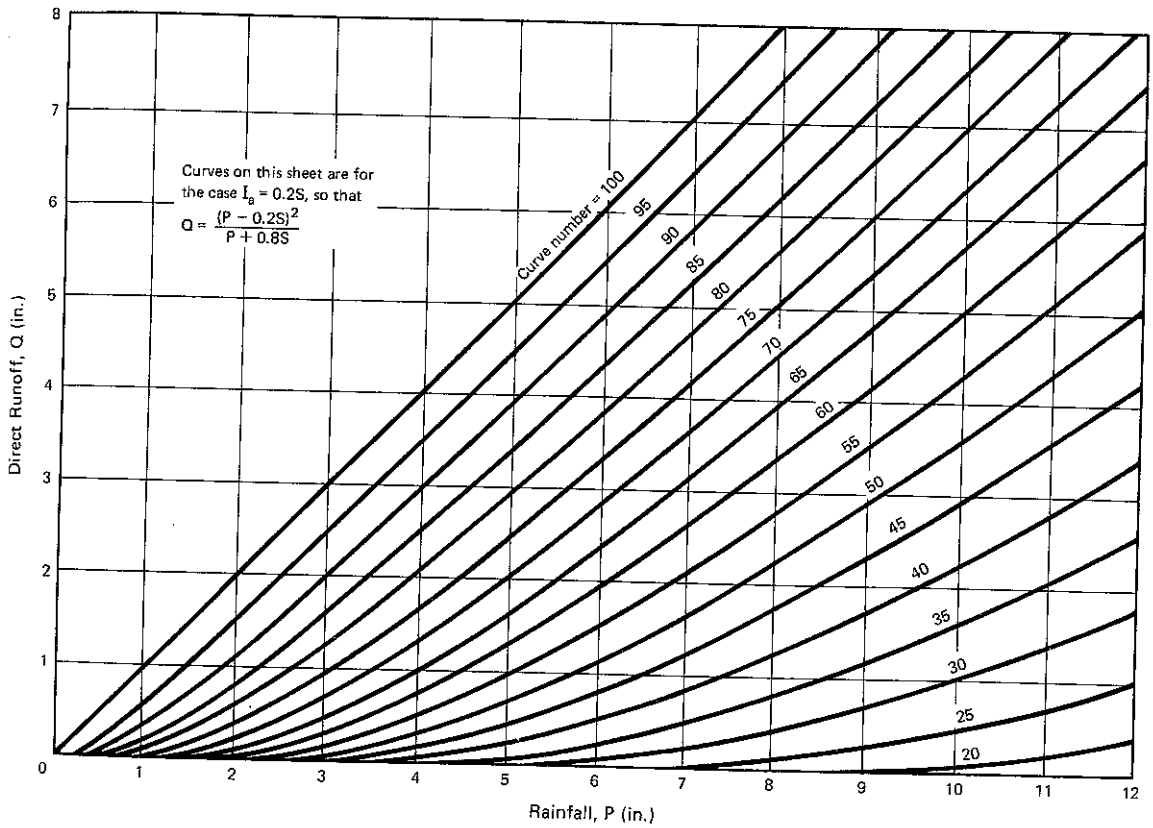

Fig. 7-8. Solution of runoff equation.

and

$$S = \frac{1000}{\text{CN}} - 10 \tag{7-32b}$$

Example 7-8. Determine the runoff volume for the 24-hr, 100-year rainfall of 7 in. when the soil is of group B and the watershed is in row crop, contoured in good hydrologic condition. Table 7-6 yields a CN of 75. Using either the mathematical formulas, the mass curve of Fig. 7-8, or Table 7-8 provides a runoff volume of 4.15 in.

Example 7-9. Determine the runoff volume for a 24-hr, 100-year rainfall of 7 in. for antecedent soil moisture condition II, with the following land uses and soil groups:

Area Fraction	Land Use/Condition	Soil Group
0.40	Meadow: good condition	D
0.25	Wooded: poor cover	C
0.20	Open space: good condition	D
0.15	Residential (1/4-acre lots)	C

REF. A.8

rainfall of 7 in. The fraction of the watershed in each land use/soil group combination is computed as follows:

Land Use	Soil Group	Area	CN	Q
Wooded	B	0.4(0.75) = 0.30	55	2.12
	C	0.4(0.25) = 0.10	70	3.62
Residential	B	0.6(0.75) = 0.45	75	4.15
	C	0.6(0.25) = 0.15	83	5.03

The weighted Q is

$$Q = 0.30(2.12) + 0.10(3.62) + 0.45(4.15) + 0.15(5.03) = 3.62 \text{ in.} \tag{7-37}$$

Using the weighted CN approach, the weighted CN would be 69.7 (use 70), which yields a Q of 3.62 in. Thus in this case the precipitation is large, so the two methods provide the same estimate of Q.

7.7 SCS Graphical Peak Discharge Method

For many peak discharge estimation methods, the input includes variables to reflect the size of the contributing area, the amount of rainfall, the potential watershed storage, and the time–area distribution of the watershed. These are often translated into input variables such as the drainage area, the depth of rainfall, an index reflecting land use and soil type, and the time of concentration. The SCS Graphical Method is typical of many peak discharge methods that are based on input such as that described.

7.7.1 *The I_a/P Parameter*

I_a/P is a new parameter that has been added to the methods for estimating peak discharge. I_a denotes the initial abstraction, and P is the 24-hr rainfall depth. The I_a/P value can be obtained from Table 7-9 for a given CN and P. Because SCS procedures for hydrograph generation are based on unit hydrograph theory, classifying hydrographs by unit runoff response is desirable. Using I_a/P will make this possible.

For a given 24-hr rainfall distribution, I_a/P represents the fraction of rainfall that must occur before runoff begins. Vary the I_a/P and the runoff response time changes. Hold I_a/P constant and the unit runoff response is identical no matter what combination of CN and P is used to form the I_a/P ratio. Table 7-10 shows the beginning runoff times and 0.1-hr peak runoff for a range of I_a/P values.

REF A.9

TABLE 7-9 I_a/P for selected runoff curve numbers and rainfall depths[a]

Rainfall (in.)	Runoff Curve Number								
	55	60	65	70	75	80	85	90	95
1.0	**	**	**	**	0.67	0.50	0.35	0.22	0.11
1.5	Use 0.5	**	0.72	0.57	0.44	0.33	0.24	0.15	0.07
2.0	**	**	0.54	0.43	0.33	0.25	0.18	0.11	0.05
2.5	0.65	0.53	0.43	0.34	0.27	0.20	0.14	0.09	0.04
3.0	0.55	0.44	0.36	0.29	0.22	0.17	0.12	0.07	0.04
3.5	0.47	0.38	0.31	0.24	0.19	0.14	0.10	0.06	0.03
4.0	0.41	0.33	0.27	0.21	0.17	0.13	0.09	0.06	0.03
4.5	0.36	0.30	0.24	0.19	0.15	0.11	0.08	0.05	0.02
5.0	0.33	0.27	0.22	0.17	0.13	0.10	0.07	0.04	0.02
6.0	0.27	0.22	0.18	0.14	0.11	0.08	0.06	0.04	0.02
7.0	0.23	0.19	0.15	0.12	0.10	0.07	0.05	0.03	0.02
8.0	0.20	0.17	0.13	0.11	0.08	0.06	0.04	0.03	0.01
9.0	0.18	0.15	0.12	0.10	0.07	0.06	Use 0.1	0.02	0.01
10.0	0.16	0.13	0.11	0.09	0.07	0.05		0.02	0.01
11.0	0.15	0.12	0.10	0.08	0.06	0.05	0.03	0.02	0.01
12.0	0.14	0.11	0.09	0.07	0.06	0.04	0.03	0.02	0.01
13.0	0.13	0.10	0.08	0.07	0.05	0.04	0.03	0.02	0.01
14.0	0.12	0.10	0.08	0.06	0.05	0.04	0.03	0.02	0.01
15.0	0.11	0.09	0.07	0.06	0.04	0.03	0.02	0.01	0.01

[a] ** signifies no runoff.

Use $I_a/P = 0.1$

TABLE 7-10 Effect of I_a/P on runoff response

	Type I Rainfall Distribution		Type II Rainfall Distribution	
	Time Runoff Begins	Maximum 0.1-hr Runoff	Time Runoff Begins	Maximum 0.1-hr Runoff
I_a/P	(hrs)	(%)	(hrs)	(%)
0.1	5.0	8.2	7.1	16.3
0.2	8.1	7.1	10.4	15.7
0.3	9.5	5.0	11.6	13.5
0.4	9.8	3.1	11.8	12.7
0.5	10.0	0.9	11.9	9.8

7.7.2 *Peak Discharge Computation*

The following equation can be used to compute a peak discharge with the SCS graphical method:

$$q_p = q_{um} A_m Q \tag{7-38}$$

REF A.10

To illustrate the constant intensity design storm, we will assume the following condition: (1) the design standard specifies a 10-year return period for design; (2) the watershed time of concentration is 15 minutes; and (3) the watershed is located in Baltimore, Maryland. From Fig. 4-2 the rainfall intensity is 5.5 in./hr, which yields a storm volume of 1.375 in. The resulting design storm is shown in Fig. 4-3.

4.3.2 *The SCS 24-Hour Storm Distributions*

The SCS developed four dimensionless rainfall distributions using the Weather Bureau's Rainfall Frequency Atlases. The rainfall frequency data for areas less than 400 mi^2, for durations to 24 hr, and for frequencies from 1 to 100 years were used. Data analysis indicated four major regions, and the resulting rainfall distributions were labeled type I, IA, II, and III. The locations where these design storms should be used are shown in Fig. 4-4.

The distributions are based on the generalized rainfall volume–duration–frequency relationships shown in technical publications of the Weather Bureau. Rainfall depths for durations from 6 minutes to 24-hr were obtained from the volume–duration–frequency information in these publications and used to derive the storm distributions. Using increments of 6 minutes, incremental rainfall depths were determined. For example, the maximum 6-minute depth was subtracted from the maximum 12-minute depth and this 12-minute depth was subtracted from the maximum 18-minute depth,

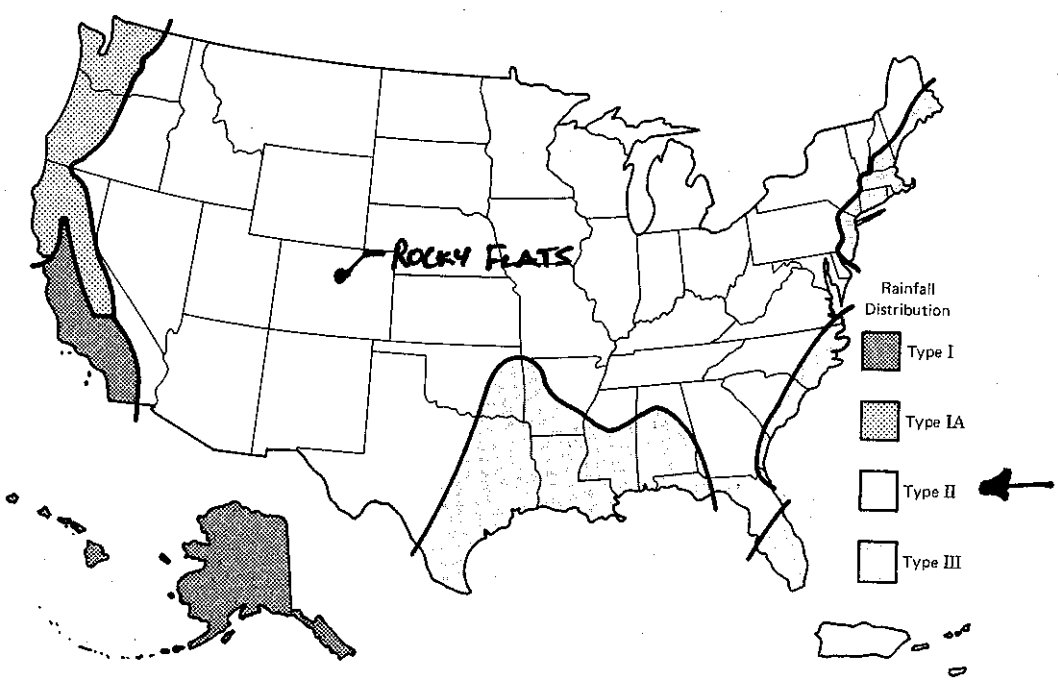

Fig. 4-4 Approximate geographic areas for SCS rainfall distributions.

REF. A.11

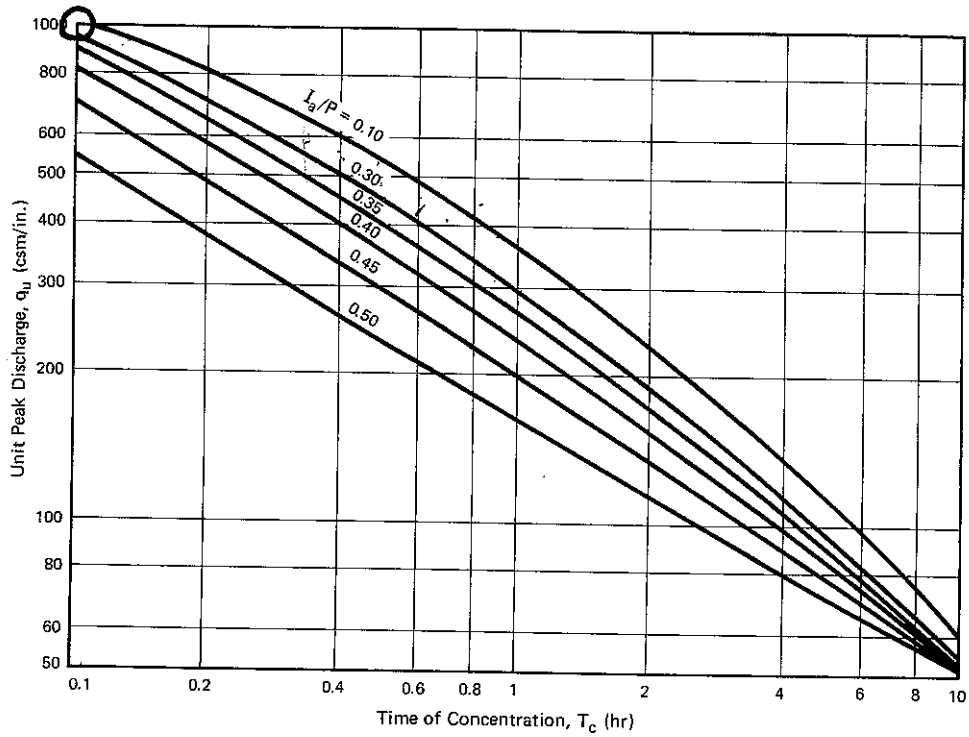

Fig. 7-10(c) Unit peak discharge (q_u) for SCS type II rainfall distribution.

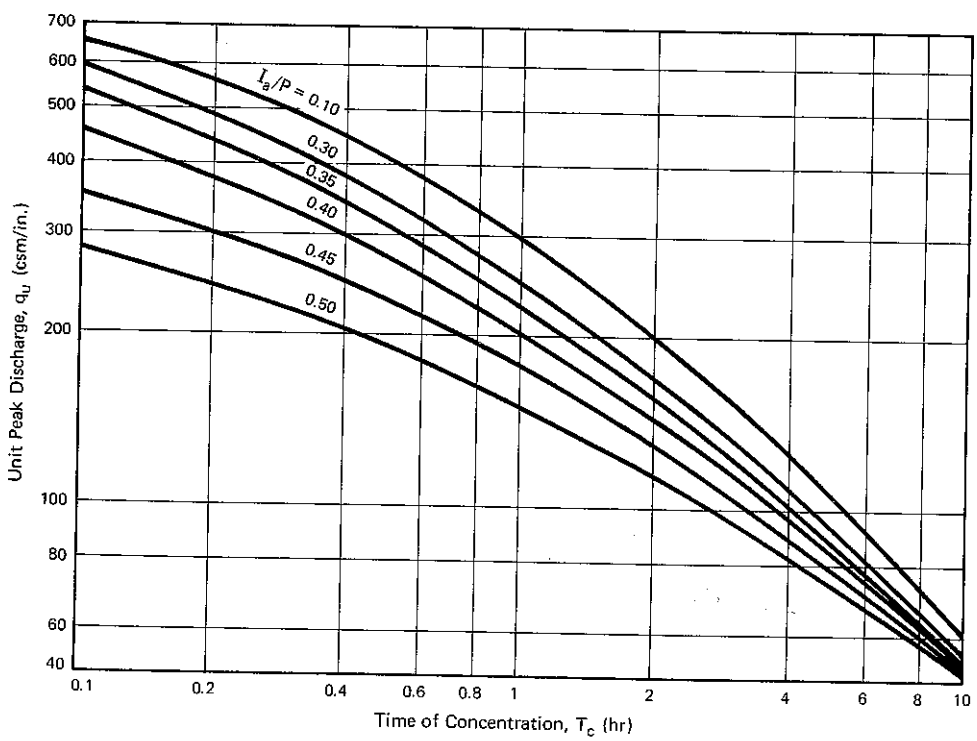

Fig. 7-10(d) Unit peak discharge (q_u) for SCS type III rainfall distribution.

REF. B

APPENDIX D

LANDFILL ENGINEERING – FINAL DESIGN
SURFACE WATER MANAGEMENT SYSTEM ASSESSMENT

APPENDIX D

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
ACCELERATED ACTION DESIGN FOR THE ORIGINAL LANDFILL

LANDFILL ENGINEERING – FINAL DESIGN
SURFACE WATER MANAGEMENT SYSTEM ASSESSMENT

MAY 11, 2005

Prepared by:

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This calculation was performed by Earth Tech, Inc. Although each sheet composing this calculation may or may not be initialed, it has nonetheless been reviewed and checked.

Prepared By:	RA	Date: 5/11/05
Checked By:	RT	Date: 5/11/05
Approved By:	RT	Date: 5/11/05

LIST OF TABLES

Table D-1 Original Landfill – Structure Design
Table D-2 Original Landfill – Check Dams
Table D-3 Original Landfill – 1000-Year 24-Hour Comparison

LIST OF ATTACHMENTS

Attachment 1 Surface Water Drainage Map
Attachment 2 SEDCAD Reports
Attachment 3 NAG Reports

1.0 INTRODUCTION

This Surface Water Management Plan was developed to address potential storm water impacts the Original Landfill Accelerated Action may have to the surrounding area.

This Plan addresses two elements:

1. Surface water control structures that will be required to adequately convey the run-on to and run-off from the Original Landfill due to a 100-year 24-hour storm event with freeboard capacity to handle the 1000-year 24-hour storm event.

2. Reduce sediment transport following construction while the landfill area is disturbed. Once vegetation is established, conditions will be similar to surrounding areas.

2.0 LANDFILL DESCRIPTION, LOCATION AND DRAINAGE

The Original Landfill site is located south of RFETS Buildings 440 and 460, along the north hillside of a ravine in the Woman Creek drainage area, extending from approximate Elevation 6,040 feet at the top to Elevation 5,950 feet at its base. Waste operations began in the early 1950s and continued through 1968. The Original Landfill site footprint has a maximum length along the east-west direction of approximately 1,700 feet, and approximately 500 feet in the north-south direction, with an approximate area on the order of 20 acres.

Due to the canyon-fill nature of the Original Landfill, minimal surface water run-on is expected to occur. Run-off from the cover will be controlled by the construction of 7 diversion berms which route water to lined channels on the west and east side. The berms were spaced no greater than 150 feet to limit sediment transport from the cover to the side channels. To reduce erosion on the buttress sideslope, without using permanent erosion controls, diversion berms spaced no greater than 30 feet apart (see Appendix C) have been designed. The proposed surface water management plan is shown on Attachment 1.

3.0 REFERENCES

The surface water management system for the Original Landfill was evaluated using guidelines provided in the following documents:

1. "SEDCAD 4 for Windows 95/98 & NT". Design Manual and User's Guide. 2001.

2. "Regulations Pertaining to Solid Waste Disposal Sites and Facilities" (Regulations), 6 CCR 1007-2, Colorado Department of Public Health and Environment.

3. "Urban Storm Drainage Criteria Manual" (Drainage Manual), Denver Urban Drainage and Flood Control District.

4. "Erosion Control Materials Design Software Version 4.2 for Windows". North American Green (NAG). 2002.

4.0 DESIGN CRITERIA

The attached model was used to evaluate the existing drainage characteristics at the Original Landfill and to size appropriate drainage structures for the Original Landfill. Evaluation and design of the Original Landfill surface water control system will meet the following design criteria:

1. Collect and control surface water run-on flow onto the closed landfill as a result of the 100-year 24-hour storm event with freeboard capacity to handle the 1000-year 24-hour storm event;
2. Collect and control surface water run-off from the landfill as a result of the 100-year 24-hour storm event with freeboard capacity to handle the 1000-year 24-hour storm event;
3. Comply with any provisions of the RFETS storm water discharge permit requirements including reduction of sediment transport;
4. Minimize site erosion;
5. Protect the integrity and effectiveness of the landfill cover; and
6. Minimize surface water management post-closure maintenance requirements.

5.0 HYDROLOGIC AND HYDRAULIC DESIGN APPROACH

The design process used to locate and size the surface water management structures at the Original Landfill is as follows:

1. The goal of the surface water management structures is to reduce the sediment delivered to Woman Creek from the disturbed areas or roughly the area between the west and east channels. The areas outside the channels will remain in native-type condition and the sediment currently generated from these native areas will not change after construction. The first step is to therefore place enough diversion berms on the cover to create smaller subwatersheds where sediment can be contained on the cover. The sediment will be controlled within the diversion berms with the use of removable geosynthetic check dams. It was determined that 10 diversion berms are needed to reduce sediment based on the 25-year 24-hour storm.
2. The 100-year 24-hour storm is then modeled to calculate the required height of the diversion berm and the channels which route the diversion berm water below the buttress fill.
3. The peak flows are modeled with NAG software to determine the required diversion berm and channel lining as well as the maximum slope and minimum bend radius of the channels.
4. The 1000-year 24-hour event is then modeled to check the freeboard capacity of the structures.

As shown in Attachment 1, overland flow is greater than 200 feet in the southern portion but the gradual slope at the top of the buttress fill reduces erosion. A check using the RUSLE shows that 220-feet of overland flow at 5% results in 1.50 tons/acre/year and 225-feet of overland flow at 2.75% results in 0.82 tons/acre/year (bare conditions – RFA prior to mature state). The top of the buttress will be lined with NAG C125 erosion mat following construction further reducing erosion.

SEDCAD4 software was used for surface water modeling at the Original Landfill. SEDCAD uses the National Resource Conservation Service (NRCS) approach for rainfall distribution and the NRCS curve number/unit

hydrograph to predict peak flows. The NRCS Storm Type Distributions are considered very conservative leading to higher peak flows than almost any actual measured storm (SEDCAD 4 User's Manual).

Input into the SEDCAD software include:

- A 100-year 24-hour design storm according to the Regulations;
- A 1000-year 24-hour design storm to check freeboard capacity;
- An NRCS Type II storm;
- A rainfall depth of 5.0 inches according to the Drainage Manual for the 100-year 24-hour storm and 6.4 inches for the 1000-year 24-hour storm and 3.25 for the 25-year 24-hour storm;
- A conservative NRCS curve number of 86; and,
- A medium hydrograph response.

NAG software calculates flow depth, velocity, and hydraulic radius using the continuity equation (Q=VA) and Manning's equation. Once these are known, the shear stress on the lining material is calculated including any channel bend.

5.1 SURFACE WATER DESIGN RESULTS

The design is organized into nine models:

- West channel sediment reduction;
- West channel 100-year 24-hour design;
- West channel 1000-year 24-hour check;
- East channel sediment reduction;
- East channel 100-year 24-hour design;,
- East channel 1000-year 24-hour check;
- Buttress sediment reduction;
- Buttress sideslope 100-year 24-hour design; and,
- Buttress sideslope 1000-year 24-hour design.

Please see Attachment 1 for the SEDCAD models and Attachment 2 for NAG results. Since the west subwatersheds are similar, the sediment reduction model to space the check dams is based on only one of the watersheds. The same methodology was used on the east side. Results are summarized in the following table.

Table D-1
Original Landfill – Structure Design

Structure	Slope	Shape	Minimum Bend Radius	Sideslopes	Minimum Height or Depth	Permanent Lining	Temporary Lining
West Diversion Berm 1	2%	Triangular	5 feet	5.6H:1V Uphill 3H:1V Downhill	3 feet	Grass	Erosion Mat (NAG C125)
West Diversion Berm 2	2%	Triangular	5 feet	5.6H:1V Uphill 3H:1V Downhill	3 feet	Grass	Erosion Mat (NAG C125)
West Diversion Berm 3	2%	Triangular	5 feet	5.6H:1V Uphill 3H:1V Downhill	3 feet	Grass	Erosion Mat (NAG C125)
West Channel	2-12%	Trapezoidal Min. 10-foot bottom	105 feet	3H:1V	2 feet	Erosion Mat (NAG P550)	Erosion Mat (P550) / Grass
East Diversion Berm 1	~~2%~~	Triangular	5 feet	5.6H:1V Uphill 3H:1V Downhill	~~3 feet~~	~~Grass~~	Erosion Mat (NAG C125)
East Diversion Berm 2	2%	Triangular	5 feet	5.6H:1V Uphill 3H:1V Downhill	3 feet	Grass	Erosion Mat (NAG C125)
East Diversion Berm 3	2%	Triangular	5 feet	5.6H:1V Uphill 3H:1V Downhill	3 feet	Grass	Erosion Mat (NAG C125)
East Diversion Berm 4	2%	Triangular	5 feet	5.6H:1V Uphill 3H:1V Downhill	3 feet	Grass	Erosion Mat (NAG C125)
East Channel	2-12%	Trapezoidal Min. 18-foot bottom	200 feet	3H:1V	2 feet	Erosion Mat (NAG P550)	Erosion Mat (P550) / Grass
Typical Downstream Channel	33%	Triangular	NA	3H:1V	3 feet	Erosion Mat (NAG C125)	Grass
Buttress Diversion Berm 1	3.5%	Triangular	5 feet	1H:1V	3 ~~feet~~	Grass	Erosion Mat (NAG C125)
Buttress Diversion Berm 2	3.5%	Triangular	5 feet	1H:1V	3 feet	Grass	Erosion Mat (NAG C125)
Buttress Diversion Berm 3	3.5%	Triangular	5 feet	1H:1V	3 feet	Grass	Erosion Mat (NAG C125)

Sediment reduction load was determined by placing the minimum amount of check dams within the diversion berm until the downstream dams overtop. The following was calculated based on five check dams in each diversion berm. Values are a minimum and more can be placed per berm in accordance with manufacturer's recommendations.

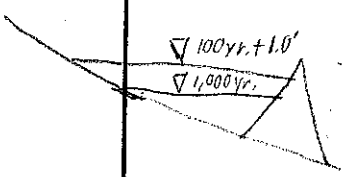
Table D-2
Original Landfill – Check Dam

Area	Sediment Load without Check Dams	Sediment Load with Check Dams	Minimum Check Dam Spacing
West Subwatersheds	9.5 tons	3.0 tons	130 feet
East Subwatersheds	9.0 tons	2.7 tons	200 feet
Buttress Sideslope	10.0 tons	2.0 tons	130 feet

5.2 1000-YEAR 24-HOUR STORM

To determine if the freeboard capacity of the 100-year 24-hour storm is sufficient to handle the 1000-year 24-hour storm, the design was conducted with a rainfall depth of 6.4 inches. The output is provided in Attachment 2. A summary of the findings is found in the following table:

Table D-3
Original Landfill – 1000-Year 24-Hour Comparison



Structure		100-Year Flow Depth with Freeboard (ft)	1000-Year Flow Depth without freeboard (ft)
West Diversion Berm 1	1	2.49	1.60
West Diversion Berm 2	2	2.64	1.75
West Diversion Berm 3	3	2.53	1.64
West Channel		1.46	0.54
East Diversion Berm 1	4	2.67	1.79
East Diversion Berm 2	5	2.67	1.79
East Diversion Berm 3	6	2.67	1.79
East Diversion Berm 4	7	2.67	1.79
East Channel		1.44	0.53
Buttress Diversion Berm 1		2.38	1.48
Buttress Diversion Berm 2		3.09	2.24
Buttress Diversion Berm 3		3.05	2.19/

As shown in Table D-3, the design based on the 100-year 24-hour [redacted] is sufficient to handle surface water from the 1000-year 24-hour storm for the diversion berms and the channels.

6.0 CONCLUSIONS

Surface water management features required at the Original Landfill to achieve the design criteria listed in Section 4.0 include the following:

- Ten diversion berms with check dams to capture overland flow, reduce sediment load, and route it to channels.
- A permanent erosion control lined channel on the west to convey stormwater to below the buttress fill.
- A permanent erosion control/vegetation lined channel on the east to convey stormwater to below the buttress fill.

APPENDIX D

ATTACHMENT 2
SEDCAD REPORTS

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RFETS

WEST CHANNEL SEDIMENT

Ryan Archibald

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	0.460	0.018	0.000	0.000	86.000	M	1.47	0.072
	Σ	**0.460**						**1.47**	**0.072**
#2	Σ	**0.460**						**1.47**	**0.072**
#3	1	0.460	0.018	0.000	0.000	86.000	M	1.47	0.072
	Σ	**0.920**						**2.94**	**0.144**
#4	Σ	**0.920**						**2.94**	**0.144**
#5	1	0.460	0.018	0.000	0.000	86.000	M	1.47	0.072
	Σ	**1.380**						**4.41**	**0.216**
#6	Σ	**1.380**						**4.41**	**0.216**
#7	1	0.460	0.018	0.000	0.000	86.000	M	1.47	0.072
	Σ	**1.840**						**5.88**	**0.288**
#8	Σ	**1.840**						**5.88**	**0.288**
#9	1	0.460	0.018	0.000	0.000	86.000	M	1.47	0.072
	Σ	**2.300**						**7.35**	**0.360**
#10	Σ	**2.300**						**7.35**	**0.360**
#11	Σ	**2.300**						**7.35**	**0.360**

FROM Appendix C FROM NAG CUTSHEETS APP C

Subwatershed Sedimentology Detail:

SEDIMENT FROM 1 SUBWATERSHED

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.283	130.00	18.00	0.0700	0.9850	1	1.9	40,772	29.95	2.67
	Σ							**1.9**	**40,772**	**29.95**	**2.67**
#2	Σ							**1.9**	**40,772**	**29.95**	**2.67**
#3	1	0.283	130.00	18.00	0.0700	0.9850	1	1.9	40,772	29.95	2.67
	Σ							**2.0**	**22,515**	**15.33**	**1.36**
#4	Σ							**2.0**	**22,515**	**15.33**	**1.36**
#5	1	0.283	130.00	18.00	0.0700	0.9850	1	1.9	40,772	29.95	2.67
	Σ							**2.2**	**16,363**	**10.40**	**0.92**

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#6	Σ							**2.2**	**16,363**	**10.40**	**0.92**
#7	1	0.283	130.00	18.00	0.0700	0.9850	1	1.9	40,772	29.95	2.67
	Σ							**2.7**	**14,806**	**9.15**	**0.81**
#8	Σ							**2.7**	**14,806**	**9.15**	**0.81**
#9	1	0.283	130.00	18.00	0.0700	0.9850	1	1.9	40,772	29.95	2.67
	Σ							**3.0**	**13,202**	**7.87**	**0.69**
#10	Σ							**3.0**	**13,202**	**7.87**	**0.69**
#11	Σ							**3.0**	**13,202**	**7.87**	**0.69**

TOTAL SED w/o DAMS = 1.9(5) = 9.5 w/out check dams
TOTAL WITH DAMS = 3

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	3. Short grass pasture	18.00	23.40	130.00	3.390	0.010
		8. Large gullies, diversions, and low flowing streams	2.00	2.60	130.00	4.240	0.008
#1	**1**	**Time of Concentration:**					**0.018**
#3	1	3. Short grass pasture	18.00	23.40	130.00	3.390	0.010
		8. Large gullies, diversions, and low flowing streams	2.00	2.60	130.00	4.240	0.008
#3	**1**	**Time of Concentration:**					**0.018**
#5	1	3. Short grass pasture	18.00	23.40	130.00	3.390	0.010
		8. Large gullies, diversions, and low flowing streams	2.00	2.60	130.00	4.240	0.008
#5	**1**	**Time of Concentration:**					**0.018**
#7	1	3. Short grass pasture	18.00	23.40	130.00	3.390	0.010
		8. Large gullies, diversions, and low flowing streams	2.00	2.60	130.00	4.240	0.008
#7	**1**	**Time of Concentration:**					**0.018**
#9	1	3. Short grass pasture	18.00	23.40	130.00	3.390	0.010
		8. Large gullies, diversions, and low flowing streams	2.00	2.60	130.00	4.240	0.008
#9	**1**	**Time of Concentration:**					**0.018**

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RFETS-100 YEAR

WEST CHANNEL

Ryan Archibald

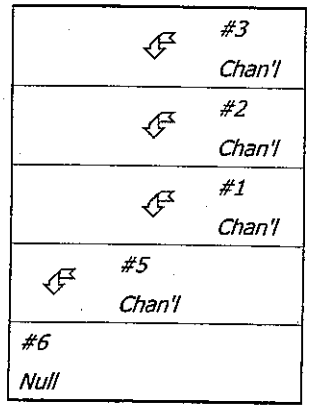
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	5.000 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#5	0.032	0.417	
Channel	#2	==>	#5	0.032	0.417	
Channel	#3	==>	#5	0.032	0.417	
Channel	#5	==>	#6	0.000	0.000	
Null	#6	==>	End	0.000	0.000	



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	8.00	80.00	1,000.00	8.48	0.032
#1	**Muskingum K:**					**0.032**
#2	8. Large gullies, diversions, and low flowing streams	8.00	80.00	1,000.00	8.48	0.032
#2	**Muskingum K:**					**0.032**
#3	8. Large gullies, diversions, and low flowing streams	8.00	80.00	1,000.00	8.48	0.032
#3	**Muskingum K:**					**0.032**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#3	1.700	1.700	9.76	0.49
#2	2.300	2.300	13.21	0.66
#1	1.500	1.500	8.61	0.43
#5	1.000	6.500	37.33	1.88
#6	0.000	6.500	37.33	1.88

Structure Detail:

Structure #3 (Vegetated Channel)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	5.6:1	2.0	D, B	1.00			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	9.76 cfs		9.76 cfs	
Depth:	0.99 ft	1.99 ft	1.53 ft	2.53 ft
Top Width:	8.55 ft	17.15 ft	13.19 ft	21.79 ft
Velocity:	2.30 fps		0.96 fps	
X-Section Area:	4.25 sq ft		10.12 sq ft	
Hydraulic Radius:	0.484		0.747	
Froude Number:	0.57		0.19	
Roughness Coefficient:	0.0564		0.1796	

Structure #2 (Vegetated Channel)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	5.6:1	2.0	D, B	1.00			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	13.21 cfs		13.21 cfs	
Depth:	1.09 ft	2.09 ft	1.64 ft	2.64 ft
Top Width:	9.34 ft	17.94 ft	14.10 ft	22.70 ft

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Velocity:	2.60 fps		1.14 fps	
X-Section Area:	5.07 sq ft		11.57 sq ft	
Hydraulic Radius:	0.529		0.799	
Froude Number:	0.62		0.22	
Roughness Coefficient:	0.0529		0.1587	

Structure #1 (Vegetated Channel)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	5.6:1	2.0	D, B	1.00			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	8.61 cfs		8.61 cfs	
Depth:	0.96 ft	1.96 ft	1.49 ft	2.49 ft
Top Width:	8.24 ft	16.84 ft	12.83 ft	21.43 ft
Velocity:	2.18 fps		0.90 fps	
X-Section Area:	3.95 sq ft		9.57 sq ft	
Hydraulic Radius:	0.467		0.727	
Froude Number:	0.56		0.18	
Roughness Coefficient:	0.0580		0.1890	

Structure #5 (Nonerodible Channel)

Trapezoidal Nonerodible Channel Inputs:

Material: Plastic

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
10.00	3.0:1	3.0:1	12.0	0.0390	1.00		

Nonerodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	37.33 cfs	
Depth:	0.46 ft	1.46 ft
Top Width:	12.73 ft	18.73 ft
Velocity:	7.21 fps	
X-Section Area:	5.18 sq ft	
Hydraulic Radius:	0.402	
Froude Number:	1.99	

Structure #6 (Null)

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#3	1	1.700	0.036	0.000	0.000	86.000	M	9.76	0.491
	Σ	**1.700**						**9.76**	**0.491**
#2	1	2.300	0.051	0.000	0.000	86.000	M	13.21	0.665
	Σ	**2.300**						**13.21**	**0.665**
#1	1	1.500	0.048	0.000	0.000	86.000	M	8.61	0.433
	Σ	**1.500**						**8.61**	**0.433**
#5	1	1.000	0.008	0.000	0.000	86.000	M	5.74	0.289
	Σ	**6.500**						**37.33**	**1.878**
#6	Σ	**6.500**						**37.33**	**1.878**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	2.00	14.79	739.50	4.240	0.048
#1	**1**	**Time of Concentration:**					**0.048**
#2	1	3. Short grass pasture	18.00	23.40	130.00	3.390	0.010
		8. Large gullies, diversions, and low flowing streams	2.00	12.79	639.50	4.240	0.041
#2	**1**	**Time of Concentration:**					**0.051**
#3	1	3. Short grass pasture	18.00	18.00	99.99	3.390	0.008
		8. Large gullies, diversions, and low flowing streams	2.00	8.80	440.00	4.240	0.028
#3	**1**	**Time of Concentration:**					**0.036**
#5	1	3. Short grass pasture	18.00	18.00	99.99	3.390	0.008
#5	**1**	**Time of Concentration:**					**0.008**

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RFETS-1000 YEAR

WEST CHANNEL

Ryan Archibald

Structure Detail:

Structure #3 (Vegetated Channel)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	5.6:1	2.0	D, B	1.00			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	13.23 cfs		13.23 cfs	
Depth:	1.09 ft	2.09 ft	1.64 ft	2.64 ft
Top Width:	9.35 ft	17.95 ft	14.10 ft	22.70 ft
Velocity:	2.60 fps		1.14 fps	
X-Section Area:	5.08 sq ft		11.57 sq ft	
Hydraulic Radius:	0.529		0.799	
Froude Number:	0.62		0.22	
Roughness Coefficient:	0.0529		0.1585	

Structure #2 (Vegetated Channel)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	5.6:1	2.0	D, B	1.00			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	17.91 cfs		17.91 cfs	
Depth:	1.19 ft	2.19 ft	1.75 ft	2.75 ft
Top Width:	10.22 ft	18.82 ft	15.08 ft	23.68 ft

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Velocity:	2.95 fps		1.35 fps	
X-Section Area:	6.07 sq ft		13.23 sq ft	
Hydraulic Radius:	0.579		0.854	
Froude Number:	0.67		0.25	
Roughness Coefficient:	0.0495		0.1401	

Structure #1 (Vegetated Channel)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	5.6:1	2.0	D, B	1.00			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	11.68 cfs		11.68 cfs	
Depth:	1.05 ft	2.05 ft	1.60 ft	2.60 ft
Top Width:	9.01 ft	17.61 ft	13.73 ft	22.33 ft
Velocity:	2.47 fps		1.07 fps	
X-Section Area:	4.72 sq ft		10.95 sq ft	
Hydraulic Radius:	0.510		0.777	
Froude Number:	0.60		0.21	
Roughness Coefficient:	0.0543		0.1669	

Structure #5 (Nonerodible Channel)

Trapezoidal Nonerodible Channel Inputs:

Material: Plastic

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
10.00	3.0:1	3.0:1	12.0	0.0390	1.00		

Nonerodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	50.60 cfs	
Depth:	0.54 ft	1.54 ft
Top Width:	13.26 ft	19.26 ft
Velocity:	8.01 fps	
X-Section Area:	6.32 sq ft	
Hydraulic Radius:	0.470	
Froude Number:	2.04	

Structure #6 (Null)

RFETS

EAST CHANNEL SEDIMENT

Ryan Archibald

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	0.500	0.021	0.000	0.000	86.000	M	1.60	0.078
	Σ	**0.500**						**1.60**	**0.078**
#2	Σ	**0.500**						**1.60**	**0.078**
#3	1	0.500	0.021	0.000	0.000	86.000	M	1.60	0.078
	Σ	**1.000**						**3.20**	**0.157**
#4	Σ	**1.000**						**3.20**	**0.157**
#5	1	0.500	0.021	0.000	0.000	86.000	M	1.60	0.078
	Σ	**1.500**						**4.80**	**0.235**
#6	Σ	**1.500**						**4.80**	**0.235**
#7	1	0.500	0.021	0.000	0.000	86.000	M	1.60	0.078
	Σ	**2.000**						**6.39**	**0.313**
#8	Σ	**2.000**						**6.39**	**0.313**
#9	1	0.500	0.021	0.000	0.000	86.000	M	1.60	0.078
	Σ	**2.500**						**7.99**	**0.391**
#10	Σ	**2.500**						**7.99**	**0.391**
#11	Σ	**2.500**						**7.99**	**0.391**

APP C NAG APPC

SEDIMENT FROM 1 SUBWATERSHED

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.283	100.00	18.00	0.0700	0.9850	1	1.8	35,249	25.89	2.30
	Σ							**1.8**	**35,249**	**25.89**	**2.30**
#2	Σ							**1.8**	**35,249**	**25.89**	**2.30**
#3	1	0.283	100.00	18.00	0.0700	0.9850	1	1.8	35,249	25.89	2.30
	Σ							**1.9**	**19,446**	**13.24**	**1.17**
#4	Σ							**1.9**	**19,446**	**13.24**	**1.17**
#5	1	0.283	100.00	18.00	0.0700	0.9850	1	1.8	35,249	25.89	2.30

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	Σ							**2.1**	**14,127**	**8.98**	**0.79**
#6	Σ							**2.1**	**14,127**	**8.98**	**0.79**
#7	1	0.283	100.00	18.00	0.0700	0.9850	1	1.8	35,249	25.89	2.30
	Σ							**2.6**	**13,250**	**8.27**	**0.73**
#8	Σ							**2.6**	**13,250**	**8.27**	**0.73**
#9	1	0.283	100.00	18.00	0.0700	0.9850	1	1.8	35,249	25.89	2.30
	Σ							**2.7**	**10,846**	**6.35**	**0.56**
#10	Σ							**2.7**	**10,846**	**6.35**	**0.56**
#11	Σ							**2.7**	**10,846**	**6.35**	**0.56**

TOTAL SED W/O DAMS : 1.8(5) = 9 tons
TOTAL W/ DAMS : 2.7 tons

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	3. Short grass pasture	18.00	18.00	99.99	3.390	0.008
		8. Large gullies, diversions, and low flowing streams	2.00	4.00	200.00	4.240	0.013
#1	**1**	**Time of Concentration:**					**0.021**
#3	1	3. Short grass pasture	18.00	18.00	99.99	3.390	0.008
		8. Large gullies, diversions, and low flowing streams	2.00	4.00	200.00	4.240	0.013
#3	**1**	**Time of Concentration:**					**0.021**
#5	1	3. Short grass pasture	18.00	18.00	100.00	3.390	0.008
		8. Large gullies, diversions, and low flowing streams	2.00	4.00	200.00	4.240	0.013
#5	**1**	**Time of Concentration:**					**0.021**
#7	1	3. Short grass pasture	18.00	18.00	100.00	3.390	0.008
		8. Large gullies, diversions, and low flowing streams	2.00	4.00	200.00	4.240	0.013
#7	**1**	**Time of Concentration:**					**0.021**
#9	1	3. Short grass pasture	18.00	18.00	100.00	3.390	0.008
		8. Large gullies, diversions, and low flowing streams	2.00	4.00	200.00	4.240	0.013
#9	**1**	**Time of Concentration:**					**0.021**

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RFETS-100 YEAR

EAST CHANNEL

Ryan Archibald

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	5.000 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#5	0.032	0.417	
Channel	#2	==>	#5	0.032	0.417	
Channel	#3	==>	#5	0.032	0.417	
Channel	#4	==>	#5	0.032	0.417	
Channel	#5	==>	#6	0.000	0.000	
Null	#6	==>	End	0.000	0.000	

	#4 Chan'l
	#3 Chan'l
	#2 Chan'l
	#1 Chan'l
#5 Chan'l	
#6 Null	

Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	8.00	80.00	1,000.00	8.48	0.032
#1	**Muskingum K:**					**0.032**
#2	8. Large gullies, diversions, and low flowing streams	8.00	80.00	1,000.00	8.48	0.032
#2	**Muskingum K:**					**0.032**
#3	8. Large gullies, diversions, and low flowing streams	8.00	80.00	1,000.00	8.48	0.032
#3	**Muskingum K:**					**0.032**
#4	8. Large gullies, diversions, and low flowing streams	8.00	80.00	1,000.00	8.48	0.032
#4	**Muskingum K:**					**0.032**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#4	2.500	2.500	14.36	0.72
#3	2.500	2.500	14.36	0.72
#2	2.500	2.500	14.36	0.72
#1	2.500	2.500	14.36	0.72
#5	1.000	11.000	63.18	3.18
#6	0.000	11.000	63.18	3.18

Structure Detail:

Structure #4 (Vegetated Channel)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	5.6:1	2.0	D, B	1.00			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	14.36 cfs		14.36 cfs	
Depth:	1.11 ft	2.11 ft	1.67 ft	2.67 ft
Top Width:	9.57 ft	18.17 ft	14.36 ft	22.96 ft
Velocity:	2.70 fps		1.20 fps	
X-Section Area:	5.33 sq ft		11.99 sq ft	
Hydraulic Radius:	0.542		0.813	
Froude Number:	0.64		0.23	
Roughness Coefficient:	0.0519		0.1533	

Structure #3 (Vegetated Channel)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	5.6:1	2.0	D, B	1.00			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	14.36 cfs		14.36 cfs	
Depth:	1.11 ft	2.11 ft	1.67 ft	2.67 ft
Top Width:	9.57 ft	18.17 ft	14.36 ft	22.96 ft

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Velocity:	2.70 fps		1.20 fps	
X-Section Area:	5.33 sq ft		11.99 sq ft	
Hydraulic Radius:	0.542		0.813	
Froude Number:	0.64		0.23	
Roughness Coefficient:	0.0519		0.1533	

Structure #2 (Vegetated Channel)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	5.6:1	2.0	D, B	1.00			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	14.36 cfs		14.36 cfs	
Depth:	1.11 ft	2.11 ft	1.67 ft	2.67 ft
Top Width:	9.57 ft	18.17 ft	14.36 ft	22.96 ft
Velocity:	2.70 fps		1.20 fps	
X-Section Area:	5.33 sq ft		11.99 sq ft	
Hydraulic Radius:	0.542		0.813	
Froude Number:	0.64		0.23	
Roughness Coefficient:	0.0519		0.1533	

Structure #1 (Vegetated Channel)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	5.6:1	2.0	D, B	1.00			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	14.36 cfs		14.36 cfs	
Depth:	1.11 ft	2.11 ft	1.67 ft	2.67 ft
Top Width:	9.57 ft	18.17 ft	14.36 ft	22.96 ft
Velocity:	2.70 fps		1.20 fps	
X-Section Area:	5.33 sq ft		11.99 sq ft	
Hydraulic Radius:	0.542		0.813	
Froude Number:	0.64		0.23	
Roughness Coefficient:	0.0519		0.1533	

Structure #5 (Nonerodible Channel)

Trapezoidal Nonerodible Channel Inputs:

Material: Plastic

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
18.00	3.0:1	3.0:1	12.0	0.0390	1.00		

Nonerodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	63.18 cfs	
Depth:	0.44 ft	1.44 ft
Top Width:	20.67 ft	26.67 ft
Velocity:	7.34 fps	
X-Section Area:	8.60 sq ft	
Hydraulic Radius:	0.413	
Froude Number:	2.01	

Structure #6 (Null)

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#4	1	2.500	0.073	0.000	0.000	86.000	M	14.36	0.722
	Σ	**2.500**						**14.36**	**0.722**
#3	1	2.500	0.073	0.000	0.000	86.000	M	14.36	0.722
	Σ	**2.500**						**14.36**	**0.722**
#2	1	2.500	0.073	0.000	0.000	86.000	M	14.36	0.722
	Σ	**2.500**						**14.36**	**0.722**
#1	1	2.500	0.073	0.000	0.000	86.000	M	14.36	0.722
	Σ	**2.500**						**14.36**	**0.722**
#5	1	1.000	0.008	0.000	0.000	86.000	M	5.74	0.289
	Σ	**11.000**						**63.18**	**3.178**
#6	Σ	**11.000**						**63.18**	**3.178**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	3. Short grass pasture	18.00	18.00	99.99	3.390	0.008
		8. Large gullies, diversions, and low flowing streams	2.00	20.00	1,000.00	4.240	0.065
#1	**1**	**Time of Concentration:**					**0.073**
#2	1	3. Short grass pasture	18.00	18.00	100.00	3.390	0.008
		8. Large gullies, diversions, and low flowing streams	2.00	20.00	1,000.00	4.240	0.065
#2	**1**	**Time of Concentration:**					**0.073**
#3	1	3. Short grass pasture	18.00	18.00	100.00	3.390	0.008
		8. Large gullies, diversions, and low flowing streams	2.00	20.00	1,000.00	4.240	0.065
#3	**1**	**Time of Concentration:**					**0.073**
#4	1	3. Short grass pasture	18.00	18.00	100.00	3.390	0.008
		8. Large gullies, diversions, and low flowing streams	2.00	20.00	1,000.00	4.240	0.065
#4	**1**	**Time of Concentration:**					**0.073**
#5	1	3. Short grass pasture	18.00	18.00	99.99	3.390	0.008
#5	**1**	**Time of Concentration:**					**0.008**

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RFETS-1000 YEAR

EAST CHANNEL

Ryan Archibald

Structure Detail:

Structure #4 (Vegetated Channel)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	5.6:1	2.0	D, B	1.00			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	19.46 cfs		19.46 cfs	
Depth:	1.22 ft	2.22 ft	1.79 ft	2.79 ft
Top Width:	10.47 ft	19.07 ft	15.37 ft	23.97 ft
Velocity:	3.06 fps		1.42 fps	
X-Section Area:	6.37 sq ft		13.73 sq ft	
Hydraulic Radius:	0.593		0.870	
Froude Number:	0.69		0.26	
Roughness Coefficient:	0.0486		0.1354	

Structure #3 (Vegetated Channel)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	5.6:1	2.0	D, B	1.00			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	19.46 cfs		19.46 cfs	
Depth:	1.22 ft	2.22 ft	1.79 ft	2.79 ft
Top Width:	10.47 ft	19.07 ft	15.37 ft	23.97 ft

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Velocity:	3.06 fps		1.42 fps	
X-Section Area:	6.37 sq ft		13.73 sq ft	
Hydraulic Radius:	0.593		0.870	
Froude Number:	0.69		0.26	
Roughness Coefficient:	0.0486		0.1354	

Structure #2 (Vegetated Channel)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	5.6:1	2.0	D, B	1.00			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	19.46 cfs		19.46 cfs	
Depth:	1.22 ft	2.22 ft	1.79 ft	2.79 ft
Top Width:	10.47 ft	19.07 ft	15.37 ft	23.97 ft
Velocity:	3.06 fps		1.42 fps	
X-Section Area:	6.37 sq ft		13.73 sq ft	
Hydraulic Radius:	0.593		0.870	
Froude Number:	0.69		0.26	
Roughness Coefficient:	0.0486		0.1354	

Structure #1 (Vegetated Channel)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	5.6:1	2.0	D, B	1.00			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	19.46 cfs		19.46 cfs	
Depth:	1.22 ft	2.22 ft	1.79 ft	2.79 ft
Top Width:	10.47 ft	19.07 ft	15.37 ft	23.97 ft
Velocity:	3.06 fps		1.42 fps	
X-Section Area:	6.37 sq ft		13.73 sq ft	
Hydraulic Radius:	0.593		0.870	
Froude Number:	0.69		0.26	
Roughness Coefficient:	0.0486		0.1354	

Structure #5 (Nonerodible Channel)

Trapezoidal Nonerodible Channel Inputs:

Material: Plastic

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
18.00	3.0:1	3.0:1	12.0	0.0390	1.00		

Nonerodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	85.64 cfs	
Depth:	0.53 ft	1.53 ft
Top Width:	21.19 ft	27.19 ft
Velocity:	8.21 fps	
X-Section Area:	10.43 sq ft	
Hydraulic Radius:	0.488	
Froude Number:	2.06	

Structure #6 (Null)

REF C.

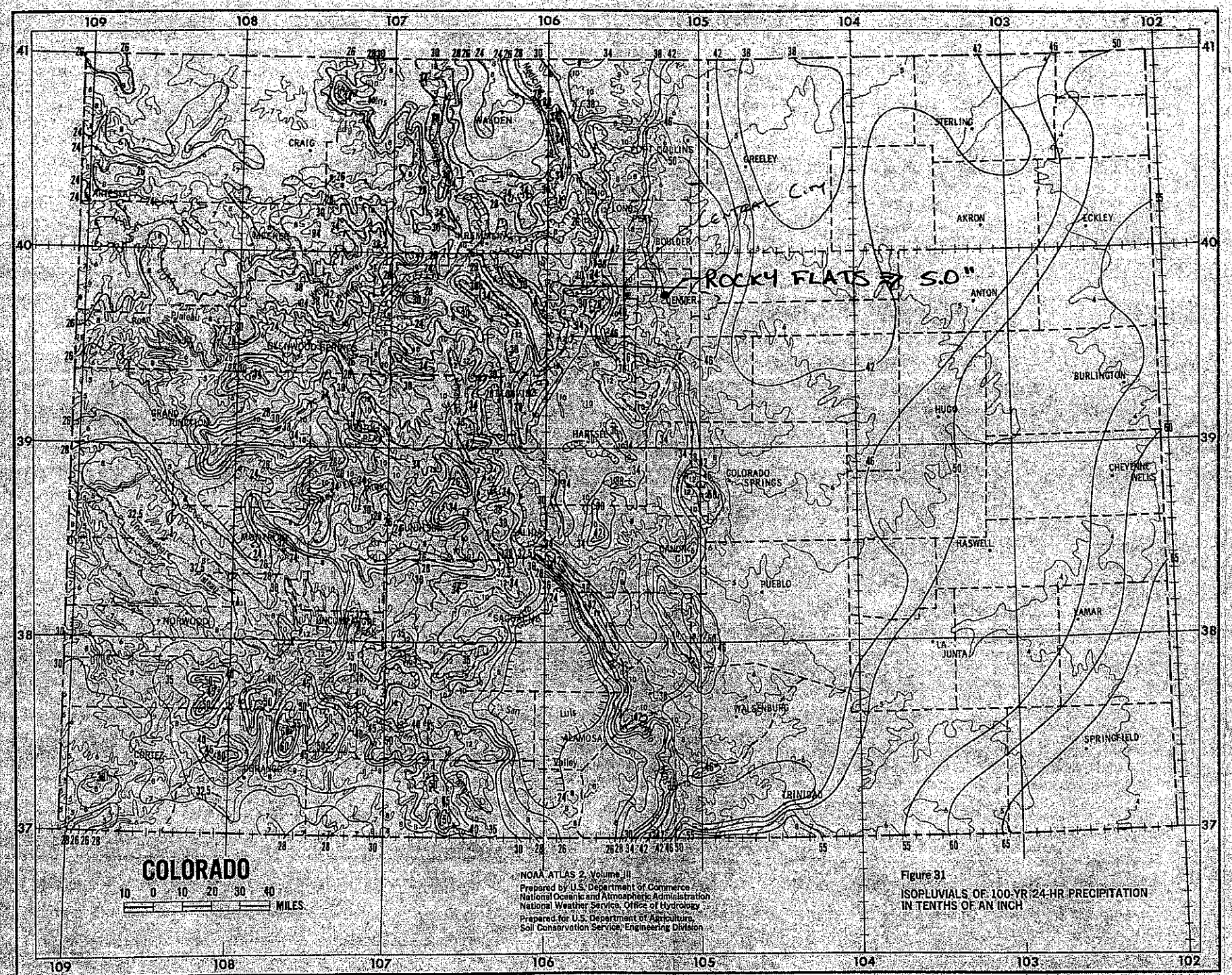


Figure 31

ISOPLUVIALS OF 100-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

HEC-RAS OUTPUT TABLES

REF D.1

Plan: Imported Pla RIVER-1 Reach-1 RS: 54 Profile: PF 1

INPUT FROM TABLE 16

E.G. Elev (ft)	6038.75	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.00	Wt. n-Val.		0.167	
W.S. Elev (ft)	6038.75	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)		Flow Area (sq ft)		7.33	
E.G. Slope (ft/ft)	0.008474	Area (sq ft)		7.33	
Q Total (cfs)	4.09	Flow (cfs)		4.09	
Top Width (ft)	12.69	Top Width (ft)		12.69	
Vel Total (ft/s)	0.56	Avg. Vel. (ft/s)		0.56	
Max Chl Dpth (ft)	1.16	Hydr. Depth (ft)		0.58	
Conv. Total (cfs)	44.4	Conv. (cfs)		44.4	
Length Wtd. (ft)	10.00	Wetted Per. (ft)		13.05	
Min Ch El (ft)	6037.59	Shear (lb/sq ft)		0.30	
Alpha	1.00	Stream Power (lb/ft s)		0.17	
Frctn Loss (ft)	0.10	Cum Volume (acre-ft)	0.00	0.11	
C & E Loss (ft)	0.00	Cum SA (acres)	0.00	0.17	

CHANNEL DEPTH VALUE USED IN TABLE 17.

INPUT FROM TABLE 1 ESTIMATE

BERM No. 1 - 1000-YR

NOTE:

1) NOT ALL INPUT/OUTPUT CROSS SECTIONS PROVIDED DUE TO LARGE QUANTITY AVAILABLE UPON REQUEST.

2) INFORMATION FROM THIS OUTPUT TABLE IS ALSO SUMMARIZED ON TABLE 2.

REF D.2

Plan: Imported Pla RIVER-1 Reach-1 RS: 54 Profile: PF 1

E.G. Elev (ft)	6038.67	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.00	Wt. n-Val.		0.189	
W.S. Elev (ft)	6038.67	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)		Flow Area (sq ft)		6.40	
E.G. Slope (ft/ft)	0.008201	Area (sq ft)		6.40	
Q Total (cfs)	2.96	Flow (cfs)		2.96	
Top Width (ft)	11.88	Top Width (ft)		11.88	
Vel Total (ft/s)	0.46	Avg. Vel. (ft/s)		0.46	
Max Chl Dpth (ft)	1.08	Hydr. Depth (ft)		0.54	
Conv. Total (cfs)	32.7	Conv. (cfs)		32.7	
Length Wtd. (ft)	10.00	Wetted Per. (ft)		12.22	
Min Ch El (ft)	6037.59	Shear (lb/sq ft)		0.27	
Alpha	1.00	Stream Power (lb/ft s)		0.12	
Frctn Loss (ft)	0.10	Cum Volume (acre-ft)	0.00	0.09	
C & E Loss (ft)	0.00	Cum SA (acres)	0.00	0.15	

BERM No. 1 - 100-YR.

Plan: Plan 01 RIVER-1 Reach-1 RS: 56 Profile: PF 1

E.G. Elev (ft)	6018.39	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.03	Wt. n-Val.		0.140	
W.S. Elev (ft)	6018.36	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)		Flow Area (sq ft)		5.67	
E.G. Slope (ft/ft)	0.041375	Area (sq ft)		5.67	
Q Total (cfs)	7.84	Flow (cfs)		7.84	
Top Width (ft)	10.67	Top Width (ft)		10.67	
Vel Total (ft/s)	1.38	Avg. Vel. (ft/s)		1.38	
Max Chl Dpth (ft)	0.88	Hydr. Depth (ft)		0.53	
Conv. Total (cfs)	38.5	Conv. (cfs)		38.5	
Length Wtd. (ft)	10.00	Wetted Per. (ft)		11.05	
Min Ch El (ft)	6017.48	Shear (lb/sq ft)		1.33	
Alpha	1.00	Stream Power (lb/ft s)		1.83	
Frctn Loss (ft)	0.35	Cum Volume (acre-ft)	0.00	0.13	0.00
C & E Loss (ft)	0.00	Cum SA (acres)	0.00	0.17	0.00

BERM No. 2 - 1,000-YR

D.4

Plan: Plan 01 RIVER-1 Reach-1 RS: 56 Profile: PF 1

E.G. Elev (ft)	6018.32	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.02	Wt. n-Val.		0.159	
W.S. Elev (ft)	6018.30	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)		Flow Area (sq ft)		5.00	
E.G. Slope (ft/ft)	0.039568	Area (sq ft)		5.00	
Q Total (cfs)	5.68	Flow (cfs)		5.68	
Top Width (ft)	10.11	Top Width (ft)		10.11	
Vel Total (ft/s)	1.14	Avg. Vel. (ft/s)		1.14	
Max Chl Dpth (ft)	0.82	Hydr. Depth (ft)		0.49	
Conv. Total (cfs)	28.6	Conv. (cfs)		28.6	
Length Wtd. (ft)	10.00	Wetted Per. (ft)		10.47	
Min Ch El (ft)	6017.48	Shear (lb/sq ft)		1.18	
Alpha	1.00	Stream Power (lb/ft s)		1.34	
Frctn Loss (ft)	0.35	Cum Volume (acre-ft)	0.00	0.11	0.00
C & E Loss (ft)	0.00	Cum SA (acres)	0.00	0.16	0.00

BERM No. 2 - 100-YR

Plan: Plan 01 RIVER-1 Reach-1 RS: 40 Profile: PF 1

E.G. Elev (ft)	5991.26	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.02	Wt. n-Val.	0.159	0.159	
W.S. Elev (ft)	5991.24	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)		Flow Area (sq ft)	2.68	2.66	
E.G. Slope (ft/ft)	0.033134	Area (sq ft)	2.68	2.66	
Q Total (cfs)	5.73	Flow (cfs)	2.94	2.79	
Top Width (ft)	10.50	Top Width (ft)	5.06	5.43	
Vel Total (ft/s)	1.07	Avg. Vel. (ft/s)	1.10	1.05	
Max Chl Dpth (ft)	1.04	Hydr. Depth (ft)	0.53	0.49	
Conv. Total (cfs)	31.5	Conv. (cfs)	16.2	15.3	
Length Wtd. (ft)	10.00	Wetted Per. (ft)	5.17	5.53	
Min Ch El (ft)	5990.20	Shear (lb/sq ft)	1.07	0.99	
Alpha	1.00	Stream Power (lb/ft s)	1.18	1.04	
Frctn Loss (ft)	0.38	Cum Volume (acre-ft)	0.03	0.04	
C & E Loss (ft)	0.00	Cum SA (acres)	0.05	0.06	

Beam No. 3 - 1000-4R

D. 6

Plan: Plan 01 RIVER-1 Reach-1 RS: 40 Profile: PF 1

E.G. Elev (ft)	5991.17	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.180	0.180	
W.S. Elev (ft)	5991.16	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)		Flow Area (sq ft)	2.30	2.25	
E.G. Slope (ft/ft)	0.033741	Area (sq ft)	2.30	2.25	
Q Total (cfs)	4.14	Flow (cfs)	2.15	1.99	
Top Width (ft)	9.64	Top Width (ft)	4.65	4.99	
Vel Total (ft/s)	0.91	Avg. Vel. (ft/s)	0.94	0.88	
Max Chl Dpth (ft)	0.96	Hydr. Depth (ft)	0.49	0.45	
Conv. Total (cfs)	22.5	Conv. (cfs)	11.7	10.8	
Length Wtd. (ft)	10.00	Wetted Per. (ft)	4.75	5.08	
Min Ch El (ft)	5990.20	Shear (lb/sq ft)	1.02	0.93	
Alpha	1.00	Stream Power (lb/ft s)	0.95	0.82	
Frctn Loss (ft)	0.39	Cum Volume (acre-ft)	0.03	0.03	
C & E Loss (ft)	0.00	Cum SA (acres)	0.05	0.05	

BERM No. 3 : 100-YR

Plan: Imported Pla RIVER-1 Reach-1 RS: 98 Profile: PF 1

E.G. Elev (ft)	6034.57	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.00	Wt. n-Val.		0.135	
W.S. Elev (ft)	6034.57	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)		Flow Area (sq ft)		4.91	
E.G. Slope (ft/ft)	0.004813	Area (sq ft)		4.91	
Q Total (cfs)	2.08	Flow (cfs)		2.08	
Top Width (ft)	11.67	Top Width (ft)		11.67	
Vel Total (ft/s)	0.42	Avg. Vel. (ft/s)		0.42	
Max Chl Dpth (ft)	0.60	Hydr. Depth (ft)		0.42	
Conv. Total (cfs)	30.0	Conv. (cfs)		30.0	
Length Wtd. (ft)	10.00	Wetted Per. (ft)		11.80	
Min Ch El (ft)	6033.97	Shear (lb/sq ft)		0.12	
Alpha	1.00	Stream Power (lb/ft s)		0.05	
Frctn Loss (ft)	0.04	Cum Volume (acre-ft)	0.00	0.14	0.00
C & E Loss (ft)	0.00	Cum SA (acres)	0.00	0.24	0.00

Berm No. 4: 1,000-yr

D.8

Plan: Imported Pla RIVER-1 Reach-1 RS: 98 Profile: PF 1

E.G. Elev (ft)	6034.51	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.00	Wt. n-Val.		0.153	
W.S. Elev (ft)	6034.51	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)		Flow Area (sq ft)		4.22	
E.G. Slope (ft/ft)	0.004902	Area (sq ft)		4.22	
Q Total (cfs)	1.50	Flow (cfs)		1.50	
Top Width (ft)	11.01	Top Width (ft)		11.01	
Vel Total (ft/s)	0.36	Avg. Vel. (ft/s)		0.36	
Max Chl Dpth (ft)	0.54	Hydr. Depth (ft)		0.38	
Conv. Total (cfs)	21.4	Conv. (cfs)		21.4	
Length Wtd. (ft)	10.00	Wetted Per. (ft)		11.13	
Min Ch El (ft)	6033.97	Shear (lb/sq ft)		0.12	
Alpha	1.00	Stream Power (lb/ft s)		0.04	
Frctn Loss (ft)	0.04	Cum Volume (acre-ft)	0.00	0.12	0.00
C & E Loss (ft)	0.00	Cum SA (acres)	0.00	0.23	0.00

Berm No. 4 : 100-yr

Plan: Berm No. 5 RIVER-1 Reach-1 RS: 99 Profile: PF 1

E.G. Elev (ft)	6015.41	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.02	Wt. n-Val.		0.135	
W.S. Elev (ft)	6015.38	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)		Flow Area (sq ft)		2.94	
E.G. Slope (ft/ft)	0.047346	Area (sq ft)		2.94	
Q Total (cfs)	3.56	Flow (cfs)		3.56	
Top Width (ft)	8.01	Top Width (ft)		8.01	
Vel Total (ft/s)	1.21	Avg. Vel. (ft/s)		1.21	
Max Chl Dpth (ft)	0.74	Hydr. Depth (ft)		0.37	
Conv. Total (cfs)	16.4	Conv. (cfs)		16.4	
Length Wtd. (ft)	10.00	Wetted Per. (ft)		8.15	
Min Ch El (ft)	6014.64	Shear (lb/sq ft)		1.07	
Alpha	1.00	Stream Power (lb/ft s)		1.29	
Frctn Loss (ft)	0.36	Cum Volume (acre-ft)	0.00	0.20	0.00
C & E Loss (ft)	0.00	Cum SA (acres)	0.00	0.29	0.00

Berm No. 5 : 1,000-yr

Plan: Berm No. 5 RIVER-1 Reach-1 RS: 99 Profile: PF 1

E.G. Elev (ft)	6015.35	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.02	Wt. n-Val.		0.153	
W.S. Elev (ft)	6015.33	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)		Flow Area (sq ft)		2.55	
E.G. Slope (ft/ft)	0.046600	Area (sq ft)		2.55	
Q Total (cfs)	2.57	Flow (cfs)		2.57	
Top Width (ft)	7.46	Top Width (ft)		7.46	
Vel Total (ft/s)	1.01	Avg. Vel. (ft/s)		1.01	
Max Chl Dpth (ft)	0.69	Hydr. Depth (ft)		0.34	
Conv. Total (cfs)	11.9	Conv. (cfs)		11.9	
Length Wtd. (ft)	10.00	Wetted Per. (ft)		7.59	
Min Ch El (ft)	6014.64	Shear (lb/sq ft)		0.98	
Alpha	1.00	Stream Power (lb/ft s)		0.98	
Frctn Loss (ft)	0.36	Cum Volume (acre-ft)	0.00	0.17	0.00
C & E Loss (ft)	0.00	Cum SA (acres)	0.00	0.27	0.00

Berm No. 5 : 100-YR

Plan: Berm 6 RIVER-1 Reach-1 RS: 107 Profile: PF 1

E.G. Elev (ft)	5996.15	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.		0.135	
W.S. Elev (ft)	5996.14	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)		Flow Area (sq ft)		3.38	
E.G. Slope (ft/ft)	0.022108	Area (sq ft)		3.38	
Q Total (cfs)	3.14	Flow (cfs)		3.14	
Top Width (ft)	7.63	Top Width (ft)		7.63	
Vel Total (ft/s)	0.93	Avg. Vel. (ft/s)		0.93	
Max Chl Dpth (ft)	0.89	Hydr. Depth (ft)		0.44	
Conv. Total (cfs)	21.1	Conv. (cfs)		21.1	
Length Wtd. (ft)	10.00	Wetted Per. (ft)		7.85	
Min Ch El (ft)	5995.25	Shear (lb/sq ft)		0.59	
Alpha	1.00	Stream Power (lb/ft s)		0.55	
Frctn Loss (ft)	0.24	Cum Volume (acre-ft)	0.00	0.22	0.00
C & E Loss (ft)	0.00	Cum SA (acres)	0.00	0.30	0.00

Berm No. 6 : 1,000-yr

D.12

Plan: Berm 6 RIVER-1 Reach-1 RS: 107 Profile: PF 1

E.G. Elev (ft)	5996.08	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.		0.153	
W.S. Elev (ft)	5996.08	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)		Flow Area (sq ft)		2.91	
E.G. Slope (ft/ft)	0.022024	Area (sq ft)		2.91	
Q Total (cfs)	2.27	Flow (cfs)		2.27	
Top Width (ft)	7.06	Top Width (ft)		7.06	
Vel Total (ft/s)	0.78	Avg. Vel. (ft/s)		0.78	
Max Chl Dpth (ft)	0.82	Hydr. Depth (ft)		0.41	
Conv. Total (cfs)	15.3	Conv. (cfs)		15.3	
Length Wtd. (ft)	10.00	Wetted Per. (ft)		7.26	
Min Ch El (ft)	5995.25	Shear (lb/sq ft)		0.55	
Alpha	1.00	Stream Power (lb/ft s)		0.43	
Frctn Loss (ft)	0.24	Cum Volume (acre-ft)	0.00	0.19	0.00
C & E Loss (ft)	0.00	Cum SA (acres)	0.00	0.28	0.00

Berm No. 6: 100-yr

Plan: Plan 01 RIVER-1 Reach-1 RS: 98 Profile: PF 1

E.G. Elev (ft)	5977.45	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.02	Wt. n-Val.		0.135	
W.S. Elev (ft)	5977.43	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)		Flow Area (sq ft)		2.67	
E.G. Slope (ft/ft)	0.043165	Area (sq ft)		2.67	
Q Total (cfs)	3.18	Flow (cfs)		3.18	
Top Width (ft)	6.94	Top Width (ft)		6.94	
Vel Total (ft/s)	1.19	Avg. Vel. (ft/s)		1.19	
Max Chl Dpth (ft)	0.73	Hydr. Depth (ft)		0.39	
Conv. Total (cfs)	15.3	Conv. (cfs)		15.3	
Length Wtd. (ft)	10.00	Wetted Per. (ft)		7.10	
Min Ch El (ft)	5976.70	Shear (lb/sq ft)		1.02	
Alpha	1.00	Stream Power (lb/ft s)		1.21	
Frctn Loss (ft)	0.34	Cum Volume (acre-ft)	0.00	0.18	0.00
C & E Loss (ft)	0.00	Cum SA (acres)	0.01	0.27	0.00

Berm No. 7 : 1,000-yr

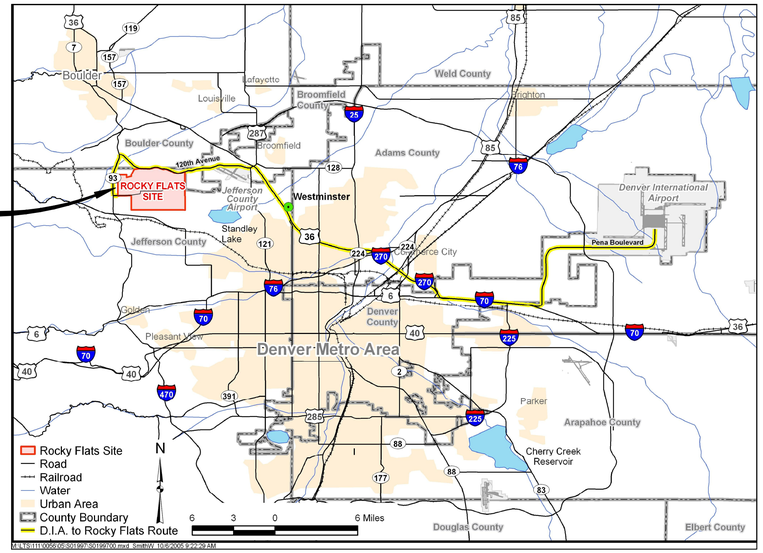
Plan: Plan 01 RIVER-1 Reach-1 RS: 98 Profile: PF 1

E.G. Elev (ft)	5977.40	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.02	Wt. n-Val.		0.153	
W.S. Elev (ft)	5977.38	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)		Flow Area (sq ft)		2.32	
E.G. Slope (ft/ft)	0.042557	Area (sq ft)		2.32	
Q Total (cfs)	2.30	Flow (cfs)		2.30	
Top Width (ft)	6.50	Top Width (ft)		6.50	
Vel Total (ft/s)	0.99	Avg. Vel. (ft/s)		0.99	
Max Chl Dpth (ft)	0.68	Hydr. Depth (ft)		0.36	
Conv. Total (cfs)	11.1	Conv. (cfs)		11.1	
Length Wtd. (ft)	10.00	Wetted Per. (ft)		6.64	
Min Ch El (ft)	5976.70	Shear (lb/sq ft)		0.93	
Alpha	1.00	Stream Power (lb/ft s)		0.92	
Frctn Loss (ft)	0.35	Cum Volume (acre-ft)	0.00	0.16	0.00
C & E Loss (ft)	0.00	Cum SA (acres)	0.00	0.25	0.00

Beam No. 7: 100-YR

UNITED STATES
DEPARTMENT OF ENERGY
LEGACY MANAGEMENT
ROCKY FLATS SITE
SEEP NO. 7 DRAIN EXTENSION

WEST GATE ENTRANCE



SITE LOCATION MAP

INDEX OF DRAWINGS

SHEET	TITLE	DRAWING NO.
1	TITLE SHEET	S03198-R00-T01-D+
2	PROJECT SITE PLAN	S03199-R00-F01-D+
3	SEEP #7 – PLAN AND SECTIONS	S03200-R00-C01-D+

ABBREVIATIONS

APPROX.	APPROXIMATE	HORIZ.	HORIZONTAL	SHT	SHEET
CY	CUBIC YARDS	INV	INVERT	STA.	STATION
℄	CENTER LINE	MAX.	MAXIMUM	THK.	THICK
DOE	DEPARTMENT OF ENERGY	MIN.	MINIMUM	TYP	TYPICAL
E	EASTING	MW	MONITORING WELL		
EL. OR ELEV.	ELEVATION	N	NORTHING		
EXIST.	EXISTING	NA	NOT APPLICABLE		
		NIC	NOT IN CONTRACT		
		NTS	NOT TO SCALE		

DRAWING LEGEND

PLAN

- —T - —O · — W— BURIED – TELEPHONE/OPTICAL/WATER
- —E- —G · — IP— BURIED – ELECTRICAL/GAS LINES/ IRRIGATION PIPE
- RAILROAD TRACK
- WIRE FENCE
- CHAIN LINK FENCE
- SILT FENCE
- DRAINAGE DITCH/WATER LINE LIMITS
- EXISTING UNIMPROVED DIRT ROAD
- OVERHEAD ELECTRICAL LINE
- TREES/SHRUBS/BRUSH
- PROJECT ACCESS/HAUL ROUTE
- UTILITY POLE
- UNDERGROUND DRAINAGE CULVERT
- XXXX EXISTING MONITORING WELL
- 38 HIGHWAY
- SLOPE/FLOW ARROW
- TOP OF SLOPE
- SURVEY CONTROL POINT
- BUILDING/STRUCTURE

SECTION

- COMPACTED SOIL
- UNDISTURBED SOIL
- GRAVEL OR DRAIN ROCK
- REVEGETATION

DETAIL SYMBOL

1 — DETAIL NUMBER/SECTION LETTER
2 — SHEET ON WHICH DETAIL/SECTION IS TAKEN FROM
3 — SHEET ON WHICH DETAIL/SECTION IS DRAWN

REVISION NO.	DATE	DESCRIPTION	DRAWN BY	CHECKED BY	PROJECT A/E	APPROVAL

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION, COLORADO

Work Performed by
S.M. Stoller Corporation
Under DOE Contract
No. DE-AM01-07LM00060

PROJECT LOCATION
ROCKY FLATS SITE
GOLDEN, COLORADO

REFERENCE

TETRA TECH

APPROVALS		
DRAWN BY: T. BOEHLER	DATE 07/30/08	
ENGINEER J. KIENHOLZ	07/30/08	
PROJECT ENGINEER Jim Kienholz	08/12/08	
APPROVED BY: D. NORDEEN	08/12/08	
PROJECT MANAGER L. KAISER	08/12/08	
DOE CONCURRENCE (SEE RECORD)	08/12/08	

ORIGINAL LANDFILL
SEEP NO. 7 DRAIN EXTENSION

TITLE SHEET

PROJECT NO. LTS-111-0056-07-001B
DRAWING NO. S03198-R00-T01-D+
SHT. 1 OF 3

ACCESS ROAD

ORIGINAL LANDFILL

DIVERSION BERM 1

DIVERSION BERM 2

DIVERSION BERM 3

DIVERSION BERM 4

DIVERSION BERM 5

DIVERSION BERM 6

DIVERSION BERM 7

Tt-1

Tt-2

Tt-3

Tt-4

Tt-5

Tt-6

Tt-7

INSTALL FRENCH DRAIN UNDERNEATH COVER TO INTERCEPT SEEP NO. 7 FLOW. SEE SHT. 2 FOR MORE DETAIL.

SATURATED AREA IN SPRING 2007 NEAR SEEP NO. 4

NEW SEEP NO. 7 FRENCH DRAIN TO INTERCEPT PREVIOUSLY CONSTRUCTED FRENCH DRAIN APPROX. 4-5 FT. BELOW THE SURFACE.

EXISTING FRENCH DRAIN

SATURATED AREA IN SPRING 2007 DUE TO SEEP NO. 7

WEST CHANNEL

EAST CHANNEL

APPROX. AREA SATURATED NEAR SEEP NO. 2 AND NO. 3

APPROX. SEEP NO. 1 AREA

BUTTRESS

APPROX. LOCATION OF SEEP #8

WOMAN CREEK

LEGEND:

— · · · — DITCH/CHANNEL/CREEK

= = = = = ROAD

Tt-1● INCLINOMETER LOCATION

NOTES:

1) EQUIPMENT INGRESS AND EGRESS TO CONSTRUCTION ZONE TO BE IDENTIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION ACTIVITIES.

2) IF DIVERSION BERMS ARE DISTURBED DURING CONSTRUCTION ACTIVITIES, BERMS MUST BE RETURNED TO A 2.0 PERCENT MINIMUM FLOWLINE SLOPE AND ORIGINAL BERM HEIGHT.

3) SURFACE CONTOURS BASED ON TOPOGRAPHIC SURVEY BY FLATIRONS, INC. IN JULY 2008.

4) DO NOT DISTURB INCLINOMETERS.

5) DRAIN ROCK STOCKPILE LOCATION TO BE APPROVED BY CONTRACTOR PRIOR TO CONSTRUCTION.

6) ACCESS/HAUL ROAD ALIGNMENT FOR EQUIPMENT AND MATERIAL TO BE APPROVED BY CONTRACTOR PRIOR TO CONSTRUCTION.

N

PROJECT SITE PLAN

SCALE IN FEET

60 30 0 60 120 180

CONTOUR INTERVAL (WITHIN OLF) = ONE FOOT
CONTOUR INTERVAL (OUTSIDE OLF) = TWO FEET

REVISION NO.	DATE	DESCRIPTION	DRAWN BY	CHECKED BY	PROJECT A/E	APPROVAL

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION, COLORADO

Work Performed by
S.M. Stoller Corporation
Under DOE Contract
No. DE-AM01-07LM00060

PROJECT LOCATION
ROCKY FLATS SITE
GOLDEN, COLORADO

REFERENCE

TETRA TECH

APPROVALS		DATE
DRAWN BY:	T. BOEHLER	07/30/08
ENGINEER	J. KIENHOLZ	07/30/08
PROJECT ENGINEER	Jim Kienholz	08/12/08
APPROVED BY	D. NORDEEN	08/12/08
PROJECT MANAGER	L. KAISER	08/12/08
DOE CONCURRENCE	(SEE RECORD)	08/12/08

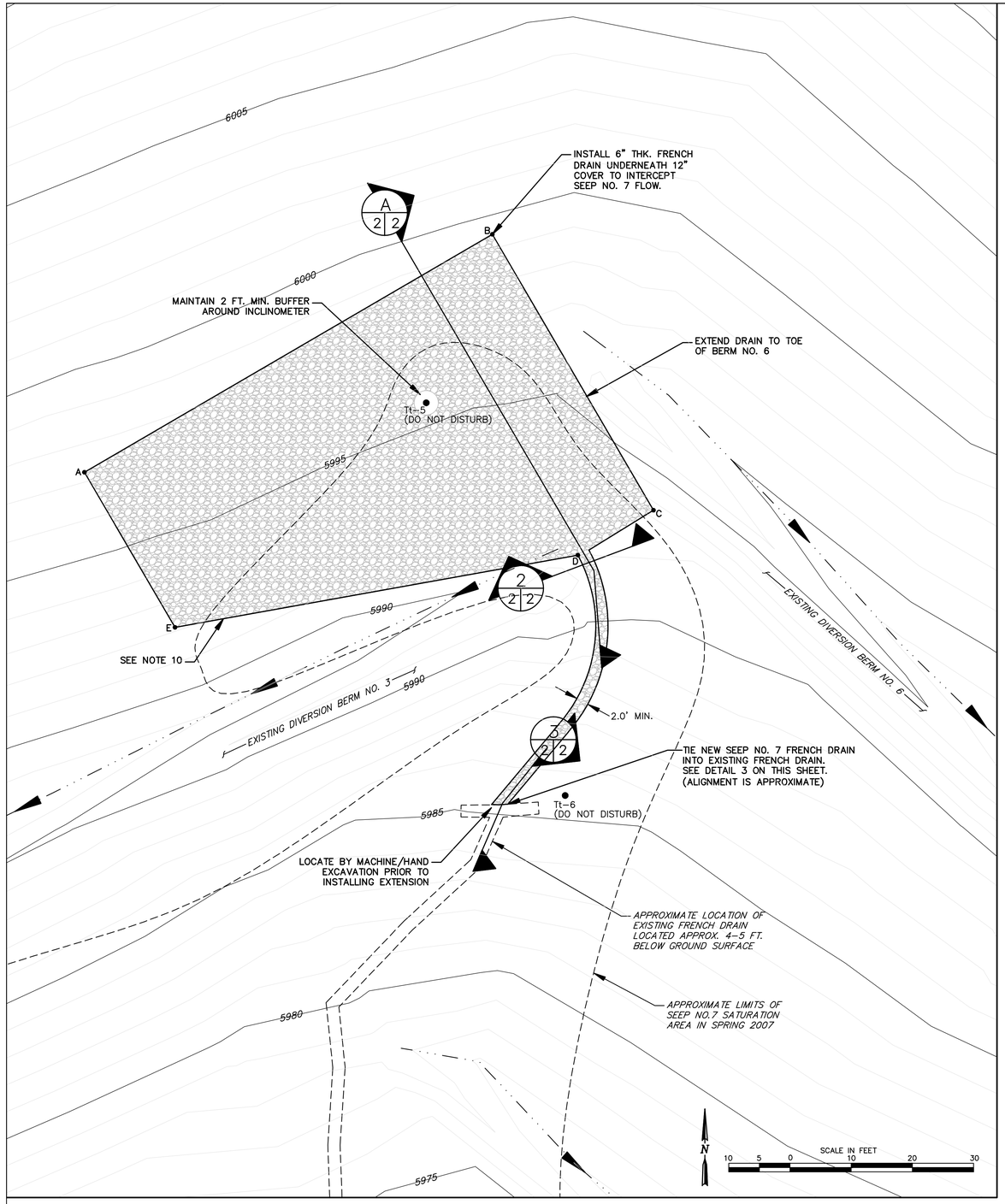
ORIGINAL LANDFILL
SEEP NO. 7 DRAIN EXTENSION

DESIGN PLAN

PROJECT NO. LTS-111-0056-07-001B

DRAWING NO. S03199-R00-F01-D+

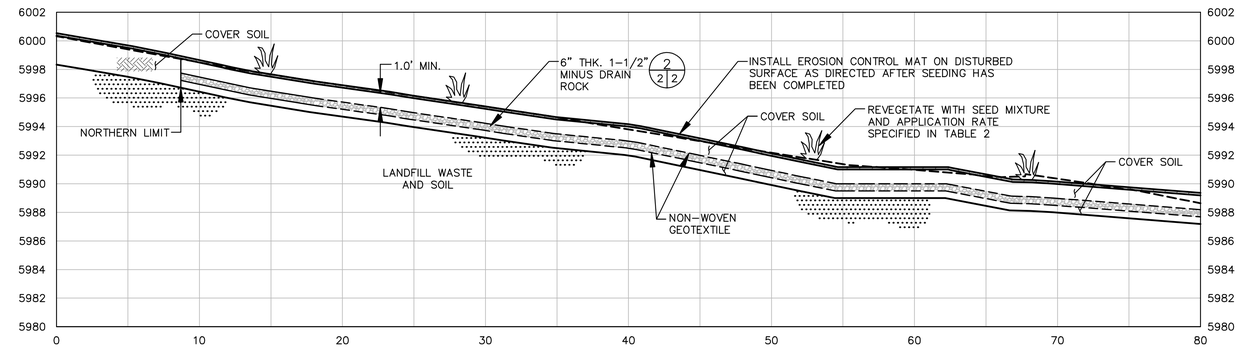
SHT. 2 OF 3



LEGEND:

- DITCH/CHANNEL/CREEK
- EXTENT OF SATURATED SOIL
- ROAD
- 6000 CONTOURS
- Tt-5● INCLINOMETER LOCATION

1 / 2 2 SEEP NO. 7 PLAN



A / 2 2 SECTION

SCALE IN FEET
5 2.5 0 5 10 15

TABLE 1

POINT ID	NORTHING	EASTING
A	747769.53	2081511.74
B	747808.43	2081578.39
C	747763.33	2081604.71
D	747755.97	2081592.37
E	747744.17	2081526.54

TABLE 2

SPECIES	COMMON NAME	LBS./ACRE (PLS)
GRAMINOLDS		
AGROPYRON DASYSTACHYUM	THICKSPIKE WHEATGRASS	0.73
AGROPYRON SMITHII	WESTERN WHEATGRASS	4.17
AGROPYRON TRACHYCAULUM	SLENDER WHEATGRASS	2.72
BOUTELOUA CURTIPENDULA	SIDE-OATS GRAMA	1.49
BOUTELOUA GRACILIS	BLUE GRAMA	0.74
BUCHLOE DACTYLOIDES	BUFALO GRASS	4.84
STIPA VIRIDULA	GREEN NEEDLE GRASS	1.21
TOTAL		15.90

1) THIS POUNDS PER ACRE ASSUMES DRILL-SEEDING IS USED. IF THE SEED IS TO BE BROADCAST, THE APPLICATION RATES ARE TO BE DOUBLED.

2) PLS - PURE LIVE SEED. BE SURE TO SPECIFIY TO THE SEED DEALER WHEN ORDERING.

3) THE SEED IS TO BE CERTIFIED WEED FREE.

NOTES:

1) GEOTEXTILE FOR USE IN THE DRAIN EXTENSION SHALL BE A NON-WOVEN POLYESTER OR POLYPROPYLENE MATERIAL HAVING A MINIMUM WEIGHT OF SIX OUNCES PER SQUARE YARD. (MIRAFI® 160N OR APPROVED EQUAL).

2) DRAIN ROCK (EST. 63 CY) SHALL BE A POORLY-SORTED CLEAN GRAVEL, HAVING A MAXIMUM PARTICLE SIZE OF 1 1/2" AND NOT MORE THAN FIVE PERCENT, BY WEIGHT, OF THE MATERIAL PASSING THE NO. 40 SIEVE.

3) DO NOT DISTURB INCLINOMETERS. MAINTAIN 2 FT. BUFFER AWAY FROM INCLINOMETER CASING.

4) ROUGHEN SURFACE PRIOR TO SEED APPLICATION. AFTER SEEDING, INSTALL EROSION CONTROL MAT PER MANUFACTURER'S SPECIFICATIONS.

5) FOLLOW CONTRACTOR HEALTH AND SAFETY PROCEDURES WHEN EXCAVATING INTO LANDFILL WASTE.

6) EROSION CONTROL MAT SHALL BE A GREENFIX AMERICA CF072B OR NORTH AMERICAN GREEN C125BN. INSTALL PER MANUFACTURER'S SPECIFICATIONS.

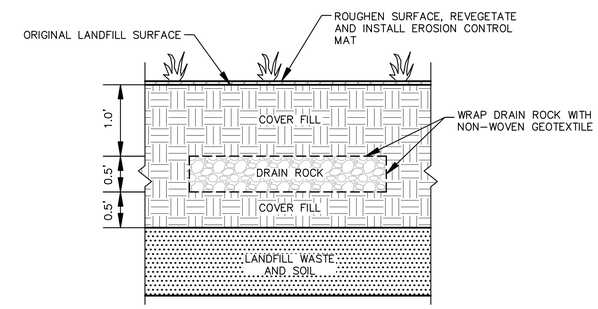
7) NO COMPACTION IS REQUIRED FOR COVER SOIL. MATERIAL PLACED WITH MINIMAL PASSES OF EQUIPMENT USED FOR BACKFILLING.

8) FOR DRAIN TRANSITION TO EXISTING FRENCH DRAIN, BACKFILL LANDFILL WASTE IN MAX. 12-INCH LIFTS AND COMPACT AROUND THE DRAIN WITH A JUMPING JACK OR APPROVED EQUIVALENT.

9) OVERLAP EDGED OF NON-WOVEN GEOTEXTILE A MINIMUM OF TWO FEET OR SEW SEAMS TOGETHER WITH MANUFACTURER APPROVED METHOD TO COMPLETELY WRAP DRAIN ROCK.

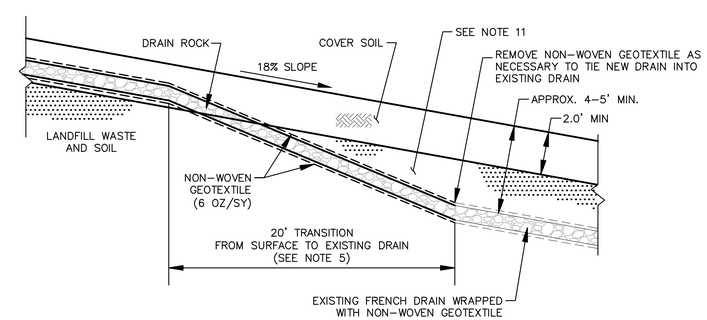
10) THE SLOPE BETWEEN POINT D AND E SHALL BE A MINIMUM 2.0% TO PREVENT PONDING WITHIN THE DRAIN ROCK.

11) SUBCONTRACTOR TO NOTIFY CONTRACTOR PRIOR TO EXCAVATING INTO POTENTIAL LANDFILL WASTE IN ORDER FOR CONTRACTOR TO MONITOR EXCAVATIONS.



2 / 2 2 SEEP NO. 7 DRAIN-DETAIL

NOT TO SCALE



3 / 2 2 SEEP NO. 7 TIE-IN DETAIL

NOT TO SCALE

REVISION NO.	DATE	DESCRIPTION	DRAWN BY	CHECKED BY	PROJECT A/E	APPROVAL

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION, COLORADO

Work Performed by
S.M. Stoller Corporation
Under DOE Contract
No. DE-AM01-07LM00060

PROJECT LOCATION: ROCKY FLATS SITE GOLDEN, COLORADO

REFERENCE

TETRA TECH

APPROVALS		DATE
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DOE CONCURRENCE	(SEE RECORD)	08/12/08

ORIGINAL LANDFILL
SEEP NO. 7 DRAIN EXTENSION

SEEP #7 - PLAN AND SECTION

PROJECT NO. LTS-111-0056-07-001B
DRAWING NO. S03200-R00-C01-D+
SHT. 3 OF 3