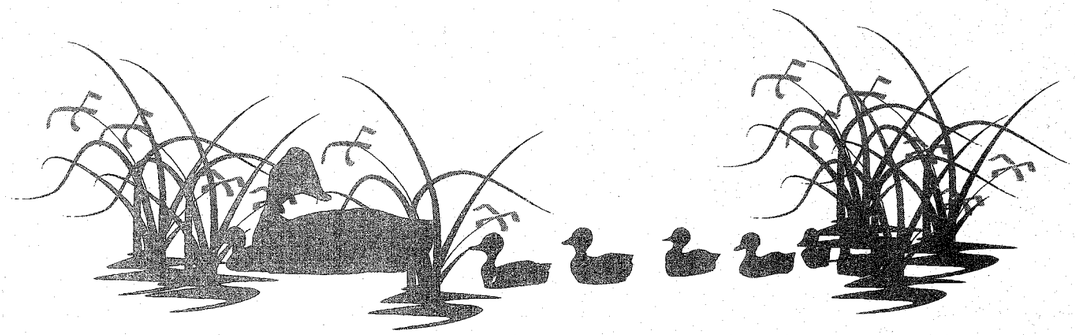
ERIE OUTFALL SYSTEMS PLANNING

PRELIMINARY DESIGN

ERIE AND ADJACENT BOULDER AND WELD COUNTY AREAS



MAY 2001

TOWN OF ERIE

1874

Town of Erie

Urban Drainage and Flood Control District

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

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May 1, 2001

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Denver, Colorado 80211

REF: 9922B – Erie Outfall Systems Planning
Preliminary Design Report
Erie and Adjacent Boulder and Weld County Areas

Dear Ben:

Enclosed, please find the *Erie Outfall Systems Planning Preliminary Design Report Erie and Adjacent Boulder and Weld County Areas*. The study area encompasses approximately 17.3 square miles and is bounded by Mineral Road to the north, Coal Creek or the Weld/Boulder County boundary line to the east, Baseline Road to the south, and U.S. Highway 287 to the west. This report is submitted in completion of the second phase of Urban Drainage and Flood Control District Agreement 99-04.09.

The report represents a significant contribution to the existing hydrologic and hydraulic data base required for stormwater management in the study area. It reviews the findings of the Phase A report, updates selected Alternate 2 drainage facilities in the Coal Creek Tributary area, and provides preliminary design plans, profiles and cost estimates for preliminary design of the proposed outfall system. The alternate analysis indicated existing stormwater conveyance facilities within the study area do not have the capacity to transport the 100-year storm event when proposed future development of the area is complete and, in some cases, under current development conditions. The preliminary design provided in this document will correct these deficiencies.

The selected outfall system plan cost includes approximately $24,425,291 for regional detention facilities, $15,495,700 for conveyance facilities, $5,679,333 for road and railroad crossings, and $719,756 for improvements to irrigation facilities. The total estimated cost for drainage improvements for the selected alternate is $46,320,080. The majority of these costs are proposed to be borne by future development.

Love & Associates, Inc. wishes to thank you and all of the members of the Advisory Board for the practical approach represented by this report to improve stormwater conveyance efficiency, reduce flood hazards, and improve water quality within the study area.

Sincerely,

LOVE & ASSOCIATES, INC.

David J. Love, P.E.,
President

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ERIE OUTFALL SYSTEMS PLANNING
ERIE AND ADJACENT BOULDER AND WELD COUNTY AREAS

PRELIMINARY DESIGN REPORT

Prepared For:

TOWN OF ERIE
BOULDER COUNTY
URBAN DRAINAGE & FLOOD CONTROL DISTRICT

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MAY, 2001

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ACKNOWLEDGMENTS

We would like to acknowledge the participation of the following individuals in the project meetings, discussion, and/or report preparation:

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Executive Summary

This document contains the preliminary design of the outfall system for Erie and adjacent Boulder and Weld County areas. The plan is sponsored jointly by the Urban Drainage and Flood Control District and the Town of Erie, Colorado. The preliminary design report was prepared by Love & Associates, Inc.

Purpose and Objective

Rapid development in the Erie Planning Area and adjacent areas, including portions of the Town of Erie, City of Lafayette, Boulder County, and Weld County, has resulted in an immediate need for an outfall system planning study. The outfall system planning study evaluates the impact of existing and projected future development on flood peaks and presents conceptual designs of alternate stormwater outfall systems which safely convey the projected 100-year storm under future development through the study area.

The study area, shown on Figure ES-1, encompasses approximately 17.3 square miles and is located near the confluence of Coal Creek and Boulder Creek. It includes the lower portions of three major watersheds: Coal Creek, Bullhead Gulch/ Prince Tributary, and Lower Boulder Creek.

Planning Process

The planning process began at the kickoff meeting in August, 1999. At that time, an Advisory Board, whose members included representatives of Urban Drainage and Flood Control District (UDFCD), Town of Erie, Boulder County, Colorado Department of Transportation (CDOT), and Union Pacific Railroad (UPRR) was formed. Input on the plan was solicited from ditch and utility companies in the Erie Planning Area. An Hydrology Report was published in January, 2000. After five formal Progress Meetings, a series of informal meetings, and the review of a Draft Alternate Evaluation Report, the Alternate Evaluation Report was published in May, 2000. The Board of Trustees for the Town of Erie approved Alternate 2 of the Alternate Report in October, 2000. Two additional progress meetings were held. The Phase B kickoff meeting was held on October 27, 2000 and a second meeting was held on December 4, 2000 to review a progress set of the preliminary design. During the December 4, 2000 meeting the Town of Erie requested Alternate 2 be modified to reflect recent development plans. The Draft Alternate Report was submitted to the District and the Town for review and comment in February, 2001.

The Advisory Board actively participated throughout the planning process. To accommodate the various needs and planning efforts of the communities within the study area, the Advisory Board adopted drainage design guidelines for detention, conveyance, and road and railroad crossings for each community. Regional and neighborhood detention is proposed to be primarily used within the Erie Planning Area to reduce major and minor developed flood peaks to historic magnitudes and improve surface water quality. Minimal stormwater infrastructure is proposed to be constructed in large areas dedicated for open space within both the Erie Planning Area and Boulder County not severely impacted by developed flows. Lands located within the City of Lafayette will employ small detention facilities in each development for stormwater control. In both the Erie Planning Area and in Boulder County, detention will be used immediately above road crossings to reduce overall drainage infrastructure construction costs by reducing culvert sizes, avoiding repetitive embankment costs, and reducing the number of outfall channels east of Northeast County Line Road. The 100-year floodplain along Coal Creek and Boulder Creek will be preserved. Bridges and culverts below the UPRR must accommodate the 100-year flood peak in accordance with published railroad design criteria.

Background

The study area is currently in transition from agricultural activities to subdivision and commercial development and is characterized by the lack of stormwater conveyance facilities. Flooding along major channels within the study area is reported in the historic record and local flooding has recently been observed. Many channels have been modified by agricultural activities and are undersized. There are no culverts below roads at most channel crossings; even culverts along the recently re-constructed Highway 287 are substantially undersized. Irrigation ditches capture, transport, and re-direct stormwater flow paths to undefined areas. Additionally, two railroad lines located within the study area impound water and modify stormwater flow directions. Existing detention facilities are too small to accommodate anticipated future development and, in some cases, existing development.

An hydrologic analysis was prepared for the study area for existing and future percent imperviousness. Data for the hydrologic analysis was developed from recent aerial topographic mapping and land use and soils maps. The results are summarized in Table ES-1. The analysis indicates more frequent and possibly severe flooding can be expected if development proceeds as anticipated without improvements to the stormwater conveyance system.

Design Criteria

Design procedures and parameters used in the study follow recommendations in *UDFCD Urban Storm Drainage Criteria Manual* and *Boulder County Stormwater Management Manual*. Computer models used in the study include CUHPF, UDSWMWIN, and HY-8. The regulatory floodplains for Boulder and Coal Creek, and the floodplain information in the Flood Insurance Study for Bullhead Gulch and Prince Tributary currently under review by the Federal Emergency Management Agency were incorporated into this study.

The design criteria for large open space areas relatively unaffected by development is to minimize stormwater improvements in these areas. Detention facilities will be used to take advantage of inadvertent detention upstream of road crossings to reduce culvert sizes and attenuate flood peaks. Conveyance will maintain natural channel and floodplains in undeveloped open space areas and, when the open space area is slightly impacted by development, a 2-year stable channel will be constructed while the natural floodplain will be maintained.

The design criteria within the Erie Planning Area recognizes a variety of constraints within the area, including such items as existing developments, existing stormwater infrastructure, flooding problems, active "moving target development", planning limitations (such as maximizing available lands zoned for commercial use), and lands which could be reasonably used for drainage facilities. General design guidelines for the Erie Planning Area include:

- Local, neighborhood, and regional detention and water quality facilities are to be employed,
- 100-year floodplains along Coal Creek and Boulder Creek are to be preserved,
- Soft conveyance channels are to be used,

- Conveyance options in low, moderate and high density developments are identified,
- Regional detention facilities are to be combined with roadway culverts where possible, and,
- Transbasin diversions are to be discouraged.

Alternate Analysis

Two outfall alternates were chosen for final evaluation. The alternates were developed to be hydraulically efficient and minimize the cost of drainage improvements. One assumes existing detention facilities could be enlarged and/or modified to function as regional facilities, the second assumes areas of proposed open space can accommodate new regional detention facilities.

Both outfall alternates convey the 100-year flood safely through the study area and require the construction of new regional detention facilities, channel improvements, culverts below roads, and improvements to irrigation ditches. For the first alternate to be implemented, significant amounts of additional land adjacent to existing detention facilities in areas committed to development are required. The second alternate can be implemented primarily using land for detention in areas designated as open space. Both alternates were similar in overall cost. The second alternate is the Engineer's recommended outfall system and, with modifications, it was used as the basis for the preliminary design of the outfall system.

Preliminary Design

The preliminary design of the outfall system incorporates regional detention facilities, flow diversions, regional channels, low flow channels, irrigation ditch improvements, and road and railroad culverts. The following components of the system are presented on Figure ES-2:

- Twenty new regional detention facilities, including thirteen in the Coal Creek Tributary area, two in the Boulder Creek Tributary area, and four in the Bullhead Gulch/Prince Tributary area,
- Two diversion elements within Bullhead Gulch/Prince Tributary directing low flows into two new flow channels, and,
- New regional conveyance channels or storm sewers connected to regional detention facilities designed to transport the 100-year flood peak and discharging into Coal Creek, Boulder Creek, or Bullhead Gulch, and,
- New low flow channels located in open space areas designed to transport 2-year flood peaks into Boulder Creek.

Conceptual cost estimates were prepared for the preliminary design of the outfall system. Cost estimates include costs for construction and land with contingencies, and allowance is provided for legal, administration, engineering, and mobilization fees. The cost for drainage facilities shown on Figure ES-2 are shown on Table ES-2. The recommended outfall system cost includes approximately $24,425,291 for regional detention facilities, $15,495,700 for conveyance facilities, $5,679,333 for road and railroad crossings, and $719,756 for improvements to irrigation facilities. Cost comparisons in the Alternate Evaluation Report assumed channels capable of conveying the 100-year flood would be constructed in all areas. Cost estimates in the Preliminary Design Report were refined assuming channels capable of conveying only the 2-year flood peak would be constructed in open space areas, no channels would be constructed in wetland areas, and floodplain overflow channels in populated areas in Bullhead Gulch/Prince Tributary were eliminated. Primarily for these reasons, channel improvement costs for Boulder Creek Tributaries and Bullhead Gulch/Prince Tributary and are substantially less in the Preliminary Design Report than those shown in the Alternate Report. The total estimated cost for drainage improvements for the recommended alternate is $46,320,080.

Table ES-1. Flood Peak Discharge Comparison: Existing, Future, and Outfall Plan

Coal Creek Tributaries							
Design Point	Location	10-year flood peak (cfs)			100-year flood peak (cfs)		
		Existing	Future	Outfall Plan	Existing	Future	Outfall Plan
506	N. 119th	28	59	*	168	210	210
508	NE Co. Line	59	120	*	347	431	365
905	Coal Ck.	63	138	*	366	454	375
510	NE Co. Line	40	67	*	242	290	N/A
906	Coal Ck.	46	91	*	277	334	121
514/1053	NE Co. Line	67	161	*	385	482	613
907	Coal Ck.	70	178	*	401	505	621
515	NE Co. Line	33	231	*	195	491	N/A
908	Coal Ck.	38	260	*	222	537	111
517/1051	NE Co. Line	38	312	*	227	674	227
910	Coal Ck.	51	381	*	300	826	371
518	-	69	311	*	405	731	314
519	NE Co. Line	81	379	*	475	883	193
520	-	87	478	*	514	1061	299
912	Coal Ck.	99	477	*	560	1120	489
521/1048	NE Co. Line	44	271	*	231	590	136
522	LA Wurl Pky.	51	355	*	276	752	258
913	Coal Ck.	56	348	*	300	792	434
534/1046	NE Co. Line	27	202	*	138	423	129
526	N. 119th	30	69	*	114	355	112
529	LA Wurl Pky.	43	194	*	213	442	223
530	Meller St.	110	240	*	478	717	462
532	UPRR	130	300	*	571	924	385
536	NE Co. Line	82	258	*	211	543	392
915	Coal Ck.	29	29	*	156	156	546
918	Coal Ck.	41	84	*	151	206	206
539	NE Co. Line	44	128	*	151	290	290
919	Coal Ck.	85	204	*	240	454	454
538	NE Co. Line	184	499	*	777	1295	191
917	Coal Ck.	215	480	*	813	1310	316

*10-Year flood peaks will be maintained at pre-developed rates using 10-year detention facilities in all developments.

Table ES-1. Flood Peak Discharge Comparison: Existing, Future, and Outfall Plan (cont'd)

Prince Tributary/Bullhead Gulch							
Design Point	Location	10-year flood peak (cfs)			100-year flood peak (cfs)		
		Existing	Future	Outfall Plan	Existing	Future	Outfall Plan
303/1027	Arapahoe Rd.	159	283	*	583	745	284
306	-	167	303	*	784	976	473
308	-	228	344	*	1199	1389	882
311	-	255	424	*	1370	1613	1061
312	LA Wurl Pky.	313	604	*	1637	1971	1290
313	-	331	636	*	1706	2080	1338
315	Flatiron Rd.	378	810	*	1932	2379	1567
321	LA Wurl Pky.	40	40	*	237	237	237
1020	Hwy 287	602	1758	*	1745	3862	3862
322	-	626	1747	*	1880	3967	3967
323	-	620	1706	*	1875	3925	2910
317	109th	941	2341	*	3340	5998	3922
318	UPRR	972	2387	*	3423	6123	4527
940	Bldr. Ck.	935	2259	*	3354	5878	4261
324	UPRR	N/A	N/A	*	N/A	N/A	1000
700	Jasper Rd.	7 (Bldr Ck)	7 (Bldr Ck)	*	45	45	1035
951	Bldr. Ck.	23 (Bldr Ck)	23 (Bldr Ck)	*	113	113	1062
Boulder Creek Tributaries							
Design Point	Location	10-year flood peak (cfs)			100-year flood peak (cfs)		
		Existing	Future	Outfall Plan	Existing	Future	Outfall Plan
707/1071	UPRR	132	234	*	409	574	174
703	-	38	39	*	187	189	374
955	Bldr. Ck.	41	41	*	181	182	355
706/1070	UPRR	137	290	*	484	691	165
708	Jasper Rd.	253	492	*	901	1276	285
710	Kenosha Rd.	240	394	*	876	1191	473
958	Bldr. Ck.	247	401	*	902	1216	505
750	Hwy 287	581	584	*	1455	1455	1455
714	N. 115th	630	630	*	1736	1736	1736
960	Bldr. Ck.	622	622	*	1726	1726	1726

*10-Year flood peaks will be maintained at pre-developed rates using 10-year detention facilities in all developments.

Table ES-2. Outfall System Improvement Costs

OUTFALL SYSTEM IMPROVEMENT COSTS						
Description			Cost			
ITEM	Length (miles)	Contrib-uting Drainage Area (sq. mi.)	Facility Improvements	Land Acquisition	Engineering, Construction, Administrative, Contingencies (40%)	Total Cost
CHANNEL REACH						
Boulder Creek Tributaries						
BC10	1.08	3.33	77,395	360,998	67,058	$505,450
BC20	0.69	0.74	32,078	249,154	37,747	$318,979
BC30	1.12	0.93	257,699	368,954	139,975	$766,627
Sub-total	**2.89**		**$367,172**	**$979,106**	**$244,780**	**$1,591,056**
Bullhead Gulch/Prince Tributary						
BP10	1.39	4.56	971,737	1,207,642	509,459	$2,688,839
BP20	3.13	3.60	2,103,649	2,419,881	1,083,448	$5,606,978
BP40	0.24	0.26	78,643	105,429	42,000	$226,071
BP50	0.22	0.28	82,513	128,047	45,810	$256,369
Sub-total	**4.98**		**$3,236,542**	**$3,860,999**	**$1,680,717**	**$8,778,257**
Coal Creek Tributaries						
CC10	1.31	1.36	483,738	842,430	277,738	$1,603,906
CC20	0.14	0.04	64,350	0	0	$64,350
CC30	0.31	0.21	51,408	176,499	38,213	$266,119
CC50	0.71	0.41	200,408	474,004	127,563	$801,975
CC60	0.90	0.78	363,718	489,596	194,447	$1,047,761
CC70	0.50	0.35	172,167	232,904	92,157	$497,228
CC80	0.19	0.95	225,521	151,061	105,315	$481,897
CC90	0.24	0.47	137,313	155,373	70,463	$363,149
Sub-total	**4.30**		**$1,698,623**	**$2,521,867**	**$905,896**	**$5,126,385**
DETENTION FACILITIES						
Boulder Creek Tributaries						
1070		0.39	$803,645	$1,074,050	$428,863	$2,306,558
1071		0.31	$490,897	$552,748	$251,634	$1,295,279
Sub-total		**0.70**	**$1,294,542**	**$1,626,798**	**$680,497**	**$3,601,837**

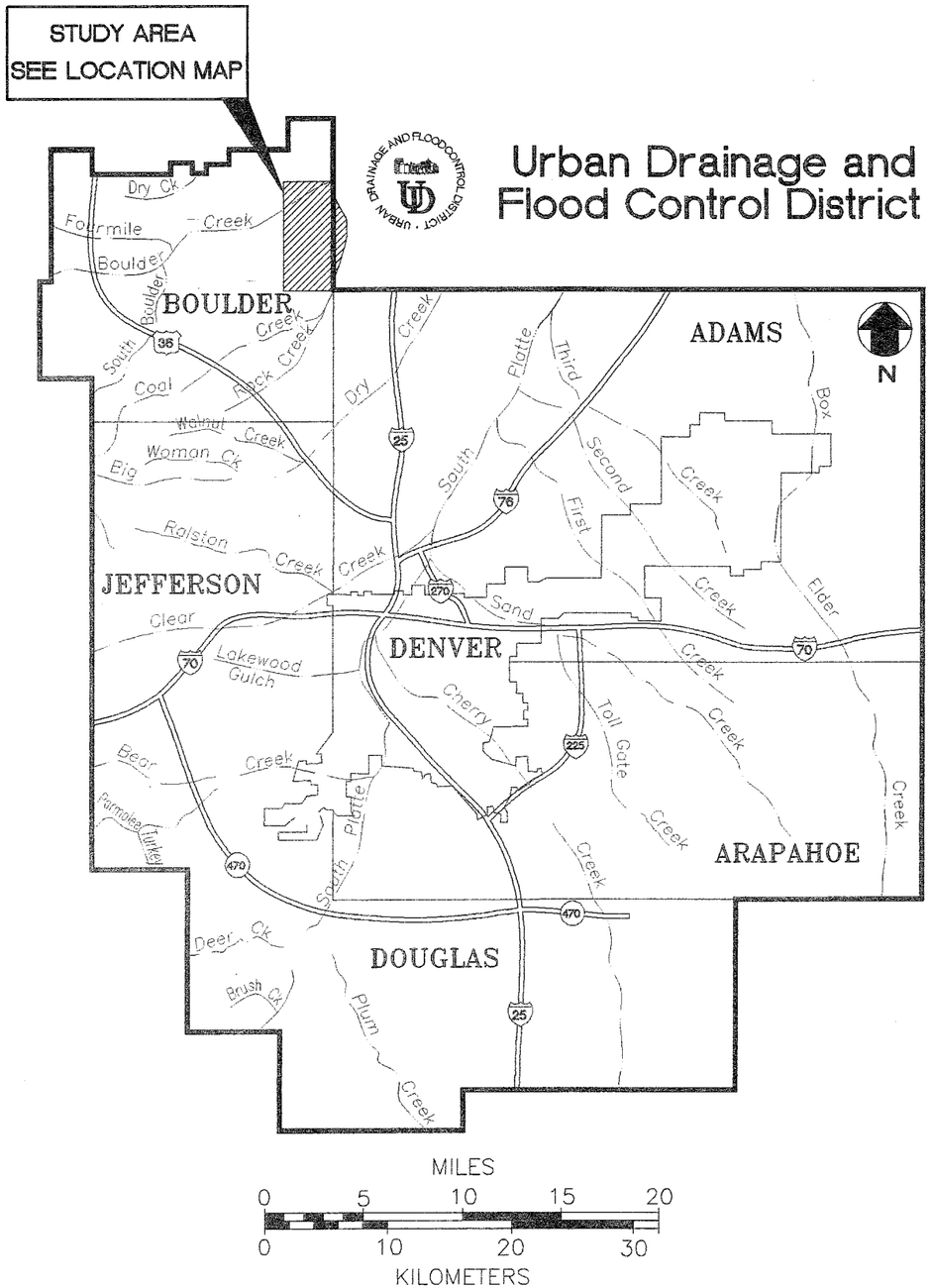
Table ES-2. Outfall System Improvement Costs (cont'd)

Description			Cost			
ITEM	Length (miles)	Contrib-uting Drainage Area (sq. mi.)	Facility Improvements	Land Acquisition	Engineering, Construction, Administrative, Contingencies (40%)	Total Cost
Bullhead Gulch/Prince Tributary						
1025		0.12	$20,000	$0	$8,000	$28,000
1026		0.24	$14,000	$0	$5,600	$19,600
1027		0.52	$651,023	$970,317	$357,441	$1,978,782
1028		0.22	$151,133	$552,748	$115,728	$819,610
1029		0.32	$264,067	$1,177,599	$223,387	$1,665,053
1030		0.23	$151,133	$552,748	$115,728	$819,610
1031		2.52	$10,487	$10,000	$5,195	$25,681
1032		0.44	$10,487	$10,000	$5,195	$25,681
Sub-total		**4.61**	**$1,272,330**	**$3,273,412**	**$836,274**	**$5,382,017**
Coal Creek Tributaries						
1042		0.68	$128,519	-	$51,407	$179,926
1043		0.21	$171,401	$194,775	$88,038	$454,213
1044		0.21	$207,051	$531,709	$135,991	$874,751
1045		1.00	$434,401	$1,342,958	$308,056	$2,085,416
1046		0.11	$177,761	$324,080	$103,513	$605,354
1048		0.19	$347,424	$866,372	$225,607	$1,439,402
1049		0.27	$327,954	$762,170	$207,399	$1,297,523
1050		0.50	$654,620	$1,280,991	$389,947	$2,325,558
1051		0.24	$127,953	$866,372	$137,818	$1,132,143
1053		0.92	$834,805	$1,074,050	$441,327	$2,350,182
1054		0.29	$366,606	$699,504	$216,593	$1,282,703
1055		0.40	$357,954	$319,806	$175,162	$852,922
1056		0.04	$77,887	$99,634	$41,118	$218,639
1057		0.07	$123,601	$154,240	$64,864	$342,705
Sub-total		**5.13**	**$4,337,937**	**$8,516,661**	**$2,586,840**	**$15,441,437**
ROADWAY CROSSINGS						
Boulder Creek Tributaries			$704,222	-	281,689	$985,911
Bullhead Gulch/ Prince Trib.			$2,115,611	-	$846,244	$2,961,856
Coal Creek Tribs.			$1,236,833	-	$494,733	$1,731,567
Sub-total			**$4,056,666**	**-**	**$1,622,666**	**$5,679,334**

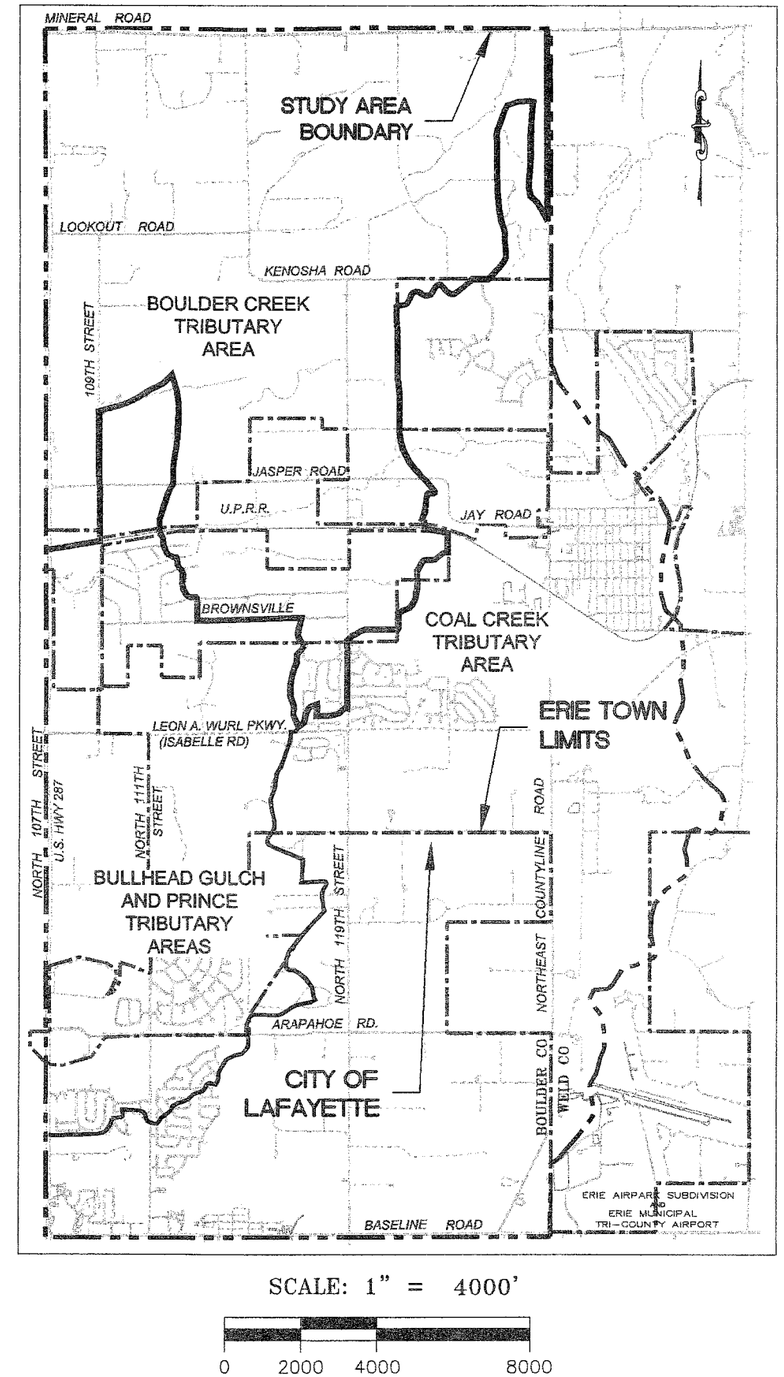
Table ES-2. Outfall System Improvement Costs (cont'd)

Description			Cost			
ITEM	Length (miles)	Contrib-uting Drainage Area (sq. mi.)	Facility Improvements	Land Acquisition	Engineering, Construction, Administrative, Contingencies (40%)	Total Cost
IRRIGATION FACILITIES						
Boulder Creek Tributaries			$175,000	-	70,000	$245,000
Bullhead Gulch/ Prince Trib.			$234,111	-	$93,645	$327,756
Coal Creek Tribs.			$105,000	-	$42,000	$147,000
Sub-total			**$514,111**	**-**	**$205,645**	**$719,756**
GRAND TOTAL			**$16,777,923**	**$20,778,843**	**$8,763,315**	**$46,320,079**

Note: The Coal Creek Tributaries are identified as UDFCD ID Nos. 3004-01 and 3004-02, Boulder Creek Tributaries as 3012-02 and Bullhead Gulch/Prince Tributary as 3014-01.



SITE VICINITY MAP



LOCATION MAP

DATE: MAY 30, 2000
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Lee & Associates, Inc. water resource consultants 841 Front Street Louisville, Colorado 80027-1849 Phone: 303-673-9795 Fax: 303-673-9796	DESIGNED: RJP DRAWN: DM CHECKED: DJL DATE: 5-00	TOWN OF ERIE URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	ERIE AND ADJACENT AREAS OUTFALL SYSTEMS PLANNING	LOCATION MAP

Figure ES-1
Page ES-5

SCALE: 1"=2300'

COAL CREEK TRIBUTARIES

STUDY AREA BOUNDARY

NORTHEAST COUNTY LINE ROAD

WELD CO

BOULDER CO

COAL CREEK

CC 10

CC 20

CC 30

CC 50

CC 60

CC 70

CC 80

CC 90

JAY ROAD

KENOSHA ROAD

BOULDER CREEK

ARAPAHOE ROAD

BASELINE ROAD

NORTH 119TH STREET

BC 30

BC 20

BC 10

JASPER ROAD

U.P.R.R.

NORTH 115TH STREET

HWY 52

BROWNSVILLE

LEON A. WURL PKWY. (ISABELLE RD)

BP 40

BP 20

BP 50

BP 10

NORTH 111TH STREET

NORTH 109TH STREET

MINERAL ROAD

LOOKOUT ROAD

NORTH 107TH STREET

US HWY 287

BOULDER CREEK TRIBUTARIES

BULLHEAD GULCH AND PRINCE TRIBUTARIES

LEGEND

WATERSHED

CATCHMENT BOUNDARY

MINOR CATCHMENT BOUNDARY

OUTFALL FLOW PATH

DESIGN POINT (800)

IMPROVEMENTS

REGIONAL DETENTION FACILITY (0000)

EXISTING DETENTION FACILITY (0000)

DIVERSION ELEMENT (0000)

REGIONAL FLOW PATH (000)

REACH IDENTIFIER BP 10

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DRAWN:	DM
CHECKED:	DJL
DATE:	01-01

TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

PROPOSED DRAINAGE FACILITIES
UDSWM ELEMENTS

Figure ES-2

DATE: JANUARY 3, 2001
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I. INTRODUCTION

A. Authorization

The Urban Drainage and Flood Control District (UDFCD) and the Town of Erie, Colorado, in response to rapid development in the Erie Planning Area east of the Boulder/Weld County line near the Town of Erie, sponsored an Outfall Systems Alternate Evaluation Study of lands within and adjacent to the Erie Planning Area.

This study was performed under the direction of the Project Sponsors (UDFCD and the Town of Erie). The firm of Love & Associates, Inc. is responsible for the study content. Input was obtained from the Advisory Board, whose members included representatives of UDFCD, Town of Erie, Boulder County, Colorado Department of Transportation (CDOT), and Union Pacific Railroad (UPRR). The study was prepared under UDFCD Agreement No. 99-04.09.

B. Purpose and Scope

The purpose of the outfall systems planning study is to identify alternate methods to convey stormwater within the study area to enhance public health and safety and minimize property damage. The hydrologic study, undertaken as a part of this project, provides public and private entities a comprehensive analysis of existing and proposed percent imperviousness within the study area for catchments of approximately 100 acres. It identifies critical areas of stormwater management and provides an analysis of alternates which may be used as a guideline for addressing water quality degradation and flood peak increases resulting from current and future development anticipated within the study area.

The outfall systems planning study entailed:

- compiling data on existing stormwater management facilities, soils, existing and proposed land uses, property ownership, wetlands, and utilities,
- identifying probable flow paths and catchments (no greater than 130 acres in area) under current land use using 1999 aerial topography,
- developing base hydrologic prediction models for existing and projected future percent imperviousness for the average storm (0.4-inch), 2, 5, 10, 50, and 100-year storm events,
- identifying existing stormwater management facilities and the adequacy of their hydraulic operation under existing and proposed percent imperviousness,
- defining critical areas requiring stormwater management, exclusion areas, and zones of rapid development,
- describing methods of stormwater management and production of general management recommendations for various catchments in the study area, and,
- recommending stormwater management alternatives for consideration by the Project Sponsors, the Advisory Committee, and public and private entities.

The preliminary design of the alternate selected by the Project Sponsors is addressed in subsequent sections of this report.

C. Baseline Information

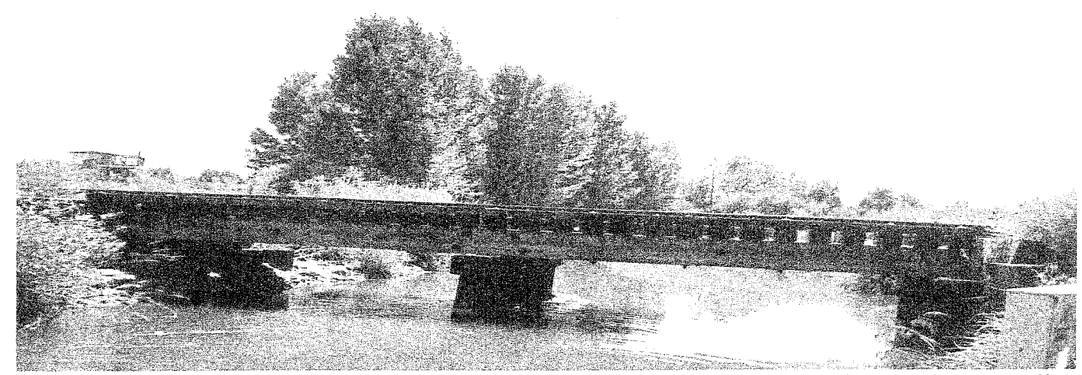
Information used for the outfall study includes:

- Topographic mapping from aerial photography flown during March, 1999 with a 2-foot contour interval and electronically filed on AutoCAD Version 14 (ACAD-14) (Aztec Consultants, Inc., 1999),
- Land use maps for the Town of Erie (Town of Erie, 1999) and City of Lafayette (City of Lafayette, 1997),
- NRCS soils maps for Boulder (SCS, 1975) and Weld Counties, Colorado (SCS, 1982),
- Ditches and reservoirs holding water rights on file with the State Engineer's Office (SEO) and with Boulder County (Boulder County Transportation Department, 1999),
- Flood Insurance Studies (FIS) and Flood Insurance Rate Maps (FIRM) for Boulder and Coal Creeks updated in 1995 (FEMA, 1995; USDA SCS, 1976; and WRC Engineering, Inc., 1996)
- FIS (Draft) for Bullhead Gulch (Taggart Engineering Associates, Inc., 1998), and,
- Various drainage reports (Erie Drainage Reports, 1995-1999) for existing and proposed developments and master plans within the study area provided by the Town of Erie.

D. Design Procedures

Design procedures and parameters used in the study follow recommendations in *UDFCD Urban Storm Drainage Criteria Manual* (UDFCD, 1969) and *Boulder County Stormwater Management Manual* (Boulder County, 1984). Computer models used in the study include CUHPF (UDFCD, 1998), UDSWM95 (UDSWM) (UDFCD, 1998b), and HY-8 (Federal Highway Administration, 1966).

The floodplains of Boulder Creek and Coal Creek are regulated by the Federal Emergency Management Agency (FEMA) under the National Flood Insurance Program. A Flood Insurance Study (FIS) has been prepared for portions of Bullhead Gulch and Prince Tributary (Taggart Engineering Associates, Inc., 1998) and is currently under review by FEMA.



Photographs of the study area shown in this report are for illustrative purposes and were taken by staff of Love & Associates, Inc.

II. STUDY AREA

A. Location

The study area is approximately 17.3 sq. mi. and is located within the Town of Erie, Colorado, and Boulder and Weld Counties, Colorado, occupying E ½ Sections 3, 10, 15, 22, 27, and 34, Sections 1, 2, 11 through 14, 23 through 26, 35, and 36, T1N, R69W, and portions of the western part of Sections 7, 18, 19, 30, and 31, T1N, R68W. This study is principally concerned with rapidly developing properties within the jurisdiction or planning area of the Town of Erie. However, portions of the study area fall within the jurisdictions of Boulder County, Weld County, and the City of Lafayette. The study area is located within the South Platte River Basin. It is bounded by Colorado Highway 52 to the north, Coal Creek or Weld/Boulder County boundary to the east, Baseline Road to the south (Highway 7), and U.S. Highway 287 to the west. Please refer to Location Map, Figure 1.

B. Catchments

Portions of three important watersheds are located within the study area: Boulder Creek, Coal Creek, and Bullhead Gulch/Prince Tributary (See Location Map, Figure 1). Boulder Creek flows northeastwardly through the study area and eventually joins St. Vrain Creek downstream of the study area. Coal Creek flows northwardly along the eastern boundary of the study area and joins Boulder Creek within the study area in Section 1, T1N, R69W. Bullhead Gulch/Prince Tributary drains northwardly through the study area and joins Boulder Creek within the study area in Section 10, T1N, R69W.

The Boulder County FIS (FEMA, 1995) reports the Boulder Creek drainage basin to be approximately 440 square miles in area at its confluence with Coal Creek and the Coal Creek basin to be approximately 79 square miles in area at its confluence with Boulder Creek. Bullhead Gulch/Prince Tributary is approximately 9.1 square miles in area at its confluence with Boulder Creek (Advanced Sciences, Inc., 1992). Within the study area, approximately 5.7 square miles is directly tributary to Boulder Creek, approximately 8.0 square miles is directly tributary to Coal Creek, and approximately 3.6 square miles is located within Bullhead Gulch/Prince Tributary. In addition to the on-site catchments, approximately 4.4 square miles of Bullhead Gulch/Prince Tributary, two off-site catchments tributary to Coal Creek (421 and 157 acres in area), and one off-site catchment tributary to Boulder Creek (1541 acres in area), were analyzed. On-site catchments are delineated on Figures 2a, 2b, and 2c and off-site catchments are delineated on Figure 3.

C. Flood History

The FIS for Boulder County (FEMA, 1995) infers periodic flooding has occurred along Boulder Creek and Coal Creek within the study area. There is no record of damage occurring in the study area published in the FIS from these flood events, probably due to the low population density in the study area at the time of the flood events. Significant flood events along Boulder Creek have been reported in the City of Boulder occurring in 1894, 1914, and 1938. The 1894 flood is considered to have approximated the 100-year flood for Boulder Creek. Flood events along Coal Creek have been reported in 1876, 1891, June 3, 1921, May 26, 1935, June 9, 1949, May 9, 1957, and May 1969. The 1876 flood peak discharge was estimated to be 13,200 cfs near Erie and is believed to approximate the 100-year flood peak.

Significant floods have occurred along Bullhead Gulch (Advanced Sciences, Inc. 1992) three times over the past 70 years. One storm in the mid-1940's produced flood depths estimated at three feet near the intersection of Isabelle Road and US Highway 287. Bullhead Gulch reportedly had eroded to a depth of 15- to 20- feet between Isabelle Road and the Leyner-Cottonwood Ditch prior to the construction of the Leyner-Cottonwood Ditch.

Recently, Erie officials have observed periodic flooding at the Pre-School and High School near Old Town Erie just downstream of the Union Pacific Railroad (UPRR) tracks. One photograph of flooding which occurred on April 30, 1999 and taken by Wendi Palmer of the Town of Erie is shown on page ES-1 of the Executive Summary of the Alternate Evaluation Report.

D. Land Characteristics

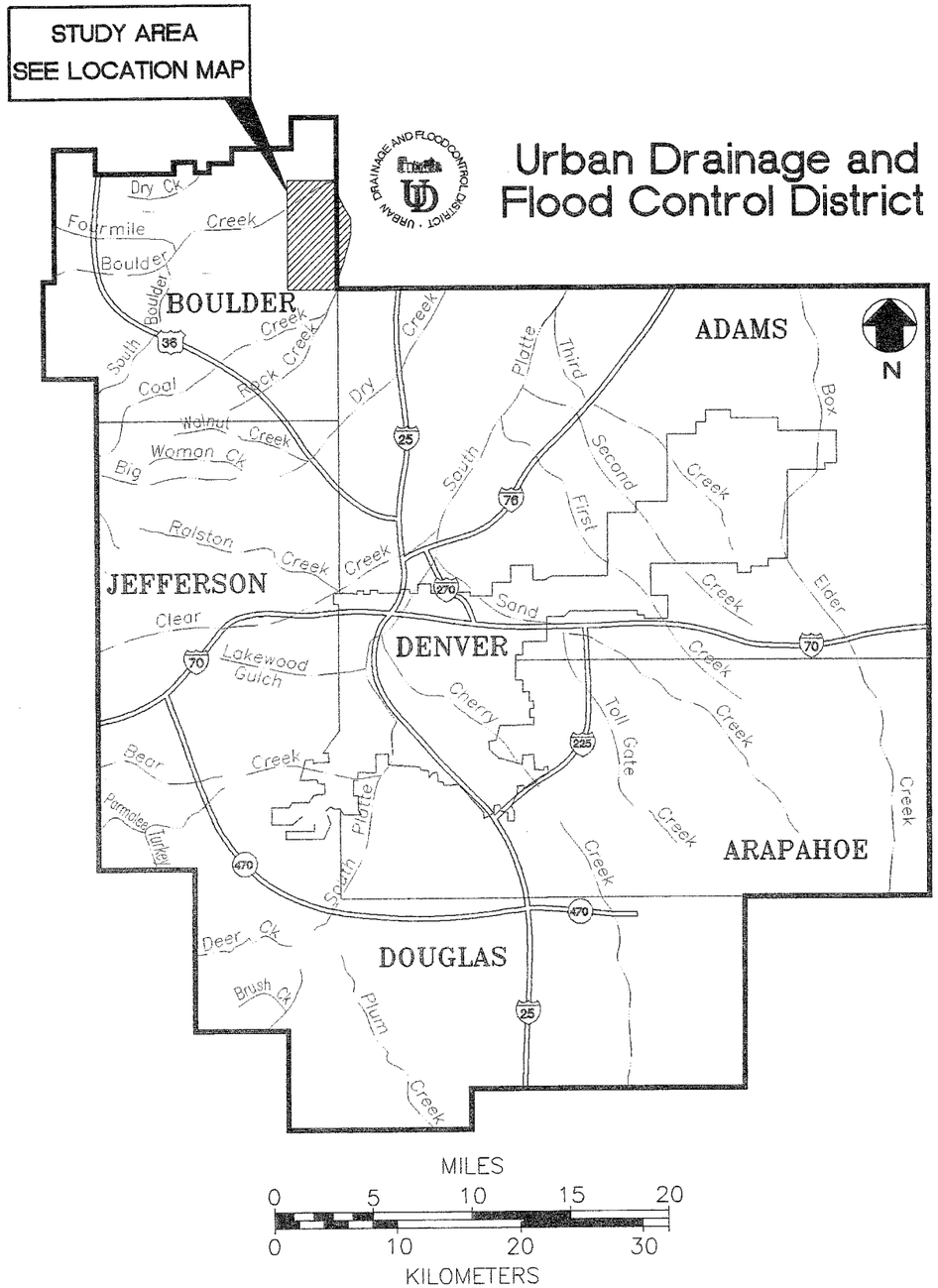
Topography within the study area is characterized by generally flat terrain along floodplains and moderate slopes adjacent to floodplains. The study area currently includes significant amounts of agricultural lands, and many of the historic channels in the study area have been smoothed or altered by agricultural practices.

Irrigation ditches have influenced historic surface drainage patterns as have small reservoirs, development, railroad embankments, and gravel mining. Few roadside ditches, culverts, or bridges operating independently of irrigation ditch structures are located in the study area. Developments have only slightly influenced drainage patterns. Flow patterns have been altered by the Burlington Northern Railroad's (BNRR) abandoned line which traverses the southeast section of the study area and the UPRR line which bisects the northern part of the study area. Gravel mining operations, located primarily within the 100-year floodplain of Boulder Creek, influence drainage patterns along Boulder Creek. The potential for stream capture by these open pit areas along Boulder Creek was not evaluated. Abandoned underground coal mines located throughout the study area have apparently not impacted surface drainage patterns at this time.

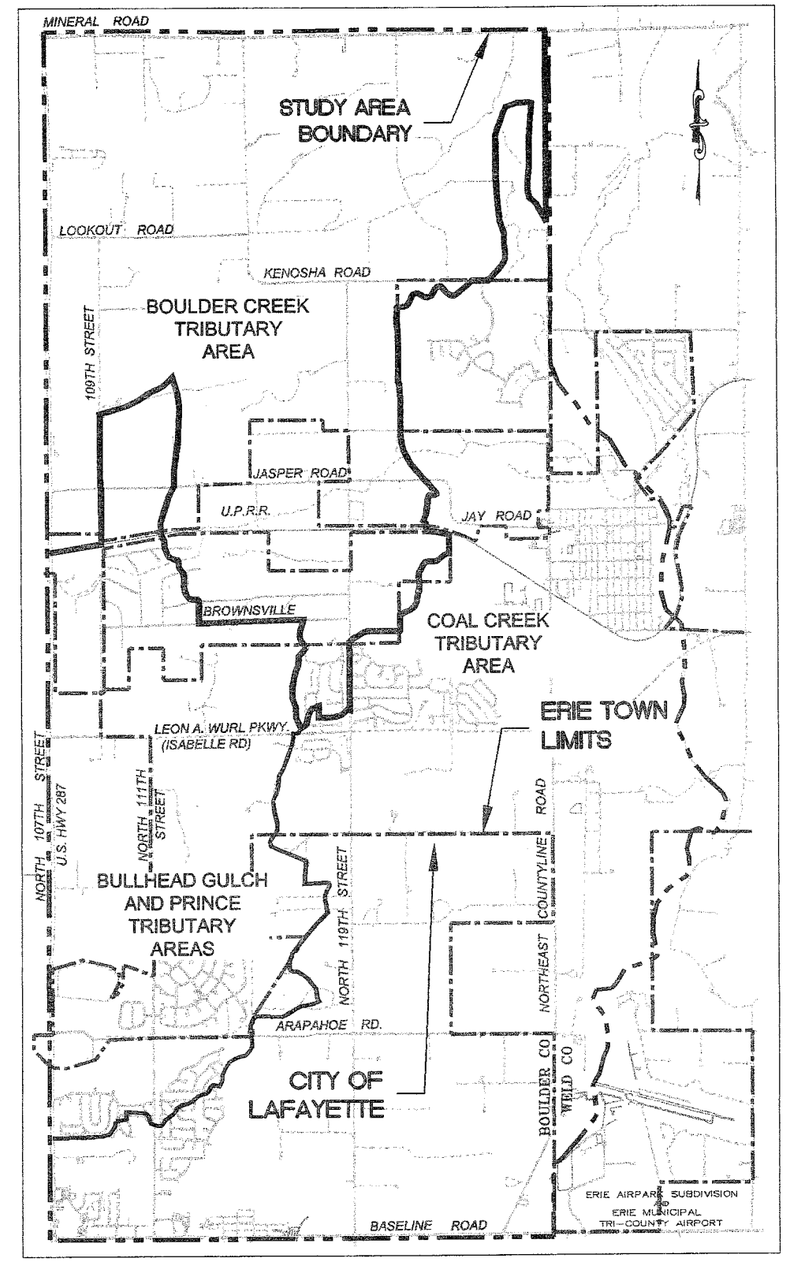
Vegetation in the study area consists of dry land and irrigated crops in agricultural areas, deciduous trees, evergreens, shrubs, and native grasses along floodplains and undisturbed areas, and landscaping in residential areas. Wetlands, which were defined conceptually by Boulder County and shown on Figure 4, are found throughout the study area.

Soils within the study area are primarily Hydrologic Soils Group B interspersed with Hydrologic Soils Group C and D, as shown on Figures 5a and 5b. Soils within and adjacent to the study area were obtained using soil maps developed by the National Resources Conservation Service (SCS, 1975 and 1982).

Surface water quality in the study area may be enhanced by wetlands which have become established in some of the new detention facilities within the study area, including Arapahoe Ridge Filing No. 1, Arapahoe Ridge Filing No. 2, and Orchard Glen No. 1. These detention facilities were not originally designed to enhance water quality; however, they currently serve that function.



SITE VICINITY MAP



SCALE: 1" = 4000'

0 2000 4000 8000

LOCATION MAP

DATE: MAY 19, 2000
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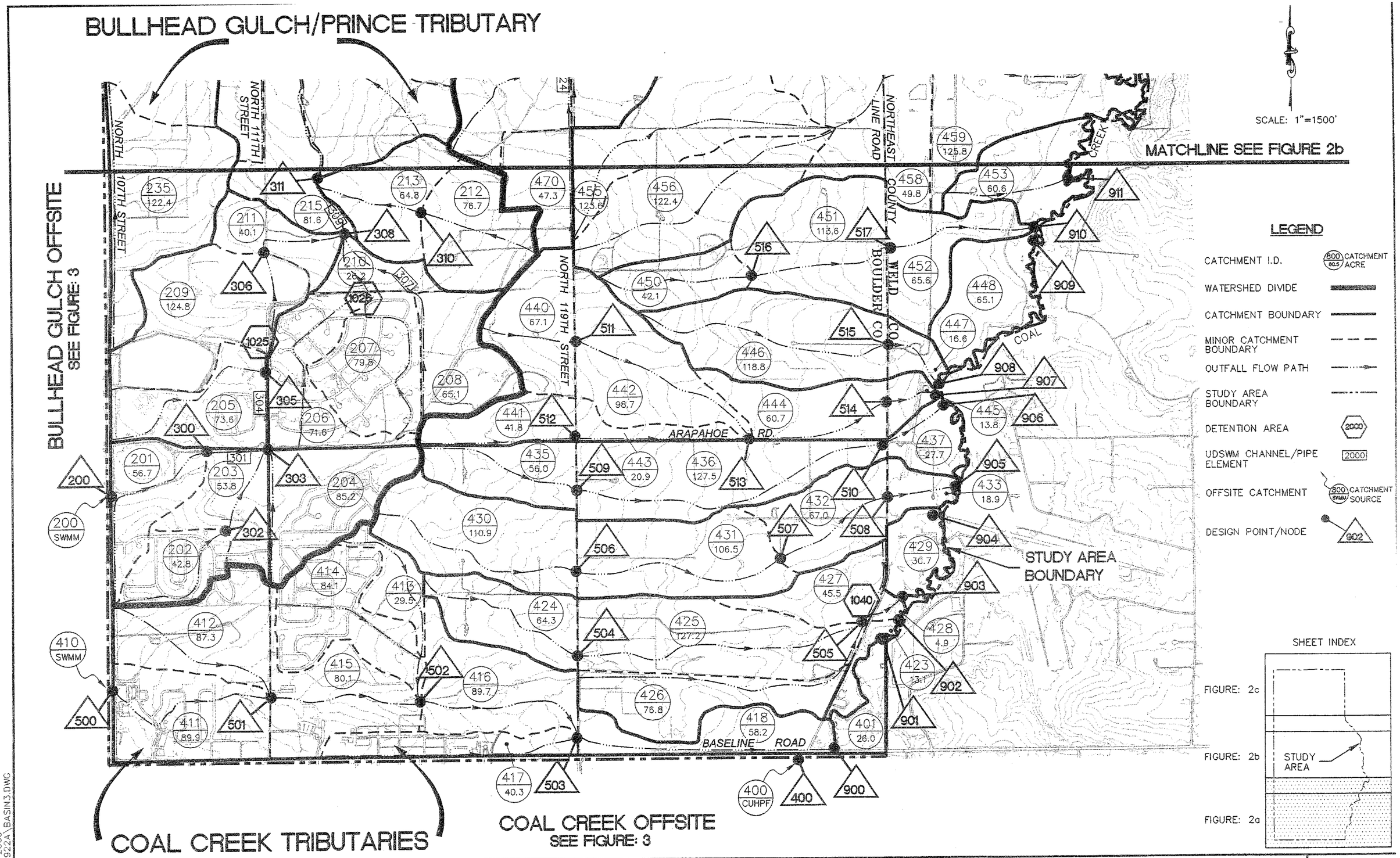
Lowe & Associates, Inc. water resource consultants 841 Front Street Louisville, Colorado 80027-1849 Phone: 303-673-9795 Fax: 303-673-9796	DESIGNED: RJP DRAWN: DM CHECKED: DJL DATE: 5-00	TOWN OF ERIE URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	ERIE AND ADJACENT AREAS OUTFALL SYSTEMS PLANNING	LOCATION MAP	FIGURE: 1 PAGE: II - 2



DATE: MAY 22, 2000
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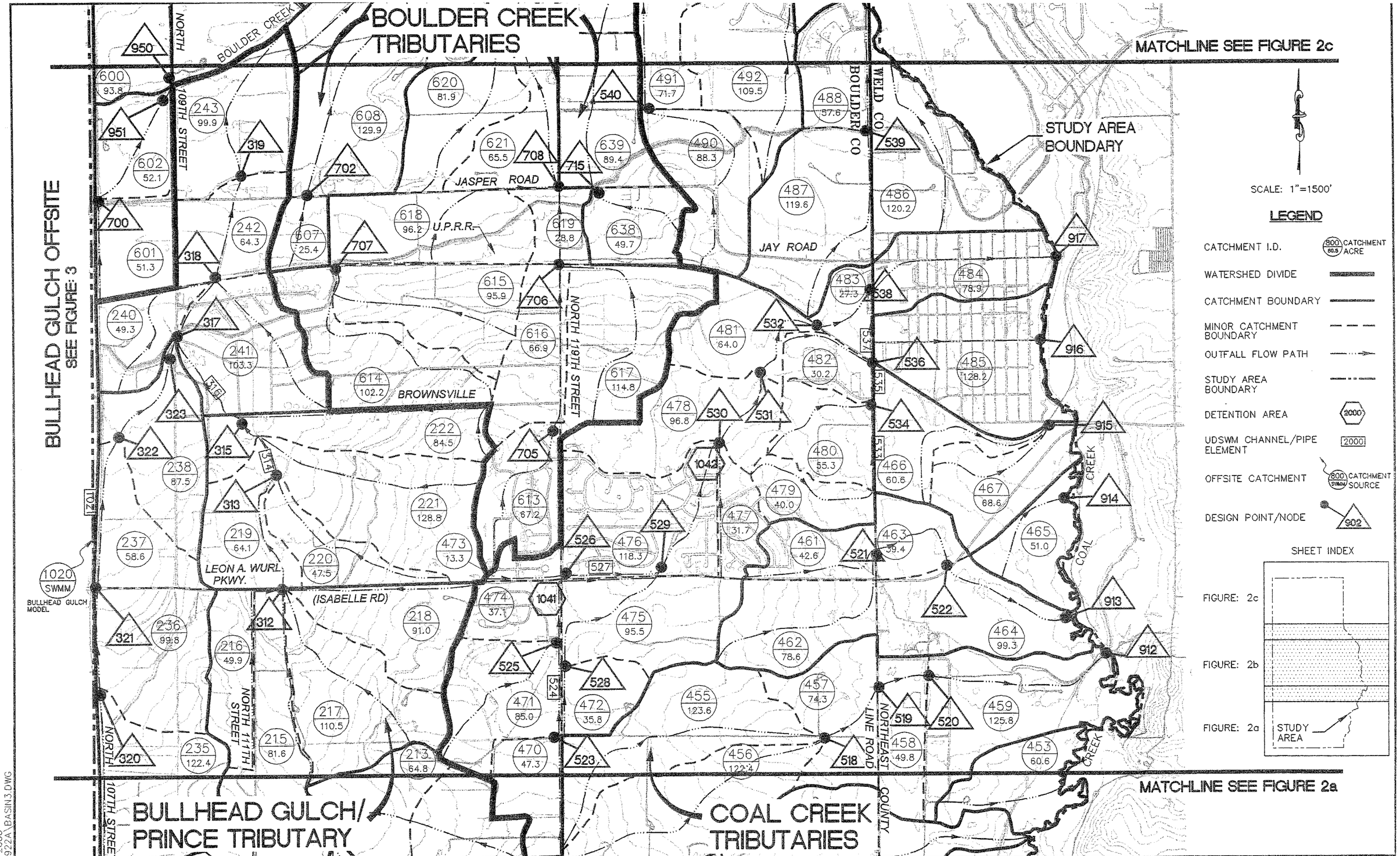
DATE:	5-00

TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

CATCHMENT DELINEATION AND SWMM ELEMENTS IN THE STUDY AREA

Figure 2a



DATE: MAY 22, 2000
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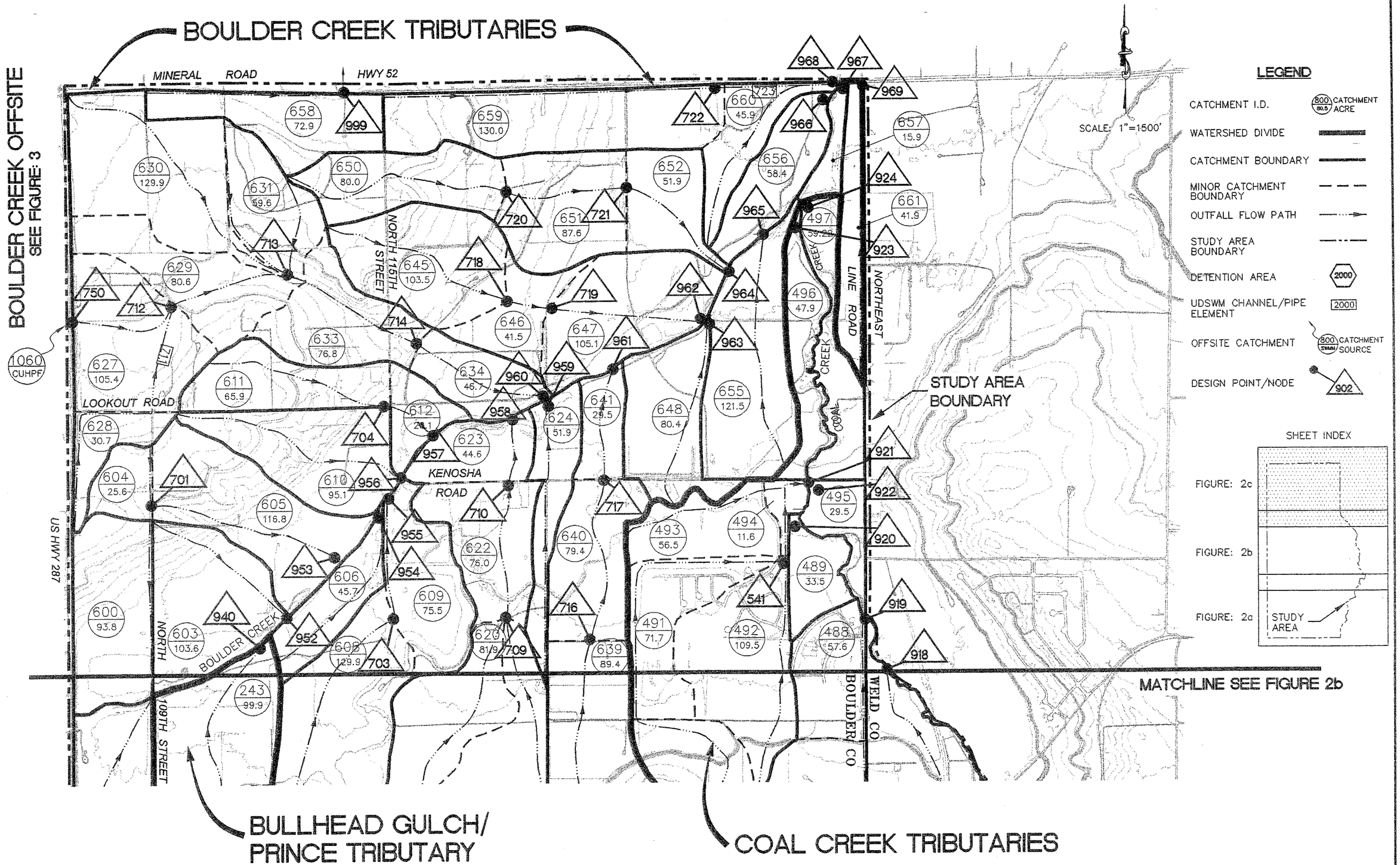
TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

CATCHMENT DELINEATION AND SWMM ELEMENTS IN THE STUDY AREA

Figure 2b



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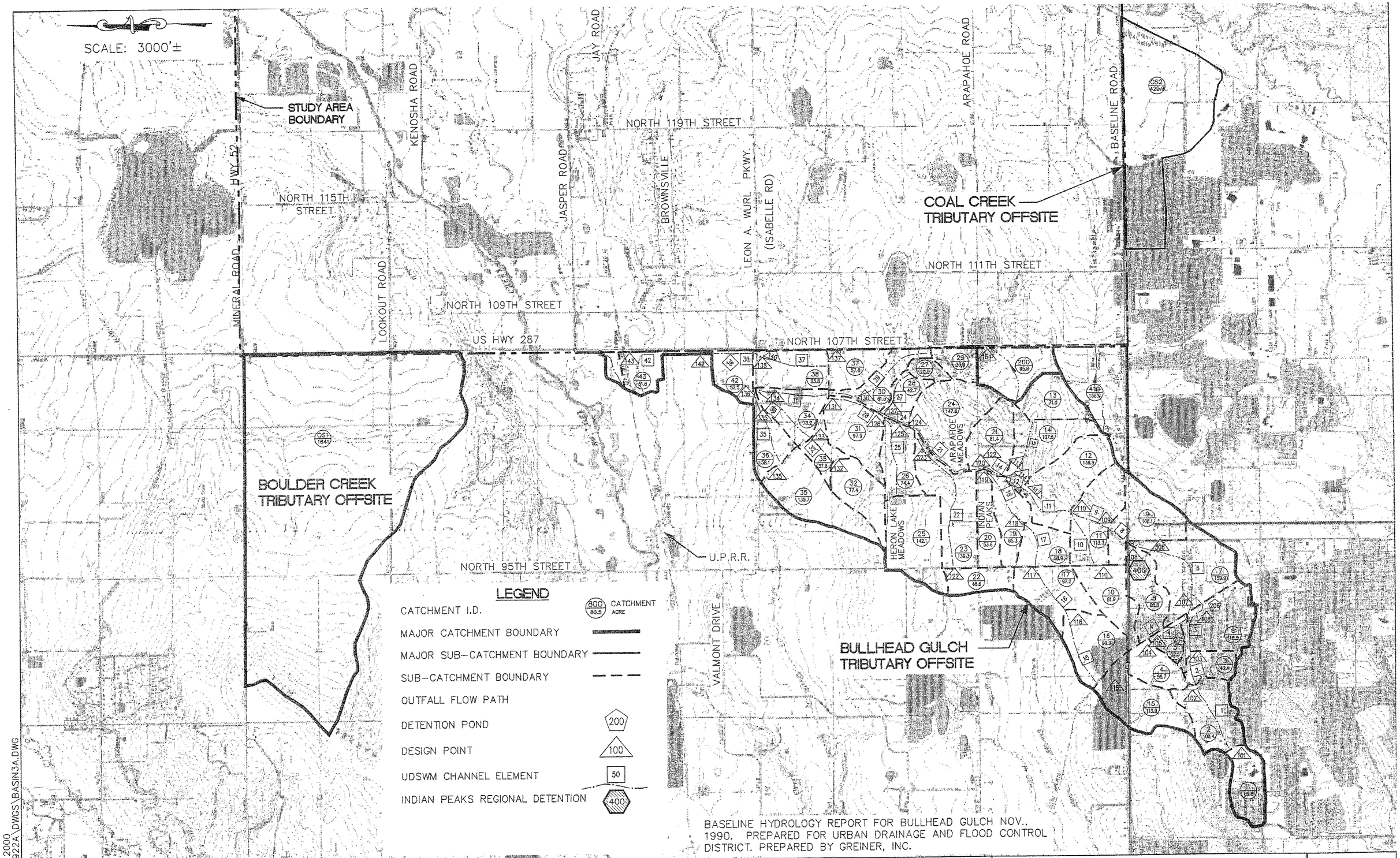
Lore & Associates, Inc. water resource consultants 841 Front Street Louisville, Colorado 80027-1849 Phone: 303-673-9795 Fax: 303-673-9796	DESIGNED: RJP DRAWN: DM CHECKED: DJL DATE: 5-00	TOWN OF ERIE URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	ERIE AND ADJACENT AREAS OUTFALL SYSTEMS PLANNING	CATCHMENT DELINEATION AND SWMM ELEMENTS IN THE STUDY AREA	Figure 2c Page II - 5



BASELINE HYDROLOGY REPORT FOR BULLHEAD GULCH NOV., 1990. PREPARED FOR URBAN DRAINAGE AND FLOOD CONTROL DISTRICT. PREPARED BY GREINER, INC.

DATE: MAY 30, 2000
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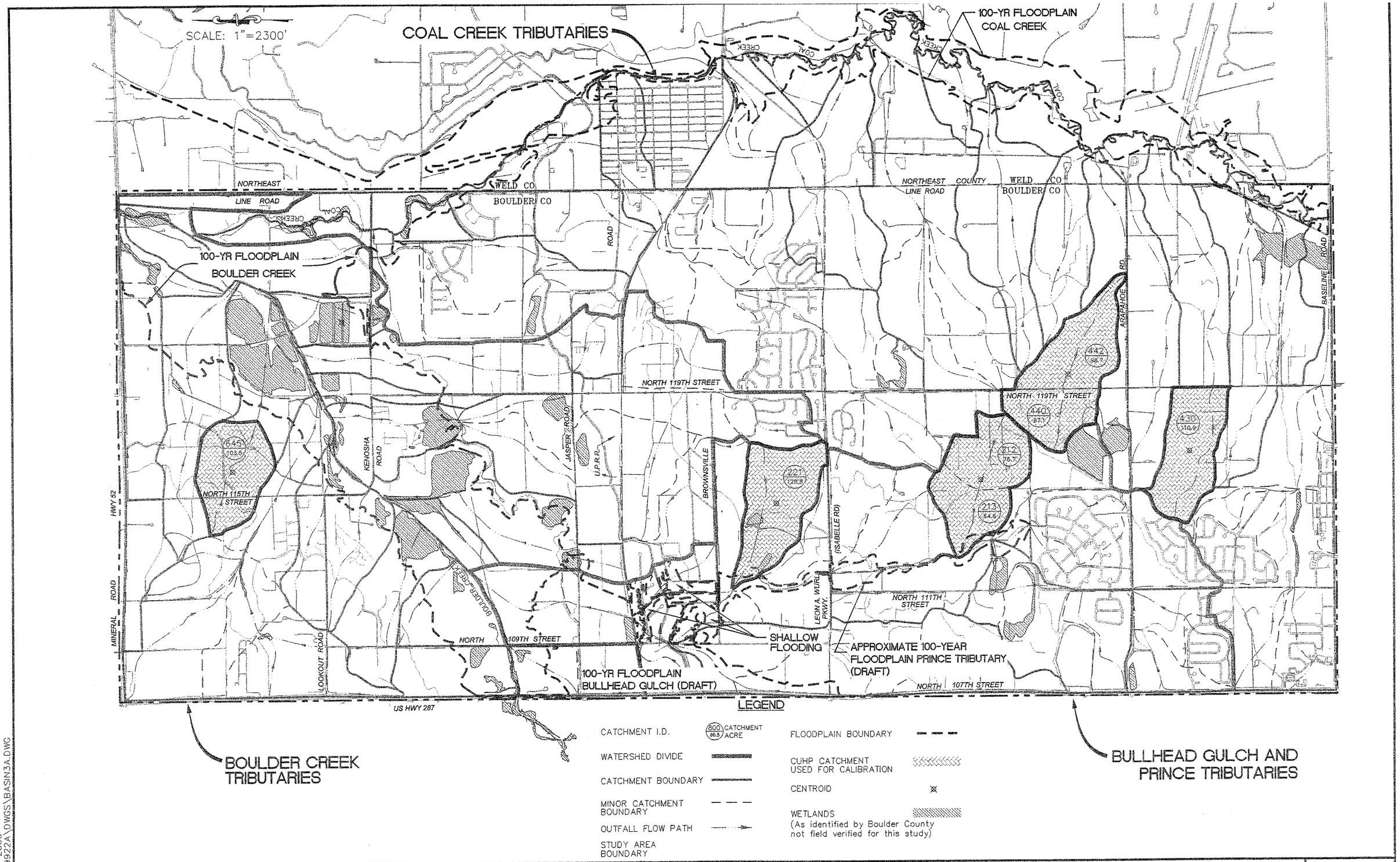
DATE:	5-00

TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

OFFSITE CATCHMENT DELINEATION AND SWMM ELEMENTS

Figure 3



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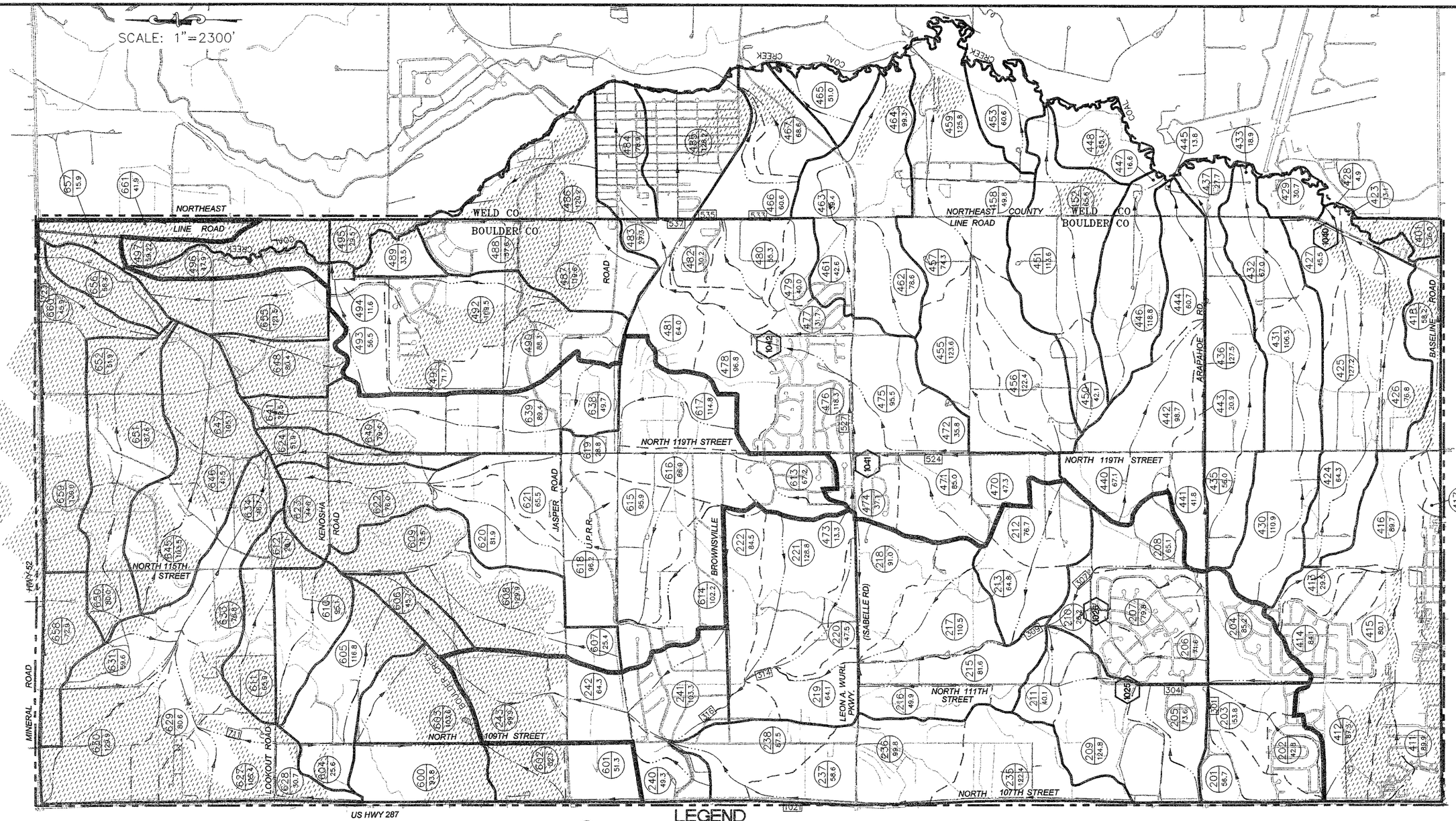
TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

WETLANDS, FLOODPLAINS, AND CALIBRATION BASINS

Figure 4



LEGEND

CATCHMENT I.D.	800 / 80.5 CATCHMENT ACRE	STUDY AREA BOUNDARY	
WATERSHED DIVIDE		DETENTION AREA	2000
CATCHMENT BOUNDARY		UDSWM CHANNEL/PIPE ELEMENT	2000
MINOR CATCHMENT BOUNDARY		SOIL GROUP "B"	
OUTFALL FLOW PATH		SOIL GROUP "C/D"	

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TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

HYDROLOGIC SOIL GROUPS
(ON SITE)

Figure 5a

DATE: MAY 30, 2000
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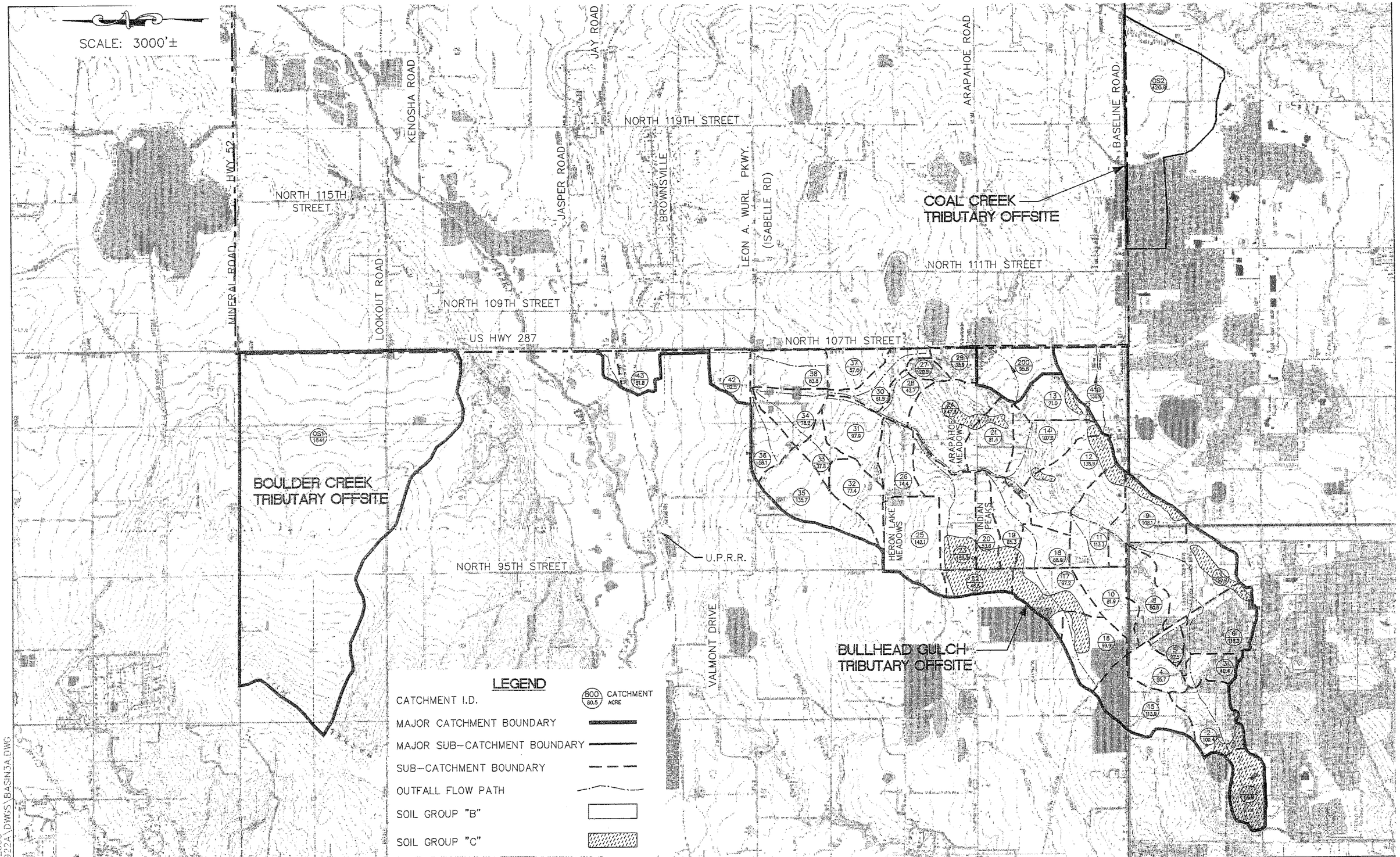

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TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

HYDROLOGIC SOIL GROUPS
(OFF SITE)

Figure 5b

E. Land Use

The study area is developing rapidly. The 1996 Comprehensive Plan for the Town of Erie (Town of Erie Planning Commission, 1996) estimates the population was approximately 4,000 individuals in the 50 square mile Planning Area surrounding the Town in 1996. The Comprehensive Plan projects a population of approximately 20,000 by the year 2020 and approximately 30,000 people by year 2045 in the Planning Area. Existing (complete or under construction) and proposed (those identified by Erie officials as of March, 2000) developments are listed on Table 1.

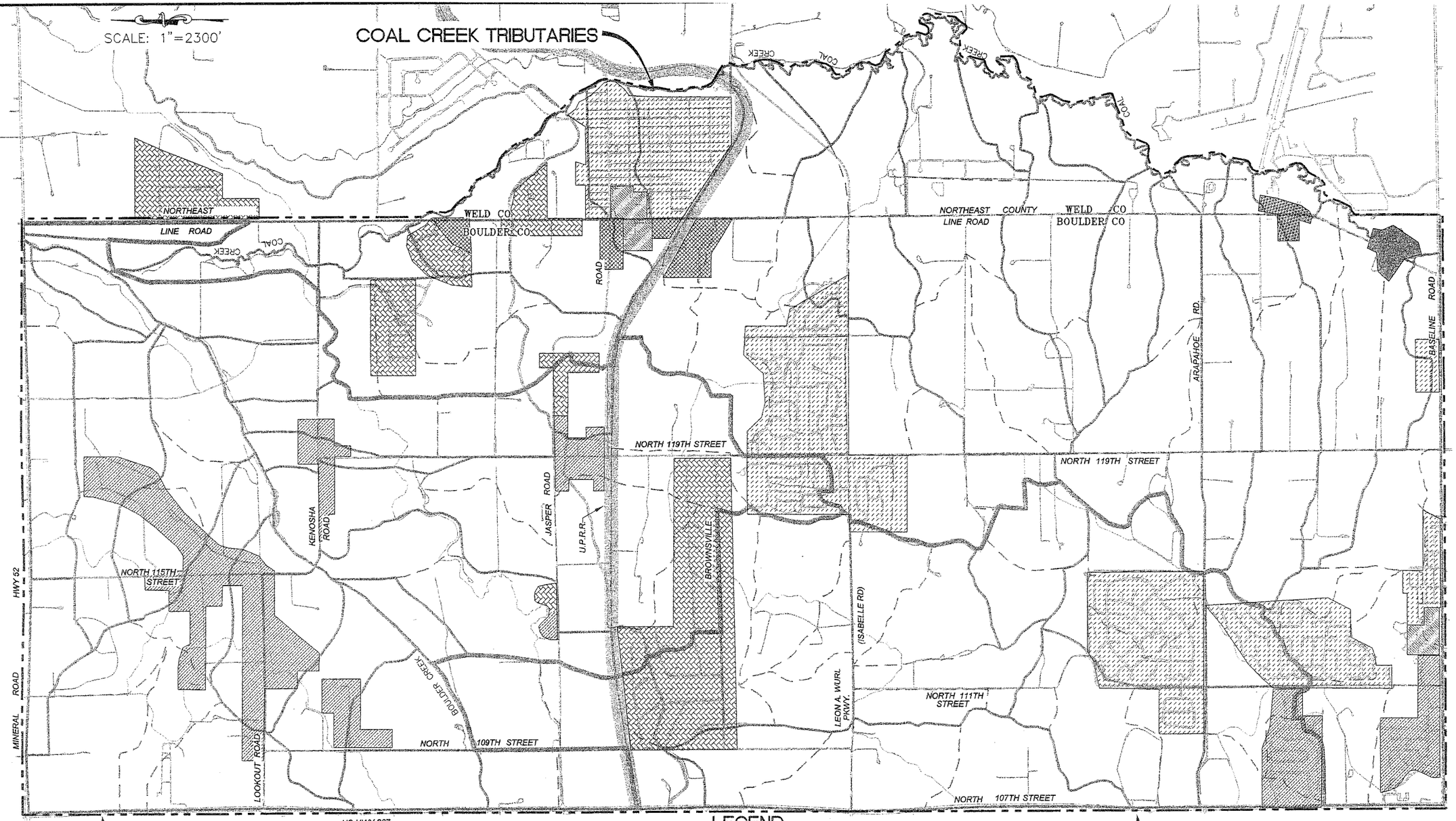
Current percent imperviousness for on-site and off-site areas are shown on Figures 6a and 6b, respectively. The percent imperviousness was identified using aerial photographs and field investigations. Projected percent imperviousness for on-site and off-site areas are shown on Figure 7a and 7b, respectively. Future percent imperviousness were identified using planning and zoning maps from the Town of Erie (Town of Erie, 1999) and the City of Lafayette (City of Lafayette, 1997).

Table 1. Existing and Proposed Developments, March 2000

Existing/Under Construction	Under Discussion
Arapahoe Ridge Filing No. 1	Aaron Arbor
Arapahoe Ridge Filing No. 2	Barb Annexation
Arapahoe Ridge Filing No. 3	Baxter Farms
Arapahoe Ridge Filing No. 4	Bell Tower
Austin Industrial Park	Candlelight Ridge
Canyon Creek Filing No. 1	Lyle Property
Canyon Creek Filing No. 2	Meadow Sweet Farm unnamed filings
Canyon Creek Filing No. 3	Schmidt Property
Erie Village Filing No. 1	Senior Housing Site
Erie Village Filing No. 2-5	Wiggett Annexation
Kenosha Farm Phases 1-6	
Meadow Sweet Farms	
Harvest Point	
Orchard Glen Filing No. 1	
Orchard Glen Filing No. 2	
Old Town Erie	
Sunwest	
Brownsville	
Lookout Estates	

Note: See Erie Drainage Reports, 1995-1996

This photograph taken by staff of Love & Associates, Inc. is representative of current developing conditions within the Town of Erie. This illustrates homes being built near irrigation ditches, unpaved roads, etc.



LEGEND

	% IMPERVIOUS		% IMPERVIOUS		
RAILROAD	20	EXISTING INDUSTRIAL	90	WATERSHED DIVIDE	
EXISTING OPENSPACE/AG	2	EXISTING COMMERCIAL	95	CATCHMENT BOUNDARY	
EXISTING LOW DENSITY RESIDENTIAL	30	EXISTING SCHOOLS	50	MINOR CATCHMENT BOUNDARY	
EXISTING MEDIUM DENSITY RESIDENTIAL	43	EXISTING GOLF COURSE/ PARK	7	STUDY AREA BOUNDARY	
EXISTING HIGH DENSITY RESIDENTIAL	50				

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TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

EXISTING PERCENT IMPERVIOUSNESS (ON SITE)

Figure 6a

DATE: MAY 30, 2000
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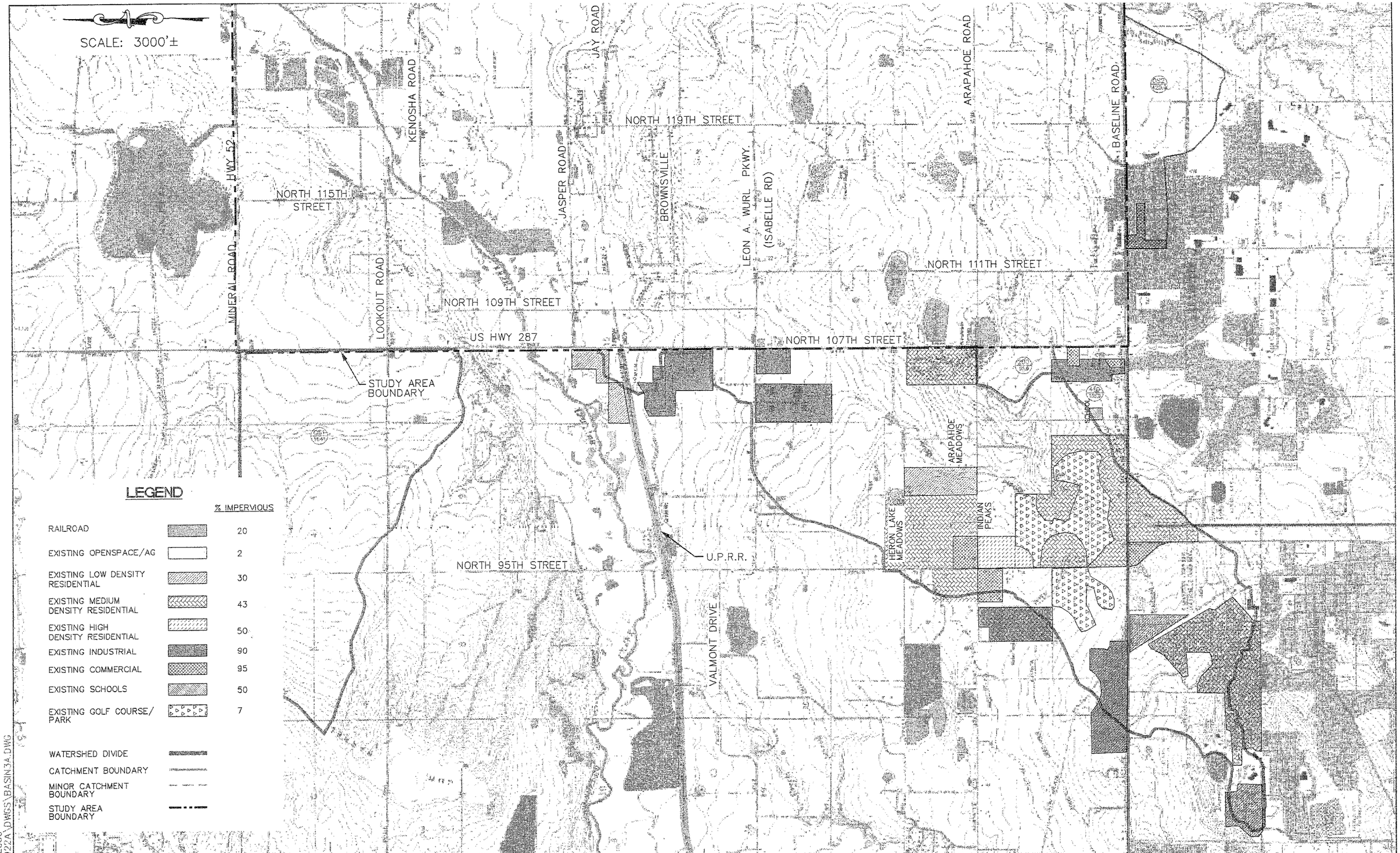

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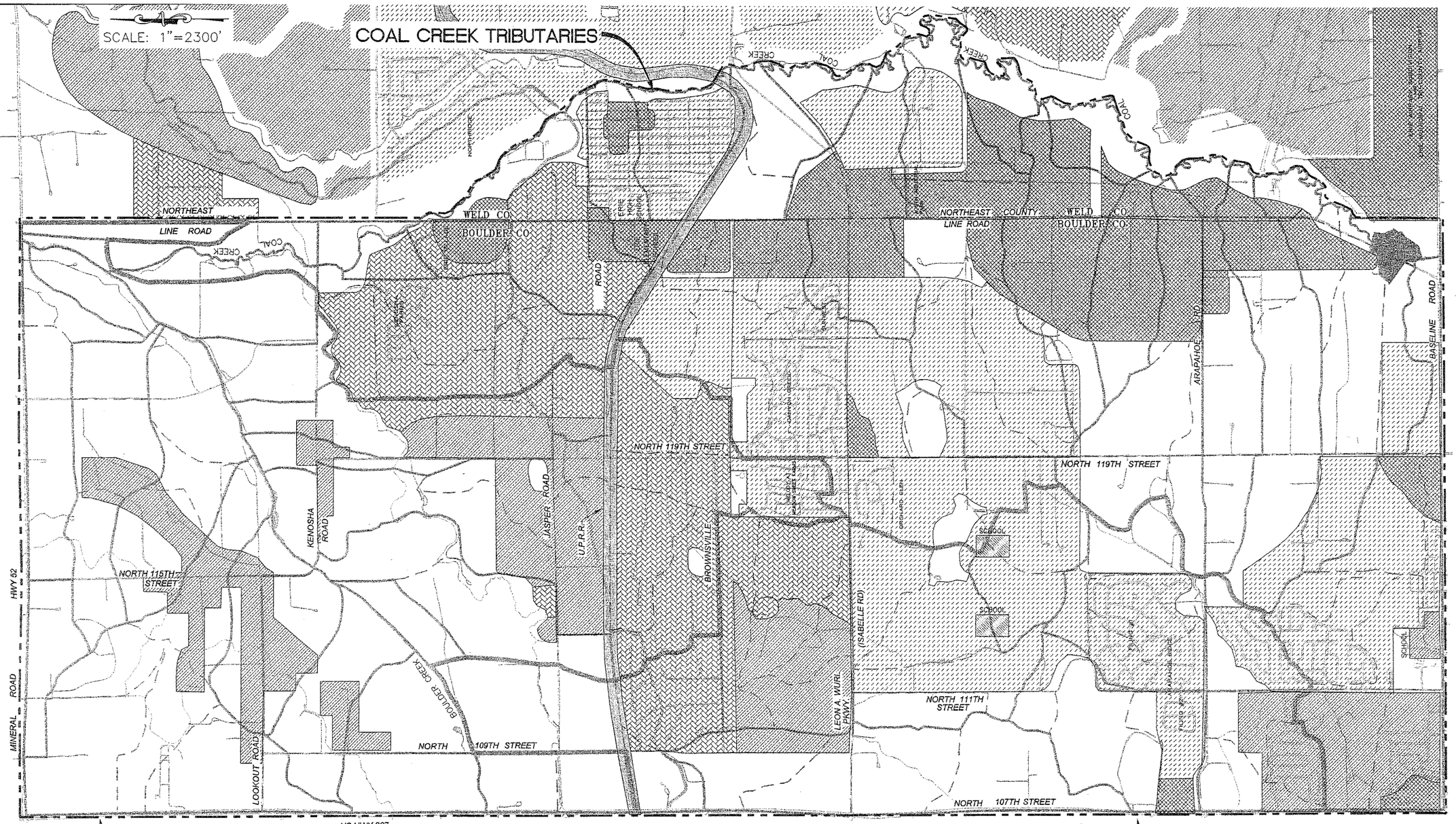
TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

EXISTING PERCENT IMPERVIOUSNESS
(OFF SITE)

Figure 6b



	% IMPERVIOUS						
RAILROAD	20	PROPOSED INDUSTRIAL	90	WATERSHED DIVIDE			
PROPOSED OPEN SPACE/AG	2	PROPOSED COMMERCIAL	95	CATCHMENT BOUNDARY			
PROPOSED LOW DENSITY RESIDENTIAL	30	PROPOSED SCHOOLS	50	MINOR CATCHMENT BOUNDARY			
PROPOSED MEDIUM DENSITY RESIDENTIAL	43	PROPOSED GOLF COURSE/ PARK	7	STUDY AREA BOUNDARY			
PROPOSED HIGH DENSITY RESIDENTIAL	50						

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TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

FUTURE PERCENT IMPERVIOUSNESS
(ON SITE)

Figure 7a

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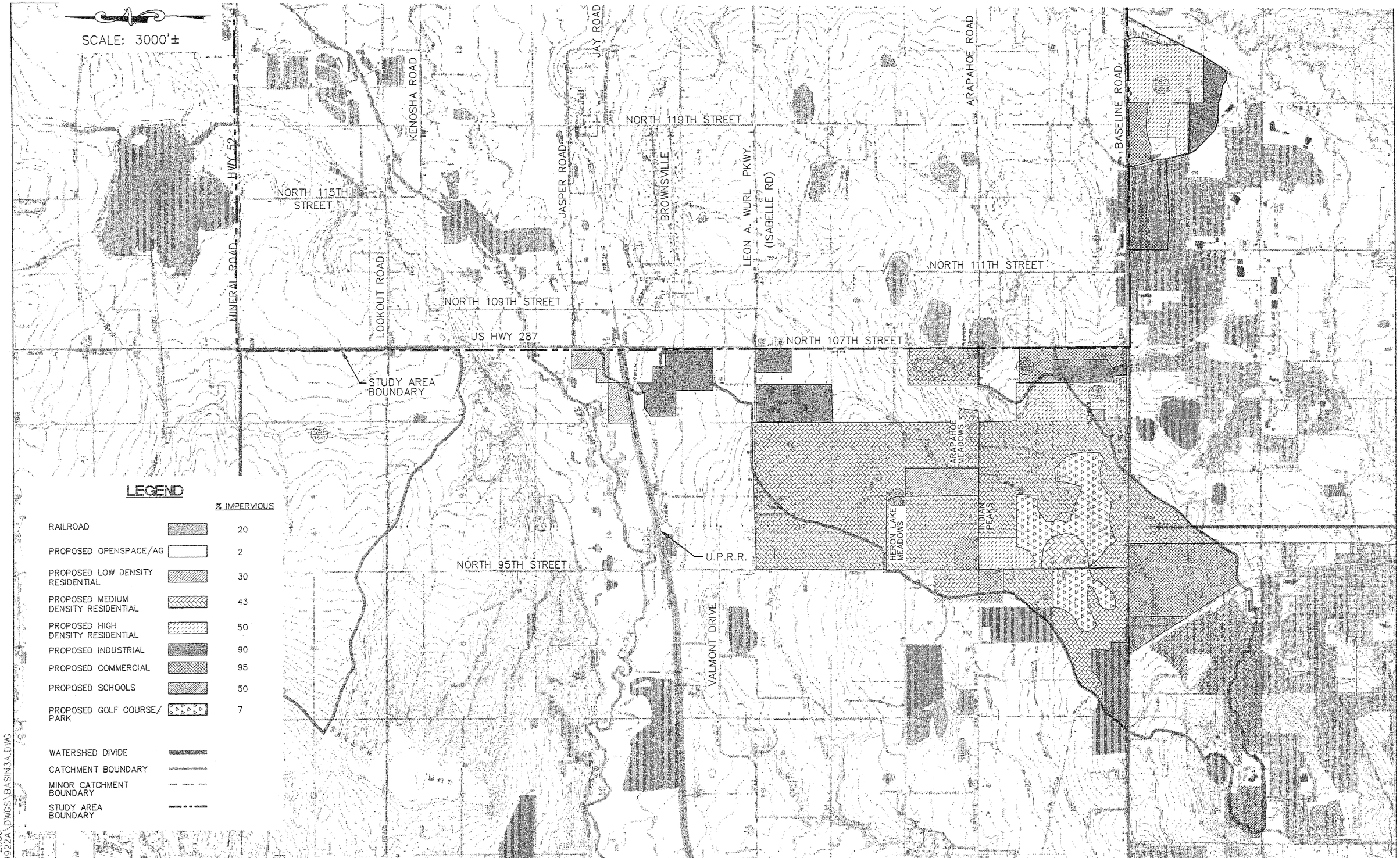

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TOWN OF ERIE
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ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

FUTURE PERCENT IMPERVIOUSNESS
(OFF SITE)

Figure 7b

III. HYDROLOGIC MODEL

A. General

Flood peaks and hydrographs for each of the three major sub-watersheds in the study area are defined using UDSWM95 (UDSWM), calibrated to CUHPF for the 100-year storm event. Standard routines in ACAD-14 and Soft Desk computer programs were used to identify basin parameters required for UDSWM and CUHPF. The detention areas are modeled using HY-8 computer program. Irrigation facilities are assumed to not transport stormwater. Catchments, flow paths, design points, and catchment and conveyance element identifiers are presented on Figures 2a, 2b, 2c and 3 in Chapter II of this report. UDSWM flow charts for the hydrologic model are presented in Appendix A1 of this report.

B. UDSWM and CUHPF Parameters

Precipitation depth and distributions were obtained from *Boulder County Storm Drainage Criteria Manual* (Boulder County, 1984) and are reproduced in Table 2.

Table 2. Precipitation Distribution for UDSWM

Time (min)	100 yr. (in/hr)	50 yr. (in/hr)	10 yr. (in/hr)	5 yr. (in/hr)	2 yr. (in/hr)	0.4"/hr (in/hr)
5	0.36	0.36	0.36	0.36	0.24	0
10	0.96	0.96	0.72	0.60	0.48	0.12
15	1.44	1.44	1.68	1.44	0.96	0.24
20	2.64	2.28	3.12	2.52	1.92	0.36
25	4.56	4.32	5.16	4.32	3.00	0.72
30	8.16	7.20	2.52	2.04	1.68	1.20
35	4.56	3.48	1.20	0.96	0.72	0.72
40	2.64	2.28	0.84	0.72	0.60	0.36
45	2.04	1.44	0.84	0.60	0.36	0.24
50	1.68	1.44	0.72	0.60	0.36	0.24
55	1.32	0.96	0.72	0.60	0.36	0.24
60	1.32	0.96	0.72	0.60	0.36	0.24
65	1.32	0.96	0.72	0.60	0.36	0.24
70	0.60	0.72	0.72	0.60	0.24	0.12
75	0.60	0.72	0.72	0.60	0.24	0.12
80	0.36	0.48	0.48	0.48	0.24	0
85	0.36	0.48	0.36	0.36	0.24	0
90	0.36	0.36	0.36	0.36	0.24	0
95	0.36	0.36	0.36	0.36	0.24	0
100	0.36	0.36	0.36	0.36	0.24	0
105	0.36	0.36	0.36	0.36	0.24	0
110	0.36	0.36	0.36	0.36	0.24	0
115	0.36	0.36	0.36	0.24	0.12	0
120	0.36	0.36	0.24	0.24	0.12	0

From Boulder County, 1984, "Two Hour Design Storm for Basins Less Than Five Square Miles"
Note: 1-hr ppt. depths: 2-yr = 1.01", 5-yr = 1.43", 10-yr = 1.73", 50-yr = 2.4", 100-yr = 2.7"

Catchment parameters, including area, stream and basin length, slopes, and distance to centroid were identified using recent (1999) topographic mapping (Aztec Consultants, Inc., 1999). Area and length measurements were obtained using the Inquiry Module of ACAD-14 and Soft Desk computer programs. Parameters for individual catchments for UDSWM are listed in the computer output summary in Appendix A1.

Hydrologic soil groups and land use were overlaid on the topographic mapping, areas obtained using ACAD-14, and catchment averages were determined using area-average calculations. Weighted soil parameters required for the model include initial and final infiltration (in/hr) and decay coefficient shown on Table 3. Soil parameters for individual catchments are listed in the computer output summary in Appendix A1.

Table 3. Soil Parameters

NRCS Hydrologic Soil Group	Infiltration (in/hr)		Decay Coefficient
	Initial	Final	
B	4.5	0.6	0.0018
C and D	3.0	0.5	0.0018

The type and density of land use defines the magnitude of the percent impervious parameter used in the hydrologic model. Percent impervious for various land uses are listed in Table 4. Percent imperviousness for individual catchments for existing and future conditions is listed in the computer output summary in Appendix A1.

Table 4. Percent Impervious for Land Uses in Study Area

Land Use	% Impervious
Open Space/Agricultural	2
Golf Course/Park	7
Railroad	20
Low Density Residential	30
Medium Density Residential	43
High Density Residential	50
Schools	50
Industrial	90
Commercial	95

UDSWM Catchment width (W) parameters were calculated using,

$$W = L_c \{ 2 - [(A_{i+1} - A_i)/A_t] \} \text{ (Huber et al., 1984),}$$

where L_c = length of the channel, A_i = area on i^{th} side of the channel, and A_t = the total area of the catchment. All conveyance elements were simulated with a main element and an overbank element. Following recommendations in the UDSWM manual (Boyle Engineering Corp., 1985), roughness

coefficients for conveyance elements were increased by 25 percent. Two types of conveyance elements within catchment areas were simulated using channel elements; a grassed channel and a street. The grassed channel simulates the channel in catchments dominated by open space and/or agricultural activities. The street channel simulates stormwater transport in catchments dominated by development. Typical parameters used for conveyance elements are shown in Table 5. Catchment widths and conveyance element parameters for individual catchments are listed in the computer output summary in Appendix A1.

Table 5. Typical Conveyance Element Parameters

	Depth (ft)	Side Slopes H:V	Manning *n* *	Bottom Width (feet)		
				1st Order[1]	2nd Order[2]	3rd Order[3]
Channel						
Main	3	3:1	0.044	5	7.5	10
Overflow	10	20:1	0.056	23	25.5	28
Street						
Main	0.5	3:1	0.020	8	8	8
Overflow	10	20:1	0.044	11	11	11

* increased by 25%
[1] single channel
[2] two channels
[3] three or more channels

C. Calibration

Hydrographs produced by UDSWM are calibrated to CUHPF hydrographs for the 100-year event using the five catchments within the study area shown on Figure 4 in Chapter II. Flood peak calibration results are summarized on Table 6. CUHPF and calibrated UDSWM flood hydrographs for the 100-year event are compared on Figure 8. All individual or contiguous catchments in the study area meeting the following criteria were used for calibration; (1) area less than 200 acres, (2) reasonably uniform shape, (3) length-width ratio less than 4, and (4) catchment slope between 0.005 and 0.037 ft/ft. Flood peak and hydrograph calibration for existing and future percent imperviousness was achieved by multiplying the UDSWM catchment width parameters for all catchments by 1.8. This multiplication factor was also applied to the catchment width parameter for all other storm events (0.4-inch average storm, and 2-, 5-, 10-, and 50-year events).

Table 6. Flood Peak Calibration, UDSWM to CUHPF

Existing Percent Imperviousness			
Catchment	Flood Peak (cfs)		% different from CUHPF
	CUHPF	UDSWM	
221 (PT)	177	183	3%
212/213 (PT)	188	187	-1%
430 (CC)	164	163	-1%
440/442 (CC)	186	223	20%
645 (BC)	204	215	5%

Future Percent Imperviousness			
Catchment	Flood Peak (cfs)		% different from CUHPF
	CUHPF	UDSWM	
221 (PT)	396	361	-9%
212/213 (PT)	503	435	-14%
430 (CC)	204	204	0%
440/442 (CC)	190	240	26%
645 (BC)	204	215	5%

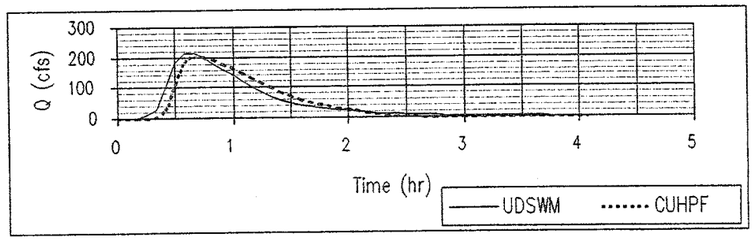
Note: PT = Prince Tributary, CC = Coal Creek Tributaries, BC = Boulder Creek Tributaries

D. Detention Areas

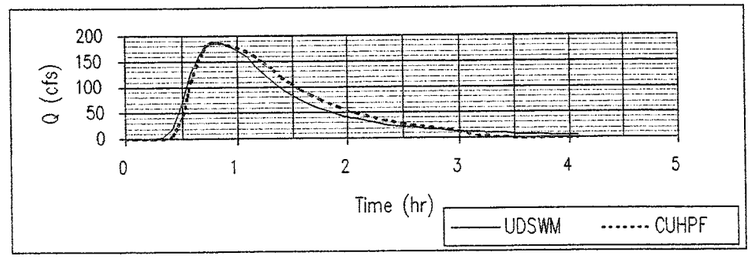
Four detention facilities located within subdivisions (Arapahoe Ridge No. 1, Arapahoe Ridge No. 2, Orchard Glen Filing No. 1, and Canyon Creek Filing No. 1) were incorporated in the existing and future conditions hydrologic models. Design information for these detention facilities was obtained from the final drainage reports for these subdivisions. There are no as-built plans available for these detention facilities. Field inspection indicates some of the detention facilities were likely not constructed according to the final drainage reports. Two small detention facilities located in Harvest Point subdivision were not modeled because of an absence of design information.

Inadvertent stormwater detention at such areas as stock ponds and at railroad embankments was generally not modeled. An undersized culvert below the abandoned BNRR embankment near Northeast County Line Road was modeled to include detention upstream of the embankment caused by the culvert, using design information obtained from aerial photography and field inspection.

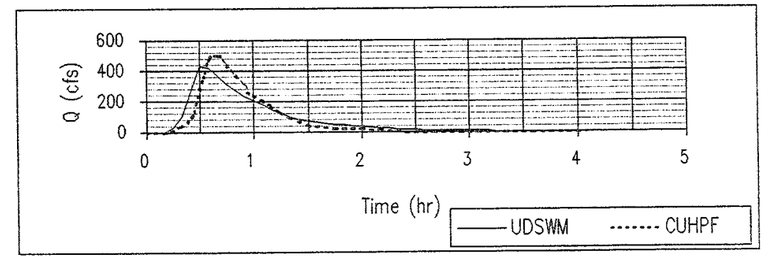
Rating curves for the detention facilities are developed using Federal Highway Administration Model HY-8 computer program (Federal Highway Administration, 1996), the orifice equation (C = 0.62 (UDFCD, 1969)), and the weir equation (C = 3.0 (UDFCD, 1969)). Stage/storage relationships were obtained from the final drainage reports. Storage/discharge relationships for detention areas are listed in the computer output summary in Appendix A1.



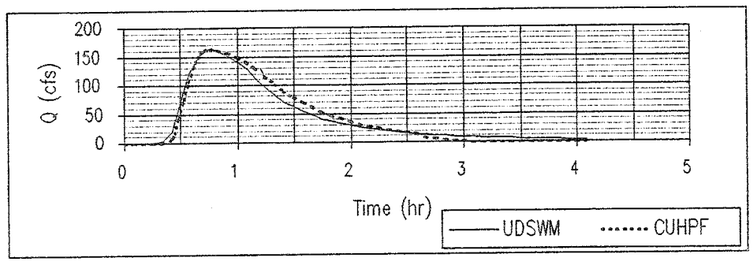
Existing/Future Conditions
Basin 645 Calibration



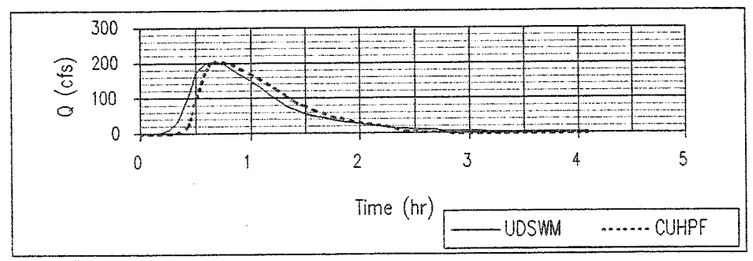
Existing Conditions
Basin 213 Calibration



Future Conditions
Basin 213 Calibration



Existing Conditions
Basin 430 Calibration



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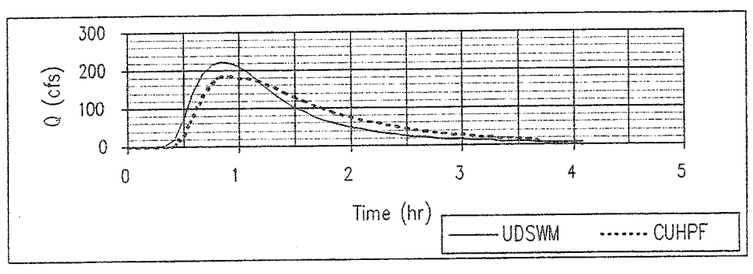

Existing Conditions
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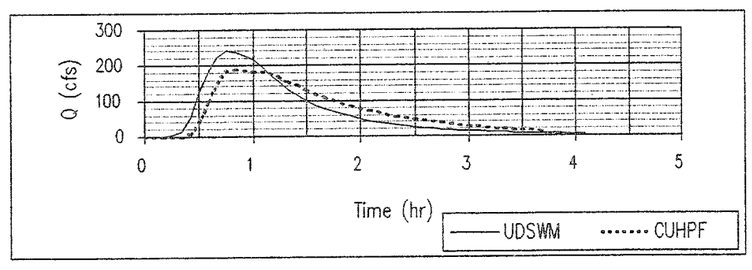

Future Conditions
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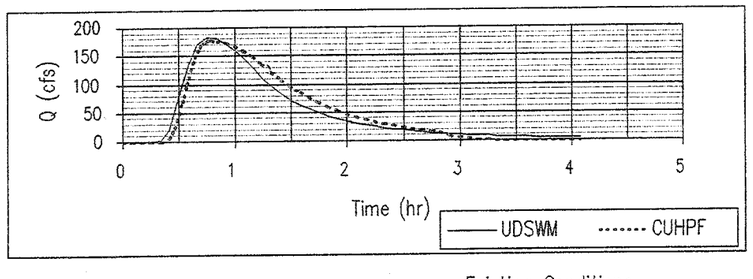
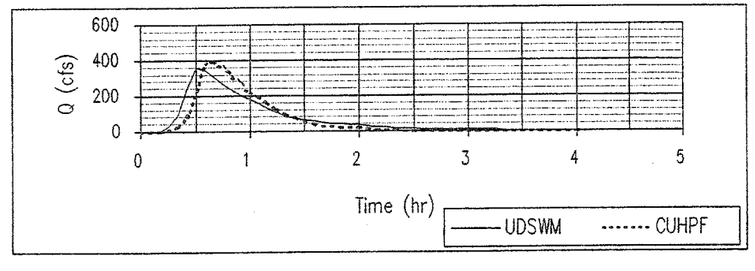


Existing Conditions
Basin 221 Calibration



Future Conditions
Basin 221 Calibration

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TOWN OF ERIE
BOULDER COUNTY
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

CALIBRATION HYDROGRAPHS, 100-YEAR EVENT

Figure 8

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E. Irrigation Facilities

Irrigation reservoirs and ditches within the study area are listed in Table 7. Major irrigation reservoirs and ditches are shown on Figure 9. Irrigation reservoirs on record in the SEO within the study area include Erie Lake, Marfell Lakes No. 1 and 2, Prince Lakes No. 1 and 2, and Thomas Reservoir. A review of design records in State Engineers Office, the physical location of the reservoirs within the catchments, and the ownership of the reservoirs indicate none of the reservoirs store significant volumes of stormwater and none were candidates for detention. SEO records indicate Panama Reservoir, located adjacent to the northern property boundary of the study area, is unlikely to overtop and spill into the study area during a 100-year event, and it too was excluded from the hydrologic model.

Table 7. Irrigation Facilities

Reservoir or Irrigation Ditch	Location / Origin* (Section)	Source	Decreed Capacity** (ac-ft or cfs)	Use
Reservoirs				
Thomas Reservoir	24			
Prince Lake (Res.) No. 1	27	South Boulder Creek	200	Domestic
Prince Lake No.	33	South Boulder Creek	83	Irrigation
Erie Lake (Reservoir)	27	South Boulder Creek	239	Domestic
Elmwood Reservoir	26	South Boulder Creek	170 (abandoned)	Irrigation
Marfell Lake No. 1	26	South Boulder Creek	79	Irrigation
Marfell Lake No. 2	26	South Boulder Creek	25	
Irrigation Ditches				
Leggett	18	Boulder Creek	31.35	Irrigation
Boulder and Weld Co.	15	Boulder Creek	61.9	Irrigation
Lower Boulder	16	Boulder Creek	103.47	Irrigation
Leyner Cottonwood No. 1	30	South Boulder Creek	30.00	Irrigation
South Boulder Canyon	T1S, R70W Sec. 9	South Boulder Creek	370.74	Irrigation
Goodhue	T1S, R69W Sec.21	South Boulder Creek	30.31	Irrigation
Howell	1	Boulder Creek	90.10	Irrigation
Howell Beasley	10	Boulder Creek	28.80	Irrigation
Beasley Slough	2	(Seepage)	3.00	Irrigation
Young	11	Rothrock Slough	2.48	Irrigation
Archuleta Seepage	12	Coal Creek	10.00	Irrigation
Chenault Drainage	24	(Drainage)	2.50	Irrigation
Chenault Drainage No. 2	26	(Drainage)	1.00	Irrigation
Chenault Waste	24	(Waste)	5.75	Irrigation
McGinn	T1S, R70W Sec. 10	South Boulder Creek	14.06	Irrigation
Dry Creek Davidson	T1S, R70W Sec. 10	South Boulder Creek	42.66	Irrigation
Martha M. Mathews	11	Boulder Creek	4.60	Irrigation
Frank R. Duffy Pipeline	11	(Seepage)	0.50	Irrigation

* Located within Township 1 North, Range 69 West unless specified otherwise

** Reservoirs in ac-ft, Irrigation Ditches in cfs

Interception of stormwater flows by an irrigation ditch can result in flooding at unpredictable locations along the path of the ditch. The hydrologic analysis assumes irrigation ditches are flowing full during all events and the ditches neither capture nor transport stormwater.

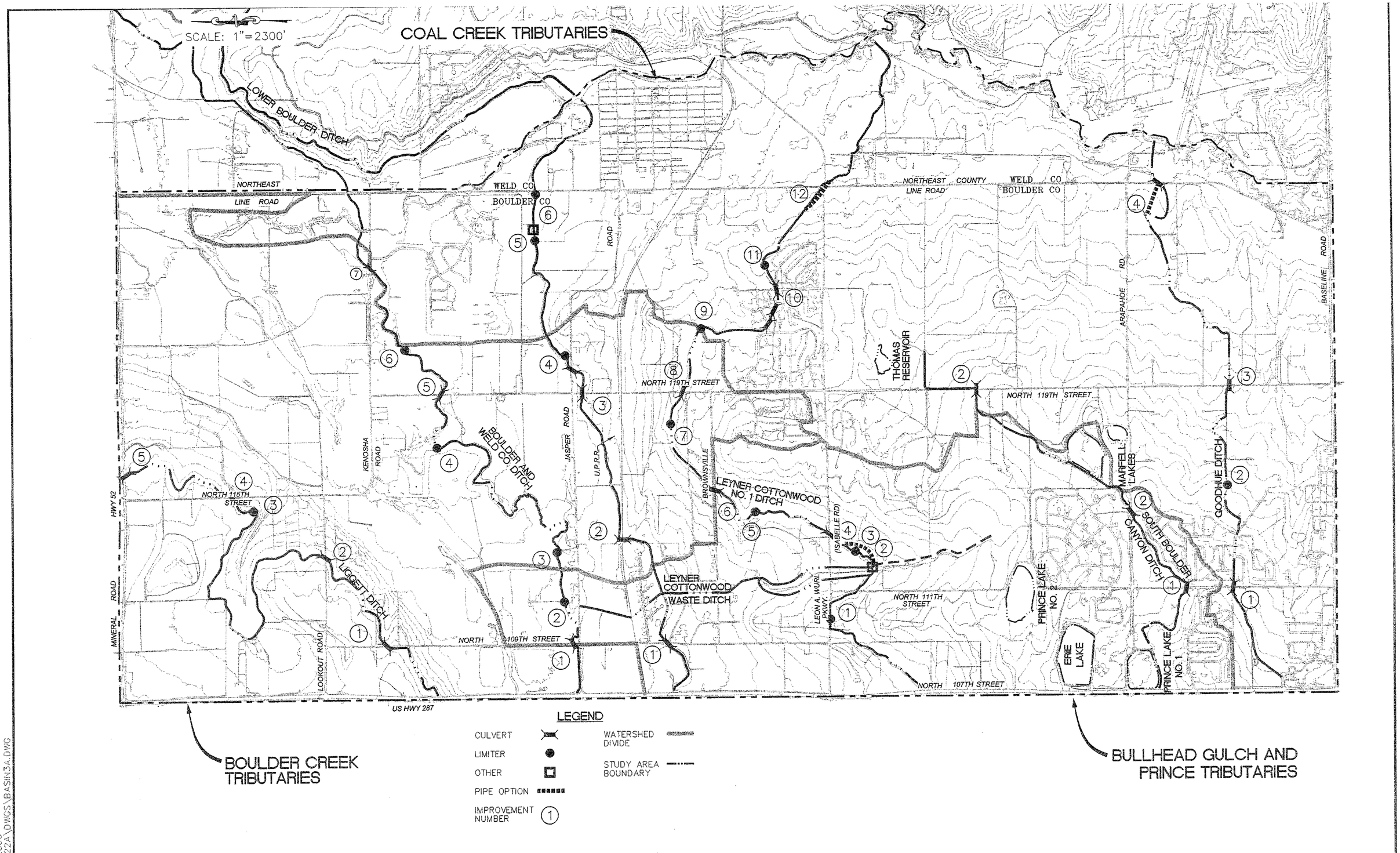
F. Off-Site Catchments

Flood hydrographs of catchments discharging into the study area were analyzed using a variety of methods. Bullhead Gulch/Prince Tributary discharging over Highway 287 was modeled in a 1992 study (Advanced Sciences, Inc., 1992) using CUHP-generated hydrographs routed with UDSWM. The 1992 existing and future percent imperviousness models were used to generate off-site flows crossing Highway 287 for the current study with minor modifications. These modifications include; (1) the percent imperviousness was changed in both models to reflect current existing and projected land uses, and (2) the regional detention pond at Indian Peaks Subdivision used to define hydrologic conditions for the recent FIS study of Bullhead Gulch (Taggart Engineering Associates, Inc.) was incorporated into both models. Off-site catchments OS1 (Design Point 1060, tributary to Boulder Creek) and OS2 (Design Point 400, tributary to Coal Creek) were over 200 acres in area and were modeled using CUHPF. Off-site catchments 410 (tributary to Coal Creek) and 200 (tributary to Bullhead Gulch/Prince Tributary) were modeled as catchment elements in the UDSWM hydrologic model. Hydrologic model data input for off-site catchments are found in Appendix A1.

G. Results

Flood peaks for the 0.4-inch and the 2-, 5-, 10-, 50-, and 100-year flood events are summarized in Tables 8 and 9 for selected design points shown on Figures 2a, 2b, 2c and 3 in Chapter II. These tables include cumulative area and percent impervious at each design point and are organized by major watershed and catchment. A comparison of existing and future hydrographs for the 10- and 100-year storm event at selected design points are shown on Figure 10. The hydrologic analysis indicates development will increase the magnitude of flood peaks for all events.

This photograph taken by staff of Love & Associates, Inc. illustrates typical culverts in the Town, undersized and blocked by debris.



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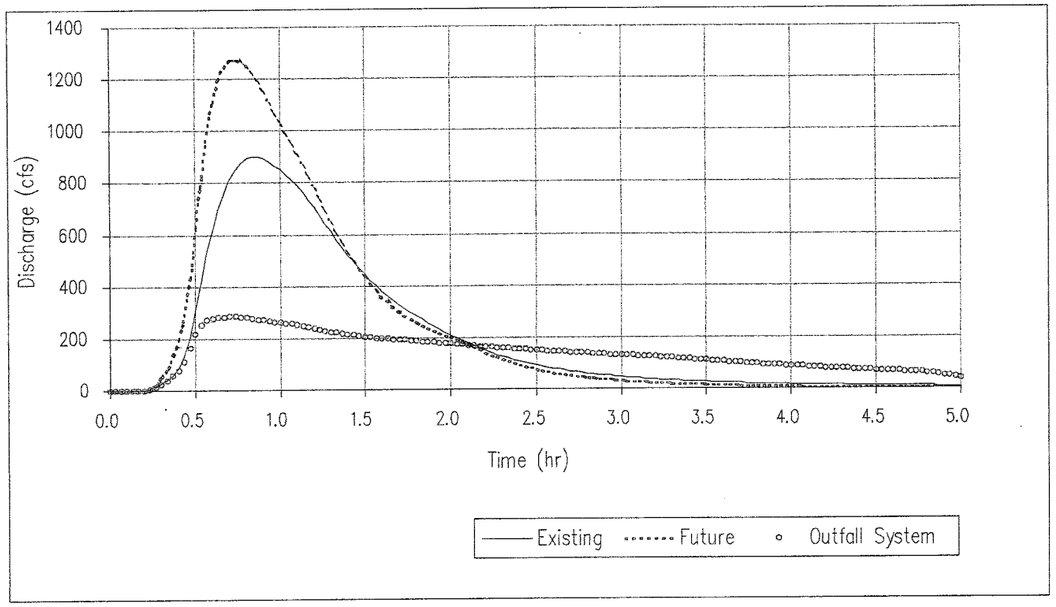
TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

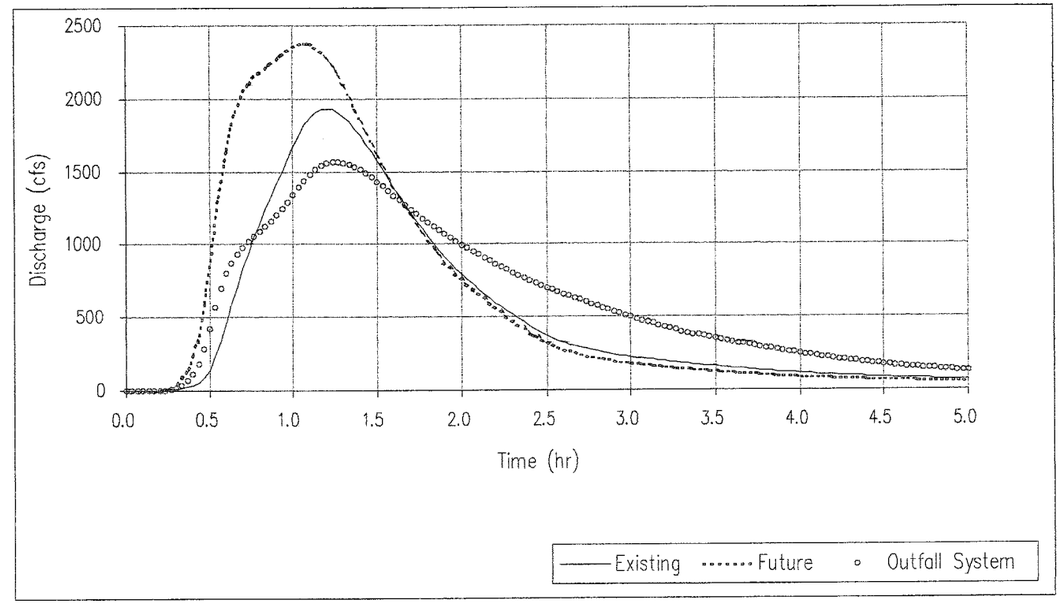
ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

IRRIGATION FACILITIES

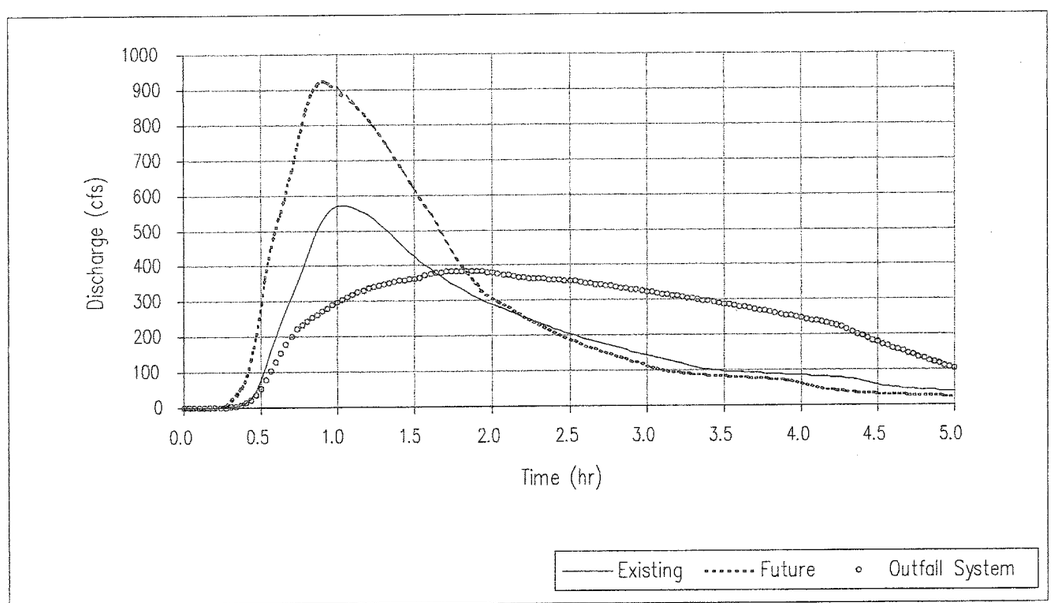
Figure 9



Boulder Creek Tributaries
Design Point 708
100-Year Event



Bullhead Gulch/Prince Tributary
Design Point 315
100-Year Event



Coal Creek Tributaries
Design Point 532
100-Year Event

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TOWN OF ERIE
BOULDER COUNTY
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

HYDROGRAPH COMPARISON AT SELECTED DESIGN POINTS

Figure 10

Table 8. Design Point Flood Peaks, Existing Percent Imperviousness

Coal Creek Tributaries Existing Percent Imperviousness

UDSWM Design Point	Peak Discharge (cfs) Flood Event 0.4-in	2-yr	5-yr	10-yr	50-yr	100-yr	Cumulative Area (ac)	Cumulative Percent Impervious
500	20	74	112	151	292	349	157	33
501	24	84	142	215	526	673	334	21
502	39	141	235	357	876	1102	528	24
503	38	133	240	384	942	1213	658	21
900	41	160	350	576	1326	1691	716	20
901	3	12	18	23	41	48	26	18
902	4	13	21	27	48	56	13	50
504	0	1	8	23	92	128	64	2
505	8	28	50	96	348	481	314	7
903	2	7	22	36	264	370	319	7
904	6	20	30	38	68	82	31	24
506	1	2	10	28	119	168	111	3
507	1	2	17	49	207	295	217	2
508	1	3	21	59	248	347	284	3
905	1	3	22	63	261	366	303	3
509	0	1	7	20	81	113	56	2
510	0	1	13	40	169	242	184	2
906	0	1	15	46	194	277	211	2
511	0	2	5	14	60	85	67	2
512	0	1	5	13	51	70	42	2
513	1	3	21	59	243	339	229	2
514	1	3	23	67	281	385	289	2
907	1	3	25	70	293	401	303	2
515	0	1	12	33	139	195	119	2
908	0	1	14	38	159	222	135	2
909	2	4	6	8	31	45	65	2
516	0	1	7	18	71	98	42	2
517	1	3	14	38	162	227	156	2
910	1	2	18	51	212	300	221	2
911	0	1	5	14	60	85	61	2
518	1	3	24	69	289	405	246	2
519	1	4	28	81	339	475	320	2
520	1	4	31	87	366	514	370	2
912	1	4	34	99	395	560	496	2
521	2	9	19	44	167	231	121	6
522	2	8	21	51	198	276	161	5
913	1	5	22	56	220	300	260	4
914	0	1	4	11	50	71	51	2
915	1	4	12	29	110	156	129	5
916	18	61	92	121	228	277	128	45
523	0	1	5	13	51	72	47	2
525	3	11	20	43	155	213	132	7

Table 8. Design Point Flood Peaks, Existing Percent Imperviousness (cont'd.)

Coal Creek Tributaries Existing Percent Imperviousness (con.)

526	5	16	23	30	97	114	183	19
528	0	1	3	7	30	42	36	2
529	4	15	25	43	156	213	314	12
530	12	35	79	110	358	478	464	24
531	12	35	84	121	385	522	561	21
532	12	35	88	130	416	571	625	19
534	3	11	17	27	99	138	95	8
536	10	41	62	82	166	211	126	22
538	21	75	124	184	567	777	778	21
917	27	86	146	215	599	813	857	24
918	4	16	27	41	111	151	120	14
539	5	18	30	44	112	151	120	15
919	12	41	62	85	184	240	177	21
920	2	7	10	13	26	32	34	7
540	1	4	11	26	96	133	88	6
541	5	17	36	72	227	321	270	10
921	5	18	41	83	265	374	338	9
922	1	2	3	4	10	15	30	2
923	1	3	4	5	10	15	48	2
924	1	3	5	7	13	18	59	2

Bullhead Gulch/Prince Tributary Existing Percent Imperviousness

UDSWM Design Point	Peak Discharge (cfs) Flood Event 0.4-in	2-yr	5-yr	10-yr	50-yr	100-yr	Cumulative Area (ac)	Cumulative Percent Impervious
300	2	9	20	46	176	245	152	6
302	6	23	32	43	90	114	43	29
303	19	70	108	159	438	583	334	14
305	22	77	124	187	526	703	408	15
306	11	26	67	167	577	784	533	12
308	29	55	107	228	872	1199	815	18
310	0	2	7	19	80	113	77	2
311	29	56	115	255	988	1370	957	15
312	28	57	135	313	1164	1637	1290	12
313	27	58	141	331	1211	1706	1401	11
315	28	63	161	378	1370	1932	1615	11
320	1	2	11	30	118	165	122	2
321	1	5	15	40	166	237	222	2
322	11	82	341	626	1429	1880	281	2
323	11	81	335	620	1422	1875	368	3
317	34	138	485	941	2481	3340	1983	9
318	36	144	503	972	2547	3423	2136	11
319	35	144	500	968	2549	3428	2200	11
940	33	141	482	935	2486	3354	2300	10

Table 8. Design Point Flood Peaks, Existing Percent Imperviousness (cont'd.)

Boulder Creek Tributaries Existing Percent Imperviousness

UDSWM Design Point	Peak Discharge (cfs) Flood Event 0.4-in	2-yr	5-yr	10-yr	50-yr	100-yr	Cumulative Area (ac)	Cumulative Percent Impervious
950	1	2	9	24	88	123	94	2
700	0	1	3	7	30	45	51	2
951	0	2	10	23	80	113	103	2
952	2	8	15	31	104	143	104	6
701	0	1	3	7	29	40	256	2
953	2	10	19	41	151	210	142	6
954	0	1	5	12	39	54	46	2
702	0	2	4	9	34	47	25	5
703	1	5	17	38	133	187	155	5
955	1	4	18	41	130	181	2308	4
956	4	15	28	51	156	208	95	13
704	5	18	31	51	131	170	66	19
957	5	21	38	63	169	222	95	16
705	13	42	60	80	154	190	67	42
706	19	60	92	137	365	484	249	19
707	16	59	92	132	314	409	198	22
708	26	94	160	253	682	901	572	18
709	17	62	129	228	628	851	719	15
710	15	59	135	240	648	876	795	14
958	15	59	138	247	666	902	840	14
959	1	4	11	21	57	76	52	9
750	0	13	318	581	1178	1455	1688	2
712	1	13	305	569	1196	1494	1744	2
713	3	16	332	629	1364	1717	2044	2
714	6	23	337	630	1375	1736	2121	3
960	5	20	332	622	1364	1726	2168	3
715	4	14	21	29	68	90	50	17
716	2	8	18	36	131	182	139	7
717	2	7	24	53	194	273	219	6
961	1	7	26	58	194	273	248	6
718	5	20	36	59	167	222	104	14
719	5	20	37	64	188	250	145	11
962	4	14	40	79	246	327	250	7
963	0	1	5	11	39	56	80	2
720	1	3	17	36	116	157	80	4
721	4	15	31	65	212	289	168	7
964	2	9	35	73	222	302	220	6
965	0	2	12	27	93	133	122	2
966	1	3	5	7	14	21	58	2
967	0	1	1	2	7	11	16	2
722	0	2	18	39	124	171	130	2
968	0	3	24	51	159	220	176	2
969	0	1	6	13	35	48	42	2
999	0	1	8	18	54	77	73	2

Table 9. Design Point Flood Peaks, Future Percent Imperviousness

Coal Creek Tributaries Future Percent Imperviousness

UDSWM Design Point	Peak Discharge (cfs) Flood Event 0.4-in	2-yr	5-yr	10-yr	50-yr	100-yr	Cumulative Area (ac)	Cumulative Percent Impervious
500	33	129	198	262	444	530	157	60
501	55	197	307	421	798	975	334	48
502	84	298	464	643	1226	1498	528	47
503	105	371	551	735	1401	1713	658	51
900	162	609	1001	1373	2388	2891	716	49
901	3	12	18	24	42	50	26	19
902	4	14	21	28	49	57	13	50
504	18	54	77	102	196	240	64	49
505	34	122	190	269	571	721	314	32
903	11	28	44	126	386	496	319	31
904	6	20	30	38	68	82	31	24
506	7	25	40	59	158	210	111	17
507	5	16	36	71	245	331	217	10
508	17	56	86	120	323	431	284	21
905	20	65	101	138	342	454	303	23
509	0	1	7	20	81	113	56	2
510	6	23	39	67	213	290	184	16
906	12	43	65	91	248	334	211	20
511	3	10	15	23	69	95	67	9
512	0	1	5	13	51	70	42	2
513	3	13	33	74	263	362	229	6
514	22	76	117	161	368	482	289	24
907	26	86	132	178	387	505	303	26
515	38	121	178	231	411	491	119	75
908	42	134	199	260	454	537	135	75
909	11	42	67	88	164	192	65	39
516	4	15	24	37	96	126	42	23
517	43	158	238	312	565	674	156	73
910	56	192	289	381	690	826	221	76
911	15	49	71	92	171	206	61	49
518	54	159	233	311	596	731	246	48
519	63	199	293	379	718	883	320	47
520	76	254	372	478	873	1061	370	53
912	75	254	364	477	911	1120	496	51
521	37	138	207	271	510	590	121	71
522	48	184	275	355	640	752	161	74
913	51	173	262	348	656	792	260	68
914	5	19	29	39	83	107	51	24
915	1	4	12	29	110	156	129	5
916	19	62	93	123	231	281	128	46
523	13	42	60	77	142	172	47	48

Table 9. Design Point Flood Peaks, Future Percent Imperviousness (cont'd)

Coal Creek Tributaries Future Percent Imperviousness (con.)

525	27	91	130	172	324	398	132	43
526	5	21	34	69	197	355	183	45
528	4	12	19	24	45	57	36	15
529	27	97	147	194	364	442	314	46
530	20	78	155	240	580	717	464	47
531	27	97	181	276	674	843	561	46
532	34	116	198	300	731	924	625	46
534	31	106	156	202	355	423	95	78
536	39	134	199	258	456	543	126	78
538	75	254	378	499	1033	1295	778	53
917	72	225	345	480	1041	1310	857	53
918	13	42	63	84	165	206	120	30
539	20	64	97	128	239	290	120	49
919	32	103	154	204	376	454	177	56
920	6	20	32	41	73	85	34	29
540	15	47	70	93	180	223	88	42
541	26	90	142	197	408	494	270	43
921	32	108	170	237	490	598	338	41
922	1	2	3	4	10	15	30	2
923	1	3	4	5	10	15	48	2
924	1	3	5	7	13	18	59	2

Bullhead Gulch/Prince Tributary Future Percent Imperviousness

UDSWM Design Point	Peak Discharge (cfs) Flood Event						Cumulative Area (ac)	Cumulative Percent Impervious
	0.4-in	2-yr	5-yr	10-yr	50-yr	100-yr		
300	17	63	96	131	277	356	152	27
302	6	23	32	43	91	115	43	30
303	37	139	207	283	585	745	334	27
305	47	167	254	347	728	921	408	30
306	19	68	180	303	754	976	533	24
308	38	101	216	344	1038	1389	815	28
310	16	59	88	115	219	265	77	47
311	54	156	267	424	1203	1613	957	31
312	84	281	438	604	1465	1971	1290	33
313	90	300	464	636	1547	2080	1401	33
315	112	381	591	810	1774	2379	1615	34
320	1	2	11	30	118	165	122	2
321	1	5	15	40	166	237	222	2
322	110	486	1146	1747	3211	3967	281	3
323	108	474	1117	1706	3170	3925	368	6
317	201	690	1526	2341	4740	5998	1983	29
318	208	704	1556	2387	4837	6123	2136	29
319	206	699	1539	2365	4813	6097	2200	28
940	189	670	1470	2259	4631	5878	2300	27

Table 9. Design Point Flood Peaks, Future Percent Imperviousness (cont'd)

Boulder Creek Tributaries Future Percent Imperviousness

UDSWM Design Pnt.	Peak Discharge (cfs)						Cumulative Area (ac)	Cumulative % Impervious
	0.4-in	2-yr	5-yr	10-yr	50-yr	100-yr		
950	1	2	9	24	88	123	94	2
700	0	1	3	7	30	45	51	2
951	0	2	10	23	80	113	103	2
952	2	8	15	31	104	143	104	6
701	0	1	3	7	29	40	26	2
953	2	10	19	41	151	210	142	6
954	0	1	5	12	39	54	46	2
702	0	2	4	9	34	48	25	5
703	2	6	18	39	134	189	155	5
955	1	4	18	41	131	182	231	4
956	4	15	28	51	156	208	95	13
704	5	19	33	52	133	172	66	20
957	6	22	39	64	171	224	95	17
705	15	46	66	87	165	203	67	47
706	49	149	218	290	558	691	249	43
707	34	117	174	234	462	574	198	41
708	75	238	360	492	1019	1276	572	39
709	55	168	272	396	913	1178	719	35
710	52	162	267	394	913	1191	795	32
958	51	161	270	401	931	1216	840	30
959	1	4	11	21	57	76	52	9
750	0	13	318	581	1178	1455	1638	2
712	1	13	305	569	1196	1494	1774	2
713	3	16	332	629	1364	1717	2044	2
714	6	23	337	630	1375	1736	2121	3
960	5	20	332	622	1364	1726	2168	3
715	10	35	50	64	120	147	50	37
716	21	66	97	128	248	307	139	36
717	19	62	99	142	313	394	219	29
961	15	49	86	130	295	379	248	26
718	5	20	36	59	167	222	104	14
719	5	20	37	64	188	250	145	11
962	4	14	40	79	246	327	250	7
963	0	1	5	11	39	56	80	2
720	1	3	17	36	116	157	80	4
721	4	15	31	65	212	289	168	7
964	2	9	35	73	222	302	220	6
965	0	2	12	27	93	133	122	2
966	1	3	5	7	14	21	58	2
967	0	1	1	2	7	11	16	2
722	0	2	18	39	124	171	130	2
968	0	3	24	51	159	220	176	2
969	0	1	6	13	35	48	42	2
999	0	1	8	18	54	77	73	2

H. Drainage Problem Areas

Based on the hydrologic analysis and field observations, general drainage concerns in the study area include: near absence of culverts below all roads in the study area, conveyance of significant runoff from off-site areas which are presently undetained, uncontrolled spills from irrigation structures, undefined or inadequately sized channels, and undersized drainage transport and storage facilities. Specific drainage problems for existing and future conditions are summarized in Table 10 below.

Table 10. Drainage Concerns Within the Study Area

Coal Creek Tributaries

Existing and Future Land Use

- Absence of road culverts or roadside swales along roads in most locations.
- Undersized culverts and inadequate conveyance for off-site drainage south of Baseline Rd.
- No defined conveyance for off-site drainage east of Highway 287.
- Uncontrolled drainage spills along irrigation ditches.
- Undefined or inadequately sized major channels.
- Inadequately sized culverts below UPRR.
- Flooding at the Pre-School and High School downstream of the UPRR.
- Meadow Sweet Farms, Canyon Creek, and Lafayette Park Subdivision detention facilities undersized.
- Improperly constructed culverts and road crossings in Canyon Creek Subdivision.
- BNRR embankment forces stormwater to flow to the north.
- No off-site drainage conveyance through Austin Industrial Park.

Future Land Use

- Orchard Glen detention facility undersized.
- Storm sewer in Leon Wurl Boulevard undersized.

Bullhead Gulch/Prince Tributary

Existing and Future Land Use

- Absence of road culverts or roadside swales along roads in most locations.
- No defined conveyance for off-site drainage east of Highway 287 near Prince Reservoir.
- Inadequately sized culverts and no defined conveyance for Bullhead Gulch east of Highway 287.
- Uncontrolled drainage spills along irrigation ditches
- Undefined or inadequately sized major channels.
- Inadequately sized culverts and bridges below UPRR.
- Inadequately sized conveyance along N 111th St. through Arapahoe Ridge.
- Arapahoe Ridge Filing 2 and Lafayette Park Subdivision east and west of 111th Street detention facilities undersized for 100-year event.
- Flooding in Brownsville from Prince Tributary and Bullhead Gulch.

Boulder Creek Tributaries

Existing and Future Land Use

- Absence of road culverts or roadside swales along roads in most locations.
- No defined conveyance for off-site drainage east of Hwy 287 north of Lookout Road.
- Uncontrolled drainage spills along irrigation ditches
- Undefined or inadequately sized major channels.
- Inadequately sized conveyance along N 119th St. south of Jasper Road
- Shallow flooding along Kenosha Road.

Photograph of typical development conditions occurring in Erie. Photograph taken by staff of Love & Associates, Inc.

IV. ALTERNATE DRAINAGE IMPROVEMENT EVALUATION

A. General

The hydrologic analysis performed for this report indicates development will increase the magnitude of flood peaks. Drainage improvements are required to safely convey flood peaks produced under fully developed conditions to minimize public health and safety concerns and property damage from flooding. A number of drainage improvement strategies have been reviewed by the Advisory Board during this phase of the work. One strategy, the null or do nothing alternate, was rejected because of the desire to protect the population as well as legal issues. A conveyance strategy, which requires channel capacity to convey 100-year flood peaks produced under fully-developed land use to major streams, was also rejected because of potential damage to downstream property owners, costs, and legal issues. A third strategy, which uses detention storage to reduce flood peaks from developed areas coupled with the construction of adjoining stormwater conveyance facilities, was selected for further investigation. A summary of the Alternate Analysis follows. For additional detail, please refer to the Alternate Analysis Report (Love & Associates, Inc., 2000).

B. Design Strategy Recommendations

After review of the advantages and disadvantages of a variety of stormwater storage and conveyance options, the Advisory Board selected a design strategy which included local, neighborhood, and regional components. When developing the design strategy, the Advisory Board recognized the strategy may not be applicable to all situations, and exceptions should be made for special conditions or cases. For example, if regional detention facilities unreasonably burden one landowner, multiple parallel ponds with unit release rates may be substituted.

Analysis of the jurisdictional and land use maps of the study area suggests the study area may be roughly divided into City of Lafayette, open space areas, and Erie Planning Area. Stormwater conveyance improvements will differ in each of these jurisdictions.

1. City of Lafayette

The City of Lafayette has indicated small, non-regional detention facilities will primarily be used for stormwater control in the study area. Small detention facilities cannot be evaluated accurately with the hydrologic model of the scale used in this study. Therefore, no alternative evaluation of stormwater control for lands located within the City of Lafayette city limits will be made, and it is assumed hydrographs representative of future conditions will leave the city limits undetained.

2. Open Space Areas

The design strategy for large open space areas relatively unaffected by development is to minimize stormwater improvements in these areas. Detention facilities will be used to take advantage of inadvertent detention upstream of road crossings to reduce culvert sizes and attenuate flood peaks. Conveyance will maintain natural channel and floodplains in undeveloped open space areas and, when the open space area is slightly impacted by development, a 2-year stable channel will be constructed while the natural floodplain will be maintained.

3. Erie Planning Area

The design strategy within the Erie Planning Area recognizes a variety of constraints within the area, including such items as existing developments, existing stormwater infrastructure, flooding problems, active "moving target development", planning limitations (such as maximizing available lands zoned for commercial use), and lands which could be reasonably used for drainage facilities. The overall drainage design strategy which will be followed in the Planning Area is summarized in Table 11.

Table 11. Drainage Design Guidelines For Erie Planning Area.

Detention Facilities

- Local detention: limit to paved areas 0.5 acre or larger, or, in conjunction with water quality (along with MDCIA (minimize directly connected impervious areas) in industrial areas.
- Neighborhood detention in parks: provide detention volume for the 10-year event and water quality, use overflow spillway for events greater than the 10-year event, flow depths in ponds less than 5-feet and no trickle channel to be compatible with park, design downstream conveyance to safely convey full 100-year discharge.
- Regional detention facilities: use for flood peak reduction from the minor and major event.

Conveyance Facilities

- Preserve 100-year floodplain for Coal Creek and Boulder Creek.
- Do not use hard channels.
- Open space areas:
  - maintain natural channel and floodplains in undeveloped open space areas.
  - construct 2-year stable channel in partially developed open space areas and maintain natural floodplain.
- Subdivision (moderate and high density developments) and commercial and industrial areas:
  - encourage MDCIA (minimize directly connected impervious areas) on lots but provide no credit for runoff reduction.
  - streets (major storm) and storm sewers (minor storms) convey drainage in Catchment areas of approximately 20 acres.
  - curb and gutter for all streets.
  - top of foundations to be a minimum of 1-foot above the top of curb or 6-inches above the major storm street discharge, whichever is greater.
  - grass lined swales for conveyance of discharges from Catchment areas greater than approximately 20 acres in area.

- Subdivision (low density):
  - roadside swales and MDCIA methods or storm sewers and neighborhood detention facilities; no credit should be given for runoff reduction.
  - for homes within 50-feet of the road, top of foundations to be at least 6-inches above the elevation of the major storm street discharge.

Roadway and Railroad Cross Flow

- When possible, in roadways, combine culvert with detention for 100-year event, release at approximately the flood peak of the 10-year future event.
- Establish wetland in detention area when possible.
- Design roads to function as an emergency overflow spillway which can pass the 100-year event at a depth of less than one foot.
- Design all railroad crossings to convey the 100-year event following railroad guidelines.

Trans-Catchment Diversions

- Consider when there is substantial discharge onto developed lands without a defined flow path.
- Use as a last resort.
- Utilize flow limiters so that only design flows will be diverted (higher discharges to follow historic flow path).
- Obtain legal opinion prior to construction.

C. Alternate Analysis

Alternate stormwater conveyance systems were designed to help convey flood flows safely and reduce projected future 100-year flood peak magnitudes to those of existing conditions. Alternate stormwater conveyance systems were tested by modifying the future condition hydrologic model.

Alternates were developed considering such variables as regional detention facilities, and regional conveyance. Two alternates were selected by the Project Sponsors for final consideration. Alternate 1 assumed existing detention facilities could be enlarged and/or modified to function as regional facilities, enlarging existing detention facilities, culverts, storm sewers, and channels and proposing additional facilities. Alternate 2 minimizes improvements to the existing stormwater infrastructure and assumes an easterly flow path following the UPRR for stormwater conveyance for the area near the Pre-School and High School. Alternate 2A is similar to Alternate 2, but assumes a northerly flow path for the area near the Pre-School and High School. Alternate 2 or 2A uses less commercial area for stormwater conveyance than Alternate 1 and is preferred by the Town of Erie.

D. Alternate Cost Estimates

Conceptual cost estimates were prepared for each of the alternates. The cost estimates are summarized in Table 12. All construction and land costs are in year 2000 dollars. No financing costs or monetary impacts of phased construction or purchase of the proposed improvements are included in these cost estimates. The cost estimates prepared for this study are conceptual in nature and should be used for comparative purposes only. The cost estimates for the preliminary design have been refined.

As noted in Table 12, the total estimated probable cost for Alternate 1 is approximately $65,026,000. The total estimated probable cost for Alternate 2 is approximately $65,099,000, and the total estimated probable cost for Alternate 2A is approximately $65,300,000. These cost estimates are conceptual, should be used for comparative purposes only, and are refined for the Selected Alternate for the Preliminary Design. All of the costs are approximately equal. Land costs account for approximately half of the total costs. Multiple purpose land use, which could reduce the overall land cost estimates, has not been included in land use estimates. Detention facilities represent approximately 40 percent, conveyance facilities represent approximately 50 percent, road and railroad crossings represent approximately 9 percent, and irrigation facility improvements represent approximately 1 percent of the total cost estimate.

Table 12. Alternate Cost Estimate Summary

Improvement	Alternate 1			Alternate 2			Alternate 2A		
	Total Construction Cost	Total Land Cost	**Total Cost**	Total Construction Cost	Total Land Cost	**Total Cost**	Total Construction Cost	Total Land Cost	**Total Cost**
Regional Detention Facilities									
Coal Creek Tributaries	$6,820,565	$11,152,137	$17,972,702	$6,638,482	$10,165,007	$16,803,489	$6,638,482	$10,165,007	$16,803,489
Bullhead Gulch/Prince Tributary	$1,623,259	$3,486,414	$5,109,673	$1,624,462	$3,600,755	$5,225,217	$1,624,462	$3,600,755	$5,225,217
Boulder Creek Tributaries	$1,792,760	$1,789,478	$3,582,237	$1,792,760	$1,789,478	$3,582,237	$1,792,760	$1,789,478	$3,582,237
Sub-Total	***$10,236,584***	***$16,428,028***	***$26,664,612***	***$10,055,703***	***$15,555,239***	***$25,610,943***	***$10,055,703***	***$15,555,239***	***$25,610,943***
Channel Improvements									
Coal Creek Tributaries	$2,899,680	$3,156,684	$6,056,365	$3,349,768	$4,339,758	$7,689,525	$3,219,328	$4,282,480	$7,501,808
Bullhead Gulch/Prince Tributary	$9,464,750	$8,604,258	$18,069,008	$8,904,404	$8,757,437	$17,661,841	$8,904,404	$8,757,437	$17,661,841
Boulder Creek Tributaries	$3,881,678	$4,102,972	$7,984,650	$3,881,678	$4,102,972	$7,984,650	$3,881,678	$4,102,972	$7,984,650
Sub-Total	***$16,246,109***	***$15,863,914***	***$32,110,023***	***$16,135,850***	***$17,200,167***	***$33,336,017***	***$16,005,410***	***$17,142,889***	***$33,148,299***
Road and Railroad Crossings									
Sub-Total	***$5,698,350***	***$0***	***$5,698,350***	***$5,598,911***	***$0***	***$5,598,911***	***$5,988,889***	***$0***	***$5,988,889***
Irrigation Facilities									
Boulder and Weld Co. Ditch	$133,000	$0	$133,000	$133,000	$0	$133,000	$133,000	$0	$133,000
Goodhue Ditch	$56,000	$0	$56,000	$56,000	$0	$56,000	$56,000	$0	$56,000
Leyner/Cottonwood Ditch	$224,000	$0	$224,000	$224,000	$0	$224,000	$224,000	$0	$224,000
Liggett Ditch	$56,000	$0	$56,000	$56,000	$0	$56,000	$56,000	$0	$56,000
Lower Boulder Ditch	$63,000	$0	$63,000	$63,000	$0	$63,000	$63,000	$0	$63,000
South Boulder Canyon Ditch	$21,000	$0	$21,000	$21,000	$0	$21,000	$21,000	$0	$21,000
Sub-Total	***$553,000***	***$0***	***$553,000***	***$553,000***	***$0***	***$553,000***	***$553,000***	***$0***	***$553,000***
TOTAL	***$32,734,043***	***$32,291,942***	**$65,025,985**	***$32,343,465***	***$32,755,406***	**$65,098,871**	***$32,603,003***	***$32,698,128***	**$65,301,131**

E. Selected Alternate Outfall System

Alternates 1, 2, and 2A convey the 100-year flood safely through the study area. All alternates require the construction of new regional detention facilities, channel improvements, culverts below roads, and improvements to irrigation ditches. Alternate 1 emphasizes enlarging existing detention facilities, while Alternates 2 and 2A require only minor improvements in existing detention facilities. Alternate 2 is the Engineer's recommended outfall systems plan.

The Alternate Analysis was presented to the Board of Trustees for the Town of Erie on October 10, 2000. Alternate 2 was approved by the Town Board, and Love & Associates, Inc. was directed by UDFCD and The Town of Erie to proceed with the Preliminary Design of the Outfall System using this Alternate. The Selected Plan and additional direction for completing the plan is summarized in correspondence from the District to consultant dated October 10, 2000, and is found in Appendix C.

Progress meetings concerning the Preliminary Design were held between UDFCD, Town of Erie, and Love & Associates, Inc. on October 27, 2000 and December 4, 2000. During the December 4, 2000 meeting the Town of Erie requested Alternate 2 be modified to reflect recent development plans. The modifications included changes in regional detention, flow paths, and catchment delineation. Specifically, sub-catchments 468, 470, 471, 472, 475, and 480, detention facilities 1041, 1043, 1044, 1046, 1056, and 1057, and channels downstream of these sub catchments and detention facilities were added or modified. Alternate 2 with these changes, implemented with the design guidelines presented in Table 11 and in conjunction with current drainage design requirements, will safely convey stormwater flows within the study area to Coal Creek and Boulder Creek.

V. PRELIMINARY DESIGN OF THE OUTFALL SYSTEM

A. General

The outfall system generally employs regional detention facilities to moderate flood peak magnitudes and regional 100-year conveyance channels and storm sewers to transport stormwaters safely to Boulder Creek, Coal Creek and Prince Tributary/Bullhead Gulch within developed areas. A path and channel generally capable of passing 2-year flood peaks is defined within open space areas. Proposed regional facilities are shown on Figure 11. Onsite catchment delineations and UDSWM elements, the hydrologic model, UDSWM flow charts, and flood peak summary tables for the outfall system are presented in Appendix A2. The preliminary design of the outfall system is shown in plan and profile at the end of this chapter, and a verbal description and cost estimates of each improvement is provided on the page facing the plan view.

As shown in the Alternate Analysis (Love & Associates, Inc., 2000) water quality provisions in the 10-year and local detention facilities should reduce flood peak magnitudes for more frequent events. These facilities were not modeled for the preliminary design because limitations of the model scale prohibits predicting these effects by modeling. Once the Master Plan is adopted, the Town of Erie and Boulder County should require final design of regional detention facilities be sized for the 10- and 100-year event using the UDSWM Outfall Systems model and water quality storage volume be designed for regional facilities using Volume 3, Urban Storm Drainage Criteria Manual (UDFCD, 1969, revised 1999). Neighborhood and local detention facilities should be sized using the detention volume equations in Boulder County, 1984 and water quality storage volume be designed for regional facilities using UDFCD, 1969 rev (Volume 3). In the event development occurs in a sub-catchment to be served by a regional pond before the regional detention facility has been constructed, the development should provide on-site detention for the 10- and 100-year events and water quality.

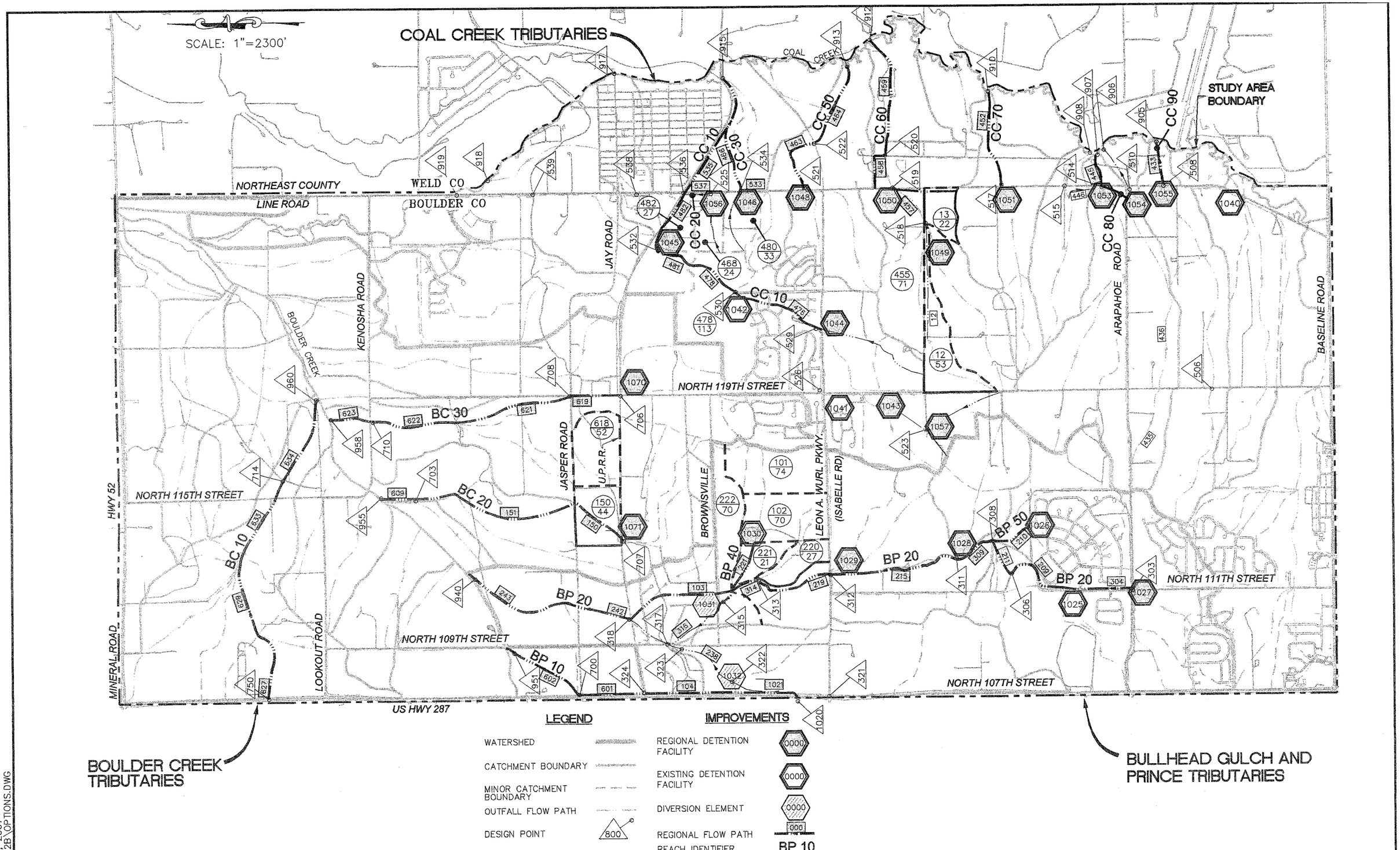
B. Description

Flood peaks at selected design points for existing and future percent imperviousness are compared to the selected outfall plan storage/conveyance strategies in Table 13 for the 10- and 100-year events. Location of proposed detention facilities, regional conveyance facilities, and conveyance improvements are shown on Figures 12a, 12b and 12c. Hydrographs for the 100-year event at selected design points for existing, future, and the selected outfall plan storage/conveyance strategies are compared on Figure 10.

Table 13. Flood Peak Discharge Comparison: Existing, Future, and Outfall Plan

Coal Creek Tributaries							
Design Point	Location	10-year flood peak (cfs)			100-year flood peak (cfs)		
		Existing	Future	Outfall Plan	Existing	Future	Outfall Plan
506	N. 119th	28	59	*	168	210	210
508	NE Co. Line	59	120	*	347	431	365
905	Coal Ck.	63	138	*	366	454	375
510	NE Co. Line	40	67	*	242	290	N/A
906	Coal Ck.	46	91	*	277	334	121
514/1053	NE Co. Line	67	161	*	385	482	613
907	Coal Ck.	70	178	*	401	505	621
515	NE Co. Line	33	231	*	195	491	N/A
908	Coal Ck.	38	260	*	222	537	111
517/1051	NE Co. Line	38	312	*	227	674	227
910	Coal Ck.	51	381	*	300	826	371
518	-	69	311	*	405	731	304
519	NE Co. Line	81	379	*	475	883	193
520	-	87	478	*	514	1061	299
912	Coal Ck.	99	477	*	560	1120	489
521/1048	NE Co. Line	44	271	*	231	590	136
522	LA Wurl Pky.	51	355	*	276	752	258
913	Coal Ck.	56	348	*	300	792	434
534/1046	NE Co. Line	27	202	*	138	423	129
526	N. 119th	30	69	*	114	355	112
529	LA Wurl Pky.	43	194	*	213	442	223
530	Meller St.	110	240	*	478	717	462
532	UPRR	130	300	*	571	924	385
536	NE Co. Line	82	258	*	211	543	392
915	Coal Ck.	29	29	*	156	156	546
918	Coal Ck.	41	84	*	151	206	206
539	NE Co. Line	44	128	*	151	290	290
919	Coal Ck.	85	204	*	240	454	454
538	NE Co. Line	184	499	*	777	1295	191
917	Coal Ck.	215	480	*	813	1310	316

*10-Year flood peaks will be maintained at pre-developed rates using 10-year detention facilities in all developments.



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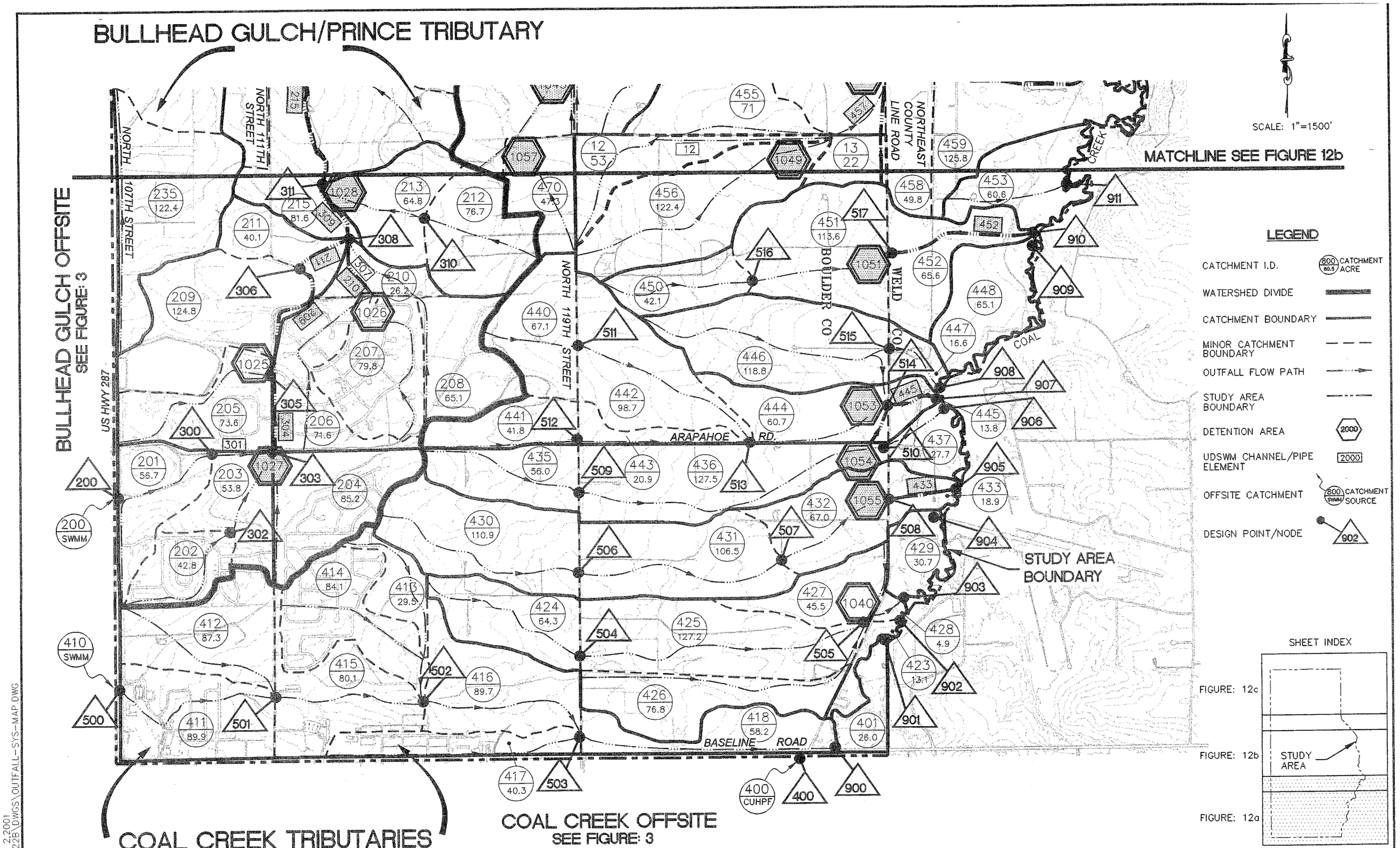
Lowe & Associates, Inc. water resource consultants 841 Front Street Louisville, Colorado 80027-1849 Phone: 303-673-9795 Fax: 303-673-9796	DESIGNED: RJP DRAWN: DM CHECKED: DJL DATE: 01-01	TOWN OF ERIE URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	ERIE AND ADJACENT AREAS OUTFALL SYSTEMS PLANNING	PROPOSED DRAINAGE FACILITIES UDSWM ELEMENTS	Figure 11 Page V-2



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TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

OUTFALL SYSTEMS MAP

Figure 12a

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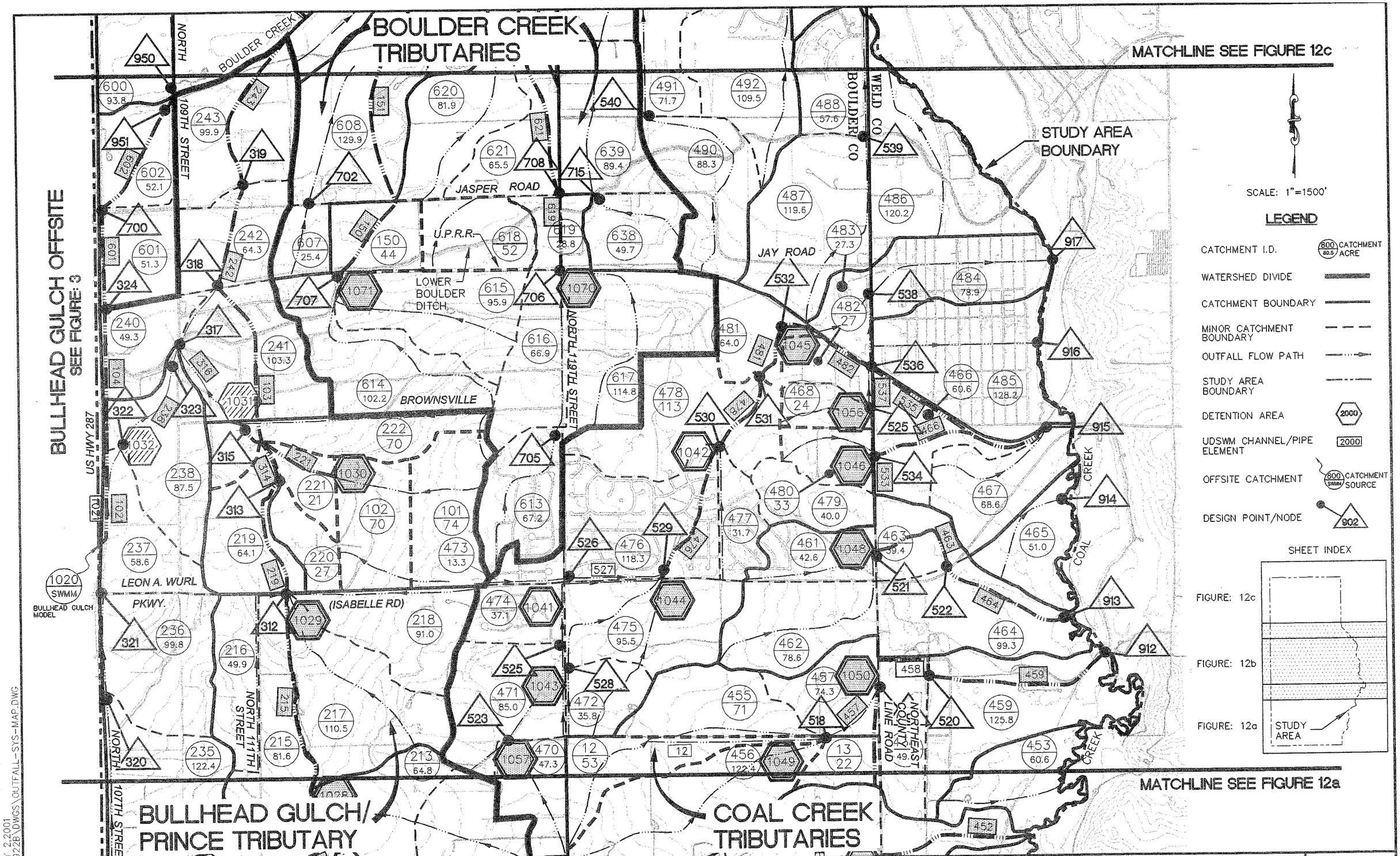

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TOWN OF ERIE
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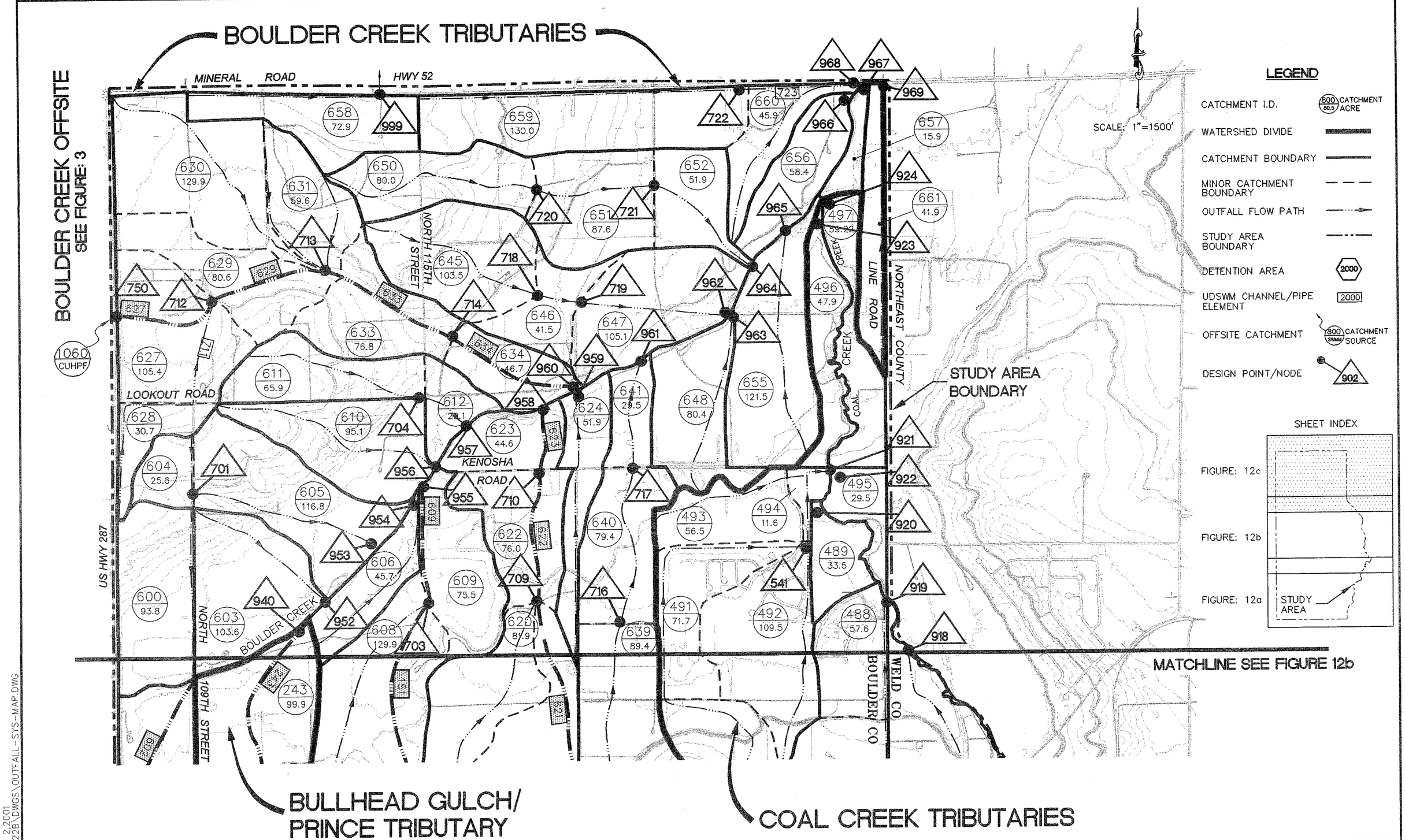
ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

OUTFALL SYSTEMS MAP

Figure 12b



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TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

OUTFALL SYSTEMS MAP

Figure 12c
Page V-5

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Table 13. Flood Peak Discharge Comparison: Existing, Future, and Outfall Plan (cont'd)

Prince Tributary/Bullhead Gulch							
Design Point	Location	10-year flood peak (cfs)			100-year flood peak (cfs)		
		Existing	Future	Outfall Plan	Existing	Future	Outfall Plan
303/1027	Arapahoe Rd.	159	283	*	583	745	284
306	-	167	303	*	784	976	473
308	-	228	344	*	1199	1389	882
311	-	255	424	*	1370	1613	1061
312	LA Wurl Pky.	313	604	*	1637	1971	1290
313	-	331	636	*	1706	2080	1338
315	Flatiron Rd.	378	810	*	1932	2379	1567
321	LA Wurl Pky.	40	40	*	237	237	237
1020	Hwy 287	602	1758	*	1745	3862	3862
322	-	626	1747	*	1880	3967	3967
323	-	620	1706	*	1875	3925	2910
317	109th	941	2341	*	3340	5998	3922
318	UPRR	972	2387	*	3423	6123	4527
940	Bldr. Ck.	935	2259	*	3354	5878	4261
324	UPRR	N/A	N/A	*	N/A	N/A	1000
700	Jasper Rd.	7 (Bldr Ck)	7 (Bldr Ck)	*	45	45	1035
951	Bldr. Ck.	23 (Bldr Ck)	23 (Bldr Ck)	*	113	113	1062
Boulder Creek Tributaries							
Design Point	Location	10-year flood peak (cfs)			100-year flood peak (cfs)		
		Existing	Future	Outfall Plan	Existing	Future	Outfall Plan
707/1071	UPRR	132	234	*	409	574	174
703	-	38	39	*	187	189	374
955	Bldr. Ck.	41	41	*	181	182	355
706/1070	UPRR	137	290	*	484	691	165
708	Jasper Rd.	253	492	*	901	1276	285
710	Kenosha Rd.	240	394	*	876	1191	473
958	Bldr. Ck.	247	401	*	902	1216	505
750	Hwy 287	581	584	*	1455	1455	1455
714	N. 115th	630	630	*	1736	1736	1736
960	Bldr. Ck.	622	622	*	1726	1726	1726

*10-Year flood peaks will be maintained at pre-developed rates using 10-year detention facilities in all developments.

1. Coal Creek Tributaries

Regional detention facilities are planned upstream of NE County Line Road for catchments flowing eastwardly towards Coal Creek. Detention facilities adjacent to the road include detention elements 1046, 1048, 1050, 1051, 1053, 1055, and 1056. Interconnected detention facilities include element 1049 which discharges into element 1050 and element 1054 which discharges into element 1053.

Detention/conveyance strategies are planned to combine catchments upstream of NE County Line Road to minimize the number of culverts below NE County Line Road and to minimize the number of regional channels discharging to Coal Creek. Combining catchments means flood peak magnitudes may exceed existing flood peak magnitudes for some alternate flow paths. One example is found at Design Point 514, where sub-catchments 435, 436, and 446 are combined and discharge into the regional channel conveyance element 445. The combination of the sub-catchments eliminates at least one channel. The proposed regional channel 445 must be designed to accommodate a larger flood peak than experienced under existing conditions.

For the Catchment upstream of the High School and Pre-School, the conveyance system includes three new detention facilities (elements 1043, 1044, and 1057) upstream of Leon A. Wurl Parkway, elimination of the Canyon Creek detention facility (element 1042), construction of a new on-channel detention facility (element 1045) upstream of the UPRR, and construction of a new detention facility (element 1056) adjacent to NE County Line Road. Road crossings along conveyance channel element 476, which passes through the existing Canyon Creek subdivision, will require improvements to pass the 100-year flood peak. The outlet of the existing detention facility (element 1042) in Canyon Creek Filing 1 will be enlarged.

The 100-year flood peak from the Catchment upstream of the High School and Pre-School discharging to the UPRR (Design Point 532) will be attenuated to below existing magnitudes for the detention/conveyance strategy, as seen on Table 13 and Figure 11. Stormwaters from Design Point 532 are discharged into an open channel running adjacent to and south of the UPRR, to NE County Line Road (Design Point 536) and eventually to Coal Creek (Design Point 915).

The design guidelines assume neighborhood and local detention facilities will be used in developed areas to reduce flood peaks from the 10-year and more frequent events. Since the location of these facilities is not known, they have not been included in the modeling effort and their impact is not shown on Table 13. However, flood peaks shown on Table 13 indicates regional ponds will attenuate flood peaks from the 10-year event under fully developed percent imperviousness.

2. Bullhead Gulch/Prince Tributary

To attenuate flood peaks from lands primarily located in Lafayette, a detention facility (element 1027) will be constructed on Boulder County property south of Arapahoe Road, reducing 100-year flood peaks to below those modeled using existing percent imperviousness. The outlet of the two existing detention facilities (elements 1025 and 1026) in Arapahoe Ridge will be modified. Three new off-line detention facilities (elements 1028, 1029, and 1030) will be constructed near Bullhead Gulch. With these

along Prince Tributary (Design Point 315), the 100-year flood peak is at least 350 cfs lower than the flood peak for existing percent imperviousness, as shown on the hydrograph for Design Point 315 on Figure 10.

Brownsville and the surrounding area is located in the 100-year floodplain of Prince Tributary and Bullhead Gulch according to the Draft FIS (Taggart Engineering Associates, Inc., 1998). To help reduce the frequency of flooding, a 500 cfs capacity channel (conveyance element 103) is proposed to be constructed in the area currently occupied by the Leyner/Cottonwood waste ditch. This channel will cross below the UPRR and a few roads and over the top of the Lower Boulder Ditch. The channel will accommodate a flood peak greater than the 10-year event at Design Point 315. A spreader/diversion device is proposed to be constructed at the entrance of the 500 cfs channel to return flood flows for events greater than the 10-year event occurring along Prince Tributary to sheet flow conditions.

Flooding along Bullhead Gulch also reaches Brownsville, and the frequency of flooding from Bullhead Gulch can be reduced by constructing a channel with a capacity of 1000 cfs along the east side of Highway 287. The channel (conveyance elements 102, 104, 601, and 602) begins at the proposed bridge below Highway 287, and it crosses below the UPRR, the Lower Boulder Ditch and Jasper Road before reaching Boulder Creek. A spreader/diversion device similar to the one used for the 1000 cfs channel will be constructed near Highway 287. This channel is similar to one proposed in an earlier study (Advanced Sciences, Inc., 1992).

Developments will be required to provide 10-year detention and water quality facilities, similar to Coal Creek Tributaries. The neighborhood and local 10-year detention facilities will help attenuate flood peaks from the 10-year and more frequent events.

3. Boulder Creek Tributaries

Much of the Boulder Creek Tributary Area will remain as open space and will not be impacted by future development. Design guidelines for open space areas should be followed in these areas. Generally, open space areas will have a 2-year low flow channel in open space areas and 10-year culverts below roads.

A regional detention facility (element 1070) close to the UPRR will reduce 100-year flood peaks below those experienced under existing percent imperviousness, as shown on the hydrographs on Figure 10 for Design Point 708 located immediately downstream. A storm sewer is proposed within North 119th Street which will transport the 100-year event from the detention facility to Jasper Road and reduce flooding in the surrounding neighborhood.

A second regional detention facility (element 1071) near the UPRR will reduce 100-year flood peaks below those experienced under existing percent imperviousness, as shown on Table 13. An open channel will transport flood flows from the detention facility to Jasper Road. It is proposed to direct these flows to the northwest onto lands owned by Boulder County to reduce the magnitude of shallow flooding which could be experienced by residents along Kenosha Road during less frequent flood events.

C. Improvement Phasing Within Erie

At this time, the Town of Erie has no formal policy regarding the funding or phasing of regional drainage facilities. Currently, a proposed development is required to provide stormwater conveyance within their development, provide regional conveyance facilities defined in the Alternate Analysis within their property, identify the hydrologic impact of the development on offsite areas and mitigate any impact, and provide temporary detention facilities to maintain 10- and 100-year historic discharges from the development if the regional detention facilities have not been constructed. These temporary detention facilities can be reclaimed or used as a 10-year or water quality detention facility once the regional detention facility is constructed. The developer is also required to promise to contribute to the regional drainage system.

When the Outfall System Preliminary Design is approved, the Town should adopt the preliminary design as their Master Drainage Plan and implement the drainage guidelines shown in Table 11. The Town should additionally formally adopt the methods in *Storm Drainage Criteria Manual* (Boulder County, 1984), and the *Urban Storm Drainage Criteria Manual* (UDFCD, 1969 rev). The Town should develop a legal framework committing developers to contribute to regional facilities with a fee system. A framework should be developed to acquire property, provide final design, and construct the regional facilities.

The Town should develop a system to coordinate drainage improvements with Boulder County and City of Lafayette, as needed. This coordination should include pursuing the development of the offsite detention facility near Arapahoe Ridge with Boulder County and the City of Lafayette and review of any new or proposed drainage facilities within Boulder County and the City of Lafayette impacting the Town.

D. Design Criteria

The locations of proposed regional detention and conveyance facilities are based on engineering judgment, constructibility, input from the Advisory Board, practicality, anticipated cost minimization, and legal requirements. Topographic variability within the study area required grades and inverts of all proposed facilities to be conceptually confirmed using topographic maps. Using these criteria and the design strategy recommendations, often only one area is conceptually "best" for regional detention facility locations.

Detention volumes shown on the plan view at the end of this chapter and used for cost estimates include the storage volume shown in the UDSWM for the 100-year event plus 1-foot of freeboard. Detention facility outlets are sized using HY-8 (Federal Highway Administration, 1996) assuming inlet control. Some facilities require a berm to achieve the required storage volume, while others require excavation below grade to achieve the required storage volume. Cut and fill volumes used for cost estimates are developed individually for these two types of facilities. Right of way requirements shown in at the end of this chapter and used for cost estimates are based on the estimated land required for the proposed regional detention facilities. The estimated land required for detention facilities equals the sum of the detention pond surface area plus 1 foot of free board plus a 12-foot strip around the perimeter of the pond to provide access for maintenance.

Conveyance channel geometry is calculated assuming a trapezoidal cross section, 4:1 side slopes, an average velocity of 5 feet per second or less, normal depth, a Froude number of approximately 0.7, and a Manning's "n" of 0.035, unless specified otherwise. All channels conveying the 100-year event are sized to include 1-foot of freeboard. To provide for maintenance access, an additional 12-feet of channel width is added to the channels reaches not located adjacent to a road or with a top width less than 40 feet. Right of way width shown at the end of this chapter and used for cost estimates of conveyance channels includes the top width of the channel required to accommodate the design event plus 1-foot of freeboard and a 12-foot maintenance access if required, unless specified otherwise.

Culverts for road and railroad crossings are sized assuming inlet control. Storm sewers are sized assuming open channel flow and normal depth.

E. Cost Estimates

Conceptual cost estimates were prepared for the outfall system preliminary design. The proposed drainage facilities are shown in plan and profile in Appendix E of this report. Proposed regional detention and conveyance facilities are identified on Figure 12a, 12b, and 12c, and proposed irrigation facility improvements are shown on Figure 9. The cost estimate was divided into four general categories; detention facilities, conveyance facilities improvements, road and railroad crossings, and irrigation facilities. These four categories are discussed in more detail below. The four categories are further subdivided into construction costs and land costs.

Construction cost estimates have been increased by 40 percent to account for contingencies, engineering, mobilization, administration and legal fees. The construction unit costs are based on recently completed projects in the Denver metro area, Colorado Department of Transportation (CDOT) Cost Data, UDFCD Bid Tabs and engineering judgment. The unit prices utilized for this study are summarized in Table 14. Unit land cost estimates are $100,000 per acre of land. Land cost estimates are increased by 10% to account for administration and legal fees.

Table 14. Unit Cost and Percentage Data

Item	Unit	Unit Cost or Percent
Construction Cost Estimates		
Earthwork		
Channel Excavation	cy	$10
Pond Excavation	cy	$8
Pond Embankment	cy	$5
Concrete Structures (box culverts, wingwalls, bridges)	cy	$500
Drop Structures		
Drop Structure, 0-500 cfs	each	$7,500
Drop Structure, 500 - 1000 cfs	each	$12,000
Drop Structure, greater the 1000 cfs	each	$15,000

Table 14. Unit Cost and Percentage Data (cont'd)

Reinforced Concrete Pipe (includes earthwork, pipe, restoration)		
18" Diameter	lf	$70
21" Diameter	lf	$75
24" Diameter	lf	$80
27" Diameter	lf	$85
30" Diameter	lf	$90
33" Diameter	lf	$95
36" Diameter	lf	$100
42" Diameter	lf	$110
48" Diameter	lf	$140
54" Diameter	lf	$165
60" Diameter	lf	$180
66" Diameter	lf	$195
72" Diameter	lf	$210
53x34" Elliptical	lf	$220
Revegetation		
Seed and Mulch	acre	$3,000
Irrigation Structure Type		
1 Bypass	each	$14,000
2 Existing Culvert, Minor Modifications	each	$7,000
3 Overflow Weir and Flow Limiter	each	$28,000
4 Underground Conduit	each	$14,000
1 or 4 Bypass or Underground Conduit	each	$10,000
2 or 3 Overflow Weir and Flow Limiter	each	$20,000
2 or 4 Culvert Minor Modifications or Underground Conduit	each	$10,000
3 or 4 Weir and Flow Limiter or Underground Conduit	each	$20,000
Roadway Restoration and Traffic Control Costs		
% of Roadway Crossing Conduit Cost		50%
Construction – Contingencies, Engineering, Admin., & Mobilize.		
Contingencies		20%
Engineering		10%
Administration and Legal		5%
Mobilization		5%
Total		*40%*
Land Cost Estimates		
Land Value	acre	$100,000
Land Administration and Legal		10%

Table 15. Regional Detention Facilities Cost Estimates

Coal Creek Tributaries

Design Point (Pond No.)	SHEET NO.	Volume (ac-ft)	Outlet Pipe Type	Culvert Length (ft)	RCP Diameter (in)	RCP Cost ($)	RCB Span (ft)	RCB Hght (ft)	RCB Total Cost ($)	Sub-Total Const. Cost ($)	Const. Conting. Cost ($)	Total Const. Cost ($)	Land Est. (ac)	Sub-Total Land Cost ($)	Land Conting. Cost ($)	Total Land Cost ($)	Total Const. + Land ($)
1041	13	NC	NC	-	-		-	-	-	-	-	-	-	-	-	-	-
1042	10	NC	RCB	200	-		10	4	128,519	128,519	51,407	179,926	-	-	-	0	179,926
1043	13	8.3	NC	-	-	0				171,401	68,560	239,961	1.9	194,775	19,477	214,252	454,213
1044	13	12.7	RCP	150	42	16,500				207,051	82,820	289,871	5.3	531,709	53,171	584,880	874,751
1045	10	44.5	RCP	100	60	18,000				434,401	173,761	608,162	13.4	1,342,958	134,296	1,477,254	2,085,416
1046	11	10.6	RCP	180	2 @ 36	32,400				177,761	71,105	248,866	3.2	324,080	32,408	356,488	605,354
1048	14	24	RCP	180	2 @ 42	39,600				347,424	138,970	486,394	8.7	866,372	86,637	953,009	1,439,402
1049	17	27	RCP	100	54	16,500				327,954	131,182	459,136	7.6	762,170	76,217	838,387	1,297,523
1050	17	30	RCP	180	66	35,100				654,620	261,848	916,468	12.8	1,280,991	128,099	1,409,090	2,325,558
1051	19	19	RCP	180	2 @ 48	50,400				127,953	51,181	179,134	8.7	866,372	86,637	953,009	1,132,143
1053	19	33	RCB	180			14	5	153,333	834,805	333,922	1,168,727	10.7	1,074,050	107,405	1,181,455	2,350,182
1054	21	16.3	RCP	150	2 @ 36	30,000				366,606	146,642	513,248	7.0	699,504	69,950	769,455	1,282,703
1055	21	11.2	RCB	180			10	5	126,667	357,954	143,182	501,136	3.2	319,806	31,981	351,787	852,922
1056	11	2.9	RCB	100	30	18,000				77,887	31,155	109,042	1.0	99,634	9,963	109,597	218,639
1057	16	5.38	RCB	125	36	12,500				123,601	49,440	173,041	1.5	154,240	15,424	169,664	342,705
Total						$269,000			$408,519	$4,337,936	$1,735,175	$6,073,111	85	$8,516,661	$851,666	$9,368,327	$15,441,437

Bullhead Gulch/Prince Tributary

Design Point (Pond No.)	SHEET NO.	Volume (ac-ft)	Outlet Pipe Type	Culvert Length (ft)	RCP Diameter (in)	RCP Cost ($)	RCB Span (ft)	RCB Hght (ft)	RCB Total Cost ($)	Sub-Total Const. Cost ($)	Const. Conting. Cost ($)	Total Const. Cost ($)	Land Est. (ac)	Sub-Total Land Cost ($)	Land Conting. Cost ($)	Total Land Cost ($)	Total Const. + Land ($)
1025	18	-	RCP	100	2 @ 36	20,000				20,000	8,000	28,000	0.0	0	0	0	28,000
1026	18	-	RCP	100	48	14,000				14,000	5,600	19,600	0.0	0	0	0	19,600
1027	20	35	RCP	200	5 @ 48	140,000				651,023	260,409	911,433	9.7	970,317	97,032	1,067,349	1,978,782
1028	15	17	RCP	100	48	14,000				151,133	60,453	211,587	5.5	552,748	55,275	608,023	819,610
1029	12	31	RCP	100	48	14,000				264,067	105,627	369,693	11.8	1,177,599	117,760	1,295,359	1,665,053
1030	9	17	RCP	100	48	14,000				151,133	60,453	211,587	5.5	552,748	55,275	608,023	819,610
1031	9	diversion								10,487	4,195	14,681	0.1	10,000	1,000	11,000	25,681
1032	12	diversion								10,487	4,195	14,681	0.1	10,000	1,000	11,000	25,681
Total						$216,000			$0	$1,272,330	$508,932	$1,781,262	32.7	$3,273,413	$327,341	$3,600,755	$5,382,017

Boulder Creek Tributaries

Design Point (Pond No.)	SHEET NO.	Volume (ac-ft)	Outlet Pipe Type	Culvert Length (ft)	RCP Diameter (in)	RCP Cost ($)	RCB Span (ft)	RCB Hght (ft)	RCB Total Cost ($)	Sub-Total Const. Cost ($)	Const. Conting. Cost ($)	Total Const. Cost ($)	Land Est. (ac)	Sub-Total Land Cost ($)	Land Conting. Cost ($)	Total Land Cost ($)	Total Const. + Land ($)
1070	8	36	STI	100	2 @ 48	28,000				803,645	321,458	1,125,104	10.7	1,074,050	107,405	1,181,455	2,306,558
1071	7	22	RCP	100	2 @ 36	20,000				490,897	196,359	687,256	5.5	552,748	55,275	608,023	1,295,279
Total						$48,000				$1,294,543	$517,817	$1,812,360	16.3	$1,626,798	$162,680	$1,789,478	$3,601,837

Table 16. Conveyance Facilities Improvements Cost Estimates

Coal Creek Tributaries

SWMM ELEMENT/ REACH/ SHEET NO.	Design Flow (cfs)	Length (ft)	Slope (ft/ft)	Bottom Width/ Diam. (ft)	Channel Depth (ft)	Channel Top Width (ft)	No. Drop Struct. (each)	Sub-Total Const. Cost ($)	Const. Conting. Cost ($)	Total Const. Cost ($)	Land Est. (ac)	Sub-Total Land Cost ($)	Land Conting. Cost ($)	Total Land Cost ($)	Total Const. + Land ($)
433-CC90-21	375	1,258	0.019	5	4.6	42	11	137,313	54,925	192,239	1.6	155,373	15,537	170,910	363,149
445-CC80-19	621	997	0.033	10	5.5	54	13	225,521	90,209	315,730	1.5	151,061	15,106	166,167	481,897
452-CC70-17	371	2,100	0.011	0	4.8	38	10	152,234	60,893	213,127	1.9	185,124	18,512	203,636	416,764
452-CC70-19	371	542	0.011	0	4.8	38	0	19,934	7,973	27,907	0.5	47,780	4,778	52,558	80,465
457-CC60-17	371	705	0.015	5	4.4	40	4	57,917	23,167	81,083	0.7	65,062	6,506	71,568	152,652
458-CC60-17	299	808	0.014	0	4.3	34	3	46,547	18,619	65,166	0.6	63,809	6,381	70,190	135,356
459-CC60-14	489	510	0.008	5	5.4	48	3	51,325	20,530	71,855	0.6	56,433	5,643	62,076	133,931
459-CC60-17	489	2,750	0.008	5	5.4	48	7	207,929	83,172	291,100	3.0	304,293	30,429	334,722	625,823
463-CC50-14	258	1,617	0.015	5	4.1	38	0	58,092	23,237	81,329	1.8	184,864	18,486	203,350	284,679
464-CC50-14	434	2,142	0.005	10	4.6	47	4	142,315	56,926	199,241	2.9	289,140	28,914	318,055	517,296
466-CC30-11	187	1,622	0.005	5	3.8	35	0	51,408	20,563	71,971	1.8	176,499	17,650	194,148	266,119
536-CC10-11^	546	1,900	0.006	25	4	49	1	118,060	47,224	165,284	2.1	213,728	21,373	235,101	400,385
478-CC10-10	626	1,423	0.0081	10	5.4	53	4	144,323	57,729	202,053	2.1	212,993	21,299	234,292	436,345
481-CC10-11	392	266	0.0116	5	4.8	43	0	12,459	4,984	17,442	0.3	33,830	3,383	37,213	54,655
481-CC10-10	392	100	0.012	5	4.8	43	1	16,684	6,674	23,357	0.1	12,718	1,272	13,990	37,347
481-CC10-10	739	337	0.012	10	5.9	57	2	50,349	20,140	70,489	0.5	53,536	5,354	58,890	129,379
482-CC10-11	392	958	0.011	5	4.8	43	1	52,370	20,948	73,319	1.2	121,839	12,184	134,023	207,342
535-CC10-11	383	1,945	0.006	5	4.8	43	0	89,492	35,797	125,289	1.9	193,786	19,379	213,164	338,453
537-CC20-11	45	715	0.014	2.5' RCP	N/A	N/A	0	0	0	64,350	0.0	0	0	0	64,350
Total								$1,634,273	$653,709	$2,352,333	25	$2,521,866	$252,187	$2,774,053	$5,126,386

Bullhead Gulch/Prince Tributary

SWMM ELEMENT/ REACH/ SHEET NO.	Design Flow (cfs)	Length (ft)	Slope (ft/ft)	Bottom Width/ Diam. (ft)	Channel Depth (ft)	Channel Top Width (ft)	No. Drop Struct. (each)	Sub-Total Const. Cost ($)	Const. Conting. Cost ($)	Total Const. Cost ($)	Land Est. (ac)	Sub-Total Land Cost ($)	Land Conting. Cost ($)	Total Land Cost ($)	Total Const. + Land ($)
210-BP50-15	341	250	0.014	0	5.4	43	0	11,544	4,618	16,161	0.2	24,793	2,479	27,273	43,434
210-BP50-18	341	406	0.014	0	5.4	43	0	18,747	7,499	26,246	0.4	40,264	4,026	44,291	70,537
210-BP50-18	341	510	0.017	5	4.6	42	4	52,222	20,889	73,110	0.6	62,989	6,299	69,288	142,398
221-BP40-9	172	415	0.007	10	4.3	44	0	19,246	7,698	26,945	0.4	42,300	4,230	46,530	73,475
221-BP40-9	172	854	0.013	5	3.4	32	5	59,396	23,759	83,155	0.6	63,129	6,313	69,441	152,596
304-BP20-18	283	1,193	0.014	5	4.2	39	1	51,127	20,451	71,578	1.1	105,716	10,572	116,287	187,866
304-BP20-20	283	386	0.014	5	4.2	39	1	21,616	8,646	30,262	0.3	34,205	3,420	37,625	67,887
209-BP20-18	473	1,839	0.0194	5	5.3	47	11	183,082	73,233	256,315	2.0	200,112	20,011	220,123	476,438
211-BP20-15	503	426	0.007	10	5	50	1	32,986	13,194	46,180	0.6	60,634	6,063	66,697	112,877
211-BP20-18	503	185	0.007	10	5	50	3	33,568	13,427	46,995	0.3	26,331	2,633	28,965	75,959

Table 16. Conveyance Facilities Improvements Cost Estimates (cont'd)

Bullhead Gulch/Prince Tributary (cont'd)

SWMM ELEMENT/ REACH/ SHEET NO.	Design Flow (cfs)	Length (ft)	Slope (ft/ft)	Bottom Width/ Diam. (ft)	Channel Depth (ft)	Channel Top Width (ft)	No. Drop Struct. (each)	Sub-Total Const. Cost ($)	Const. Conting. Cost ($)	Total Const. Cost ($)	Land Est. (ac)	Sub-Total Land Cost ($)	Land Conting. Cost ($)	Total Land Cost ($)	Total Const. + Land ($)
309-BP20-15	878	1,035	0.012	20	5.6	65	5	156,493	62,597	219,090	1.8	182,479	18,248	200,727	419,818
215-BP20-12	1,087	1,431	0.0393	25	5.9	72	12	340,270	136,108	476,379	2.8	276,607	27,661	304,268	780,647
215-BP20-15	1,087	2,000	0.0393	25	5.9	72	13	418,998	167,599	586,597	3.9	386,593	38,659	425,253	1,011,849
219-BP20-9	1,320	740	0.0135	35	5.9	82	3	144,559	57,824	202,383	1.6	160,028	16,003	176,030	378,413
219-BP20-12	1,320	1,530	0.0135	35	5.9	82	7	310,845	124,338	435,184	3.3	330,868	33,087	363,955	799,138
314-BP20-9	1,335	490	0.0135	40	5.7	86	2	97,852	39,141	136,993	1.0	96,290	9,629	105,919	242,912
242-BP20-7	218*	1,586	0.002	4	4.7	42	2	83,801	33,520	117,322	2.0	195,155	19,516	214,671	331,992
243-BP20-5	211*	240	0.002	10	4.1	43	0	10,527	4,211	14,738	0.3	30,193	3,019	33,212	47,950
243-BP20-7	211*	716	0.002	10	4.1	43	0	31,406	12,562	43,968	0.9	90,075	9,008	99,083	143,051
103-BP20-7^	500	748	0.0526	0	4.9	39	1	36,126	14,450	50,576	0.7	67,313	6,731	74,044	124,621
103-BP20-9^	500	1,970	0.0526	0	4.9	39	10	150,392	60,157	210,549	1.8	177,282	17,728	195,010	405,559
104-BP10-7^	1,000	385	0.0113	15	5.7	61	2	56,330	22,532	78,862	0.5	53,561	5,356	58,917	137,778
104-BP10-9^	1,000	2,950	0.0113	15	5.7	61	8	343,722	137,489	481,211	4.1	410,399	41,040	451,439	932,650
104-BP10-12^	1,000	686	0.0113	15	5.7	61	1	69,606	27,842	97,448	1.0	95,435	9,544	104,979	202,427
601-BP10-7	1,000	1,603	0.006	30	5.4	73	2	197,511	79,004	276,515	2.7	269,375	26,937	296,312	572,827
602-BP10-7	1,000	1,062	0.0041	50	5.8	96	2	198,044	79,218	277,262	2.4	235,025	23,502	258,527	535,789
602-BP10-5	1,000	650	0.0041	50	5.8	96	0	106,524	42,610	149,134	1.4	143,848	14,385	158,232	307,366
Total								$3,236,542	$1,294,617	$4,531,158	39	$3,860,999	$386,100	$4,247,099	$8,778,257

Boulder Creek Tributaries

SWMM ELEMENT/ REACH/ SHEET NO.	Design Flow (cfs)	Length (ft)	Slope (ft/ft)	Bottom Width/ Diam. (ft)	Channel Depth (ft)	Channel Top Width (ft)	No. Drop Struct. (each)	Sub-Total Const. Cost ($)	Const. Conting. Cost ($)	Total Const. Cost ($)	Land Est. (ac)	Sub-Total Land Cost ($)	Land Conting. Cost ($)	Total Land Cost ($)	Total Const. + Land ($)
150-BC20-7	62*	1,242	0.006	5	1.6	18	0	10,939	4,376	15,315	0.8	84,967	8,497	93,464	108,779
151-BC20-5	56*	2,400	0.006	5	1.6	18	0	21,139	8,456	29,595	1.6	164,187	16,419	180,606	210,201
619ss-BC30-8	187	1,241	0.045	4' RCP	N/A	N/A	N/A	173,740	69,496	243,236	0.0	0	0	0	243,236
621-BC30-6	72*	2,269	0.002	5	2.2	23	3	53,420	21,368	74,789	1.8	180,228	18,023	198,251	273,040
622-BC30-4	77*	1,333	0.003	5	2	21	0	15,866	6,346	22,212	1.0	100,985	10,098	111,083	133,296
623-BC30-4	77*	1,050	0.002	10	1.8	24	0	14,672	5,869	20,541	0.9	87,741	8,774	96,515	117,056
627-BC10-1	12*	683	0.002	5	0.95	13	0	3,272	1,309	4,581	0.4	38,572	3,857	42,429	47,009
627-BC10-1	12*	1,060	0.009	5	0.7	11	0	3,793	1,517	5,311	0.5	54,995	5,500	60,495	65,806
629-BC10-1	14*	970	0.013	5	0.9	10	0	3,895	1,558	5,453	0.5	48,990	4,899	53,889	59,341
633-BC10-1	630**	866	0.020	10	3.8	40	2	57,839	23,136	80,975	1.0	104,174	10,417	114,592	195,567
634-BC10-4	20*	296	0.005	5	0.8	11	0	1,196	478	1,675	0.2	15,901	1,590	17,491	19,166
634-BC10-2	20*	512	0.015	5	0.8	11	0	2,069	828	2,897	0.3	27,504	2,750	30,255	33,151
634-BC10-2	20*	1,268	0.015	5	0.8	11	0	5,124	2,050	7,174	0.7	68,116	6,812	74,927	82,101
634-BC10-1	20*	52	0.015	5	0.8	11	0	206	82	288	0.0	2,746	275	3,020	3,308
Total								$367,171	$146,869	$514,040	9.8	$979,106	$97,911	$1,077,017	$1,591,057

Table 17. Road and Railroad Crossing Cost Estimates

REACH/ SHEET NO.	Location	Design Point	Water-Shed	Design Storm	Discharge 10-yr (cfs)	Discharge 100-yr (cfs)	Type	Length (ft)	RCP Diam. (in)	RCP Total Cost ($)	RCB Span (ft)	RCB Hght (ft)	RCB Total Cost ($)	Roadway Restor. Cost ($)	Sub-Total Crossing Cost ($)	Const. Conting. Cost ($)	Total Estimated Cost ($)
N/A- 22	NE. Co. L. Rd.	505	CC	100-yr	269	721	RCB	150			12	6	128,222	55,556	183,778	73,511	257,289
CC10-11		536	CC	100-yr	218	392	RCB	150			6	6	94,889	38,889	133,778	53,511	187,289
N/A- 22	N 119th St.	503	CC	100-yr	735	1713	RCB	100			16	10	140,370	51,852	192,222	76,889	269,111
N/A- 22		504	CC	10-yr	102	240	RCP	100	48	28,000				14,000	42,000	16,800	58,800
N/A- 22		506	CC	10-yr	59	210	RCP	100	36	20,000				10,000	30,000	12,000	42,000
N/A- 22		509	CC	10-yr	20	113	RCP	100	24	16,000				8,000	24,000	9,600	33,600
N/A- 22		512	CC	10-yr	13	70	RCP	100	24	16,000				8,000	24,000	9,600	33,600
N/A- 22		511	CC	10-yr	23	95	RCP	100	24	16,000				8,000	24,000	9,600	33,600
N/A- 3	N 115th St.	704	BC	10-yr	52	172	RCP	100	36	20,000				10,000	30,000	12,000	42,000
BC10-1		714	BC	10-yr	630	1736	RCB	100			12	6	91,185	37,037	128,222	51,289	179,511
BP20-18	N 111th St.	306	BG/PT	100-yr	185	473	RCB	100			8	6	76,370	29,630	106,000	42,400	148,400
N/A-22		501	CC	100-yr	421	975	RCB	100			12	8	107,481	40,741	148,222	59,289	207,511
N/A-22	US 287	410	CC	100-yr	262	530	RCB	150			9	6	111,556	47,222	158,778	63,511	222,289
BP20-20		200	BG/PT	100-yr	117	285	RCB	150			6	5	85,556	36,111	121,667	48,667	170,333
BP10-12		1020	BG/PT	100-yr	1758	3862	Brdg	150			65	12	488,000	219,444	707,444	282,978	990,422
BC10-1		1060	BC	100-yr	581	1455	RCB	150			20	8	192,667	83,333	276,000	110,400	386,400
N/A-22	Baseline Rd.	400	CC	100-yr	728	1382	RCB	100			18	8	129,704	51,852	181,556	72,622	254,178
CC50-14	LAWurl Pkwy.	522	CC	100-yr	24	229	RCP	150	72	63,000				31,500	94,500	37,800	132,300
BP20-12		312	BG/PT	100-yr	422	1290	RCB	150			16	8	170,444	72,222	242,667	97,067	339,733
N/A-12		321	BG/PT	100-yr	40	237	RCP	150	72	63,000				31,500	94,500	37,800	132,300
BP20-7	Dobbins Run	103	BG/PT	500 cfs	407	500	RCB	50			9	6	48,593	15,741	64,333	25,733	90,067
BP20-9	Flatiron Dr.	103	BG/PT	500 cfs	500	500	RCB	50			9	6	48,593	15,741	64,333	25,733	90,067
BC20-7	UPRR	1071	BC	100-yr	98	174	RCP	50	60	18,000				9,000	27,000	10,800	37,800
BP20-7		318	BG/PT	100-yr	1249	4527	Brdg	50			90	10	225,556	94,444	320,000	128,000	448,000
BP10-7		104	BG/PT	1000 cfs	1000	1000	RCB	50			12	8	66,741	20,370	87,111	34,844	121,956
BC20-7	Jasper Rd.	708	BC	10-yr	134	285	RCP	100	54	33,000				16,500	49,500	19,800	69,300
BC30-8		150	BC	10-yr	114	220	RCP	100	54	33,000				16,500	49,500	19,800	69,300
N/A-7		702	BC	10-yr	9	48	RCP	50	24	8,000				4,000	12,000	4,800	16,800
BP20-7		319	BG/PT	10-yr	1224	4495	RCB	100			14	8	114,889	44,444	159,333	63,733	223,067
BP10-7		700	BG/PT	10-yr	1005	1035	RCB	100			12	8	107,481	40,741	148,222	59,289	207,511
N/A-4	Kenosha Rd.	717	BC	10-yr	142	394	RCP	100	60	36,000				18,000	54,000	21,600	75,600
N/A-4		624	BC	10-yr	21	76	RCP	100	24	16,000				8,000	24,000	9,600	33,600
BC30-4		710	BC	10-yr	175	473	RCP	100	60	36,000				18,000	54,000	21,600	75,600
	Total									$422,000			$2,428,296	$1,206,370	$4,056,667	$1,622,667	$5,679,333

Table 18. Irrigation Facilities Cost Estimates

All Alternates

Location	SHEET NO.	Study Area Watershed	D/S Design Point	Structure I.D.	Structure Type*	Sub-Total Const. Cost ($)	Const. Conting. Cost ($)	Total Const. Cost ($)
Boulder and Weld Co. Ditch								
109th Street	7	BC/BG/PT	951	1	2	5,000	2,000	7,000
E. of 109th Street	7	BG/PT	319	2	3	20,000	8,000	28,000
E. of 109th Street	7	BC	703	3	3	20,000	8,000	28,000
W. of 119th Street	6	BC	955	4	3	20,000	8,000	28,000
119th Street	6	BC	624	5	2	5,000	2,000	7,000
E. of 119th Street	4	BC/CC	717	6	3	20,000	8,000	28,000
Kenosha Road	4	CC	921	7	2	5,000	2,000	7,000
Subtotal								***$133,000***
Goodhue Ditch								
111th Street	22	CC	501	1	2	5,000	2,000	7,000
E. of 111th Street	20	CC	502	2	3	20,000	8,000	28,000
119th Street	22	CC	504	3	2	5,000	2,000	7,000
NE Co. Line Rd.	21	CC	508	4	2 or 4	10,000	4,000	14,000
Subtotal								***$56,000***
Leyner/Cottonwood Ditch								
LAWurl Pkwy.	12	BG/PT	321	1	3	20,000	8,000	28,000
Prince Trib channel	12	BG/PT	312	2	1 or 4	10,000	4,000	14,000
S. of LA Wurl Pkwy.	12	BG/PT	312	3	3 or 4	20,000	8,000	28,000
LAWurl Pkwy.	12	BG/PT	312	4	2	5,000	2,000	7,000
S. of Flatiron Drive	9	BG/PT	315	5	3	20,000	8,000	28,000
Flatiron Drive	9	BG/PT/BC	315	6	2	5,000	2,000	7,000
W. of 119th Street	10	BC	707	7	3	20,000	8,000	28,000
119th Street	10	BC	706	8	2	5,000	2,000	7,000
E. of 119th Street	10	BC/CC	706	9	3	20,000	8,000	28,000
Stanley Dr., Palmer Ln., Miller St.	10,13,13	CC	1042	10	2	15,000	6,000	21,000
E. of Miller Street	10	CC	530	11	3	20,000	8,000	28,000
LA Wurl Pkwy/NE Co. Line Rd. Intersection	14	CC	521	12	4	10,000	4,000	14,000
Subtotal								***$238,000***
Leyner/Cottonwood - Waste Ditch								
Pr. Trib. Channel		see PT chnl	312-319					
Liggett Ditch								
109th Street	3	BC	701	1	2	5,000	2,000	7,000
Lookout Road	3	BC	956	2	2	5,000	2,000	7,000
W. of 115th Street	1	BC	714	3	3	20,000	8,000	28,000
115th Street	1	BC	718	4	2	5,000	2,000	7,000

Table 18. Irrigation Facilities Cost Estimates (cont'd)

Location	SHEET NO.	Study Area Watershed	D/S Design Point	Structure I.D.	Structure Type*	Sub-Total Const. Cost ($)	Const. Conting. Cost ($)	Total Const. Cost ($)
36" RCP E. of US Hwy 287	1	BC	N/A	1	4	10,000	4,000	14,000
Hwy 52	22	BC	722	5	2	5,000	2,000	7,000
Subtotal								***$70,000***
Lower Boulder Ditch								
109th Street	8	BG/PT	317	1	2	5,000	2,000	7,000
Ley/Cot w.d. crossing		see PT plans	318				0	0
UPRR	7	BC	1071	2	2	5,000	2,000	7,000
119th Street	8	BC	708	3	2	5,000	2,000	7,000
Jasper Road	8	BC	715	4	2 or 3	5,000	2,000	7,000
12'x8' RCB E. of US Hwy 287	9	BP	N/A	N/A	4	87,111	34,845	121,956
60" RCP E. Dale Drive	9	BP	N/A	N/A	4	27,000	10,800	37,800
W. of NE Co. Line Rd.	22	CC	541	5	2	5,000	2,000	7,000
NE Co. Line Road	23	CC	539	6	2	5,000	2,000	7,000
Subtotal								***$201,756***
South Boulder Canyon Ditch								
N 111th Street	20	BG/PT	303	1	2	5,000	2,000	7,000
Arapahoe Rd.	20	BG/PT	303	2	2	5,000	2,000	7,000
N. 119th Street	16	CC	523	3	2	5,000	2,000	7,000
Subtotal								***$21,000***
							TOTAL	***$719,756***

Note: BC= Boulder Ck., CC = Coal Ck., BG = Bullhead G., PT = Prince Trib.

* Structure Type:

1 Bypass
2 Existing Culvert, Minor Modifications
3 Overflow Weir and Flow Limiter
4 Underground Conduit

All construction and land costs are in year 2000 dollars. No financing costs or monetary impacts of phased construction or purchase of the proposed improvements are included in these cost estimates.

The cost estimates prepared for this study are conceptual in nature and should be used for comparative purposes only.

1. Regional Detention Facilities

Proposed construction and land costs for the proposed regional detention facilities for each of the alternates are presented in Table 15. Construction costs are based on the estimated costs of pond excavation, embankment fill, outlet structure installation, and revegetation. Excavation and embankment earthwork volumes are based on the pond volume, berm height, and the cut and fill percentages tabulated in Table 15. The outlet structure costs are based on the outlet size and lengths tabulated in Table 15. Costs do not include utility relocation, water quality features, wetland reconstruction, or landscape plantings.

2. Conveyance Facilities

Proposed construction and land costs for the proposed conveyance facility improvements, including open channels and storm sewers are presented in Table 16. Construction cost estimates utilized estimated cost of channel excavation, drop structure installation, and revegetation. Channel excavation quantities are based on the bottom width, top width and channel depth indicated in Table 16. Drop structures are needed in many channels to reduce channel slopes to maintain maximum velocity and Froude number criteria. The number of drop structures along each channel was identified assuming 2-foot vertical drops and the channel length and slope tabulated in Table 16. The area requiring revegetation was calculated as the product of the total width times the channel length. Storm sewer costs were estimated using unit prices presented in Table 14.

Cost comparisons in the Alternate Evaluation Report assumed channels capable of conveying the 100-year flood would be constructed in all areas. Cost estimates in the Preliminary Design Report were refined assuming channels capable of conveying only the 2-year flood peak would be constructed in open space areas, no channels would be constructed in wetland areas, and floodplain overflow channels in populated areas in Bullhead Gulch/Prince Tributary were eliminated. Primarily for these reasons, channel improvement costs for Boulder Creek Tributaries and Bullhead Gulch/Prince Tributary and are substantially less in the Preliminary Design Report than those shown in the Alternate Report.

Land costs are based on the estimated land required for the proposed channel improvements. It is assumed there is no cost for land for 2-year channels located in open space areas. The total land required was calculated as the product of the total width of the channel times the channel length. Probable shallow groundwater precluded including concrete trickle channels in cost estimates. Channel costs do not include wetland or landscape plantings or trails.

3. Road and Railroad Crossings

Proposed construction costs for the proposed road and railroad crossings were estimated for each of the alternates and are presented in Table 17. Construction costs are based on the estimated conduit cost plus roadway restoration and traffic control. The road and railroad conduit costs are based on the conduit size and lengths tabulated in Table 17. The roadway restoration and traffic control costs are calculated as a percentage of the conduit cost. For purposes of this study it was assumed no additional land or right of way is required for the proposed roadway crossings. The roadway crossing costs do not include roadway widening, wetland or landscape plantings, or pedestrian trail underpasses.

4. Irrigation Facilities

Proposed construction costs for the proposed irrigation facilities are presented in Table 18. Irrigation facility improvements were divided into four categories; bypass structures, minor modifications to existing culverts, flow limiter with overflow weir, and underground conduits. Unit costs were developed for each of the four types of improvements.

Bypass or cross drainage structures allow storm runoff to flow over or under the irrigation ditch without affecting the flow in the irrigation ditch. Minor modifications to existing culverts include improvements to limit flows in the irrigation ditch and encourage controlled spills in excess of the ditch capacity. Flow limiter with overflow weir structures limit flows in the irrigation ditch and encourage controlled spills in excess of the ditch capacity. Underground conduits are proposed were existing irrigation facilities are in conflict with proposed detention facilities.

Construction costs are based on the structure type identified in Table 18. This study assumed no additional land or right of way is required for the proposed irrigation facilities improvements.

5. Annualized Maintenance Cost Estimate

All stormwater facilities require periodic maintenance to ensure their proper operation. Maintenance includes such items as routine mowing, sediment cleanout, and debris and trash removal. Periodic repairs to drainage facilities may also be required. For this study, annualized maintenance costs are estimated based on a percentage of construction costs; 5 percent for detention facilities, 3 percent for conveyance facilities and 2 percent for road and railroad crossings. Annualized maintenance costs are summarized in Table 19. Estimated annualized maintenance costs are approximately $1,200,000.

Table 19. Summary of Annualized Maintenance Cost Estimates

Improvement	Alternate
Regional Detention Facilities	
Coal Creek Tributaries	$331,924
Bullhead Gulch/Prince Tributary	$81,223
Boulder Creek Tributaries	$89,638
Sub-Total	$502,785
Channel Improvements	
Coal Creek Tributaries	$100,493
Bullhead Gulch/Prince Tributary	$267,132
Boulder Creek Tributaries	$116,450
Sub-Total	$484,076
Roadway Crossings	
Sub-Total	$167,967
TOTAL	$1,154,828

6. Summary

Table 20 below summarizes the overall estimated project costs. The total estimated probable cost for the Outfall System is approximately $46,320,080. These cost estimates are conceptual and should be used for comparative purposes only. Multiple purpose land use, which could reduce the overall land cost estimates, has not been included in land use estimates. Detention facilities represent approximately 53 per cent, conveyance facilities represent approximately 33 per cent, road and railroad crossings represent approximately 12 per cent, and irrigation facility improvements represent approximately 2 per cent of the total cost estimate.

Table 20. Cost Estimate Summary

IMPROVEMENT	PRELIMINARY DESIGN		
	Total Construction Cost	Total Land Cost	**Total Cost**
Regional Detention Facilities			
Coal Creek Tributaries	$6,073,111	$9,368,327	$15,441,437
Bullhead Gulch/Prince Tributary	$1,781,262	$3,600,755	$5,382,017
Boulder Creek Tributaries	$1,812,360	$1,789,478	$3,601,837
Sub-Total	**$9,666,732**	**$14,758,559**	**$24,425,291**
Channel Improvements			
Coal Creek Tributaries	$2,352,333	$2,774,053	$5,126,386
Bullhead Gulch/Prince Tributary	$4,531,158	$4,247,099	$8,778,257
Boulder Creek Tributaries	$514,040	$1,077,017	$1,591,057
Sub-Total	**$7,397,531**	**$8,098,169**	**$15,495,700**
Road and Railroad Crossings			
Coal Creek Tributaries	$1,731,567	-	$1,731,567
Bullhead Gulch/Prince Tributary	$2,961,856	-	$2,961,856
Boulder Creek Tributaries	$985,911	-	$985,911
Sub-Total	**$5,679,333**	**$0**	**$5,679,333**
Irrigation facilities			
Boulder and Weld Co. Ditch	$133,000	-	$133,000
Goodhue Ditch	$56,000	-	$56,000
Leyner/Cottonwood Ditch	$238,000	-	$238,000
Liggett Ditch	$70,000	-	$70,000
Lower Boulder Ditch	$201,756	-	$201,756
South Boulder Canyon Ditch	$21,000	-	$21,000
Sub-Total	**$719,756**	**$0**	**$719,756**
Total	**$23,463,353**	**$22,856,728**	**$46,320,080**

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APPENDIX A1

HYDROLOGIC MODELS AND UDSWM FLOW CHARTS
EXISTING AND FUTURE PERCENT IMPERVIOUSNESS

Tables

A1 On-Site Areas - UDSWM Basin and Conveyance Parameters, Existing Conditions
A2 On-Site Areas - UDSWM Basin and Conveyance Parameters, Future Conditions
A3 Off-Site Areas - Bullhead Gulch, Greiner Model CUHPF Parameters, Existing Conditions
A4 Off-Site Areas - Bullhead Gulch, Greiner Model CUHPF Parameters, Future Conditions
A5 Off-Site Areas - UDSWM Basin and Conveyance Parameters, Existing Conditions
A6 Off-Site Areas - UDSWM Basin and Conveyance Parameters, Future Conditions
A7 Off-Site Areas – OS1, and OS2, CUHPF Parameters, Existing Conditions
A8 Off-Site Areas – OS1, and OS2, CUHPF Parameters, Future Conditions

Figures

A1–A4 SWMM Flow Charts, Existing and Future Conditions

Table A1. On-Site Areas - UDSWM Basin and Conveyance Parameters, Existing Conditions

Coal Creek Tributaries, Existing Conditions

SUBAREA NUMBER	GUTTER OR MANHOLE	WIDTH (FT)	AREA (AC)	PERCENT IMPERV.	SLOPE (FT/FT)	RESISTANCE FACTOR IMPERV.	RESISTANCE FACTOR PERV.	SURFACE STORAGE(IN) IMPERV.	SURFACE STORAGE(IN) PERV.	INFILTRATION RATE(IN/HR) MAXIMUM	INFILTRATION RATE(IN/HR) MINIMUM	INFILTRATION RATE(IN/HR) DECAY RATE	GAGE NO
410	410	10546.	156.9	33.0	.0180	.020	.200	.100	.300	4.14	.58	.00180	1
411	411	9029.	89.9	17.4	.0200	.020	.200	.100	.300	3.54	.54	.00180	1
412	412	10238.	87.3	4.2	.0330	.020	.200	.100	.300	3.90	.56	.00180	1
413	413	9364.	29.5	17.4	.0270	.020	.200	.100	.300	4.50	.60	.00180	1
414	414	12312.	84.1	37.5	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
415	415	9450.	80.1	20.4	.0310	.020	.200	.100	.300	4.02	.57	.00180	1
416	416	8712.	89.7	2.0	.0130	.020	.200	.100	.300	4.50	.60	.00180	1
417	417	9428.	40.3	30.8	.0210	.020	.200	.100	.300	4.25	.58	.00180	1
418	418	9482.	58.2	8.7	.0140	.020	.200	.100	.300	4.01	.57	.00180	1
424	424	11286.	64.3	2.0	.0240	.020	.200	.100	.300	4.50	.60	.00180	1
425	425	16459.	127.2	2.9	.0130	.020	.200	.100	.300	4.35	.59	.00180	1
426	426	11844.	76.8	12.0	.0980	.020	.200	.100	.300	4.14	.58	.00180	1
427	427	3132.	45.5	15.0	.0120	.020	.200	.100	.300	4.25	.58	.00180	1
428	428	2142.	4.9	2.0	.0130	.020	.200	.100	.300	4.47	.60	.00180	1
430	430	11016.	110.9	2.5	.0240	.020	.200	.100	.300	4.50	.60	.00180	1
431	431	11858.	106.5	2.0	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
432	432	6950.	67.0	3.9	.0070	.020	.200	.100	.300	4.50	.60	.00180	1
433	433	4194.	18.9	3.9	.0190	.020	.200	.100	.300	4.50	.60	.00180	1
435	435	10350.	56.0	2.0	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
436	436	14200.	127.5	2.0	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
437	437	2860.	27.7	2.0	.0280	.020	.200	.100	.300	4.50	.60	.00180	1
440	440	5330.	67.1	2.0	.0150	.020	.200	.100	.300	4.50	.60	.00180	1
441	441	5864.	41.8	2.0	.0180	.020	.200	.100	.300	4.50	.60	.00180	1
442	442	12636.	98.7	2.0	.0200	.020	.200	.100	.300	4.50	.60	.00180	1
443	443	6448.	20.9	2.0	.0230	.020	.200	.100	.300	4.50	.60	.00180	1
444	444	6338.	60.7	2.0	.0100	.020	.200	.100	.300	4.50	.60	.00180	1
445	445	3096.	13.8	2.0	.0330	.020	.200	.100	.300	4.50	.60	.00180	1
446	446	16200.	118.8	2.0	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
447	447	4410.	16.6	2.0	.0240	.020	.200	.100	.300	4.50	.60	.00180	1
450	450	9738.	42.1	2.0	.0260	.020	.200	.100	.300	4.50	.60	.00180	1
451	451	6941.	113.6	2.0	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
452	452	7402.	65.6	2.0	.0110	.020	.200	.100	.300	4.05	.57	.00180	1
453	453	6062.	60.6	2.0	.0150	.020	.200	.100	.300	4.50	.60	.00180	1
455	455	17917.	123.6	2.0	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
456	456	18216.	122.4	2.0	.0250	.020	.200	.100	.300	4.50	.60	.00180	1
457	457	4464.	74.3	2.0	.0150	.020	.200	.100	.300	4.50	.60	.00180	1
458	458	2230.	49.8	2.0	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
459	459	8190.	125.8	2.0	.0080	.020	.200	.100	.300	4.29	.59	.00180	1
461	461	5998.	42.6	12.1	.0290	.020	.200	.100	.300	4.50	.60	.00180	1
462	462	10676.	78.6	2.0	.0240	.020	.200	.100	.300	4.50	.60	.00180	1
463	463	2750.	39.4	2.0	.0150	.020	.200	.100	.300	4.50	.60	.00180	1
464	464	7686.	99.3	2.0	.0050	.020	.200	.100	.300	4.26	.58	.00180	1
465	465	5314.	51.0	2.0	.0130	.020	.200	.100	.300	4.50	.60	.00180	1
466	466	8719.	60.6	6.9	.0090	.020	.200	.100	.300	4.40	.59	.00180	1
467	467	5947.	68.6	2.5	.0080	.020	.200	.100	.300	4.11	.57	.00180	1
470	470	4342.	47.3	2.0	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
471	471	10746.	85.0	9.7	.0170	.020	.200	.100	.300	4.50	.60	.00180	1
472	472	2430.	35.8	2.0	.0160	.020	.200	.100	.300	4.50	.60	.00180	1
473	473	2873.	13.3	50.0	.0210	.020	.200	.100	.300	4.50	.60	.00180	1
474	474	2214.	37.1	50.0	.0080	.020	.200	.100	.300	4.50	.60	.00180	1
475	475	4045.	95.5	3.4	.0120	.020	.200	.100	.300	4.50	.60	.00180	1
476	476	10382.	118.3	50.0	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
477	477	4946.	31.7	43.3	.0230	.020	.200	.100	.300	4.50	.60	.00180	1
478	478	4118.	96.8	6.8	.0080	.020	.200	.100	.300	4.50	.60	.00180	1
479	479	5998.	40.0	2.0	.0160	.020	.200	.100	.300	4.50	.60	.00180	1
480	480	4421.	55.3	12.2	.0120	.020	.200	.100	.300	4.50	.60	.00180	1
481	481	4145.	64.0	4.9	.0120	.020	.200	.100	.300	4.50	.60	.00180	1
482	482	3564.	30.2	66.8	.0110	.020	.200	.100	.300	4.50	.60	.00180	1
483	483	4212.	27.3	56.2	.0100	.020	.200	.100	.300	4.50	.60	.00180	1
484	484	10708.	78.9	48.6	.0050	.020	.200	.100	.300	4.50	.60	.00180	1
485	485	8208.	128.2	45.2	.0060	.020	.200	.100	.300	4.17	.58	.00180	1
486	486	10562.	120.2	13.9	.0070	.020	.200	.100	.300	3.62	.54	.00180	1
487	487	9034.	119.6	15.2	.0090	.020	.200	.100	.300	3.68	.55	.00180	1
488	488	4428.	57.6	33.6	.0100	.020	.200	.100	.300	3.72	.55	.00180	1
490	490	12830.	88.3	6.0	.0120	.020	.200	.100	.300	4.14	.58	.00180	1
491	491	10325.	71.7	17.6	.0040	.020	.200	.100	.300	4.10	.57	.00180	1
492	492	10055.	109.5	9.4	.0090	.020	.200	.100	.300	3.68	.55	.00180	1
493	493	6111.	56.5	6.1	.0020	.020	.200	.100	.300	4.50	.60	.00180	1
494	494	3420.	11.6	2.8	.0070	.020	.200	.100	.300	3.95	.56	.00180	1
401	901	900.	26.0	17.8	.0200	.020	.200	.100	.300	3.21	.51	.00180	1
423	902	540.	13.1	49.5	.0330	.020	.200	.100	.300	3.78	.55	.00180	1
429	904	1710.	30.7	24.3	.0290	.020	.200	.100	.300	4.50	.60	.00180	1
448	909	1980.	65.1	2.0	.0140	.020	.200	.100	.300	4.35	.59	.00180	1
489	920	1620.	33.5	7.3	.0090	.020	.200	.100	.300	4.02	.57	.00180	1
495	922	1080.	29.5	2.0	.0030	.020	.200	.100	.300	3.00	.50	.00180	1
496	923	900.	47.9	2.0	.0040	.020	.200	.100	.300	4.35	.59	.00180	1
497	924	1080.	59.2	2.0	.0030	.020	.200	.100	.300	3.00	.50	.00180	1

TOTAL TRIBUTARY AREA (ACRES), 5130.20

Table A1. On-Site Areas - UDSWM Basin and Conveyance Parameters, Existing Conditions (con.)

Coal Creek Tributaries, Existing Conditions (con.)

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	SIDE SLOPES HORIZ TO VERT R	OVERBANK/SURCHARGE MANNING N	OVERBANK/SURCHARGE DEPTH (FT)	JK
410	500	0	4	CHANNEL	5.0	3255.	.0180	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3255.	.0180	20.0	20.0	.056	10.00	
411	501	0	4	CHANNEL	8.0	3160.	.0330	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3160.	.0330	20.0	20.0	.044	10.00	
412	501	0	4	CHANNEL	5.0	3160.	.0330	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3160.	.0330	20.0	20.0	.056	10.00	
413	502	0	4	CHANNEL	5.0	2890.	.0270	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2890.	.0270	20.0	20.0	.056	10.00	
414	502	0	4	CHANNEL	8.0	3420.	.0220	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3420.	.0220	20.0	20.0	.044	10.00	
415	502	0	4	CHANNEL	10.0	2625.	.0310	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	2625.	.0310	20.0	20.0	.056	10.00	
416	503	0	4	CHANNEL	10.0	3025.	.0130	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	3025.	.0130	20.0	20.0	.056	10.00	
417	503	0	4	CHANNEL	8.0	4365.	.0210	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4365.	.0210	20.0	20.0	.044	10.00	
418	900	0	4	CHANNEL	8.0	4390.	.0140	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4390.	.0140	20.0	20.0	.044	10.00	
424	504	0	4	CHANNEL	5.0	3135.	.0240	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3135.	.0240	20.0	20.0	.056	10.00	
425	505	0	4	CHANNEL	8.0	5080.	.0130	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	5080.	.0130	20.0	20.0	.056	10.00	
426	505	0	4	CHANNEL	5.0	4700.	.0980	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	4700.	.0980	20.0	20.0	.056	10.00	
427	505	0	4	CHANNEL	8.0	1450.	.0120	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1450.	.0120	20.0	20.0	.044	10.00	
428	903	0	4	CHANNEL	10.0	595.	.0130	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	595.	.0130	20.0	20.0	.056	10.00	
430	506	0	4	CHANNEL	5.0	3825.	.0240	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3825.	.0240	20.0	20.0	.056	10.00	
431	507	0	4	CHANNEL	8.0	3660.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	3660.	.0140	20.0	20.0	.056	10.00	
432	508	0	4	CHANNEL	10.0	2145.	.0070	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2145.	.0070	20.0	20.0	.056	10.00	
433	905	0	4	CHANNEL	10.0	1165.	.0190	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1165.	.0190	20.0	20.0	.056	10.00	
435	509	0	4	CHANNEL	5.0	2875.	.0220	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2875.	.0220	20.0	20.0	.056	10.00	
436	510	0	4	CHANNEL	8.0	5635.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	5635.	.0140	20.0	20.0	.056	10.00	
437	906	0	4	CHANNEL	10.0	1135.	.0280	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1135.	.0280	20.0	20.0	.056	10.00	
440	511	0	4	CHANNEL	5.0	1645.	.0150	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	1645.	.0150	20.0	20.0	.056	10.00	
441	512	0	4	CHANNEL	8.0	2715.	.0180	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2715.	.0180	20.0	20.0	.044	10.00	
442	513	0	4	CHANNEL	8.0	3510.	.0200	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	3510.	.0200	20.0	20.0	.056	10.00	
443	513	0	4	CHANNEL	8.0	2985.	.0230	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2985.	.0230	20.0	20.0	.044	10.00	
444	514	0	4	CHANNEL	10.0	2515.	.0100	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2515.	.0100	20.0	20.0	.056	10.00	
445	907	0	4	CHANNEL	10.0	860.	.0330	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	860.	.0330	20.0	20.0	.056	10.00	
446	515	0	4	CHANNEL	5.0	4500.	.0220	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	4500.	.0220	20.0	20.0	.056	10.00	
447	908	0	4	CHANNEL	8.0	1225.	.0240	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	1225.	.0240	20.0	20.0	.056	10.00	
450	516	0	4	CHANNEL	5.0	2705.	.0260	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2705.	.0260	20.0	20.0	.056	10.00	
451	517	0	4	CHANNEL	8.0	2410.	.0220	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	2410.	.0220	20.0	20.0	.056	10.00	
452	910	0	4	CHANNEL	10.0	2570.	.0110	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2570.	.0110	20.0	20.0	.056	10.00	
453	911	0	4	CHANNEL	5.0	2105.	.0150	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2105.	.0150	20.0	20.0	.056	10.00	
455	518	0	4	CHANNEL	5.0	5530.	.0220	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	5530.	.0220	20.0	20.0	.056	10.00	
456	518	0	4	CHANNEL	5.0	5060.	.0250	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	5060.	.0250	20.0	20.0	.056	10.00	
457	519	0	4	CHANNEL	8.0	1240.	.0150	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	1240.	.0150	20.0	20.0	.056	10.00	
458	520	0	4	CHANNEL	10.0	885.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	885.	.0140	20.0	20.0	.056	10.00	
459	912	0	4	CHANNEL	10.0	3250.	.0080	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	3250.	.0080	20.0	20.0	.056	10.00	
461	521	0	4	CHANNEL	5.0	2380.	.0290	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2380.	.0290	20.0	20.0	.056	10.00	

Table A1. On-Site Areas - UDSWM Basin and Conveyance Parameters, Existing Conditions (con.)

Coal Creek Tributaries, Existing Conditions (con.)

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	OVERBANK/SURCHARGE MANNING N	DEPTH (FT)	JK
462	521	0	4	CHANNEL	5.0	3295.	.0240	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3295.	.0240	20.0	20.0	.056	10.00	
463	522	0	4	CHANNEL	8.0	955.	.0150	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	955.	.0150	20.0	20.0	.056	10.00	
464	913	0	4	CHANNEL	10.0	3050.	.0050	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	3050.	.0050	20.0	20.0	.056	10.00	
465	914	0	4	CHANNEL	5.0	1845.	.0130	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	1845.	.0130	20.0	20.0	.056	10.00	
466	915	0	4	CHANNEL	5.0	3460.	.0090	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3460.	.0090	20.0	20.0	.056	10.00	
467	915	0	4	CHANNEL	5.0	2360.	.0080	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2360.	.0080	20.0	20.0	.056	10.00	
470	523	0	4	CHANNEL	8.0	2010.	.0220	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2010.	.0220	20.0	20.0	.044	10.00	
471	525	0	4	CHANNEL	5.0	2985.	.0170	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2985.	.0170	20.0	20.0	.056	10.00	
472	528	0	4	CHANNEL	8.0	1125.	.0160	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1125.	.0160	20.0	20.0	.044	10.00	
473	526	0	4	CHANNEL	8.0	1330.	.0210	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1330.	.0210	20.0	20.0	.044	10.00	
474	1041	0	4	CHANNEL	8.0	1025.	.0080	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1025.	.0080	20.0	20.0	.044	10.00	
475	529	0	4	CHANNEL	8.0	1605.	.0120	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	1605.	.0120	20.0	20.0	.056	10.00	
476	1042	0	4	CHANNEL	10.0	4120.	.0140	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	4120.	.0140	20.0	20.0	.056	10.00	
477	530	0	4	CHANNEL	8.0	2290.	.0230	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2290.	.0230	20.0	20.0	.044	10.00	
478	531	0	4	CHANNEL	10.0	1430.	.0080	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1430.	.0080	20.0	20.0	.056	10.00	
479	533	0	4	CHANNEL	5.0	2380.	.0160	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2380.	.0160	20.0	20.0	.056	10.00	
480	534	0	4	CHANNEL	5.0	1535.	.0120	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	1535.	.0120	20.0	20.0	.056	10.00	
481	532	0	4	CHANNEL	10.0	1645.	.0120	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1645.	.0120	20.0	20.0	.056	10.00	
482	536	0	4	CHANNEL	5.0	1650.	.0110	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	1650.	.0110	20.0	20.0	.056	10.00	
483	538	0	4	CHANNEL	10.0	1170.	.0100	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1170.	.0100	20.0	20.0	.056	10.00	
484	917	0	4	CHANNEL	8.0	3305.	.0050	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3305.	.0050	20.0	20.0	.044	10.00	
485	916	0	4	CHANNEL	8.0	2850.	.0060	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2850.	.0060	20.0	20.0	.044	10.00	
486	918	0	4	CHANNEL	5.0	3260.	.0070	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3260.	.0070	20.0	20.0	.056	10.00	
487	539	0	4	CHANNEL	5.0	3585.	.0090	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3585.	.0090	20.0	20.0	.056	10.00	
488	919	0	4	CHANNEL	8.0	2050.	.0100	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2050.	.0100	20.0	20.0	.044	10.00	
490	540	0	4	CHANNEL	5.0	3960.	.0120	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3960.	.0120	20.0	20.0	.056	10.00	
491	541	0	4	CHANNEL	8.0	4780.	.0040	3.0	3.0	.038	3.00	0
				OVERFLOW	26.0	4780.	.0040	20.0	20.0	.056	10.00	
492	541	0	4	CHANNEL	5.0	3990.	.0090	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3990.	.0090	20.0	20.0	.056	10.00	
493	921	0	4	CHANNEL	5.0	2425.	.0020	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2425.	.0020	20.0	20.0	.056	10.00	
494	921	0	4	CHANNEL	10.0	950.	.0070	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	950.	.0070	20.0	20.0	.056	10.00	
524	525	0	4	CHANNEL	8.0	1615.	.0170	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1615.	.0170	20.0	20.0	.044	10.00	
527	529	0	4	CHANNEL	8.0	2485.	.0140	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2485.	.0140	20.0	20.0	.044	10.00	
533	534	0	4	CHANNEL	8.0	1500.	.0130	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1500.	.0130	20.0	20.0	.044	10.00	
535	536	0	4	CHANNEL	8.0	750.	.0090	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	750.	.0090	20.0	20.0	.044	10.00	
537	538	0	4	CHANNEL	8.0	1190.	.0050	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1190.	.0050	20.0	20.0	.044	10.00	
1040	428	7	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	2.8	22.0	10.2	48.0	11.1	147.0	12.6	296.0	20.5 644.0
		28.4	991.0									
1042	530	11	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	.8	10.0	1.7	20.0	2.7	22.0	2.9	65.0	4.5 77.0
		4.8	79.0	5.7	185.0	6.2	249.0	7.3	523.0	8.5	797.0	

Table A1. On-Site Areas - UDSWM Basin and Conveyance Parameters, Existing Conditions (con.)

Coal Creek Tributaries, Existing Conditions (con.)

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	OVERBANK/SURCHARGE MANNING N	DEPTH (FT)	JK
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	1.6	5.0	2.7	9.0	4.4	21.0	7.0	33.0	9.0 87.0
		11.2	99.0	13.2	111.0	13.6	334.0	13.8	557.0			
400	900	17	3			.0	0.	.0001	.0	.0	.001	.01 -1
		TIME IN HRS VS INFLOW IN CFS										
		.0	.0	.3	1.0	.4	17.6	.5	88.4	.8	449.9	.8 500.8
		.9	513.5	1.0	506.3	1.2	479.9	1.5	350.2	2.0	200.5	2.5 111.4
		3.0	60.6	3.5	33.0	4.0	17.8	5.0	.0	8.0	.0	

Bullhead Gulch/Prince Tributary, Existing Conditions

SUBAREA NUMBER	GUTTER OR MANHOLE	WIDTH (FT)	AREA (AC)	PERCENT IMPERV.	SLOPE (FT/FT)	RESISTANCE FACTOR IMPERV.	PERV.	SURFACE STORAGE(IN) IMPERV.	PERV.	INFILTRATION RATE(IN/HR) MAXIMUM	MINIMUM	DECAY RATE	GAGE NO
200	200	7889.	95.6	4.0	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
201	201	11713.	56.7	8.4	.0150	.020	.200	.100	.300	4.50	.60	.00180	1
202	202	8003.	42.8	29.4	.0160	.020	.200	.100	.300	4.50	.60	.00180	1
203	203	5688.	53.8	6.8	.0200	.020	.200	.100	.300	4.50	.60	.00180	1
204	204	4860.	85.2	27.4	.0190	.020	.200	.100	.300	4.50	.60	.00180	1
205	205	9331.	73.6	17.4	.0160	.020	.200	.100	.300	4.50	.60	.00180	1
206	206	12114.	71.6	50.0	.0150	.020	.200	.100	.300	4.50	.60	.00180	1
207	207	10584.	79.8	50.0	.0130	.020	.200	.100	.300	4.50	.60	.00180	1
208	208	4666.	65.1	2.5	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
209	209	4561.	124.8	3.4	.0190	.020	.200	.100	.300	4.50	.60	.00180	1
210	210	3564.	26.2	2.0	.0170	.020	.200	.100	.300	4.50	.60	.00180	1
211	211	5022.	40.1	2.0	.0070	.020	.200	.100	.300	4.50	.60	.00180	1
212	212	6804.	76.7	2.0	.0210	.020	.200	.100	.300	4.50	.60	.00180	1
213	213	6552.	64.8	2.0	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
215	215	7852.	81.6	2.0	.0150	.020	.200	.100	.300	4.50	.60	.00180	1
216	216	6426.	49.9	2.0	.0210	.020	.200	.100	.300	4.50	.60	.00180	1
217	217	11405.	110.5	2.0	.0280	.020	.200	.100	.300	4.50	.60	.00180	1
218	218	6880.	91.0	3.4	.0230	.020	.200	.100	.300	4.50	.60	.00180	1
219	219	5393.	64.1	2.0	.0130	.020	.200	.100	.300	4.50	.60	.00180	1
220	220	9198.	47.5	2.0	.0270	.020	.200	.100	.300	4.50	.60	.00180	1
221	221	11246.	128.8	2.0	.0260	.020	.200	.100	.300	4.50	.60	.00180	1
222	222	11167.	84.5	19.7	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
235	235	9817.	122.4	2.0	.0270	.020	.200	.100	.300	4.50	.60	.00180	1
236	236	3652.	99.8	2.0	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
237	237	5530.	58.6	2.0	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
238	238	5166.	87.5	7.3	.0060	.020	.200	.100	.300	4.50	.60	.00180	1
240	240	9380.	49.3	5.0	.0080	.020	.200	.100	.300	4.50	.60	.00180	1
241	241	8482.	103.3	42.3	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
242	242	6552.	64.3	3.8	.0070	.020	.200	.100	.300	4.34	.59	.00180	1
243	243	10314.	99.9	2.0	.0030	.020	.200	.100	.300	3.06	.50	.00180	1

TOTAL TRIBUTARY AREA (ACRES), 2299.80

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	OVERBANK/SURCHARGE MANNING N	DEPTH (FT)	JK
200	300	0	4	CHANNEL	5.0	2435.	.0220	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2435.	.0220	20.0	20.0	.056	10.00	
201	300	0	4	CHANNEL	5.0	3615.	.0150	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3615.	.0150	20.0	20.0	.056	10.00	
202	302	0	4	CHANNEL	8.0	2615.	.0160	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2615.	.0160	20.0	20.0	.044	10.00	
203	303	0	4	CHANNEL	8.0	1580.	.0200	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	1580.	.0200	20.0	20.0	.056	10.00	
204	303	0	4	CHANNEL	8.0	2250.	.0190	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2250.	.0190	20.0	20.0	.044	10.00	
205	305	0	4	CHANNEL	8.0	3240.	.0160	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3240.	.0160	20.0	20.0	.044	10.00	
206	1026	0	4	CHANNEL	8.0	3365.	.0150	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3365.	.0150	20.0	20.0	.044	10.00	
207	1026	0	4	CHANNEL	8.0	3675.	.0130	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3675.	.0130	20.0	20.0	.044	10.00	
208	307	0	4	CHANNEL	5.0	2160.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2160.	.0140	20.0	20.0	.056	10.00	
209	306	0	4	CHANNEL	10.0	1810.	.0190	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1810.	.0190	20.0	20.0	.056	10.00	
210	308	0	4	CHANNEL	8.0	1100.	.0170	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	1100.	.0170	20.0	20.0	.056	10.00	
211	308	0	4	CHANNEL	10.0	1550.	.0070	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1550.	.0070	20.0	20.0	.056	10.00	
212	310	0	4	CHANNEL	5.0	2100.	.0210	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2100.	.0210	20.0	20.0	.056	10.00	
213	311	0	4	CHANNEL	8.0	1820.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	1820.	.0140	20.0	20.0	.056	10.00	

Table A1. On-Site Areas - UDSWM Basin and Conveyance Parameters, Existing Conditions (con.)

Bullhead Gulch/Prince Tributary, Existing Conditions (con.)

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	MANNING N	OVERBANK/SURCHARGE DEPTH (FT)	JK
215	312	0	4	CHANNEL	10.0	3635.	.0150	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	3635.	.0150	20.0	20.0	.056	10.00	
216	312	0	4	CHANNEL	8.0	2975.	.0210	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2975.	.0210	20.0	20.0	.044	10.00	
217	312	0	4	CHANNEL	5.0	3520.	.0280	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3520.	.0280	20.0	20.0	.056	10.00	
218	312	0	4	CHANNEL	8.0	3185.	.0230	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3185.	.0230	20.0	20.0	.044	10.00	
219	313	0	4	CHANNEL	10.0	2140.	.0130	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	2140.	.0130	20.0	20.0	.056	10.00	
220	313	0	4	CHANNEL	5.0	3650.	.0270	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3650.	.0270	20.0	20.0	.056	10.00	
221	315	0	4	CHANNEL	5.0	3905.	.0260	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3905.	.0260	20.0	20.0	.056	10.00	
222	315	0	4	CHANNEL	8.0	5170.	.0220	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	5170.	.0220	20.0	20.0	.044	10.00	
235	320	0	4	CHANNEL	8.0	4545.	.0270	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4545.	.0270	20.0	20.0	.044	10.00	
236	321	0	4	CHANNEL	8.0	1691.	.0140	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1691.	.0140	20.0	20.0	.044	10.00	
237	322	0	4	CHANNEL	10.0	2560.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2560.	.0140	20.0	20.0	.056	10.00	
238	323	0	4	CHANNEL	10.0	2050.	.0060	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2050.	.0060	20.0	20.0	.056	10.00	
240	318	0	4	CHANNEL	5.0	2895.	.0080	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2895.	.0080	20.0	20.0	.056	10.00	
241	318	0	4	CHANNEL	5.0	2945.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2945.	.0140	20.0	20.0	.056	10.00	
242	319	0	4	CHANNEL	10.0	1820.	.0070	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1820.	.0070	20.0	20.0	.056	10.00	
243	940	0	4	CHANNEL	10.0	2865.	.0030	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2865.	.0030	20.0	20.0	.056	10.00	
301	303	0	4	CHANNEL	8.0	1010.	.0200	3.0	3.0	.038	2.00	0
				OVERFLOW	20.0	1010.	.0200	20.0	20.0	.056	10.00	
304	305	0	4	CHANNEL	8.0	1600.	.0140	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1600.	.0140	20.0	20.0	.044	10.00	
307	308	0	4	CHANNEL	5.0	1690.	.0220	3.0	3.0	.038	3.00	0
				OVERFLOW	23.0	1690.	.0220	20.0	20.0	.056	10.00	
309	311	0	4	CHANNEL	10.0	900.	.0120	3.0	3.0	.038	1.50	0
				OVERFLOW	19.0	900.	.0120	20.0	20.0	.056	10.00	
314	315	0	4	CHANNEL	10.0	800.	.0130	3.0	3.0	.038	1.50	0
				OVERFLOW	19.0	800.	.0130	20.0	20.0	.056	10.00	
316	317	0	4	CHANNEL	10.0	2735.	.0100	3.0	3.0	.038	1.50	0
				OVERFLOW	19.0	2735.	.0100	20.0	20.0	.056	10.00	
1021	322	0	4	CHANNEL	10.0	1600.	.0110	3.0	3.0	.038	1.50	0
				OVERFLOW	19.0	1600.	.0110	20.0	20.0	.056	10.00	
1026	210	10	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	.5	18.0	2.2	26.0	5.1	32.0	7.4	35.0	8.9 106.0
		11.0	300.0	13.1	494.0	13.5	777.0	13.8	1060.0			
1025	209	8	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	.1	8.0	.7	12.0	2.2	26.0	4.5	74.0	4.6 91.0
		4.8	174.0	4.8	325.0							
1020	1021	17	3		.0	0.	.0001	.0	.0	.001	.01	-1
		TIME IN HRS VS INFLOW IN CFS										
		.0	.0	.3	.0	.5	9.8	1.0	503.6	1.4	1571.4	1.5 1683.8
		1.6	1734.3	1.7	1730.9	1.8	1685.0	2.0	1404.5	2.5	841.4	3.0 490.0
		3.5	318.7	4.0	218.6	5.0	115.2	6.0	71.6	8.0	.0	

Boulder Creek Tribuaries, Existing Conditions

SUBAREA NUMBER	GUTTER OR MANHOLE	WIDTH (FT)	AREA (AC)	PERCENT IMPERV.	SLOPE (FT/FT)	RESISTANCE FACTOR IMPERV.	PERV.	SURFACE STORAGE(IN) IMPERV.	PERV.	INFILTRATION RATE(IN/HR) MAXIMUM	MINIMUM	DECAY RATE	GAGE NO
600	600	6156.	93.8	2.0	.0240	.020	.200	.100	.300	3.84	.56	.00180	1
601	601	3715.	51.3	2.0	.0060	.020	.200	.100	.300	4.47	.60	.00180	1
602	602	8208.	52.1	2.0	.0060	.020	.200	.100	.300	3.03	.50	.00180	1
603	603	6968.	103.6	5.6	.0200	.020	.200	.100	.300	3.42	.53	.00180	1
604	604	2203.	25.6	2.0	.0220	.020	.200	.100	.300	4.16	.58	.00180	1
605	605	9475.	116.8	6.8	.0210	.020	.200	.100	.300	3.98	.57	.00180	1
606	606	10579.	45.7	2.0	.0030	.020	.200	.100	.300	3.00	.50	.00180	1
607	607	4428.	25.4	4.9	.0110	.020	.200	.100	.300	4.50	.60	.00180	1
608	608	12037.	129.9	4.8	.0080	.020	.200	.100	.300	3.41	.53	.00180	1
609	609	4309.	75.5	2.0	.0010	.020	.200	.100	.300	3.17	.51	.00180	1
610	610	14382.	95.1	13.2	.0280	.020	.200	.100	.300	4.02	.57	.00180	1
611	611	10352.	65.9	19.1	.0290	.020	.200	.100	.300	3.63	.54	.00180	1
612	612	3132.	29.1	9.8	.0140	.020	.200	.100	.300	3.15	.51	.00180	1
613	613	10944.	67.2	42.3	.0120	.020	.200	.100	.300	4.50	.60	.00180	1

Table A1. On-Site Areas - UDSWM Basin and Conveyance Parameters, Existing Conditions (con.)

Boulder Creek Tributaries, Existing Conditions (con.)

SUBAREA NUMBER	GUTTER OR MANHOLE	WIDTH (FT)	AREA (AC)	PERCENT IMPERV.	SLOPE (FT/FT)	RESISTANCE FACTOR IMPERV.	PERV.	SURFACE STORAGE(IN) IMPERV.	PERV.	INFILTRATION RATE(IN/HR) MAXIMUM	MINIMUM	DECAY RATE	GAGE NO
614	614	9967.	102.2	36.6	.0260	.020	.200	.100	.300	4.50	.60	.00180	1
615	615	12069.	95.9	7.2	.0190	.020	.200	.100	.300	4.50	.60	.00180	1
616	616	5832.	66.9	22.0	.0300	.020	.200	.100	.300	4.50	.60	.00180	1
617	617	15768.	114.8	3.1	.0190	.020	.200	.100	.300	4.50	.60	.00180	1
618	618	11664.	96.2	5.3	.0040	.020	.200	.100	.300	4.50	.60	.00180	1
619	619	4626.	28.8	28.8	.0260	.020	.200	.100	.300	4.50	.60	.00180	1
620	620	11713.	81.9	2.0	.0060	.020	.200	.100	.300	4.50	.60	.00180	1
621	621	12859.	65.5	2.0	.0040	.020	.200	.100	.300	4.50	.60	.00180	1
622	622	7339.	76.0	6.8	.0050	.020	.200	.100	.300	3.14	.51	.00180	1
623	623	2747.	44.6	2.0	.0070	.020	.200	.100	.300	3.00	.50	.00180	1
624	624	13334.	51.9	9.0	.0060	.020	.200	.100	.300	3.26	.52	.00180	1
627	627	5472.	105.4	4.2	.0050	.020	.200	.100	.300	3.59	.54	.00180	1
628	628	6782.	30.7	2.0	.0060	.020	.200	.100	.300	3.53	.54	.00180	1
629	629	5621.	80.6	5.1	.0230	.020	.200	.100	.300	3.65	.54	.00180	1
630	630	15503.	129.9	2.0	.0110	.020	.200	.100	.300	3.08	.51	.00180	1
631	631	6599.	59.6	2.0	.0120	.020	.200	.100	.300	3.96	.56	.00180	1
633	633	6955.	76.8	16.8	.0110	.020	.200	.100	.300	4.10	.57	.00180	1
634	634	8424.	46.7	4.5	.0090	.020	.200	.100	.300	3.32	.52	.00180	1
638	638	4486.	49.7	16.6	.0180	.020	.200	.100	.300	4.50	.60	.00180	1
639	639	8554.	89.4	2.0	.0090	.020	.200	.100	.300	4.50	.60	.00180	1
640	640	9007.	79.4	3.4	.0090	.020	.200	.100	.300	3.78	.55	.00180	1
641	641	6786.	29.5	5.4	.0020	.020	.200	.100	.300	3.00	.50	.00180	1
645	645	11952.	103.5	13.8	.0280	.020	.200	.100	.300	3.65	.54	.00180	1
646	646	2682.	41.5	3.1	.0050	.020	.200	.100	.300	3.15	.51	.00180	1
647	647	9090.	105.1	2.0	.0060	.020	.200	.100	.300	3.00	.50	.00180	1
648	648	8203.	80.4	2.0	.0020	.020	.200	.100	.300	3.14	.51	.00180	1
650	650	14058.	80.0	3.7	.0190	.020	.200	.100	.300	3.11	.51	.00180	1
651	651	6626.	87.6	10.1	.0220	.020	.200	.100	.300	3.56	.54	.00180	1
652	652	7956.	51.9	2.0	.0030	.020	.200	.100	.300	3.00	.50	.00180	1
655	655	11275.	121.5	2.0	.0080	.020	.200	.100	.300	3.26	.52	.00180	1
658	658	7258.	72.9	2.0	.0060	.020	.200	.100	.300	3.02	.50	.00180	1
659	659	12280.	130.0	2.0	.0180	.020	.200	.100	.300	3.15	.51	.00180	1
660	660	10546.	45.9	2.0	.0040	.020	.200	.100	.300	3.00	.50	.00180	1
661	661	10584.	41.9	2.0	.0040	.020	.200	.100	.300	3.00	.50	.00180	1
656	966	1620.	58.4	2.0	.0020	.020	.200	.100	.300	3.00	.50	.00180	1
657	967	540.	15.9	2.0	.0070	.020	.200	.100	.300	3.00	.50	.00180	1

TOTAL TRIBUTARY AREA (ACRES), 3615.90

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	MANNING N	OVERBANK/SURCHARGE DEPTH (FT)	JK
600	950	0	4	CHANNEL	8.0	2850.	.0240	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2850.	.0240	20.0	20.0	.044	10.00	
601	700	0	4	CHANNEL	8.0	1720.	.0060	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1720.	.0060	20.0	20.0	.044	10.00	
602	951	0	4	CHANNEL	8.0	2280.	.0060	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	2280.	.0060	20.0	20.0	.056	10.00	
603	952	0	4	CHANNEL	5.0	2765.	.0270	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2765.	.0270	20.0	20.0	.056	10.00	
604	701	0	4	CHANNEL	8.0	1020.	.0220	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1020.	.0220	20.0	20.0	.044	10.00	
605	953	0	4	CHANNEL	8.0	3290.	.0230	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	3290.	.0230	20.0	20.0	.056	10.00	
606	954	0	4	CHANNEL	5.0	3265.	.0030	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3265.	.0030	20.0	20.0	.056	10.00	
607	702	0	4	CHANNEL	5.0	1230.	.0110	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	1230.	.0110	20.0	20.0	.056	10.00	
608	703	0	4	CHANNEL	8.0	3715.	.0080	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	3715.	.0080	20.0	20.0	.056	10.00	
609	955	0	4	CHANNEL	10.0	1995.	.0010	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1995.	.0010	20.0	20.0	.056	10.00	
610	956	0	4	CHANNEL	5.0	3995.	.0250	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3995.	.0250	20.0	20.0	.056	10.00	
611	704	0	4	CHANNEL	5.0	3195.	.0290	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3195.	.0290	20.0	20.0	.056	10.00	
612	957	0	4	CHANNEL	8.0	870.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	870.	.0140	20.0	20.0	.056	10.00	
613	705	0	4	CHANNEL	8.0	3040.	.0120	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3040.	.0120	20.0	20.0	.044	10.00	
614	707	0	4	CHANNEL	5.0	3955.	.0260	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3955.	.0260	20.0	20.0	.056	10.00	
615	707	0	4	CHANNEL	5.0	3725.	.0190	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3725.	.0190	20.0	20.0	.056	10.00	
616	706	0	4	CHANNEL	8.0	2700.	.0300	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2700.	.0300	20.0	20.0	.044	10.00	
617	706	0	4	CHANNEL	5.0	4380.	.0190	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	4380.	.0190	20.0	20.0	.056	10.00	
618	708	0	4	CHANNEL	8.0	3240.	.0040	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	3240.	.0040	20.0	20.0	.056	10.00	

Table A1. On-Site Areas - UDSWM Basin and Conveyance Parameters, Existing Conditions (con.)

Boulder Creek Tributaries, Existing Conditions (con.)

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	OVERBANK/SURCHARGE MANNING N	DEPTH (FT)	JK
619	708	0	4	CHANNEL	8.0	1285.	.0260	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1285.	.0260	20.0	20.0	.044	10.00	
620	709	0	4	CHANNEL	5.0	3615.	.0060	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3615.	.0060	20.0	20.0	.056	10.00	
621	709	0	4	CHANNEL	10.0	4465.	.0040	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	4465.	.0040	20.0	20.0	.056	10.00	
622	710	0	4	CHANNEL	10.0	2265.	.0050	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2265.	.0050	20.0	20.0	.056	10.00	
623	958	0	4	CHANNEL	10.0	1090.	.0070	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1090.	.0070	20.0	20.0	.056	10.00	
624	959	0	4	CHANNEL	8.0	4630.	.0060	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4630.	.0060	20.0	20.0	.044	10.00	
627	712	0	4	CHANNEL	10.0	1900.	.0050	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1900.	.0050	20.0	20.0	.056	10.00	
628	711	0	4	CHANNEL	8.0	3140.	.0060	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3140.	.0060	20.0	20.0	.044	10.00	
629	713	0	4	CHANNEL	10.0	1735.	.0230	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	1735.	.0230	20.0	20.0	.056	10.00	
630	713	0	4	CHANNEL	5.0	4785.	.0110	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	4785.	.0110	20.0	20.0	.056	10.00	
631	713	0	4	CHANNEL	5.0	3055.	.0120	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3055.	.0120	20.0	20.0	.056	10.00	
633	714	0	4	CHANNEL	10.0	2415.	.0110	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	2415.	.0110	20.0	20.0	.056	10.00	
634	960	0	4	CHANNEL	10.0	2340.	.0090	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2340.	.0090	20.0	20.0	.056	10.00	
638	715	0	4	CHANNEL	5.0	1780.	.0180	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	1780.	.0180	20.0	20.0	.056	10.00	
639	716	0	4	CHANNEL	8.0	2640.	.0090	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	2640.	.0090	20.0	20.0	.056	10.00	
640	717	0	4	CHANNEL	10.0	2780.	.0090	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2780.	.0090	20.0	20.0	.056	10.00	
641	961	0	4	CHANNEL	10.0	1885.	.0020	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1885.	.0020	20.0	20.0	.056	10.00	
645	718	0	4	CHANNEL	5.0	3320.	.0280	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3320.	.0280	20.0	20.0	.056	10.00	
646	719	0	4	CHANNEL	8.0	745.	.0050	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	745.	.0050	20.0	20.0	.056	10.00	
647	962	0	4	CHANNEL	10.0	2525.	.0060	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2525.	.0060	20.0	20.0	.056	10.00	
648	963	0	4	CHANNEL	5.0	3255.	.0020	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3255.	.0020	20.0	20.0	.056	10.00	
650	720	0	4	CHANNEL	5.0	3905.	.0190	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3905.	.0190	20.0	20.0	.056	10.00	
651	721	0	4	CHANNEL	8.0	2045.	.0220	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	2045.	.0220	20.0	20.0	.056	10.00	
652	964	0	4	CHANNEL	10.0	2210.	.0030	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2210.	.0030	20.0	20.0	.056	10.00	
655	965	0	4	CHANNEL	5.0	3915.	.0080	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3915.	.0080	20.0	20.0	.056	10.00	
658	999	0	4	CHANNEL	8.0	3360.	.0060	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3360.	.0060	20.0	20.0	.044	10.00	
659	722	0	4	CHANNEL	8.0	5685.	.0180	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	5685.	.0180	20.0	20.0	.044	10.00	
660	968	0	4	CHANNEL	5.0	3255.	.0040	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3255.	.0040	20.0	20.0	.056	10.00	
661	969	0	4	CHANNEL	8.0	4900.	.0040	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4900.	.0040	20.0	20.0	.044	10.00	
711	712	0	4	CHANNEL	5.0	1815.	.0120	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	1815.	.0120	20.0	20.0	.056	10.00	
723	968	0	4	CHANNEL	8.0	1925.	.0050	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1925.	.0050	20.0	20.0	.044	10.00	
1060	750	17	3		.0	0.	.0001	.0	.0	.001	.01	-1

TIME IN HRS VS INFLOW IN CFS

.0	.0	.4	1.2	.5	58.6	.8	646.5	1.0	1240.4	1.2	1421.0
1.3	1439.7	1.3	1414.2	1.8	1071.6	2.0	856.3	2.5	557.3	3.0	365.2
3.5	239.4	4.0	157.0	5.0	67.5	6.0	29.0	8.0	.0		

Table A2. On-Site Areas - UDSWM Basin and Conveyance Parameters, Future Conditions

Coal Creek Tributaries, Future Conditions

SUBAREA NUMBER	GUTTER OR MANHOLE	WIDTH (FT)	AREA (AC)	PERCENT IMPERV.	SLOPE (FT/FT)	RESISTANCE FACTOR IMPERV.	PERV.	SURFACE STORAGE(IN) IMPERV.	PERV.	INFILTRATION RATE(IN/HR) MAXIMUM	MINIMUM	DECAY RATE	GAGE NO
410	410	10546.	156.9	60.0	.0180	.020	.200	.100	.300	4.14	.58	.00180	1
411	411	9029.	89.9	42.4	.0200	.020	.200	.100	.300	3.54	.54	.00180	1
412	412	10238.	87.3	30.8	.0330	.020	.200	.100	.300	3.90	.56	.00180	1
413	413	9364.	29.5	50.0	.0270	.020	.200	.100	.300	4.50	.60	.00180	1
414	414	12312.	84.1	50.0	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
415	415	9450.	80.1	38.0	.0310	.020	.200	.100	.300	4.02	.57	.00180	1
416	416	8712.	89.7	59.0	.0130	.020	.200	.100	.300	4.50	.60	.00180	1
417	417	9428.	40.3	95.0	.0210	.020	.200	.100	.300	4.25	.58	.00180	1
418	418	9482.	58.2	24.6	.0140	.020	.200	.100	.300	4.01	.57	.00180	1
424	424	11286.	64.3	49.0	.0240	.020	.200	.100	.300	4.50	.60	.00180	1
425	425	16459.	127.2	9.4	.0130	.020	.200	.100	.300	4.35	.59	.00180	1
426	426	11844.	76.8	38.4	.0980	.020	.200	.100	.300	4.14	.58	.00180	1
427	427	3132.	45.5	57.8	.0120	.020	.200	.100	.300	4.25	.58	.00180	1
428	428	2142.	4.9	2.0	.0130	.020	.200	.100	.300	4.47	.60	.00180	1
430	430	11016.	110.9	17.4	.0240	.020	.200	.100	.300	4.50	.60	.00180	1
431	431	11858.	106.5	2.0	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
432	432	6950.	67.0	57.8	.0070	.020	.200	.100	.300	4.50	.60	.00180	1
433	433	4194.	18.9	57.8	.0190	.020	.200	.100	.300	4.50	.60	.00180	1
435	435	10350.	56.0	2.0	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
436	436	14200.	127.5	21.5	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
437	437	2860.	27.7	48.5	.0280	.020	.200	.100	.300	4.50	.60	.00180	1
440	440	5330.	67.1	9.2	.0150	.020	.200	.100	.300	4.50	.60	.00180	1
441	441	5864.	41.8	2.0	.0180	.020	.200	.100	.300	4.50	.60	.00180	1
442	442	12636.	98.7	6.7	.0200	.020	.200	.100	.300	4.50	.60	.00180	1
443	443	6448.	20.9	2.9	.0230	.020	.200	.100	.300	4.50	.60	.00180	1
444	444	6338.	60.7	89.4	.0100	.020	.200	.100	.300	4.50	.60	.00180	1
445	445	3096.	13.8	83.8	.0330	.020	.200	.100	.300	4.50	.60	.00180	1
446	446	16200.	118.8	74.5	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
447	447	4410.	16.6	81.1	.0240	.020	.200	.100	.300	4.50	.60	.00180	1
450	450	9738.	42.1	23.3	.0260	.020	.200	.100	.300	4.50	.60	.00180	1
451	451	6941.	113.6	91.3	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
452	452	7402.	65.6	83.8	.0110	.020	.200	.100	.300	4.05	.57	.00180	1
453	453	6062.	60.6	48.5	.0150	.020	.200	.100	.300	4.50	.60	.00180	1
455	455	17917.	123.6	47.6	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
456	456	18216.	122.4	49.4	.0250	.020	.200	.100	.300	4.50	.60	.00180	1
457	457	4464.	74.3	40.7	.0150	.020	.200	.100	.300	4.50	.60	.00180	1
458	458	2230.	49.8	95.0	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
459	459	8190.	125.8	46.5	.0080	.020	.200	.100	.300	4.29	.59	.00180	1
461	461	5998.	42.6	78.8	.0290	.020	.200	.100	.300	4.50	.60	.00180	1
462	462	10676.	78.6	67.5	.0240	.020	.200	.100	.300	4.50	.60	.00180	1
463	463	2750.	39.4	80.1	.0150	.020	.200	.100	.300	4.50	.60	.00180	1
464	464	7686.	99.3	60.0	.0050	.020	.200	.100	.300	4.26	.58	.00180	1
465	465	5314.	51.0	23.6	.0130	.020	.200	.100	.300	4.50	.60	.00180	1
466	466	8719.	60.6	6.9	.0090	.020	.200	.100	.300	4.40	.59	.00180	1
467	467	5947.	68.6	2.5	.0080	.020	.200	.100	.300	4.11	.57	.00180	1
470	470	4342.	47.3	48.1	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
471	471	10746.	85.0	40.9	.0170	.020	.200	.100	.300	4.50	.60	.00180	1
472	472	2430.	35.8	15.4	.0160	.020	.200	.100	.300	4.50	.60	.00180	1
473	473	2873.	13.3	50.0	.0210	.020	.200	.100	.300	4.50	.60	.00180	1
474	474	2214.	37.1	50.0	.0080	.020	.200	.100	.300	4.50	.60	.00180	1
475	475	4045.	95.5	57.7	.0120	.020	.200	.100	.300	4.50	.60	.00180	1
476	476	10382.	118.3	50.0	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
477	477	4946.	31.7	50.0	.0230	.020	.200	.100	.300	4.50	.60	.00180	1
478	478	4118.	96.8	43.0	.0080	.020	.200	.100	.300	4.50	.60	.00180	1
479	479	5998.	40.0	75.7	.0160	.020	.200	.100	.300	4.50	.60	.00180	1
480	480	4421.	55.3	79.0	.0120	.020	.200	.100	.300	4.50	.60	.00180	1
481	481	4145.	64.0	45.2	.0120	.020	.200	.100	.300	4.50	.60	.00180	1
482	482	3564.	30.2	79.8	.0110	.020	.200	.100	.300	4.50	.60	.00180	1
483	483	4212.	27.3	86.2	.0100	.020	.200	.100	.300	4.50	.60	.00180	1
484	484	10708.	78.9	55.1	.0050	.020	.200	.100	.300	4.50	.60	.00180	1
485	485	8208.	128.2	46.0	.0060	.020	.200	.100	.300	4.17	.58	.00180	1
486	486	10562.	120.2	29.9	.0070	.020	.200	.100	.300	3.62	.54	.00180	1
487	487	9034.	119.6	48.8	.0090	.020	.200	.100	.300	3.68	.55	.00180	1
488	488	4428.	57.6	71.3	.0100	.020	.200	.100	.300	3.72	.55	.00180	1
490	490	12830.	88.3	42.1	.0120	.020	.200	.100	.300	4.14	.58	.00180	1
491	491	10325.	71.7	43.0	.0040	.020	.200	.100	.300	4.10	.57	.00180	1
492	492	10055.	109.5	43.0	.0090	.020	.200	.100	.300	3.68	.55	.00180	1
493	493	6111.	56.5	38.5	.0020	.020	.200	.100	.300	4.50	.60	.00180	1
494	494	3420.	11.6	5.7	.0070	.020	.200	.100	.300	3.95	.56	.00180	1
401	901	900.	26.0	18.7	.0200	.020	.200	.100	.300	3.21	.51	.00180	1
423	902	540.	13.1	50.4	.0330	.020	.200	.100	.300	3.78	.55	.00180	1
429	904	1710.	30.7	24.3	.0290	.020	.200	.100	.300	4.50	.60	.00180	1
448	909	1980.	65.1	39.2	.0140	.020	.200	.100	.300	4.35	.59	.00180	1
489	920	1620.	33.5	28.7	.0090	.020	.200	.100	.300	4.02	.57	.00180	1
495	922	1080.	29.5	2.0	.0030	.020	.200	.100	.300	3.00	.50	.00180	1
496	923	900.	47.9	2.0	.0040	.020	.200	.100	.300	4.35	.59	.00180	1
497	924	1080.	59.2	2.0	.0030	.020	.200	.100	.300	3.00	.50	.00180	1

TOTAL TRIBUTARY AREA (ACRES), 5130.20

Table A2. On-Site Areas - UDSWM Basin and Conveyance Parameters, Future Conditions (con.)

Coal Creek Tributaries, Future Conditions (con.)

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	OVERBANK/SURCHARGE MANNING N	DEPTH (FT)	JK
410	500	0	4	CHANNEL	5.0	3255.	.0180	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3255.	.0180	20.0	20.0	.056	10.00	
411	501	0	4	CHANNEL	8.0	3160.	.0330	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3160.	.0330	20.0	20.0	.044	10.00	
412	501	0	4	CHANNEL	8.0	3160.	.0330	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3160.	.0330	20.0	20.0	.044	10.00	
413	502	0	4	CHANNEL	5.0	2890.	.0270	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2890.	.0270	20.0	20.0	.056	10.00	
414	502	0	4	CHANNEL	8.0	3420.	.0220	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3420.	.0220	20.0	20.0	.044	10.00	
415	502	0	4	CHANNEL	10.0	2625.	.0310	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	2625.	.0310	20.0	20.0	.056	10.00	
416	503	0	4	CHANNEL	10.0	3025.	.0130	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	3025.	.0130	20.0	20.0	.056	10.00	
417	503	0	4	CHANNEL	8.0	4365.	.0210	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4365.	.0210	20.0	20.0	.044	10.00	
418	900	0	4	CHANNEL	8.0	4390.	.0140	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4390.	.0140	20.0	20.0	.044	10.00	
424	504	0	4	CHANNEL	8.0	3135.	.0240	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3135.	.0240	20.0	20.0	.044	10.00	
425	505	0	4	CHANNEL	8.0	5080.	.0130	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	5080.	.0130	20.0	20.0	.056	10.00	
426	505	0	4	CHANNEL	8.0	4700.	.0980	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4700.	.0980	20.0	20.0	.044	10.00	
427	505	0	4	CHANNEL	8.0	1450.	.0120	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1450.	.0120	20.0	20.0	.044	10.00	
428	903	0	4	CHANNEL	10.0	595.	.0130	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	595.	.0130	20.0	20.0	.056	10.00	
430	506	0	4	CHANNEL	5.0	3825.	.0240	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3825.	.0240	20.0	20.0	.056	10.00	
431	507	0	4	CHANNEL	8.0	3660.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	3660.	.0140	20.0	20.0	.056	10.00	
432	508	0	4	CHANNEL	8.0	2145.	.0070	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2145.	.0070	20.0	20.0	.044	10.00	
433	905	0	4	CHANNEL	10.0	1165.	.0190	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1165.	.0190	20.0	20.0	.056	10.00	
435	509	0	4	CHANNEL	5.0	2875.	.0220	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2875.	.0220	20.0	20.0	.056	10.00	
436	510	0	4	CHANNEL	8.0	5635.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	5635.	.0140	20.0	20.0	.056	10.00	
437	906	0	4	CHANNEL	8.0	1135.	.0280	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1135.	.0280	20.0	20.0	.044	10.00	
440	511	0	4	CHANNEL	5.0	1645.	.0150	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	1645.	.0150	20.0	20.0	.056	10.00	
441	512	0	4	CHANNEL	8.0	2715.	.0180	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2715.	.0180	20.0	20.0	.044	10.00	
442	513	0	4	CHANNEL	8.0	3510.	.0200	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	3510.	.0200	20.0	20.0	.056	10.00	
443	513	0	4	CHANNEL	8.0	2985.	.0230	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2985.	.0230	20.0	20.0	.044	10.00	
444	514	0	4	CHANNEL	8.0	2515.	.0100	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2515.	.0100	20.0	20.0	.044	10.00	
445	907	0	4	CHANNEL	8.0	860.	.0330	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	860.	.0330	20.0	20.0	.044	10.00	
446	515	0	4	CHANNEL	8.0	4500.	.0220	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4500.	.0220	20.0	20.0	.044	10.00	
447	908	0	4	CHANNEL	8.0	1225.	.0240	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	1225.	.0240	20.0	20.0	.056	10.00	
450	516	0	4	CHANNEL	5.0	2705.	.0260	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2705.	.0260	20.0	20.0	.056	10.00	
451	517	0	4	CHANNEL	8.0	2410.	.0220	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2410.	.0220	20.0	20.0	.044	10.00	
452	910	0	4	CHANNEL	8.0	2570.	.0110	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2570.	.0110	20.0	20.0	.044	10.00	
453	911	0	4	CHANNEL	8.0	2105.	.0150	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2105.	.0150	20.0	20.0	.044	10.00	
455	518	0	4	CHANNEL	8.0	5530.	.0220	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	5530.	.0220	20.0	20.0	.044	10.00	
456	518	0	4	CHANNEL	8.0	5060.	.0250	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	5060.	.0250	20.0	20.0	.044	10.00	
457	519	0	4	CHANNEL	8.0	1240.	.0150	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	1240.	.0150	20.0	20.0	.056	10.00	
458	520	0	4	CHANNEL	10.0	885.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	885.	.0140	20.0	20.0	.056	10.00	
459	912	0	4	CHANNEL	10.0	3250.	.0080	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	3250.	.0080	20.0	20.0	.056	10.00	
461	521	0	4	CHANNEL	5.0	2380.	.0290	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2380.	.0290	20.0	20.0	.056	10.00	
462	521	0	4	CHANNEL	5.0	3295.	.0240	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3295.	.0240	20.0	20.0	.056	10.00	

Table A2. On-Site Areas - UDSWM Basin and Conveyance Parameters, Future Conditions (con.)

Coal Creek Tributaries, Future Conditions (con.)

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	OVERBANK/SURCHARGE MANNING N	DEPTH (FT)	JK
463	522	0	4	CHANNEL	8.0	955.	.0150	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	955.	.0150	20.0	20.0	.056	10.00	
464	913	0	4	CHANNEL	8.0	3050.	.0050	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3050.	.0050	20.0	20.0	.044	10.00	
465	914	0	4	CHANNEL	5.0	1845.	.0130	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	1845.	.0130	20.0	20.0	.056	10.00	
466	915	0	4	CHANNEL	5.0	3460.	.0090	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3460.	.0090	20.0	20.0	.056	10.00	
467	915	0	4	CHANNEL	5.0	2360.	.0080	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2360.	.0080	20.0	20.0	.056	10.00	
470	523	0	4	CHANNEL	8.0	2010.	.0220	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2010.	.0220	20.0	20.0	.044	10.00	
471	525	0	4	CHANNEL	8.0	2985.	.0170	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2985.	.0170	20.0	20.0	.044	10.00	
472	528	0	4	CHANNEL	8.0	1125.	.0160	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1125.	.0160	20.0	20.0	.044	10.00	
473	526	0	4	CHANNEL	8.0	1330.	.0210	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1330.	.0210	20.0	20.0	.044	10.00	
474	1041	0	4	CHANNEL	8.0	1025.	.0080	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1025.	.0080	20.0	20.0	.044	10.00	
475	529	0	4	CHANNEL	8.0	1605.	.0120	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1605.	.0120	20.0	20.0	.044	10.00	
476	1042	0	4	CHANNEL	10.0	4120.	.0140	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	4120.	.0140	20.0	20.0	.056	10.00	
477	530	0	4	CHANNEL	8.0	2290.	.0230	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2290.	.0230	20.0	20.0	.044	10.00	
478	531	0	4	CHANNEL	8.0	1430.	.0080	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1430.	.0080	20.0	20.0	.044	10.00	
479	533	0	4	CHANNEL	8.0	2380.	.0160	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2380.	.0160	20.0	20.0	.044	10.00	
480	534	0	4	CHANNEL	8.0	1535.	.0120	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1535.	.0120	20.0	20.0	.044	10.00	
481	532	0	4	CHANNEL	8.0	1645.	.0120	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1645.	.0120	20.0	20.0	.044	10.00	
482	536	0	4	CHANNEL	5.0	1650.	.0110	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	1650.	.0110	20.0	20.0	.056	10.00	
483	538	0	4	CHANNEL	10.0	1170.	.0100	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1170.	.0100	20.0	20.0	.056	10.00	
484	917	0	4	CHANNEL	8.0	3305.	.0050	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3305.	.0050	20.0	20.0	.044	10.00	
485	916	0	4	CHANNEL	8.0	2850.	.0060	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2850.	.0060	20.0	20.0	.044	10.00	
486	918	0	4	CHANNEL	8.0	3260.	.0070	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3260.	.0070	20.0	20.0	.044	10.00	
487	539	0	4	CHANNEL	8.0	3585.	.0090	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3585.	.0090	20.0	20.0	.044	10.00	
488	919	0	4	CHANNEL	8.0	2050.	.0100	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2050.	.0100	20.0	20.0	.044	10.00	
490	540	0	4	CHANNEL	8.0	3960.	.0120	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3960.	.0120	20.0	20.0	.044	10.00	
491	541	0	4	CHANNEL	8.0	4780.	.0040	3.0	3.0	.038	3.00	0
				OVERFLOW	26.0	4780.	.0040	20.0	20.0	.056	10.00	
492	541	0	4	CHANNEL	5.0	3990.	.0090	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3990.	.0090	20.0	20.0	.056	10.00	
493	921	0	4	CHANNEL	8.0	2425.	.0020	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2425.	.0020	20.0	20.0	.044	10.00	
494	921	0	4	CHANNEL	10.0	950.	.0070	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	950.	.0070	20.0	20.0	.056	10.00	
524	525	0	4	CHANNEL	8.0	1615.	.0170	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1615.	.0170	20.0	20.0	.044	10.00	
527	529	0	5	PIPE	4.5	2485.	.0140	.0	.0	.016	4.50	0
				OVERFLOW	11.0	2485.	.0140	20.0	20.0	.044	10.00	
533	534	0	4	CHANNEL	8.0	1500.	.0130	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1500.	.0130	20.0	20.0	.044	10.00	
535	536	0	4	CHANNEL	8.0	750.	.0090	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	750.	.0090	20.0	20.0	.044	10.00	
537	538	0	4	CHANNEL	8.0	1190.	.0050	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1190.	.0050	20.0	20.0	.044	10.00	
1040	428	7	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	2.8	22.0	10.2	48.0	11.1	147.0	12.6	296.0	20.5 644.0
		28.4	991.0									
1042	530	11	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	.8	10.0	1.7	20.0	2.7	22.0	2.9	65.0	4.5 77.0
		4.8	79.0	5.7	185.0	6.2	249.0	7.3	523.0	8.5	797.0	

Table A2. On-Site Areas - UDSWM Basin and Conveyance Parameters, Future Conditions (con.)

Coal Creek Tributaries, Future Conditions (con.)

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	OVERBANK/SURCHARGE MANNING N	DEPTH (FT)	JK
1041	526	10	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	1.6 5.0	2.7	9.0	4.4	21.0	7.0	33.0	9.0 87.0	
		11.2	99.0	13.2 111.0	13.6	334.0	13.8	557.0				
400	900	17	3		.0	0.	.0001	.0	.0	.001	.01	-1
		TIME IN HRS VS INFLOW IN CFS										
		.0	.0	.3 9.8	.3	46.4	.5	368.8	.7	1197.9	.8 1344.2	
		.8	1240.0	1.0 924.6	1.2	678.0	1.5	292.5	1.8	157.2	2.0 103.4	
		2.5	20.4	3.0 2.3	3.5	.0	4.0	.0	8.0	.0		

Bullhead Gulch/Prince Tributary, Future Conditions

SUBAREA NUMBER	GUTTER OR MANHOLE	WIDTH (FT)	AREA (AC)	PERCENT IMPERV.	SLOPE (FT/FT)	RESISTANCE FACTOR IMPERV.	PERV.	SURFACE STORAGE(IN) IMPERV.	PERV.	INFILTRATION RATE(IN/HR) MAXIMUM	MINIMUM	DECAY RATE	GAGE NO
200	200	7889.	95.6	37.3	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
201	201	11713.	56.7	8.4	.0150	.020	.200	.100	.300	4.50	.60	.00180	1
202	202	8003.	42.8	30.0	.0160	.020	.200	.100	.300	4.50	.60	.00180	1
203	203	5688.	53.8	18.0	.0200	.020	.200	.100	.300	4.50	.60	.00180	1
204	204	4860.	85.2	30.3	.0190	.020	.200	.100	.300	4.50	.60	.00180	1
205	205	9331.	73.6	47.1	.0160	.020	.200	.100	.300	4.50	.60	.00180	1
206	206	12114.	71.6	50.0	.0150	.020	.200	.100	.300	4.50	.60	.00180	1
207	207	10584.	79.8	50.0	.0130	.020	.200	.100	.300	4.50	.60	.00180	1
208	208	4666.	65.1	3.4	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
209	209	4561.	124.8	3.4	.0190	.020	.200	.100	.300	4.50	.60	.00180	1
210	210	3564.	26.2	48.1	.0170	.020	.200	.100	.300	4.50	.60	.00180	1
211	211	5022.	40.1	21.7	.0070	.020	.200	.100	.300	4.50	.60	.00180	1
212	212	5292.	76.7	46.6	.0210	.020	.200	.100	.300	4.50	.60	.00180	1
213	213	6552.	64.8	50.0	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
215	215	7852.	81.6	45.2	.0150	.020	.200	.100	.300	4.50	.60	.00180	1
216	216	6426.	49.9	2.0	.0210	.020	.200	.100	.300	4.50	.60	.00180	1
217	217	11405.	110.5	44.2	.0280	.020	.200	.100	.300	4.50	.60	.00180	1
218	218	6880.	91.0	50.0	.0230	.020	.200	.100	.300	4.50	.60	.00180	1
219	219	5393.	64.1	30.0	.0130	.020	.200	.100	.300	4.50	.60	.00180	1
220	220	9198.	47.5	33.5	.0270	.020	.200	.100	.300	4.50	.60	.00180	1
221	221	11246.	128.8	38.5	.0260	.020	.200	.100	.300	4.50	.60	.00180	1
222	222	11167.	84.5	39.0	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
235	235	9817.	122.4	2.0	.0270	.020	.200	.100	.300	4.50	.60	.00180	1
236	236	3652.	99.8	2.0	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
237	237	5530.	58.6	4.5	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
238	238	5166.	87.5	16.8	.0060	.020	.200	.100	.300	4.50	.60	.00180	1
240	240	9380.	49.3	5.0	.0080	.020	.200	.100	.300	4.50	.60	.00180	1
241	241	8482.	103.3	42.3	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
242	242	6552.	64.3	3.8	.0070	.020	.200	.100	.300	4.34	.59	.00180	1
243	243	10314.	99.9	2.0	.0030	.020	.200	.100	.300	3.06	.50	.00180	1

TOTAL TRIBUTARY AREA (ACRES), 2299.80

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	OVERBANK/SURCHARGE MANNING N	DEPTH (FT)	JK
200	300	0	4	CHANNEL	5.0	2435.	.0220	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2435.	.0220	20.0	20.0	.056	10.00	
201	300	0	4	CHANNEL	5.0	3615.	.0150	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3615.	.0150	20.0	20.0	.056	10.00	
202	302	0	4	CHANNEL	8.0	2615.	.0160	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2615.	.0160	20.0	20.0	.044	10.00	
203	303	0	4	CHANNEL	8.0	1580.	.0200	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	1580.	.0200	20.0	20.0	.056	10.00	
204	303	0	4	CHANNEL	8.0	2250.	.0190	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2250.	.0190	20.0	20.0	.044	10.00	
205	305	0	4	CHANNEL	8.0	3240.	.0160	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3240.	.0160	20.0	20.0	.044	10.00	
206	1026	0	4	CHANNEL	8.0	3365.	.0150	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3365.	.0150	20.0	20.0	.044	10.00	
207	1026	0	4	CHANNEL	8.0	3675.	.0130	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3675.	.0130	20.0	20.0	.044	10.00	
208	307	0	4	CHANNEL	5.0	2160.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2160.	.0140	20.0	20.0	.056	10.00	
209	306	0	4	CHANNEL	10.0	1810.	.0190	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1810.	.0190	20.0	20.0	.056	10.00	
210	308	0	4	CHANNEL	8.0	1100.	.0170	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	1100.	.0170	20.0	20.0	.056	10.00	
211	308	0	4	CHANNEL	10.0	1550.	.0070	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1550.	.0070	20.0	20.0	.056	10.00	
212	310	0	4	CHANNEL	5.0	2100.	.0210	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2100.	.0210	20.0	20.0	.056	10.00	
213	311	0	4	CHANNEL	8.0	1820.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	1820.	.0140	20.0	20.0	.056	10.00	
215	312	0	4	CHANNEL	10.0	3635.	.0150	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	3635.	.0150	20.0	20.0	.056	10.00	

Table A2. On-Site Areas - UDSWM Basin and Conveyance Parameters, Future Conditions (con.)

Bullhead Gulch/Prince Tributary, Future Conditions (con.)

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	OVERBANK/SURCHARGE MANNING N	DEPTH (FT)	JK
216	312	0	4	CHANNEL	8.0	2975.	.0210	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2975.	.0210	20.0	20.0	.044	10.00	
217	312	0	4	CHANNEL	5.0	3520.	.0280	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3520.	.0280	20.0	20.0	.056	10.00	
218	312	0	4	CHANNEL	8.0	3185.	.0230	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3185.	.0230	20.0	20.0	.044	10.00	
219	313	0	4	CHANNEL	10.0	2140.	.0130	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	2140.	.0130	20.0	20.0	.056	10.00	
220	313	0	4	CHANNEL	5.0	3650.	.0270	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3650.	.0270	20.0	20.0	.056	10.00	
221	315	0	4	CHANNEL	5.0	3905.	.0260	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3905.	.0260	20.0	20.0	.056	10.00	
222	315	0	4	CHANNEL	8.0	5170.	.0220	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	5170.	.0220	20.0	20.0	.044	10.00	
235	320	0	4	CHANNEL	8.0	4545.	.0270	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4545.	.0270	20.0	20.0	.044	10.00	
236	321	0	4	CHANNEL	8.0	1691.	.0140	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1691.	.0140	20.0	20.0	.044	10.00	
237	322	0	4	CHANNEL	10.0	2560.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2560.	.0140	20.0	20.0	.056	10.00	
238	323	0	4	CHANNEL	10.0	2050.	.0060	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2050.	.0060	20.0	20.0	.056	10.00	
240	318	0	4	CHANNEL	5.0	2895.	.0080	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2895.	.0080	20.0	20.0	.056	10.00	
241	318	0	4	CHANNEL	5.0	2945.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2945.	.0140	20.0	20.0	.056	10.00	
242	319	0	4	CHANNEL	10.0	1820.	.0070	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1820.	.0070	20.0	20.0	.056	10.00	
243	940	0	4	CHANNEL	10.0	2865.	.0030	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2865.	.0030	20.0	20.0	.056	10.00	
301	303	0	4	CHANNEL	8.0	1010.	.0200	3.0	3.0	.038	2.00	0
				OVERFLOW	20.0	1010.	.0200	20.0	20.0	.056	10.00	
304	305	0	4	CHANNEL	8.0	1600.	.0140	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1600.	.0140	20.0	20.0	.044	10.00	
307	308	0	4	CHANNEL	5.0	1690.	.0220	3.0	3.0	.038	3.00	0
				OVERFLOW	23.0	1690.	.0220	20.0	20.0	.056	10.00	
309	311	0	4	CHANNEL	10.0	900.	.0120	3.0	3.0	.038	1.50	0
				OVERFLOW	19.0	900.	.0120	20.0	20.0	.056	10.00	
314	315	0	4	CHANNEL	10.0	800.	.0130	3.0	3.0	.038	1.50	0
				OVERFLOW	19.0	800.	.0130	20.0	20.0	.056	10.00	
316	317	0	4	CHANNEL	10.0	2735.	.0100	3.0	3.0	.038	1.50	0
				OVERFLOW	19.0	2735.	.0100	20.0	20.0	.056	10.00	
1021	322	0	4	CHANNEL	10.0	1600.	.0110	3.0	3.0	.038	1.50	0
				OVERFLOW	19.0	1600.	.0110	20.0	20.0	.056	10.00	
1026	210	10	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	.5 18.0	2.2	26.0	5.1	32.0	7.4	35.0	8.9 106.0	
		11.0	300.0	13.1 494.0	13.5	777.0	13.8	1060.0				
1025	209	8	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	.1 8.0	.7	12.0	2.2	26.0	4.5	74.0	4.6 91.0	
		4.8	174.0	4.8 325.0								
1020	1021	17	3		.0	0.	.0001	.0	.0	.001	.01	-1
		TIME IN HRS VS INFLOW IN CFS										
		.0	.0	.3 12.8	.4	62.4	.8	1355.5	1.2	3612.7	1.3 3753.8	
		1.3	3746.0	1.4 3612.7	1.8	2523.5	2.0	1799.9	2.5	948.0	3.0 565.2	
		3.5	365.8	4.0 277.2	5.0	161.6	6.0	71.6	8.0	.0		

Boulder Creek Tributaries, Future Conditions

SUBAREA NUMBER	GUTTER OR MANHOLE	WIDTH (FT)	AREA (AC)	PERCENT IMPERV.	SLOPE (FT/FT)	RESISTANCE FACTOR IMPERV.	PERV.	SURFACE STORAGE(IN) IMPERV.	PERV.	INFILTRATION RATE(IN/HR) MAXIMUM	MINIMUM	DECAY RATE	GAGE NO
600	600	6156.	93.8	2.0	.0240	.020	.200	.100	.300	3.84	.56	.00180	1
601	601	3715.	51.3	2.0	.0060	.020	.200	.100	.300	4.47	.60	.00180	1
602	602	8208.	52.1	2.0	.0060	.020	.200	.100	.300	3.03	.50	.00180	1
603	603	6968.	103.6	5.6	.0200	.020	.200	.100	.300	3.42	.53	.00180	1
604	604	2203.	25.6	2.0	.0220	.020	.200	.100	.300	4.16	.58	.00180	1
605	605	9475.	116.8	6.8	.0210	.020	.200	.100	.300	3.98	.57	.00180	1
606	606	10579.	45.7	2.0	.0030	.020	.200	.100	.300	3.00	.50	.00180	1
607	607	4428.	25.4	4.9	.0110	.020	.200	.100	.300	4.50	.60	.00180	1
608	608	12037.	129.9	5.5	.0080	.020	.200	.100	.300	3.41	.53	.00180	1
609	609	4309.	75.5	2.0	.0010	.020	.200	.100	.300	3.17	.51	.00180	1
610	610	14382.	95.1	13.2	.0280	.020	.200	.100	.300	4.02	.57	.00180	1
611	611	10352.	65.9	19.9	.0290	.020	.200	.100	.300	3.63	.54	.00180	1
612	612	3132.	29.1	10.1	.0140	.020	.200	.100	.300	3.15	.51	.00180	1
613	613	10944.	67.2	46.6	.0120	.020	.200	.100	.300	4.50	.60	.00180	1
614	614	9967.	102.2	42.3	.0260	.020	.200	.100	.300	4.50	.60	.00180	1
615	615	12069.	95.9	40.0	.0190	.020	.200	.100	.300	4.50	.60	.00180	1
616	616	5832.	66.9	40.5	.0300	.020	.200	.100	.300	4.50	.60	.00180	1

Table A2. On-Site Areas - UDSWM Basin and Conveyance Parameters, Future Conditions (con.)

Boulder Creek Tributaries, Future Conditions (con.)

SUBAREA NUMBER	GUTTER OR MANHOLE	WIDTH (FT)	AREA (AC)	PERCENT IMPERV.	SLOPE (FT/FT)	RESISTANCE FACTOR IMPERV.	RESISTANCE FACTOR PERV.	SURFACE STORAGE(IN) IMPERV.	SURFACE STORAGE(IN) PERV.	INFILTRATION RATE(IN/HR) MAXIMUM	INFILTRATION RATE(IN/HR) MINIMUM	INFILTRATION RATE(IN/HR) DECAY RATE	GAGE NO
617	617	15768.	114.8	42.7	.0190	.020	.200	.100	.300	4.50	.60	.00180	1
618	618	11664.	96.2	28.8	.0040	.020	.200	.100	.300	4.50	.60	.00180	1
619	619	4626.	28.8	28.8	.0260	.020	.200	.100	.300	4.50	.60	.00180	1
620	620	11713.	81.9	14.0	.0060	.020	.200	.100	.300	4.50	.60	.00180	1
621	621	12859.	65.5	18.5	.0040	.020	.200	.100	.300	4.50	.60	.00180	1
622	622	7339.	76.0	6.8	.0050	.020	.200	.100	.300	3.14	.51	.00180	1
623	623	2747.	44.6	2.0	.0070	.020	.200	.100	.300	3.00	.50	.00180	1
624	624	13334.	51.9	9.0	.0060	.020	.200	.100	.300	3.26	.52	.00180	1
627	627	5472.	105.4	4.2	.0050	.020	.200	.100	.300	3.59	.54	.00180	1
628	628	6782.	30.7	2.0	.0060	.020	.200	.100	.300	3.53	.54	.00180	1
629	629	5621.	80.6	5.1	.0230	.020	.200	.100	.300	3.65	.54	.00180	1
630	630	15503.	129.9	2.0	.0110	.020	.200	.100	.300	3.08	.51	.00180	1
631	631	6599.	59.6	2.0	.0120	.020	.200	.100	.300	3.96	.56	.00180	1
633	633	6955.	76.8	16.8	.0110	.020	.200	.100	.300	4.10	.57	.00180	1
634	634	8424.	46.7	4.5	.0090	.020	.200	.100	.300	3.32	.52	.00180	1
638	638	4486.	49.7	37.0	.0180	.020	.200	.100	.300	4.50	.60	.00180	1
639	639	8554.	89.4	34.8	.0090	.020	.200	.100	.300	4.50	.60	.00180	1
640	640	9007.	79.4	17.6	.0090	.020	.200	.100	.300	3.78	.55	.00180	1
641	641	6786.	29.5	5.4	.0020	.020	.200	.100	.300	3.00	.50	.00180	1
645	645	11952.	103.5	13.8	.0280	.020	.200	.100	.300	3.65	.54	.00180	1
646	646	2682.	41.5	3.1	.0050	.020	.200	.100	.300	3.15	.51	.00180	1
647	647	9090.	105.1	2.0	.0060	.020	.200	.100	.300	3.00	.50	.00180	1
648	648	8203.	80.4	2.0	.0020	.020	.200	.100	.300	3.14	.51	.00180	1
650	650	14058.	80.0	3.7	.0190	.020	.200	.100	.300	3.11	.51	.00180	1
651	651	6626.	87.6	10.1	.0220	.020	.200	.100	.300	3.56	.54	.00180	1
652	652	7956.	51.9	2.0	.0030	.020	.200	.100	.300	3.00	.50	.00180	1
655	655	11275.	121.5	2.0	.0080	.020	.200	.100	.300	3.26	.52	.00180	1
658	658	7258.	72.9	2.0	.0060	.020	.200	.100	.300	3.02	.50	.00180	1
659	659	12280.	130.0	2.0	.0180	.020	.200	.100	.300	3.15	.51	.00180	1
660	660	10546.	45.9	2.0	.0040	.020	.200	.100	.300	3.00	.50	.00180	1
661	661	10584.	41.9	2.0	.0040	.020	.200	.100	.300	3.00	.50	.00180	1
656	966	1620.	58.4	2.0	.0020	.020	.200	.100	.300	3.00	.50	.00180	1
657	967	540.	15.9	2.0	.0070	.020	.200	.100	.300	3.00	.50	.00180	1

TOTAL TRIBUTARY AREA (ACRES), 3615.90

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	SIDE SLOPES HORIZ TO VERT R	OVERBANK/SURCHARGE MANNING N	OVERBANK/SURCHARGE DEPTH (FT)	JK
600	950	0	4	CHANNEL	8.0	2850.	.0240	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2850.	.0240	20.0	20.0	.044	10.00	
601	700	0	4	CHANNEL	8.0	1720.	.0060	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1720.	.0060	20.0	20.0	.044	10.00	
602	951	0	4	CHANNEL	8.0	2280.	.0060	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	2280.	.0060	20.0	20.0	.056	10.00	
603	952	0	4	CHANNEL	5.0	2765.	.0270	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2765.	.0270	20.0	20.0	.056	10.00	
604	701	0	4	CHANNEL	8.0	1020.	.0220	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1020.	.0220	20.0	20.0	.044	10.00	
605	953	0	4	CHANNEL	8.0	3290.	.0230	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	3290.	.0230	20.0	20.0	.056	10.00	
606	954	0	4	CHANNEL	5.0	3265.	.0030	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3265.	.0030	20.0	20.0	.056	10.00	
607	702	0	4	CHANNEL	8.0	1230.	.0110	3.0	3.0	.035	3.00	0
				OVERFLOW	11.0	1230.	.0110	20.0	20.0	.056	10.00	
608	703	0	4	CHANNEL	8.0	3715.	.0080	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	3715.	.0080	20.0	20.0	.056	10.00	
609	955	0	4	CHANNEL	10.0	1995.	.0010	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1995.	.0010	20.0	20.0	.056	10.00	
610	956	0	4	CHANNEL	5.0	3995.	.0250	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3995.	.0250	20.0	20.0	.056	10.00	
611	704	0	4	CHANNEL	5.0	3195.	.0290	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3195.	.0290	20.0	20.0	.056	10.00	
612	957	0	4	CHANNEL	8.0	870.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	870.	.0140	20.0	20.0	.056	10.00	
613	705	0	4	CHANNEL	8.0	3040.	.0120	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3040.	.0120	20.0	20.0	.044	10.00	
614	707	0	4	CHANNEL	5.0	3955.	.0260	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3955.	.0260	20.0	20.0	.056	10.00	
615	707	0	4	CHANNEL	8.0	3725.	.0190	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3725.	.0190	20.0	20.0	.044	10.00	
616	706	0	4	CHANNEL	8.0	2700.	.0300	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2700.	.0300	20.0	20.0	.044	10.00	
617	706	0	4	CHANNEL	8.0	4380.	.0190	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4380.	.0190	20.0	20.0	.044	10.00	
618	708	0	4	CHANNEL	8.0	3240.	.0040	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3240.	.0040	20.0	20.0	.044	10.00	
619	708	0	4	CHANNEL	8.0	1285.	.0260	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1285.	.0260	20.0	20.0	.044	10.00	
620	709	0	4	CHANNEL	5.0	3615.	.0060	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3615.	.0060	20.0	20.0	.056	10.00	

Table A2. On-Site Areas - UDSWM Basin and Conveyance Parameters, Future Conditions (con.)

Boulder Creek Tributaries, Future Conditions (con.)

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	SIDE SLOPES HORIZ TO VERT R	OVERBANK/SURCHARGE MANNING N	OVERBANK/SURCHARGE DEPTH (FT)	JK
621	709	0	4	CHANNEL	8.0	4465.	.0040	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4465.	.0040	20.0	20.0	.044	10.00	
622	710	0	4	CHANNEL	10.0	2265.	.0050	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2265.	.0050	20.0	20.0	.056	10.00	
623	958	0	4	CHANNEL	10.0	1090.	.0070	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1090.	.0070	20.0	20.0	.056	10.00	
624	959	0	4	CHANNEL	8.0	4630.	.0060	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4630.	.0060	20.0	20.0	.044	10.00	
627	712	0	4	CHANNEL	10.0	1900.	.0050	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1900.	.0050	20.0	20.0	.056	10.00	
628	711	0	4	CHANNEL	8.0	3140.	.0060	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3140.	.0060	20.0	20.0	.044	10.00	
629	713	0	4	CHANNEL	10.0	1735.	.0230	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	1735.	.0230	20.0	20.0	.056	10.00	
630	713	0	4	CHANNEL	5.0	4785.	.0110	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	4785.	.0110	20.0	20.0	.056	10.00	
631	713	0	4	CHANNEL	5.0	3055.	.0120	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3055.	.0120	20.0	20.0	.056	10.00	
633	714	0	4	CHANNEL	10.0	2415.	.0110	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	2415.	.0110	20.0	20.0	.056	10.00	
634	960	0	4	CHANNEL	10.0	2340.	.0090	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2340.	.0090	20.0	20.0	.056	10.00	
638	715	0	4	CHANNEL	8.0	1780.	.0180	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1780.	.0180	20.0	20.0	.044	10.00	
639	716	0	4	CHANNEL	8.0	2640.	.0090	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2640.	.0090	20.0	20.0	.044	10.00	
640	717	0	4	CHANNEL	10.0	2780.	.0090	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2780.	.0090	20.0	20.0	.056	10.00	
641	961	0	4	CHANNEL	10.0	1885.	.0020	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1885.	.0020	20.0	20.0	.056	10.00	
645	718	0	4	CHANNEL	5.0	3320.	.0280	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3320.	.0280	20.0	20.0	.056	10.00	
646	719	0	4	CHANNEL	8.0	745.	.0050	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	745.	.0050	20.0	20.0	.056	10.00	
647	962	0	4	CHANNEL	10.0	2525.	.0060	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2525.	.0060	20.0	20.0	.056	10.00	
648	963	0	4	CHANNEL	5.0	3255.	.0020	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3255.	.0020	20.0	20.0	.056	10.00	
650	720	0	4	CHANNEL	5.0	3905.	.0190	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3905.	.0190	20.0	20.0	.056	10.00	
651	721	0	4	CHANNEL	8.0	2045.	.0220	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	2045.	.0220	20.0	20.0	.056	10.00	
652	964	0	4	CHANNEL	10.0	2210.	.0030	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2210.	.0030	20.0	20.0	.056	10.00	
655	965	0	4	CHANNEL	5.0	3915.	.0080	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3915.	.0080	20.0	20.0	.056	10.00	
658	999	0	4	CHANNEL	8.0	3360.	.0060	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3360.	.0060	20.0	20.0	.044	10.00	
659	722	0	4	CHANNEL	8.0	5685.	.0180	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	5685.	.0180	20.0	20.0	.044	10.00	
660	968	0	4	CHANNEL	5.0	3255.	.0040	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3255.	.0040	20.0	20.0	.056	10.00	
661	969	0	4	CHANNEL	8.0	4900.	.0040	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4900.	.0040	20.0	20.0	.044	10.00	
711	712	0	4	CHANNEL	5.0	1815.	.0120	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	1815.	.0120	20.0	20.0	.056	10.00	
723	968	0	4	CHANNEL	8.0	1925.	.0050	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1925.	.0050	20.0	20.0	.044	10.00	
1060	750	17	3		.0	0.	.0001	.0	.0	.001	.01	-1

TIME IN HRS VS INFLOW IN CFS

.0	.0	.4	1.2	.5	58.6	.8	646.5	1.0	1240.4	1.2	1421.0
1.3	1439.7	1.3	1414.2	1.8	1071.6	2.0	856.3	2.5	557.3	3.0	365.2
3.5	239.4	4.0	157.0	5.0	67.5	6.0	29.0	8.0	.0		

Table A3. Off-Site Areas - Bullhead Gulch, Greiner Model CUHPF Parameters, Existing Conditions

Catchment ID	Area (sq mi)	Length (mi)	Centroid (mi)	Imperv. (%)	Slope (ft/ft)	Time of Conc. (min)	Perv. Dep. Storage (in)	Imp Dep. Storage (in)	Initial Infil. Rate (in/hr)	Decay Coeff. (sec-1)	Final Infil. Rate (in/hr)
1	0.109	0.62	0.25	18	0.007	28	0.4	0.1	3	0.0018	0.5
2	0.157	0.58	0.23	13	0.042		0.4	0.1	4.26	0.0018	0.58
3	0.063	0.38	0.21	25	0.046	21	0.4	0.1	4.5	0.0018	0.6
4	0.087	0.45	0.15	2	0.026	36	0.4	0.1	4.5	0.0018	0.6
5	0.043	0.49	0.23	43	0.02	24	0.4	0.1	4.5	0.0018	0.6
6	0.182	0.57	0.25	34	0.031		0.4	0.1	4.5	0.0018	0.6
7	0.25	0.82	0.56	10	0.019		0.4	0.1	4.32	0.0018	0.59
8	0.126	0.77	0.37	18	0.022	33	0.4	0.1	4.5	0.0018	0.6
9	0.169	0.68	0.27	42	0.026		0.4	0.1	4.28	0.0018	0.59
10	0.128	0.72	0.29	6	0.021	127	0.4	0.1	4.5	0.0018	0.6
11	0.177	0.45	0.09	22	0.023		0.4	0.1	4.39	0.0018	0.59
12	0.217	0.85	0.32	23	0.031		0.4	0.1	4.3	0.0018	0.59
13	0.111	0.43	0.14	4	0.035	23	0.4	0.1	4.37	0.0018	0.59
14	0.168	0.85	0.39	7	0.033		0.4	0.1	4.43	0.0018	0.6
15	0.178	0.84	0.32	12	0.027		0.4	0.1	4.5	0.0018	0.6
16	0.156	0.59	0.3	9	0.028		0.4	0.1	4.26	0.0018	0.58
17	0.152	0.56	0.19	7	0.028		0.4	0.1	3.67	0.0018	0.54
18	0.092	0.41	0.21	29	0.026	22	0.4	0.1	4.5	0.0018	0.6
19	0.102	0.7	0.37	17	0.021	77	0.4	0.1	4.5	0.0018	0.6
20	0.084	0.7	0.38	20	0.023	88	0.4	0.1	4.5	0.0018	0.6
21	0.127	0.59	0.25	2	0.036	52	0.4	0.1	4.5	0.0018	0.6
22	0.076	0.45	0.17	54	0.012	66	0.4	0.1	4.5	0.0018	0.6
23	0.218	1.15	0.63	45	0.014		0.4	0.1	4.5	0.0018	0.6
24	0.231	0.71	0.23	4	0.035		0.4	0.1	4.5	0.0018	0.6
25	0.222	0.8	0.32	39	0.013		0.4	0.1	4.5	0.0018	0.6
26	0.116	0.63	0.32	6	0.023	79	0.4	0.1	4.5	0.0018	0.6
27	0.032	0.34	0.14	43	0.028	50	0.4	0.1	4.5	0.0018	0.6
28	0.067	0.47	0.22	8	0.028	41	0.4	0.1	4.5	0.0018	0.6
29	0.053	0.44	0.26	43	0.017	48	0.4	0.1	4.5	0.0018	0.6
30	0.096	0.85	0.44	7	0.022	94	0.4	0.1	4.5	0.0018	0.6
31	0.153	0.81	0.41	7	0.015		0.4	0.1	4.5	0.0018	0.6
32	0.121	0.75	0.27	2	0.021	94	0.4	0.1	4.5	0.0018	0.6
33	0.059	0.31	0.13	7	0.02	39	0.4	0.1	4.5	0.0018	0.6
34	0.122	0.5	0.31	72	0.014	63	0.4	0.1	4.5	0.0018	0.6
35	0.212	0.86	0.34	2	0.023		0.4	0.1	4.5	0.0018	0.6
36	0.091	0.61	0.34	12	0.012	89	0.4	0.1	4.5	0.0018	0.6
37	0.09	0.41	0.15	2	0.033	40	0.4	0.1	4.5	0.0018	0.6
38	0.131	0.57	0.33	36	0.012	100	0.4	0.1	4.5	0.0018	0.6
39	0.179	0.72	0.16	2	0.015		0.4	0.1	4.5	0.0018	0.6
40	0.098	0.57	0.36	2	0.025	56	0.4	0.1	4.5	0.0018	0.6
41	0.062	0.49	0.26	2	0.019	54	0.4	0.1	4.5	0.0018	0.6
42	0.082	0.48	0.28	2	0.009	70	0.4	0.1	4.5	0.0018	0.6
43	0.081	0.41	0.18	14	0.006	72	0.4	0.1	4.5	0.0018	0.6
44	0.121	0.6	0.26	9.38	0.017	66	0.4	0.1	4.5	0.0018	0.6
45	0.261	1.16	0.54	2	0.014		0.4	0.1	4.5	0.0018	0.6
46	0.041	0.26	0.13	2	0.004	46	0.4	0.1	4.5	0.0018	0.6
47	0.131	0.67	0.31	19.02	0.019	30	0.4	0.1	4.5	0.0018	0.6

Table A3. Off-Site Areas - Bullhead Gulch, Greiner Model CUHPF Parameters, Existing Conditions (con.)

Catchment ID	Area (sq mi)	Length (mi)	Centroid (mi)	Imperv. (%)	Slope (ft/ft)	Time of Conc. (min)	Perv. Dep. Storage (in)	Imp Dep. Storage (in)	Initial Infil. Rate (in/hr)	Decay Coeff. (sec-1)	Final Infil. Rate (in/hr)
48	0.126	0.5	0.19	19.79	0.011	25	0.4	0.1	4.5	0.0018	0.6
49	0.101	0.48	0.13	2	0.019	47	0.4	0.1	4.5	0.0018	0.6
50	0.145	0.64	0.36	22	0.015		0.4	0.1	4.5	0.0018	0.6
51	0.214	0.71	0.4	2	0.01		0.4	0.1	4.5	0.0018	0.6
52	0.287	0.85	0.5	2	0.019		0.4	0.1	4.34	0.0018	0.59
53	0.094	0.63	0.27	2	0.017	92	0.4	0.1	4.5	0.0018	0.6
54	0.155	0.56	0.15	2	0.02		0.4	0.1	4.5	0.0018	0.6
55	0.076	0.57	0.16	12.41	0.013	72	0.4	0.1	4.5	0.0018	0.6
56	0.101	0.4	0.22	2	0.005	39	0.4	0.1	4.5	0.0018	0.6
57	0.166	0.64	0.19	2	0.017		0.4	0.1	4.5	0.0018	0.6
58	0.153	0.73	0.43	2	0.031		0.4	0.1	4.38	0.0018	0.59
59	0.146	0.82	0.44	2	0.023		0.4	0.1	3.7	0.0018	0.55
60	0.164	0.73	0.36	2	0.027		0.4	0.1	4.5	0.0018	0.6
61	0.17	0.51	0.18	2	0.022		0.4	0.1	3.27	0.0018	0.52
62	0.133	0.61	0.39	2	0.014	107	0.4	0.1	4.45	0.0018	0.6
63	0.072	0.56	0.4	2	0.016	70	0.4	0.1	4.5	0.0018	0.6
64	0.173	0.58	0.18	13.03	0.02		0.4	0.1	4.5	0.0018	0.6
65	0.125	0.43	0.15	2	0.005	126	0.4	0.1	4.44	0.0018	0.6
66	0.08	0.34	0.17	2	0.003	100	0.4	0.1	3	0.0018	0.5
67	0.058	0.71	0.31	2	0.007	125	0.4	0.1	4.15	0.0018	0.58
68	0.084	0.41	0.2	2	0.006	90	0.4	0.1	3	0.0018	0.5
69	0.126	0.61	0.34	2	0.006	134	0.4	0.1	3	0.0018	0.5
70	0.097	0.59	0.28	2	0.005	173	0.4	0.1	3	0.0018	0.5

Table A4. Off-Site Areas - Bullhead Gulch, Greiner Model CUHPF Parameters, Future Conditions

Catchment ID	Area (sq mi)	Length (mi)	Centroid (mi)	Imperv. (%)	Slope (ft/ft)	Time of Conc. (min)	Perv. Dep. Storage (in)	Imp Dep. Storage (in)	Initial Infil. Rate (in/hr)	Decay Coeff. (sec-1)	Final Infil. Rate (in/hr)
1	0.109	0.62	0.25	18	0.007	28	0.4	0.1	3	0.0018	0.5
2	0.157	0.58	0.23	13	0.042		0.4	0.1	4.26	0.0018	0.58
3	0.063	0.38	0.21	25	0.046	21	0.4	0.1	4.5	0.0018	0.6
4	0.087	0.45	0.15	2	0.026	36	0.4	0.1	4.5	0.0018	0.6
5	0.043	0.49	0.23	43	0.02	24	0.4	0.1	4.5	0.0018	0.6
6	0.182	0.57	0.25	34	0.031		0.4	0.1	4.5	0.0018	0.6
7	0.25	0.82	0.56	89	0.019		0.4	0.1	4.32	0.0018	0.59
8	0.126	0.77	0.37	79	0.022	33	0.4	0.1	4.5	0.0018	0.6
9	0.169	0.68	0.27	42	0.026		0.4	0.1	4.28	0.0018	0.59
10	0.128	0.72	0.29	35	0.021	127	0.4	0.1	4.5	0.0018	0.6
11	0.177	0.45	0.09	22	0.023		0.4	0.1	4.39	0.0018	0.59
12	0.217	0.85	0.32	28	0.031		0.4	0.1	4.3	0.0018	0.59
13	0.111	0.43	0.14	52	0.035	23	0.4	0.1	4.37	0.0018	0.59
14	0.168	0.85	0.39	3	0.033		0.4	0.1	4.43	0.0018	0.6
15	0.178	0.84	0.32	13	0.027		0.4	0.1	4.5	0.0018	0.6
16	0.156	0.59	0.3	37	0.028		0.4	0.1	4.26	0.0018	0.58

Table A4. Off-Site Areas - Bullhead Gulch, Greiner Model CUHPF Parameters, Future Conditions (con.)

Catchment ID	Area (sq mi)	Length (mi)	Centroid (mi)	Imperv. (%)	Slope (ft/ft)	Time of Conc. (min)	Perv. Dep. Storage (in)	Imp Dep. Storage (in)	Initial Infil. Rate (in/hr)	Decay Coeff. (sec-1)	Final Infil. Rate (in/hr)
17	0.152	0.56	0.19	29	0.028		0.4	0.1	3.67	0.0018	0.54
18	0.092	0.41	0.21	29.08	0.026	22	0.4	0.1	4.5	0.0018	0.6
19	0.102	0.7	0.37	36	0.021	31	0.4	0.1	4.5	0.0018	0.6
20	0.084	0.7	0.38	46	0.023	31	0.4	0.1	4.5	0.0018	0.6
21	0.127	0.59	0.25	35	0.036	52	0.4	0.1	4.5	0.0018	0.6
22	0.076	0.45	0.17	60	0.012	23	0.4	0.1	4.5	0.0018	0.6
23	0.218	1.15	0.63	48	0.014		0.4	0.1	4.5	0.0018	0.6
24	0.231	0.71	0.23	22	0.035		0.4	0.1	4.5	0.0018	0.6
25	0.222	0.8	0.32	39	0.013		0.4	0.1	4.5	0.0018	0.6
26	0.116	0.63	0.32	41	0.023	28	0.4	0.1	4.5	0.0018	0.6
27	0.032	0.34	0.14	43	0.028	50	0.4	0.1	4.5	0.0018	0.6
28	0.067	0.47	0.22	8	0.028	24	0.4	0.1	4.5	0.0018	0.6
29	0.053	0.44	0.26	43	0.017	48	0.4	0.1	4.5	0.0018	0.6
30	0.096	0.85	0.44	7	0.022	35	0.4	0.1	4.5	0.0018	0.6
31	0.153	0.81	0.41	34	0.015		0.4	0.1	4.5	0.0018	0.6
32	0.121	0.75	0.27	43	0.021	32	0.4	0.1	4.5	0.0018	0.6
33	0.059	0.31	0.13	46	0.02	19	0.4	0.1	4.5	0.0018	0.6
34	0.122	0.5	0.31	80	0.014	25	0.4	0.1	4.5	0.0018	0.6
35	0.212	0.86	0.34	43	0.023		0.4	0.1	4.5	0.0018	0.6
36	0.091	0.61	0.34	45	0.012	28	0.4	0.1	4.5	0.0018	0.6
37	0.09	0.41	0.15	2	0.033	22	0.4	0.1	4.5	0.0018	0.6
38	0.131	0.57	0.33	36	0.012	27	0.4	0.1	4.5	0.0018	0.6
39	0.179	0.72	0.16	36	0.015		0.4	0.1	4.5	0.0018	0.6
40	0.098	0.57	0.36	40	0.025	27	0.4	0.1	4.5	0.0018	0.6
41	0.062	0.49	0.26	40	0.019	24	0.4	0.1	4.5	0.0018	0.6
42	0.082	0.48	0.28	2	0.009	24	0.4	0.1	4.5	0.0018	0.6
43	0.081	0.41	0.18	14	0.006	22	0.4	0.1	4.5	0.0018	0.6
44	0.121	0.6	0.26	40	0.017	28	0.4	0.1	4.5	0.0018	0.6
45	0.261	1.16	0.54	40	0.014		0.4	0.1	4.5	0.0018	0.6
46	0.041	0.26	0.13	40	0.004	18	0.4	0.1	4.5	0.0018	0.6
47	0.131	0.67	0.31	37	0.019	30	0.4	0.1	4.5	0.0018	0.6
48	0.126	0.5	0.19	40	0.011	25	0.4	0.1	4.5	0.0018	0.6
49	0.101	0.48	0.13	40	0.019	24	0.4	0.1	4.5	0.0018	0.6
50	0.145	0.64	0.36	40	0.015		0.4	0.1	4.5	0.0018	0.6
51	0.214	0.71	0.4	40	0.01		0.4	0.1	4.5	0.0018	0.6
52	0.287	0.85	0.5	40	0.019		0.4	0.1	4.34	0.0018	0.59
53	0.094	0.63	0.27	40	0.017	28	0.4	0.1	4.5	0.0018	0.6
54	0.155	0.56	0.15	40	0.02		0.4	0.1	4.5	0.0018	0.6
55	0.076	0.57	0.16	40	0.013	27	0.4	0.1	4.5	0.0018	0.6
56	0.101	0.4	0.22	40	0.005	22	0.4	0.1	4.5	0.0018	0.6
57	0.166	0.64	0.19	40	0.017		0.4	0.1	4.5	0.0018	0.6
58	0.153	0.73	0.43	40	0.031		0.4	0.1	4.38	0.0018	0.59
59	0.146	0.82	0.44	40	0.023		0.4	0.1	3.7	0.0018	0.55
60	0.164	0.73	0.36	40	0.027		0.4	0.1	4.5	0.0018	0.6
61	0.17	0.51	0.18	40	0.022		0.4	0.1	3.27	0.0018	0.52
62	0.133	0.61	0.39	40	0.014	28	0.4	0.1	4.45	0.0018	0.6
63	0.072	0.56	0.4	40	0.016	26	0.4	0.1	4.5	0.0018	0.6

Table A4. Off-Site Areas – Bullhead Gulch, Greiner Model CUHPF Parameters, Future Conditions (con.)

Catchment ID	Area (sq mi)	Length (mi)	Centroid (mi)	Imperv. (%)	Slope (ft/ft)	Time of Conc. (min)	Perv. Dep. Storage (in)	Imp Dep. Storage (in)	Initial Infil. Rate (in/hr)	Decay Coeff. (sec-1)	Final Infil. Rate (in/hr)
64	0.173	0.58	0.18	13	0.02		0.4	0.1	4.5	0.0018	0.6
65	0.125	0.43	0.15	40	0.005	23	0.4	0.1	4.44	0.0018	0.6
66	0.08	0.34	0.17	20	0.003	20	0.4	0.1	3	0.0018	0.5
67	0.058	0.71	0.31	40	0.007	31	0.4	0.1	4.15	0.0018	0.58
68	0.084	0.41	0.2	20	0.006	22	0.4	0.1	3	0.0018	0.5
69	0.126	0.61	0.34	20	0.006	28	0.4	0.1	3	0.0018	0.5
70	0.097	0.59	0.28	2	0.005	173	0.4	0.1	3	0.0018	0.5

Table A5. Off-Site Areas - UDSWM Conveyance Parameters, Existing Conditions

Bullhead Gulch/Prince Tributary, Existing Conditions

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	OVERBANK/SURCHARGE MANNING N	DEPTH (FT)	JK
101	1	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
1	102	0	1	CHANNEL	25.0	2700.	.0200	20.0	20.0	.050	10.00	0
102	2	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
2	103	0	1	CHANNEL	150.0	1100.	.0320	20.0	20.0	.050	1.50	0
103	3	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
3	106	0	5	PIPE	2.0	1200.	.0200	.0	.0	.020	2.00	0
				OVERFLOW	20.0	1400.	.0171	10.0	20.0	.040	10.00	
104	4	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
4	105	0	1	CHANNEL	20.0	1100.	.0230	10.0	10.0	.045	10.00	0
105	205	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
205	107	4	2	PIPE	2.0	60.	.0100	.0	.0	.020	2.00	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	1.3 28.0	3.3	37.0	4.6	492.0				
106	206	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
206	107	4	2	PIPE	2.0	70.	.0060	.0	.0	.020	2.00	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	3.0 22.0	30.0	45.0	39.0	550.0				
107	6	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
6	306	0	1	CHANNEL	.0	4000.	.0190	20.0	20.0	.085	10.00	0
306	108	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
108	400	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
8	109	0	1	CHANNEL	.0	800.	.0130	10.0	10.0	.085	10.00	0
109	9	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
9	111	0	1	CHANNEL	.0	1400.	.0190	25.0	25.0	.085	10.00	0
110	10	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
10	111	0	1	CHANNEL	.0	2000.	.0240	100.0	100.0	.050	10.00	0
111	11	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
11	112	0	1	CHANNEL	.0	2500.	.0150	25.0	25.0	.085	10.00	0
112	12	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
12	314	0	1	CHANNEL	.0	700.	.0140	5.0	5.0	.085	10.00	0
113	13	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
13	114	0	1	CHANNEL	.0	2400.	.0250	20.0	20.0	.050	10.00	0
114	314	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
314	14	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
14	120	0	1	CHANNEL	.0	1200.	.0130	5.0	5.0	.085	10.00	0
120	121	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
115	15	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
15	116	0	1	CHANNEL	.0	2700.	.0220	100.0	100.0	.050	10.00	0
116	16	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
16	117	0	1	CHANNEL	.0	2000.	.0240	50.0	50.0	.050	10.00	0
117	17	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
17	118	0	1	CHANNEL	.0	1700.	.0170	100.0	100.0	.050	10.00	0
118	18	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
18	119	0	1	CHANNEL	.0	2200.	.0210	50.0	50.0	.050	10.00	0
119	121	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
121	21	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
21	124	0	1	CHANNEL	20.0	3000.	.0130	5.0	5.0	.085	10.00	0
122	22	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
22	323	0	1	CHANNEL	.0	5400.	.0200	100.0	100.0	.050	10.00	0
323	124	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
124	24	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
24	126	0	1	CHANNEL	40.0	1200.	.0130	5.0	5.0	.085	10.00	0
126	128	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
125	25	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
25	325	0	1	CHANNEL	.0	3000.	.0210	50.0	50.0	.050	10.00	0
325	128	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
27	127	0	1	CHANNEL	.0	2000.	.0330	100.0	100.0	.050	10.00	0

Table A5. Off-Site Areas - UDSWM Conveyance Parameters, Existing Conditions (con.)

Bullhead Gulch/Prince Tributary, Existing Conditions (con.)

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	MANNING N	OVERBANK/SURCHARGE DEPTH (FT)	JK
127	128	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
128	28	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
28	131	0	1	CHANNEL	40.0	2000.	.0090	5.0	5.0	.085	10.00	0
129	29	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
29	130	0	1	CHANNEL	.0	4300.	.0260	100.0	100.0	.050	10.00	0
130	131	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
131	31	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
31	136	0	1	CHANNEL	.0	2700.	.0120	50.0	50.0	.085	10.00	0
132	32	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
32	133	0	1	CHANNEL	.0	1200.	.0250	200.0	200.0	.050	10.00	0
133	33	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
33	333	0	1	CHANNEL	.0	2800.	.0140	200.0	200.0	.050	10.00	0
333	136	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
135	35	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
134	136	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
35	335	0	1	CHANNEL	.0	2800.	.0140	200.0	200.0	.050	10.00	0
335	136	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
136	36	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
36	142	0	1	CHANNEL	.0	1900.	.0130	200.0	200.0	.085	10.00	0
137	37	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
37	138	0	1	CHANNEL	.0	2800.	.0160	200.0	200.0	.050	10.00	0
139	39	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
39	140	0	1	CHANNEL	.0	2600.	.0170	200.0	200.0	.050	10.00	0
138	38	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
140	138	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
38	142	0	1	CHANNEL	50.0	1400.	.0110	200.0	200.0	.050	10.00	0
410	42	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
411	41	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
42	143	0	1	CHANNEL	10.0	3300.	.0110	4.0	10.0	.085	10.00	0
143	43	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
141	41	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
41	145	0	1	CHANNEL	50.0	3800.	.0110	200.0	200.0	.085	10.00	0
43	145	0	1	CHANNEL	15.0	1300.	.0040	15.0	100.0	.085	10.00	0
148	49	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
149	49	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
49	151	0	1	CHANNEL	.0	3100.	.0150	200.0	200.0	.085	10.00	0
151	51	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
51	158	0	1	CHANNEL	5.0	2500.	.0150	10.0	10.0	.085	10.00	0
154	54	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
54	155	0	1	CHANNEL	100.0	900.	.0050	500.0	500.0	.030	10.00	0
155	55	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
55	156	0	1	CHANNEL	100.0	1900.	.0090	500.0	500.0	.030	10.00	0
156	56	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
56	157	0	1	CHANNEL	100.0	2200.	.0280	500.0	500.0	.030	10.00	0
157	57	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
57	158	0	1	CHANNEL	.0	1600.	.0160	100.0	100.0	.080	10.00	0
158	58	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
58	160	0	1	CHANNEL	10.0	3000.	.0200	40.0	40.0	.090	10.00	0
160	60	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
60	163	0	1	CHANNEL	10.0	2700.	.0090	15.0	15.0	.090	10.00	0
161	61	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
61	162	0	1	CHANNEL	5.0	2000.	.0200	20.0	20.0	.085	10.00	0
162	163	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
163	63	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
63	144	0	4	CHANNEL	5.0	2400.	.0100	2.0	2.0	.085	3.00	0
				OVERFLOW	.0	2400.	.0100	100.0	100.0	.085	.00	
144	145	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
145	45	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
45	146	0	1	CHANNEL	.0	300.	.0090	200.0	200.0	.085	10.00	0
146	46	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
164	64	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
64	165	0	1	CHANNEL	.0	1400.	.0070	50.0	50.0	.085	10.00	0
46	165	0	1	CHANNEL	.0	2200.	.0050	100.0	100.0	.085	10.00	0
165	65	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
65	166	0	1	CHANNEL	.0	1500.	.0030	100.0	100.0	.080	10.00	0
166	170	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
167	67	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
67	168	0	1	CHANNEL	.0	1800.	.0060	20.0	20.0	.085	10.00	0
168	68	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
68	169	0	1	CHANNEL	10.0	2500.	.0030	10.0	10.0	.060	10.00	0
169	170	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
170	69	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
69	171	0	1	CHANNEL	20.0	3000.	.0030	20.0	20.0	.080	10.00	0
171	70	0	3		.0	1.	.0010	.0	.0	.001	10.00	0

Table A5. Off-Site Areas - UDSWM Conveyance Parameters, Existing Conditions (con.)

Bullhead Gulch/Prince Tributary, Existing Conditions (con.)

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	MANNING N	OVERBANK/SURCHARGE DEPTH (FT)	JK
400	8	14	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	4.6 6.2	11.1	20.6	17.9	29.4	24.9	37.7	28.6	41.3
		32.3	54.8	36.0 92.1	39.9	142.6	43.8	203.3	47.8	240.0	51.8	260.0
		56.0	280.0	56.1 2000.0								
142	410	6	3		.0	1.	.0010	.0	.0	.001	10.00	411
		DIVERSION TO GUTTER NUMBER 411 - TOTAL Q VS DIVERTED Q IN CFS										
		.0	.0	807.0 383.0	2095.0	868.0	2811.0	1049.0	3642.0	1253.0	5000.0	1500.0

Table A6. Off-Site Areas - UDSWM Conveyance Parameters, Future Conditions

Bullhead Gulch/Prince Tributary, Future Conditions

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	MANNING N	OVERBANK/SURCHARGE DEPTH (FT)	JK
101	1	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
1	102	0	4	CHANNEL	1.0	2700.	.0200	2.0	2.0	.050	2.00	0
				OVERFLOW	25.0	2700.	.0200	20.0	20.0	.060	10.00	
102	2	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
2	103	0	4	CHANNEL	1.5	1100.	.0320	2.0	2.0	.050	2.50	0
				OVERFLOW	150.0	1100.	.0320	20.0	20.0	.060	10.00	
103	3	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
3	106	0	5	PIPE	1.5	1200.	.0200	.0	.0	.020	2.50	0
				OVERFLOW	20.0	1400.	.0171	10.0	20.0	.040	10.00	
104	4	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
4	105	0	4	CHANNEL	1.0	1100.	.0230	2.0	2.0	.040	2.00	0
				OVERFLOW	20.0	1100.	.0230	10.0	10.0	.045	10.00	
105	205	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
205	107	4	2	PIPE	2.0	60.	.0100	.0	.0	.020	2.00	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	1.3 28.0	3.3	37.0	4.6	492.0				
106	206	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
206	107	4	2	PIPE	2.0	70.	.0060	.0	.0	.020	2.00	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	3.0 22.0	30.0	45.0	39.0	550.0				
107	6	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
6	306	0	4	CHANNEL	1.0	4000.	.0190	2.0	2.0	.070	2.00	0
				OVERFLOW	10.0	4000.	.0190	20.0	20.0	.085	10.00	
306	108	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
108	400	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
8	109	0	4	CHANNEL	2.0	800.	.0130	2.0	2.0	.070	2.50	0
				OVERFLOW	12.0	800.	.0130	10.0	10.0	.085	10.00	
109	9	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
9	111	0	4	CHANNEL	2.0	1400.	.0190	2.0	2.0	.070	3.50	0
				OVERFLOW	16.0	1400.	.0190	20.0	20.0	.085	10.00	
110	10	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
10	111	0	4	CHANNEL	1.0	2000.	.0240	2.0	2.0	.050	2.00	0
				OVERFLOW	10.0	2000.	.0240	20.0	20.0	.060	10.00	
111	11	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
11	112	0	4	CHANNEL	2.0	2500.	.0150	2.0	2.0	.070	3.50	0
				OVERFLOW	16.0	2500.	.0150	20.0	20.0	.085	10.00	
112	12	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
12	314	0	4	CHANNEL	1.0	700.	.0140	2.0	2.0	.070	2.00	0
				OVERFLOW	10.0	700.	.0140	5.0	5.0	.085	10.00	
113	13	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
13	114	0	4	CHANNEL	1.5	2400.	.0250	2.0	2.0	.050	2.50	0
				OVERFLOW	12.0	2400.	.0250	20.0	20.0	.060	10.00	
114	314	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
314	14	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
14	120	0	4	CHANNEL	2.0	1200.	.0130	2.0	2.0	.070	4.00	0
				OVERFLOW	18.0	1200.	.0130	5.0	5.0	.085	10.00	
120	121	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
115	15	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
15	116	0	4	CHANNEL	1.0	2700.	.0220	2.0	2.0	.050	2.00	0
				OVERFLOW	10.0	2700.	.0220	20.0	20.0	.060	10.00	
116	16	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
16	117	0	4	CHANNEL	1.5	2000.	.0240	2.0	2.0	.050	2.50	0
				OVERFLOW	12.0	2000.	.0240	20.0	20.0	.060	10.00	
117	17	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
17	118	0	4	CHANNEL	1.5	1700.	.0170	2.0	2.0	.050	2.50	0
				OVERFLOW	12.0	1700.	.0170	20.0	20.0	.060	10.00	
118	18	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
18	119	0	4	CHANNEL	1.5	2200.	.0210	2.0	2.0	.070	2.50	0
				OVERFLOW	12.0	2200.	.0210	20.0	20.0	.050	10.00	

Table A6. Off-Site Areas – UDSWM Conveyance Parameters, Future Conditions (con.)

Bullhead Gulch/Prince Tributary, Future Conditions (con.)

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	OVERBANK/SURCHARGE MANNING N	DEPTH (FT)	JK
119	121	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
121	21	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
21	124	0	4	CHANNEL	2.0	3000.	.0130	2.0	2.0	.070	4.00	0
				OVERFLOW	20.0	3000.	.0130	5.0	5.0	.085	10.00	
122	22	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
22	323	0	4	CHANNEL	1.0	5400.	.0200	2.0	2.0	.050	2.00	0
				OVERFLOW	10.0	5400.	.0200	20.0	20.0	.070	10.00	
323	124	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
124	24	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
24	126	0	4	CHANNEL	3.0	1200.	.0130	2.0	2.0	.070	6.00	0
				OVERFLOW	40.0	1200.	.0130	5.0	5.0	.085	10.00	
126	128	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
125	25	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
25	325	0	4	CHANNEL	1.0	3000.	.0210	2.0	2.0	.050	2.00	0
				OVERFLOW	10.0	3000.	.0210	20.0	20.0	.070	10.00	
325	128	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
27	127	0	4	CHANNEL	1.0	2000.	.0330	2.0	2.0	.050	2.00	0
				OVERFLOW	10.0	2000.	.0330	20.0	20.0	.070	10.00	
127	128	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
128	28	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
28	131	0	4	CHANNEL	2.0	2000.	.0090	2.0	2.0	.070	4.00	0
				OVERFLOW	40.0	2000.	.0090	5.0	5.0	.085	15.00	
129	29	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
29	130	0	4	CHANNEL	1.0	4300.	.0260	2.0	2.0	.050	2.00	0
				OVERFLOW	10.0	4300.	.0260	20.0	20.0	.070	10.00	
130	131	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
131	31	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
31	136	0	4	CHANNEL	3.0	2700.	.0120	2.0	2.0	.070	4.00	0
				OVERFLOW	20.0	2700.	.0120	20.0	20.0	.085	10.00	
132	32	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
32	133	0	4	CHANNEL	1.0	1200.	.0250	2.0	2.0	.050	2.00	0
				OVERFLOW	10.0	1200.	.0250	20.0	20.0	.070	10.00	
133	33	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
33	333	0	4	CHANNEL	1.0	2800.	.0140	2.0	2.0	.050	2.00	0
				OVERFLOW	10.0	2800.	.0140	20.0	20.0	.070	10.00	
333	136	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
135	35	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
134	136	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
35	335	0	4	CHANNEL	1.0	2800.	.0140	2.0	2.0	.050	2.00	0
				OVERFLOW	10.0	2800.	.0140	20.0	20.0	.070	10.00	
335	136	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
136	36	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
36	142	0	4	CHANNEL	3.0	1900.	.0130	2.0	2.0	.070	6.00	0
				OVERFLOW	30.0	1900.	.0130	20.0	20.0	.085	15.00	
137	37	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
37	138	0	4	CHANNEL	1.0	2800.	.0160	2.0	2.0	.050	2.00	0
				OVERFLOW	10.0	2800.	.0160	20.0	20.0	.070	10.00	
139	39	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
39	140	0	4	CHANNEL	1.0	2600.	.0170	2.0	2.0	.050	2.00	0
				OVERFLOW	10.0	2600.	.0170	20.0	20.0	.070	10.00	
140	138	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
38	142	0	4	CHANNEL	1.5	1400.	.0110	2.0	2.0	.050	2.50	0
				OVERFLOW	50.0	1400.	.0110	20.0	20.0	.070	10.00	
410	42	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
411	41	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
42	143	0	1	CHANNEL	10.0	3300.	.0110	4.0	10.0	.085	10.00	0
143	43	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
141	41	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
41	145	0	4	CHANNEL	3.0	3800.	.0110	2.0	2.0	.070	6.00	0
				OVERFLOW	50.0	3800.	.0110	20.0	20.0	.085	15.00	
43	145	0	4	CHANNEL	1.0	1300.	.0040	2.0	2.0	.070	2.00	0
				OVERFLOW	15.0	1300.	.0040	15.0	100.0	.085	10.00	
148	49	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
149	49	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
49	151	0	4	CHANNEL	1.5	3100.	.0150	2.0	2.0	.070	2.50	0
				OVERFLOW	12.0	3100.	.0150	20.0	20.0	.085	10.00	
151	51	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
51	158	0	4	CHANNEL	1.5	2500.	.0150	2.0	2.0	.070	2.50	0
				OVERFLOW	12.0	2500.	.0150	10.0	10.0	.085	10.00	
154	54	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
54	155	0	4	CHANNEL	1.0	900.	.0050	2.0	2.0	.050	2.00	0
				OVERFLOW	100.0	900.	.0050	20.0	20.0	.070	10.00	
155	55	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
55	156	0	4	CHANNEL	1.5	1900.	.0090	2.0	2.0	.050	2.50	0
				OVERFLOW	100.0	1900.	.0090	20.0	20.0	.070	10.00	
156	56	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
56	157	0	4	CHANNEL	1.5	2200.	.0280	2.0	2.0	.050	2.50	0
				OVERFLOW	100.0	2200.	.0280	20.0	20.0	.070	10.00	
157	57	0	3		.0	1.	.0010	.0	.0	.001	10.00	0

Table A6. Off-Site Areas - UDSWM Conveyance Parameters, Future Conditions (con.)

Bullhead Gulch/Prince Tributary, Future Conditions (con.)

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	OVERBANK/SURCHARGE MANNING N	DEPTH (FT)	JK
57	158	0	4	CHANNEL	1.5	1600.	.0160	2.0	2.0	.065	2.50	0
				OVERFLOW	12.0	1600.	.0160	20.0	20.0	.080	10.00	
158	58	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
58	160	0	4	CHANNEL	2.0	3000.	.0200	2.0	2.0	.070	4.00	0
				OVERFLOW	20.0	3000.	.0200	20.0	20.0	.090	10.00	
160	60	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
60	163	0	4	CHANNEL	2.0	2700.	.0090	2.0	2.0	.070	4.00	0
				OVERFLOW	20.0	2700.	.0090	20.0	20.0	.090	10.00	
161	61	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
61	162	0	4	CHANNEL	1.0	2000.	.0200	2.0	2.0	.060	2.00	0
				OVERFLOW	10.0	2000.	.0200	20.0	20.0	.085	10.00	
162	163	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
163	63	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
63	144	0	4	CHANNEL	2.0	2400.	.0100	2.0	2.0	.070	4.00	0
				OVERFLOW	20.0	2400.	.0100	20.0	20.0	.085	10.00	
144	145	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
145	45	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
45	146	0	4	CHANNEL	3.0	300.	.0090	2.0	2.0	.070	6.00	0
				OVERFLOW	30.0	300.	.0090	20.0	20.0	.085	15.00	
146	46	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
164	64	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
64	165	0	4	CHANNEL	2.0	1400.	.0070	2.0	2.0	.070	4.00	0
				OVERFLOW	20.0	1400.	.0070	20.0	20.0	.085	10.00	
46	165	0	4	CHANNEL	2.0	2200.	.0050	2.0	2.0	.070	4.50	0
				OVERFLOW	20.0	2200.	.0050	20.0	20.0	.085	15.00	
165	65	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
65	166	0	4	CHANNEL	3.0	1500.	.0030	2.0	2.0	.060	5.50	0
				OVERFLOW	25.0	1500.	.0030	20.0	20.0	.080	20.00	
166	170	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
167	67	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
67	168	0	4	CHANNEL	1.0	1800.	.0060	2.0	2.0	.060	2.00	0
				OVERFLOW	10.0	1800.	.0060	20.0	20.0	.085	10.00	
168	68	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
68	169	0	4	CHANNEL	1.0	2500.	.0030	2.0	2.0	.050	2.00	0
				OVERFLOW	10.0	2500.	.0030	20.0	20.0	.060	10.00	
169	170	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
170	69	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
69	171	0	4	CHANNEL	3.0	3000.	.0030	2.0	2.0	.070	5.50	0
				OVERFLOW	25.0	3000.	.0030	20.0	20.0	.080	20.00	
171	70	0	3		.0	1.	.0010	.0	.0	.001	10.00	0
400	8	14	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0

RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW

.0	.0	4.6	6.2	11.1	20.6	17.9	29.4	24.9	37.7	28.6	41.3
32.3	54.8	36.0	92.1	39.9	142.6	43.8	203.3	47.8	240.0	51.8	260.0
56.0	280.0	56.1	2000.0								

142	410	2	3		.0	1.	.0010	.0	.0	.001	10.00	411

DIVERSION TO GUTTER NUMBER 411 - TOTAL Q VS DIVERTED Q IN CFS

.0	.0	10000.0	.0

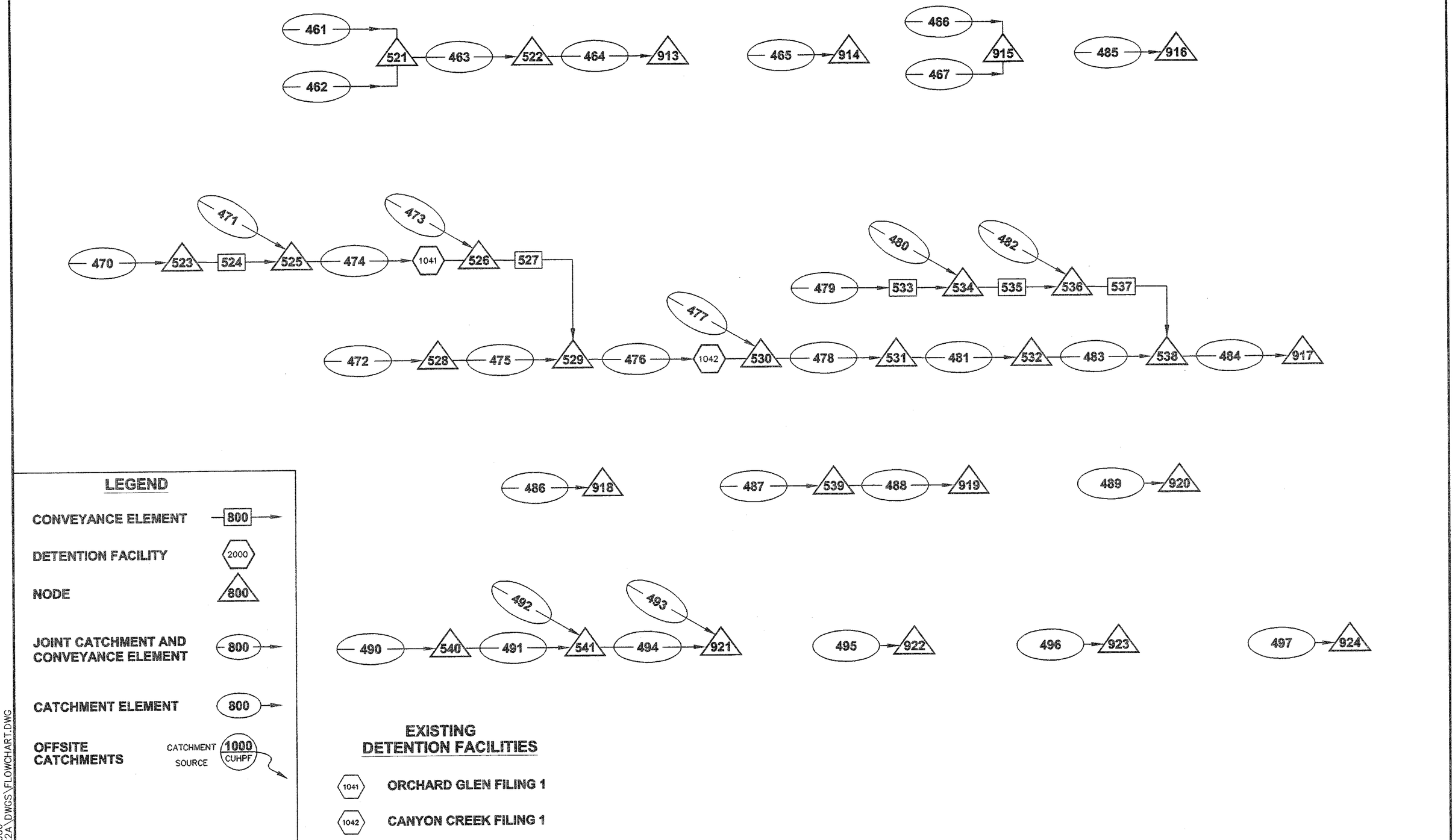
Table A7. Off-Site Areas – OS1, and OS2, CUHPF Parameters, Existing Conditions

Catchment ID	Area (sq mi)	Length (mi)	Centroid (mi)	Imperv. (%)	Slope (ft/ft)	Time of Conc. (min)	Perv. Dep. Storage (in)	Imp Dep. Storage (in)	Initial Infil. Rate (in/hr)	Decay Coeff. (sec^{-1})	Final Infil. Rate (in/hr)
OS1	2.56	2.74	1.08	2	0.03		0.5	0.1	3.26	0.0018	0.52
OS2	0.66	1.55	0.71	20	0.016		0.5	0.1	4.34	0.0018	0.59

Table A8. Off-Site Areas – OS1, and OS2, CUHPF Parameters, Future Conditions

Catchment ID	Area (sq mi)	Length (mi)	Centroid (mi)	Imperv. (%)	Slope (ft/ft)	Time of Conc. (min)	Perv. Dep. Storage (in)	Imp Dep. Storage (in)	Initial Infil. Rate (in/hr)	Decay Coeff. (sec^{-1})	Final Infil. Rate (in/hr)
OS1	2.56	2.74	1.08	2	0.03		0.5	0.1	3.26	0.0018	0.52
OS2	0.66	1.55	0.71	57	0.016		0.5	0.1	4.34	0.0018	0.59

COAL CREEK TRIBUTARIES



DATE: MAY 30, 2000
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Lore & Associates, Inc
water resource consultants
841 Front Street
Louisville, Colorado 80027-1849
Phone: 303-673-9795
Fax: 303-673-9796

DESIGNED:	RJP
DRAWN:	DM
CHECKED:	DJL
DATE:	4-00

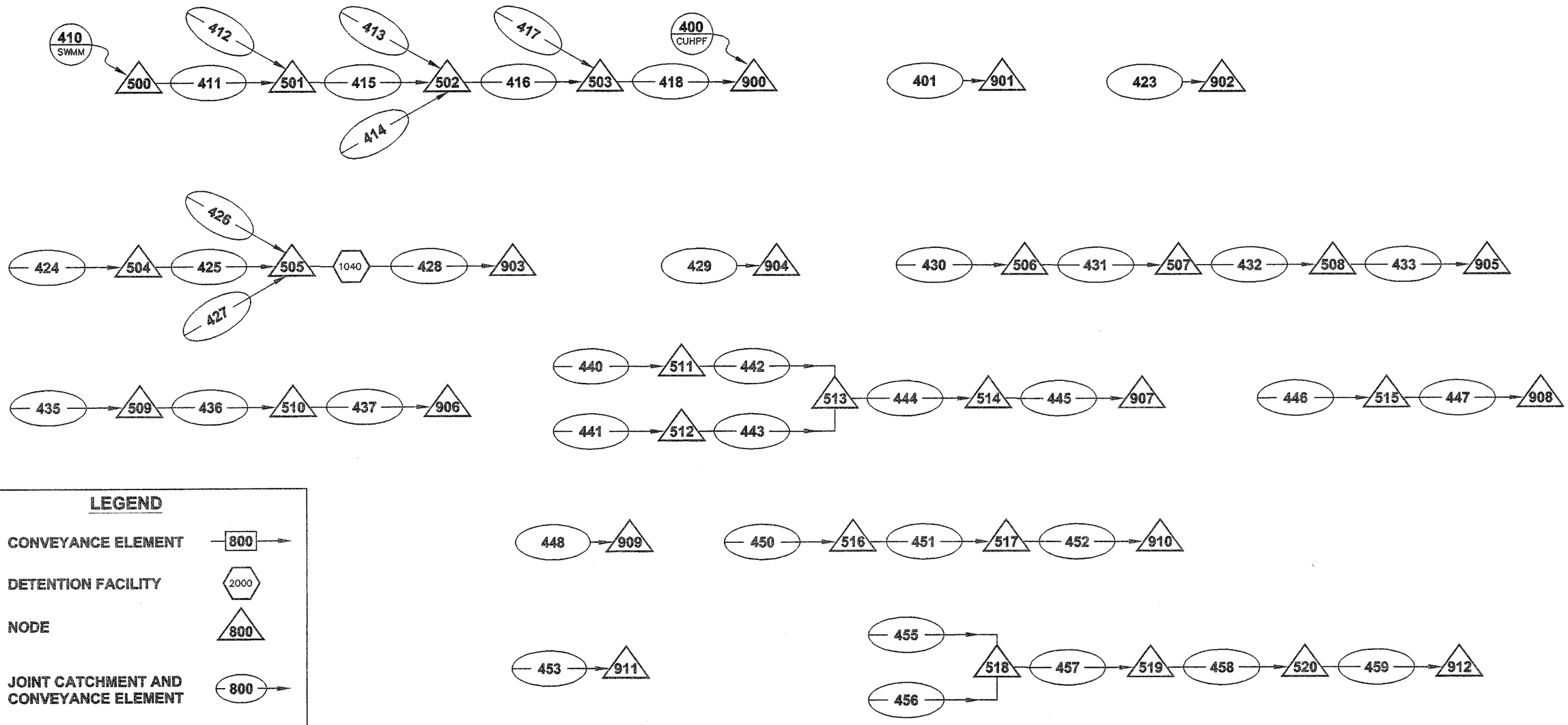
TOWN OF ERIE
BOULDER COUNTY
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

SWMM FLOW CHARTS
EXISTING AND FUTURE CONDITIONS

Figure A1

COAL CREEK TRIBUTARIES



LEGEND

CONVEYANCE ELEMENT — 800

DETENTION FACILITY — 2000

NODE — 800

JOINT CATCHMENT AND CONVEYANCE ELEMENT — 800

CATCHMENT ELEMENT — 800

OFFSITE CATCHMENTS — CATCHMENT 1000 / SOURCE CUHPF

EXISTING DETENTION FACILITIES

1040 B.N.R.R. EMBANKMENT

Lowe & Associates, Inc
water resource consultants
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Louisville, Colorado 80027-1849
Phone: 303-673-9795
Fax: 303-673-9796

DESIGNED:	RJP
DRAWN:	DM
CHECKED:	DJL
DATE:	4-00

TOWN OF ERIE
BOULDER COUNTY
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

SWMM FLOW CHARTS
EXISTING AND FUTURE CONDITIONS

Figure A2

DATE: MAY 30, 2000
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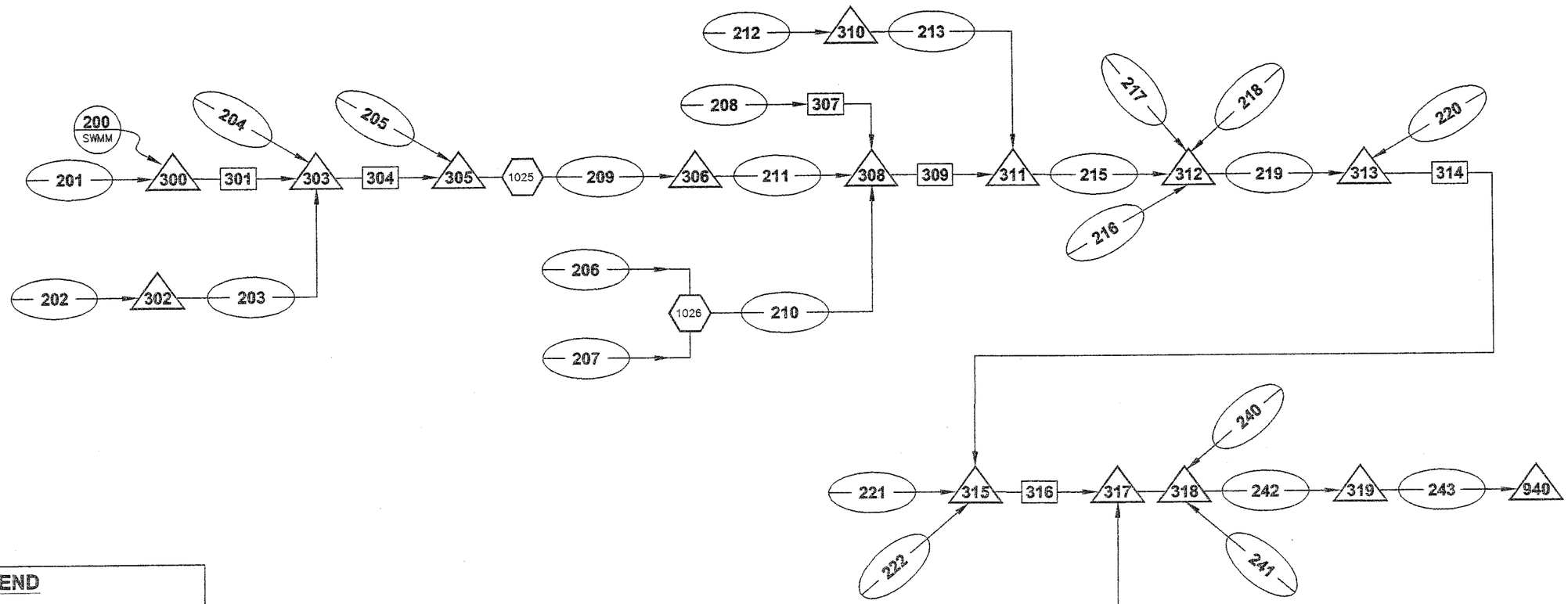
BULLHEAD GULCH/PRINCE TRIBUTARY



LEGEND

CONVEYANCE ELEMENT — 800

DETENTION FACILITY — 2000

NODE — 800

JOINT CATCHMENT AND CONVEYANCE ELEMENT — 800

CATCHMENT ELEMENT — 800

OFFSITE CATCHMENTS — CATCHMENT SOURCE 1000 CUHPF

EXISTING DETENTION FACILITIES

1025 ARAPAHOE RIDGE FILING 2

1026 ARAPAHOE RIDGE FILING 1

DATE: MAY 30, 2000
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DATE:	4-00

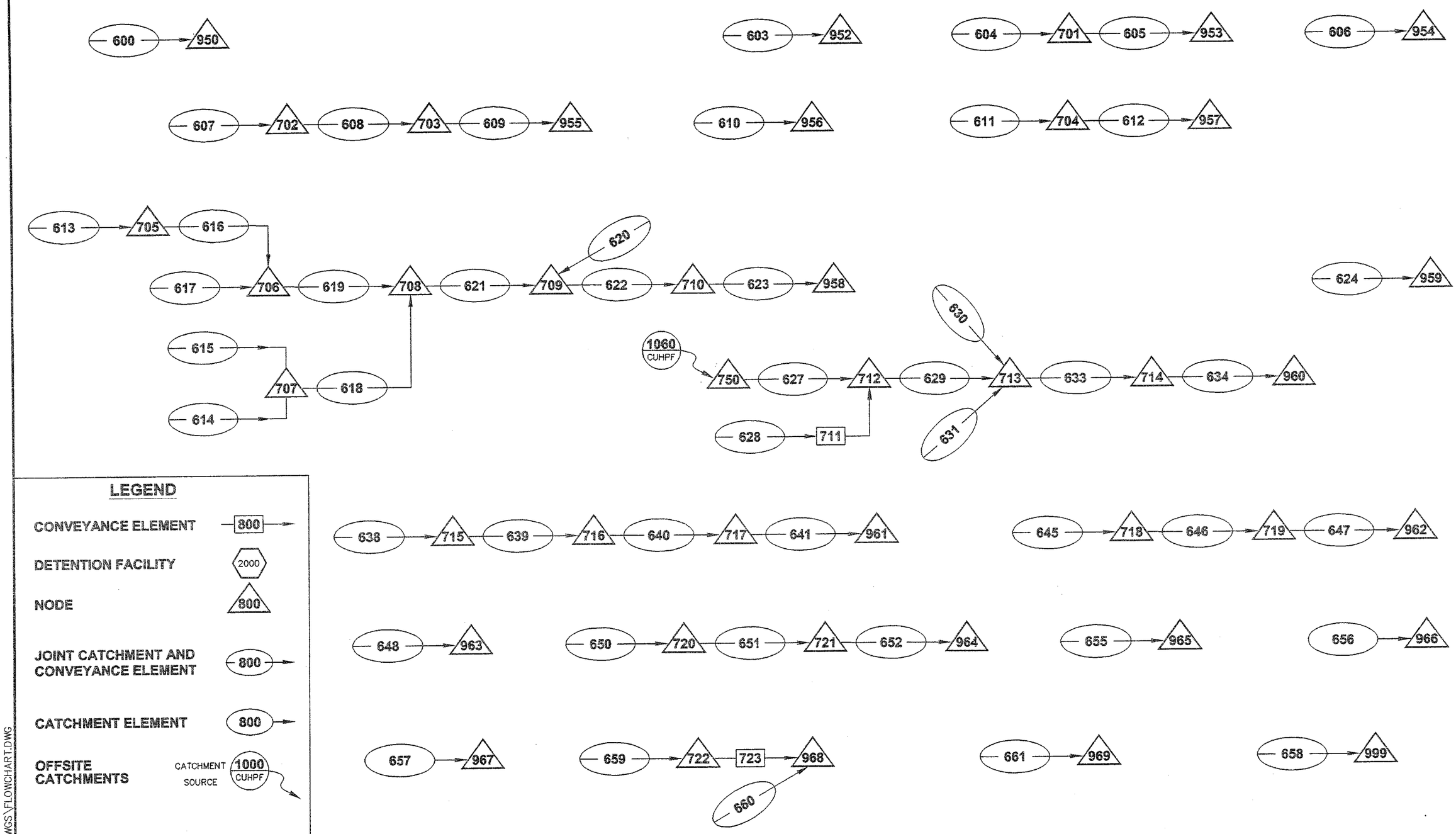
TOWN OF ERIE
BOULDER COUNTY
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

SWMM FLOW CHARTS
EXISTING AND FUTURE CONDITIONS

Figure A3

BOULDER CREEK TRIBUTARIES



DATE: MAY 30, 2000
E:\PROJECTS\9922A\DWGS\FLOWCHART.DWG

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DATE:	4-00

TOWN OF ERIE
BOULDER COUNTY
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

SWMM FLOW CHARTS
EXISTING AND FUTURE CONDITIONS

Figure A4

APPENDIX A2

HYDROLOGIC MODELS AND UDSWM FLOW CHARTS
OUTFALL SYSTEM

Tables

A9 UDSWM Basin and Conveyance Parameters, Outfall System

Figures

A5–A8 Catchment Delineation and SWMM Elements, Outfall System

Table A9. UDSWM Basin and Conveyance Parameters, Outfall System

Coal Creek Tributaries

SUBAREA NUMBER	GUTTER OR MANHOLE	WIDTH (FT)	AREA (AC)	PERCENT IMPERV.	SLOPE (FT/FT)	RESISTANCE FACTOR IMPERV.	RESISTANCE FACTOR PERV.	SURFACE STORAGE(IN) IMPERV.	SURFACE STORAGE(IN) PERV.	INFILTRATION RATE(IN/HR) MAXIMUM	INFILTRATION RATE(IN/HR) MINIMUM	DECAY RATE	GAGE NO
-1	0	2.	.0	1.0	1.0000	1.000	1.000	1.000	1.000	1.00	1.00	1.00000	
410	410	10546.	156.9	60.0	.0180	.020	.200	.100	.300	4.14	.58	.00180	1
411	411	9029.	89.9	42.4	.0200	.020	.200	.100	.300	3.54	.54	.00180	1
412	412	10238.	87.3	30.8	.0330	.020	.200	.100	.300	3.90	.56	.00180	1
413	413	9364.	29.5	50.0	.0270	.020	.200	.100	.300	4.50	.60	.00180	1
414	414	12312.	84.1	50.0	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
415	415	9450.	80.1	38.0	.0310	.020	.200	.100	.300	4.02	.57	.00180	1
416	416	8712.	89.7	59.0	.0130	.020	.200	.100	.300	4.50	.60	.00180	1
417	417	9428.	40.3	95.0	.0210	.020	.200	.100	.300	4.25	.58	.00180	1
418	418	9482.	58.2	24.6	.0140	.020	.200	.100	.300	4.01	.57	.00180	1
424	424	11286.	64.3	49.0	.0240	.020	.200	.100	.300	4.50	.60	.00180	1
425	425	16459.	127.2	9.4	.0130	.020	.200	.100	.300	4.35	.59	.00180	1
426	426	11844.	76.8	38.4	.0980	.020	.200	.100	.300	4.14	.58	.00180	1
427	427	3132.	45.5	57.8	.0120	.020	.200	.100	.300	4.25	.58	.00180	1
428	428	2142.	4.9	2.0	.0130	.020	.200	.100	.300	4.47	.60	.00180	1
430	430	11016.	110.9	17.4	.0240	.020	.200	.100	.300	4.50	.60	.00180	1
431	431	11858.	106.5	2.0	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
432	432	6950.	67.0	57.8	.0070	.020	.200	.100	.300	4.50	.60	.00180	1
433	433	4194.	18.9	57.8	.0190	.020	.200	.100	.300	4.50	.60	.00180	1
435	435	10350.	56.0	2.0	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
436	436	14200.	127.5	21.5	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
437	437	2860.	27.7	48.5	.0280	.020	.200	.100	.300	4.50	.60	.00180	1
440	440	5330.	67.1	9.2	.0150	.020	.200	.100	.300	4.50	.60	.00180	1
441	441	5864.	41.8	2.0	.0180	.020	.200	.100	.300	4.50	.60	.00180	1
442	442	12636.	98.7	6.7	.0200	.020	.200	.100	.300	4.50	.60	.00180	1
443	443	6448.	20.9	2.9	.0230	.020	.200	.100	.300	4.50	.60	.00180	1
444	444	6338.	60.7	89.4	.0100	.020	.200	.100	.300	4.50	.60	.00180	1
445	445	3096.	13.8	83.8	.0330	.020	.200	.100	.300	4.50	.60	.00180	1
446	446	16200.	118.8	74.5	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
447	447	4410.	16.6	81.1	.0240	.020	.200	.100	.300	4.50	.60	.00180	1
450	450	9738.	42.1	23.3	.0260	.020	.200	.100	.300	4.50	.60	.00180	1
451	451	6941.	113.6	91.3	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
452	452	7402.	65.6	83.8	.0110	.020	.200	.100	.300	4.05	.57	.00180	1
453	453	6062.	60.6	48.5	.0150	.020	.200	.100	.300	4.50	.60	.00180	1
455	455	7884.	70.5	47.6	.0210	.020	.200	.100	.300	4.50	.60	.00180	1
456	456	18216.	122.4	49.4	.0250	.020	.200	.100	.300	4.50	.60	.00180	1
457	457	3125.	52.3	16.1	.0150	.020	.200	.100	.300	4.50	.60	.00180	1
458	458	2230.	49.8	95.0	.0140	.020	.200	.100	.300	4.29	.59	.00180	1
459	459	8190.	125.8	46.5	.0080	.020	.200	.100	.300	4.50	.60	.00180	1
461	461	5998.	42.6	78.8	.0290	.020	.200	.100	.300	4.50	.60	.00180	1
462	462	10676.	78.6	67.5	.0240	.020	.200	.100	.300	4.50	.60	.00180	1
463	463	2750.	39.4	80.1	.0150	.020	.200	.100	.300	4.50	.60	.00180	1
464	464	7686.	99.3	60.0	.0050	.020	.200	.100	.300	4.26	.58	.00180	1
465	465	5314.	51.0	23.6	.0130	.020	.200	.100	.300	4.50	.60	.00180	1
466	466	8719.	60.6	6.9	.0060	.020	.200	.100	.300	4.40	.59	.00180	1
467	467	5947.	68.6	2.5	.0080	.020	.200	.100	.300	4.11	.57	.00180	1
468	468	5213.	24.0	67.0	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
470	470	4342.	47.3	48.1	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
471	471	10746.	85.0	40.9	.0170	.020	.200	.100	.300	4.50	.60	.00180	1
472	472	4453.	35.8	15.4	.0120	.020	.200	.100	.300	4.50	.60	.00180	1
473	473	2873.	13.3	50.0	.0210	.020	.200	.100	.300	4.50	.60	.00180	1
474	474.	2214.	37.1	50.0	.0080	.020	.200	.100	.300	4.50	.60	.00180	1
475	475	4354.	95.5	57.7	.0240	.020	.200	.100	.300	4.50	.60	.00180	1
476	476	10382.	118.3	50.0	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
477	477	4946.	31.7	50.0	.0230	.020	.200	.100	.300	4.50	.60	.00180	1
478	478	4118.	113.0	43.0	.0080	.020	.200	.100	.300	4.50	.60	.00180	1
479	479	5998.	40.0	75.7	.0160	.020	.200	.100	.300	4.50	.60	.00180	1
480	480	4901.	33.0	88.0	.0250	.020	.200	.100	.300	4.50	.60	.00180	1
481	481	4145.	64.0	45.2	.0120	.020	.200	.100	.300	4.50	.60	.00180	1
482	482	2484.	27.0	79.8	.0110	.020	.200	.100	.300	4.50	.60	.00180	1
483	483	4212.	27.3	86.2	.0100	.020	.200	.100	.300	4.50	.60	.00180	1
484	484	10708.	78.9	55.1	.0050	.020	.200	.100	.300	4.50	.60	.00180	1
485	485	8208.	128.2	46.0	.0060	.020	.200	.100	.300	4.17	.58	.00180	1
486	486	10562.	120.2	29.9	.0070	.020	.200	.100	.300	3.62	.54	.00180	1
487	487	9034.	119.6	48.8	.0090	.020	.200	.100	.300	3.68	.55	.00180	1
488	488	4428.	57.6	71.3	.0100	.020	.200	.100	.300	3.72	.55	.00180	1
490	490	12830.	88.3	42.1	.0120	.020	.200	.100	.300	4.14	.58	.00180	1
491	491	10325.	71.7	43.0	.0040	.020	.200	.100	.300	4.10	.57	.00180	1
492	492	10055.	109.5	43.0	.0090	.020	.200	.100	.300	3.68	.55	.00180	1
493	493	6111.	56.5	38.5	.0020	.020	.200	.100	.300	4.50	.60	.00180	1
494	494	3420.	11.6	5.7	.0070	.020	.200	.100	.300	3.95	.56	.00180	1
401	901	900.	26.0	18.7	.0200	.020	.200	.100	.300	3.21	.51	.00180	1
423	902	540.	13.1	50.4	.0330	.020	.200	.100	.300	3.78	.55	.00180	1
429	904	1710.	30.7	24.3	.0290	.020	.200	.100	.300	4.50	.60	.00180	1
448	909	1980.	65.1	39.2	.0140	.020	.200	.100	.300	4.35	.59	.00180	1
489	920	1620.	33.5	28.7	.0090	.020	.200	.100	.300	4.02	.57	.00180	1
495	922	1080.	29.5	2.0	.0030	.020	.200	.100	.300	3.00	.50	.00180	1
496	923	900.	47.9	2.0	.0040	.020	.200	.100	.300	4.35	.59	.00180	1
497	924	1080.	59.2	2.0	.0030	.020	.200	.100	.300	3.00	.50	.00180	1
12	12	9612.	53.1	47.6	.0280	.020	.200	.100	.300	4.50	.60	.00180	1
13	13	5400.	22.0	95.0	.0330	.020	.200	.100	.300	4.50	.60	.00180	1

TOTAL TRIBUTARY AREA (ACRES), 5144.90

Table A9. UDSWM Basin and Conveyance Parameters, Outfall System (con.)

Coal Creek Tributaries

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ L	SIDE SLOPES TO VERT R	OVERBANK/SURCHARGE MANNING N	OVERBANK/SURCHARGE DEPTH (FT)	JK
410	500	0	4	CHANNEL	5.0	3255.	.0180	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3255.	.0180	20.0	20.0	.056	10.00	
411	501	0	4	CHANNEL	8.0	3160.	.0330	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3160.	.0330	20.0	20.0	.044	10.00	
412	501	0	4	CHANNEL	8.0	3160.	.0330	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3160.	.0330	20.0	20.0	.044	10.00	
413	502	0	4	CHANNEL	5.0	2890.	.0270	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2890.	.0270	20.0	20.0	.056	10.00	
414	502	0	4	CHANNEL	8.0	3420.	.0220	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3420.	.0220	20.0	20.0	.044	10.00	
415	502	0	4	CHANNEL	10.0	2625.	.0310	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	2625.	.0310	20.0	20.0	.056	10.00	
416	503	0	4	CHANNEL	10.0	3025.	.0130	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	3025.	.0130	20.0	20.0	.056	10.00	
417	503	0	4	CHANNEL	8.0	4365.	.0210	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4365.	.0210	20.0	20.0	.044	10.00	
418	900	0	4	CHANNEL	8.0	4390.	.0140	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4390.	.0140	20.0	20.0	.044	10.00	
424	504	0	4	CHANNEL	8.0	3135.	.0240	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3135.	.0240	20.0	20.0	.044	10.00	
425	505	0	4	CHANNEL	8.0	5080.	.0130	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	5080.	.0130	20.0	20.0	.056	10.00	
426	505	0	4	CHANNEL	8.0	4700.	.0980	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4700.	.0980	20.0	20.0	.044	10.00	
427	505	0	4	CHANNEL	8.0	1450.	.0120	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1450.	.0120	20.0	20.0	.044	10.00	
428	903	0	4	CHANNEL	10.0	595.	.0130	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	595.	.0130	20.0	20.0	.056	10.00	
430	506	0	4	CHANNEL	5.0	3825.	.0240	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3825.	.0240	20.0	20.0	.056	10.00	
431	507	0	4	CHANNEL	8.0	3660.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	3660.	.0140	20.0	20.0	.056	10.00	
432	1055	0	4	CHANNEL	8.0	2145.	.0070	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2145.	.0070	20.0	20.0	.044	10.00	
433	905	0	4	CHANNEL	10.0	1165.	.0190	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1165.	.0190	20.0	20.0	.056	10.00	
435	509	0	4	CHANNEL	5.0	2875.	.0220	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2875.	.0220	20.0	20.0	.056	10.00	
436	1054	0	4	CHANNEL	8.0	5635.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	5635.	.0140	20.0	20.0	.056	10.00	
437	906	0	4	CHANNEL	8.0	1135.	.0280	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1135.	.0280	20.0	20.0	.044	10.00	
440	511	0	4	CHANNEL	5.0	1645.	.0150	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	1645.	.0150	20.0	20.0	.056	10.00	
441	512	0	4	CHANNEL	8.0	2715.	.0180	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2715.	.0180	20.0	20.0	.044	10.00	
442	513	0	4	CHANNEL	8.0	3510.	.0200	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	3510.	.0200	20.0	20.0	.056	10.00	
443	513	0	4	CHANNEL	8.0	2985.	.0230	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2985.	.0230	20.0	20.0	.044	10.00	
444	514	0	4	CHANNEL	8.0	2515.	.0100	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2515.	.0100	20.0	20.0	.044	10.00	
445	907	0	4	CHANNEL	8.0	860.	.0330	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	860.	.0330	20.0	20.0	.044	10.00	
446	514	0	4	CHANNEL	8.0	4500.	.0220	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4500.	.0220	20.0	20.0	.044	10.00	
447	908	0	4	CHANNEL	8.0	1225.	.0240	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	1225.	.0240	20.0	20.0	.056	10.00	
450	516	0	4	CHANNEL	5.0	2705.	.0260	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2705.	.0260	20.0	20.0	.056	10.00	
451	1051	0	4	CHANNEL	8.0	2410.	.0220	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2410.	.0220	20.0	20.0	.044	10.00	
452	910	0	4	CHANNEL	8.0	2570.	.0110	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2570.	.0110	20.0	20.0	.044	10.00	
453	911	0	4	CHANNEL	8.0	2105.	.0150	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2105.	.0150	20.0	20.0	.044	10.00	
455	518	0	4	CHANNEL	8.0	3650.	.0210	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3650.	.0210	20.0	20.0	.044	10.00	
456	1049	0	4	CHANNEL	8.0	5060.	.0250	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	5060.	.0250	20.0	20.0	.044	10.00	
457	1050	0	4	CHANNEL	8.0	1240.	.0150	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	1240.	.0150	20.0	20.0	.056	10.00	
458	520	0	4	CHANNEL	10.0	885.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	885.	.0140	20.0	20.0	.056	10.00	
459	912	0	4	CHANNEL	10.0	3250.	.0080	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	3250.	.0080	20.0	20.0	.056	10.00	
461	521	0	4	CHANNEL	5.0	2380.	.0290	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2380.	.0290	20.0	20.0	.056	10.00	
462	1047	0	4	CHANNEL	5.0	3295.	.0240	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3295.	.0240	20.0	20.0	.056	10.00	
463	522	0	4	CHANNEL	8.0	955.	.0150	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	955.	.0150	20.0	20.0	.056	10.00	
464	913	0	4	CHANNEL	8.0	3050.	.0050	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3050.	.0050	20.0	20.0	.044	10.00	
465	914	0	4	CHANNEL	5.0	1845.	.0130	3.0	3.0	.044	3.00	0

Table A9. UDSWM Basin and Conveyance Parameters, Outfall System

Coal Creek Tributaries

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	OVERBANK/SURCHARGE MANNING N	DEPTH (FT)	JK
				OVERFLOW	23.0	1845.	.0130	20.0	20.0	.056	10.00	
466	915	0	4	CHANNEL	5.0	3460.	.0060	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3460.	.0060	20.0	20.0	.056	10.00	
467	915	0	4	CHANNEL	5.0	2360.	.0080	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2360.	.0080	20.0	20.0	.056	10.00	
468	1056	0	4	CHANNEL	8.0	1609.	.0220	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1609.	.0220	20.0	20.0	.044	10.00	
470	1057	0	4	CHANNEL	8.0	2010.	.0220	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2010.	.0220	20.0	20.0	.044	10.00	
471	1043	0	4	CHANNEL	8.0	2985.	.0170	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2985.	.0170	20.0	20.0	.044	10.00	
472	528	0	4	CHANNEL	5.0	1546.	.0120	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	1546.	.0120	20.0	20.0	.056	10.00	
473	526	0	4	CHANNEL	8.0	1330.	.0210	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1330.	.0210	20.0	20.0	.044	10.00	
474	1041	0	4	CHANNEL	8.0	1025.	.0080	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1025.	.0080	20.0	20.0	.044	10.00	
475	1044	0	4	CHANNEL	5.0	1512.	.0240	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	1512.	.0240	20.0	20.0	.056	10.00	
476	1042	0	4	CHANNEL	10.0	4120.	.0140	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	4120.	.0140	20.0	20.0	.056	10.00	
477	20	0	4	CHANNEL	8.0	2290.	.0230	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2290.	.0230	20.0	20.0	.044	10.00	
478	531	0	4	CHANNEL	10.0	1430.	.0080	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1430.	.0080	20.0	20.0	.056	10.00	
479	533	0	4	CHANNEL	8.0	2380.	.0160	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2380.	.0160	20.0	20.0	.044	10.00	
480	534	0	4	CHANNEL	8.0	1702.	.0250	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1702.	.0250	20.0	20.0	.044	10.00	
481	1045	0	4	CHANNEL	8.0	1645.	.0120	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1645.	.0120	20.0	20.0	.044	10.00	
482	536	0	4	CHANNEL	5.0	1650.	.0110	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	1650.	.0110	20.0	20.0	.056	10.00	
483	538	0	4	CHANNEL	10.0	1170.	.0100	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1170.	.0100	20.0	20.0	.056	10.00	
484	917	0	4	CHANNEL	8.0	3305.	.0050	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3305.	.0050	20.0	20.0	.044	10.00	
485	916	0	4	CHANNEL	8.0	2850.	.0060	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2850.	.0060	20.0	20.0	.044	10.00	
486	918	0	4	CHANNEL	8.0	3260.	.0070	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3260.	.0070	20.0	20.0	.044	10.00	
487	539	0	4	CHANNEL	8.0	3585.	.0090	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3585.	.0090	20.0	20.0	.044	10.00	
488	919	0	4	CHANNEL	8.0	2050.	.0100	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2050.	.0100	20.0	20.0	.044	10.00	
490	540	0	4	CHANNEL	8.0	3960.	.0120	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3960.	.0120	20.0	20.0	.044	10.00	
491	541	0	4	CHANNEL	8.0	4780.	.0040	3.0	3.0	.038	3.00	0
				OVERFLOW	26.0	4780.	.0040	20.0	20.0	.056	10.00	
492	541	0	4	CHANNEL	5.0	3990.	.0090	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3990.	.0090	20.0	20.0	.056	10.00	
493	921	0	4	CHANNEL	8.0	2425.	.0020	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2425.	.0020	20.0	20.0	.044	10.00	
494	921	0	4	CHANNEL	10.0	950.	.0070	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	950.	.0070	20.0	20.0	.056	10.00	
500	411	0	3		.0	0.	.0001	.0	.0	.001	.01	0
501	415	0	3		.0	0.	.0001	.0	.0	.001	.01	0
502	416	0	3		.0	0.	.0001	.0	.0	.001	.01	0
503	418	0	3		.0	0.	.0001	.0	.0	.001	.01	0
504	425	0	3		.0	0.	.0001	.0	.0	.001	.01	0
505	1040	0	3		.0	0.	.0001	.0	.0	.001	.01	0
506	431	0	3		.0	0.	.0001	.0	.0	.001	.01	0
507	432	0	3		.0	0.	.0001	.0	.0	.001	.01	0
508	433	0	3		.0	0.	.0001	.0	.0	.001	.01	0
509	436	0	3		.0	0.	.0001	.0	.0	.001	.01	0
510	437	0	3		.0	0.	.0001	.0	.0	.001	.01	0
511	442	0	3		.0	0.	.0001	.0	.0	.001	.01	0
512	443	0	3		.0	0.	.0001	.0	.0	.001	.01	0
513	444	0	3		.0	0.	.0001	.0	.0	.001	.01	0
514	1053	0	3		.0	0.	.0001	.0	.0	.001	.01	0
515	447	0	3		.0	0.	.0001	.0	.0	.001	.01	0
516	451	0	3		.0	0.	.0001	.0	.0	.001	.01	0
517	452	0	3		.0	0.	.0001	.0	.0	.001	.01	0
518	457	0	3		.0	0.	.0001	.0	.0	.001	.01	0
519	458	0	3		.0	0.	.0001	.0	.0	.001	.01	0
520	459	0	3		.0	0.	.0001	.0	.0	.001	.01	0
521	1048	0	3		.0	0.	.0001	.0	.0	.001	.01	0
522	464	0	3		.0	0.	.0001	.0	.0	.001	.01	0
523	471	0	3		.0	0.	.0001	.0	.0	.001	.01	0
525	537	0	3		.0	0.	.0001	.0	.0	.001	.01	0
526	527	0	3		.0	0.	.0001	.0	.0	.001	.01	0
528	475	0	3		.0	0.	.0001	.0	.0	.001	.01	0
529	476	0	3		.0	0.	.0001	.0	.0	.001	.01	0
530	478	0	3		.0	0.	.0001	.0	.0	.001	.01	0
531	481	0	3		.0	0.	.0001	.0	.0	.001	.01	0

Table A9. UDSWM Basin and Conveyance Parameters, Outfall System

Coal Creek Tributaries

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	OVERBANK/SURCHARGE MANNING N	DEPTH (FT)	JK
532	482	0	3		.0	0.	.0001	.0	.0	.001	.01	0
534	1046	0	3		.0	0.	.0001	.0	.0	.001	.01	0
536	535	0	3		.0	0.	.0001	.0	.0	.001	.01	0
538	484	0	3		.0	0.	.0001	.0	.0	.001	.01	0
539	488	0	3		.0	0.	.0001	.0	.0	.001	.01	0
540	491	0	3		.0	0.	.0001	.0	.0	.001	.01	0
541	494	0	3		.0	0.	.0001	.0	.0	.001	.01	0
900	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
901	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
902	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
903	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
904	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
905	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
906	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
907	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
908	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
909	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
910	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
911	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
912	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
913	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
914	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
915	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
916	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
917	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
918	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
919	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
920	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
921	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
922	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
923	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
924	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
527	529	0	5	PIPE	4.5	2485.	.0140	.0	.0	.016	4.50	0
				OVERFLOW	11.0	2485.	.0140	20.0	20.0	.044	10.00	
533	534	0	4	CHANNEL	8.0	617.	.0260	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	617.	.0260	20.0	20.0	.044	10.00	
535	915	0	4	CHANNEL	5.0	3460.	.0060	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3460.	.0060	20.0	20.0	.056	10.00	
537	538	0	4	CHANNEL	8.0	617.	.0130	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	617.	.0130	20.0	20.0	.044	10.00	
12	1049	0	4	CHANNEL	8.0	4450.	.0280	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4450.	.0280	20.0	20.0	.044	10.00	
13	14	0	4	CHANNEL	8.0	1500.	.0330	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1500.	.0330	20.0	20.0	.044	10.00	
14	1050	0	4	CHANNEL	8.0	820.	.0070	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	820.	.0070	20.0	20.0	.044	10.00	
20	530	0	3		.0	0.	.0001	.0	.0	.001	.01	0
1040	428	7	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	2.8	22.0	10.2	48.0	11.1	147.0	12.6	296.0	20.5 644.0
		28.4	991.0									
1041	526	10	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	1.7	12.0	3.5	28.0	5.5	26.0	7.7	90.0	9.9 98.0
		12.4	108.0	13.7	110.0	14.9	380.0	15.9	600.0			
1042	530	7	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	.3	90.0	.8	100.0	1.8	250.0	4.0	350.0	4.8 431.0
		8.0	500.0									
1043	1041	7	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	.2	1.6	1.2	14.0	3.1	118.0	5.4	142.0	6.8 153.0
		8.3	331.0									
1044	529	6	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	.5	30.0	2.0	60.0	4.6	90.0	12.5	120.0	12.7 230.0
1045	532	7	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	4.0	75.0	8.0	150.0	13.0	225.0	31.0	355.0	32.7 364.0
		36.0	450.0									
1046	466	6	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	.8	22.0	2.0	66.0	6.0	120.0	10.5	150.0	10.6 250.0
1047	521	4	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	.0	10.0	.0	30.0	.0	120.0			
1048	463	4	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	3.5	36.0	15.6	124.0	17.0	240.0			
1049	518	6	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	2.4	30.0	5.0	60.0	8.5	90.0	19.1	160.0	30.0 300.0
1050	519	6	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	3.5	40.0	15.5	120.0	18.4	138.2	25.0	220.0	27.0 400.0

Table A9. UDSWM Basin and Conveyance Parameters, Outfall System

Coal Creek Tributaries

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	MANNING N	OVERBANK/SURCHARGE DEPTH (FT)	JK
1051	517	6	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	1.6 50.0	5.0 100.0		10.2 150.0		16.4 231.0		17.0 400.0	
1053	445	9	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	3.0 90.0	6.2 180.0		10.0 270.0		13.0 360.0		15.5 450.0	
		20.7	565.0	28.8 680.0	35.0 810.0							
1054	1053	5	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	3.4 50.0	6.2 100.0		11.4 133.0		15.4 200.0			
1055	508	6	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	3.1 100.0	5.5 200.0		10.0 400.0		15.4 580.0		20.1 800.0	
1057	523	6	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	1.3 15.0	2.5 30.0		3.7 45.0		4.5 55.0		5.4 175.0	
1056	525	4	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	.9 30.0	2.7 50.0		3.5 160.0					
400	900	17	3		.0	0.	.0001	.0	.0	.001	.01	-1
		TIME IN HRS VS INFLOW IN CFS										
		.0	.0	.3 9.8	.3 46.4		.5 368.8		.7 1197.9		.8 1344.2	
		.8	1240.0	1.0 924.6	1.2 678.0		1.5 292.5		1.8 157.2		2.0 103.4	
		2.5	20.4	3.0 2.3	3.5 .0		4.0 .0		8.0 .0			

Bullhead Gulch/Prince Tributary

SUBAREA NUMBER	GUTTER OR MANHOLE	WIDTH (FT)	AREA (AC)	PERCENT IMPERV.	SLOPE (FT/FT)	RESISTANCE FACTOR IMPERV.	PERV.	SURFACE STORAGE(IN) IMPERV.	PERV.	INFILTRATION RATE(IN/HR) MAXIMUM	MINIMUM	DECAY RATE	GAGE NO
-1	0	2.	.0	1.0	1.0000	1.000	1.000	1.000	1.000	1.00	1.00	1.00000	
200	200	7889.	95.6	37.3	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
201	201	11713.	56.7	8.4	.0150	.020	.200	.100	.300	4.50	.60	.00180	1
202	202	8003.	42.8	30.0	.0160	.020	.200	.100	.300	4.50	.60	.00180	1
203	203	5688.	53.8	18.0	.0200	.020	.200	.100	.300	4.50	.60	.00180	1
204	204	4860.	85.2	30.3	.0190	.020	.200	.100	.300	4.50	.60	.00180	1
205	205	9331.	73.6	47.1	.0160	.020	.200	.100	.300	4.50	.60	.00180	1
206	206	12114.	71.6	50.0	.0150	.020	.200	.100	.300	4.50	.60	.00180	1
207	207	10584.	79.8	50.0	.0130	.020	.200	.100	.300	4.50	.60	.00180	1
208	208	4666.	65.1	3.4	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
209	209	4561.	124.8	3.4	.0190	.020	.200	.100	.300	4.50	.60	.00180	1
210	210	3564.	26.2	48.1	.0170	.020	.200	.100	.300	4.50	.60	.00180	1
211	211	5022.	40.1	21.7	.0070	.020	.200	.100	.300	4.50	.60	.00180	1
212	212	5292.	76.7	46.6	.0210	.020	.200	.100	.300	4.50	.60	.00180	1
213	213	6552.	64.8	50.0	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
215	215	7852.	81.6	45.2	.0150	.020	.200	.100	.300	4.50	.60	.00180	1
216	216	6426.	49.9	2.0	.0210	.020	.200	.100	.300	4.50	.60	.00180	1
217	217	11405.	110.5	44.2	.0280	.020	.200	.100	.300	4.50	.60	.00180	1
218	218	6880.	91.0	50.0	.0230	.020	.200	.100	.300	4.50	.60	.00180	1
219	219	5393.	64.1	30.0	.0130	.020	.200	.100	.300	4.50	.60	.00180	1
220	220	3528.	26.7	33.5	.0300	.020	.200	.100	.300	4.50	.60	.00180	1
221	221	3614.	20.6	38.5	.0130	.020	.200	.100	.300	4.50	.60	.00180	1
222	222	10087.	69.6	39.0	.0220	.020	.200	.100	.300	4.50	.60	.00180	1
235	235	9817.	122.4	2.0	.0270	.020	.200	.100	.300	4.50	.60	.00180	1
236	236	3652.	99.8	2.0	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
237	237	5530.	58.6	4.5	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
238	238	5166.	87.5	16.8	.0060	.020	.200	.100	.300	4.50	.60	.00180	1
240	240	9380.	49.3	5.0	.0080	.020	.200	.100	.300	4.50	.60	.00180	1
241	241	8482.	103.3	42.3	.0140	.020	.200	.100	.300	4.50	.60	.00180	1
242	242	6552.	64.3	3.8	.0070	.020	.200	.100	.300	4.34	.59	.00180	1
243	243	10314.	99.9	2.0	.0030	.020	.200	.100	.300	3.06	.50	.00180	1
101	101	3744.	73.6	39.0	.0260	.020	.200	.100	.300	4.50	.60	.00180	1
102	102	3888.	70.1	38.5	.0310	.020	.200	.100	.300	4.50	.60	.00180	1
601	601	3715.	51.3	2.0	.0060	.020	.200	.100	.300	4.47	.60	.00180	1
602	602	8208.	52.1	2.0	.0060	.020	.200	.100	.300	3.03	.50	.00180	1

TOTAL TRIBUTARY AREA (ACRES), 2403.20

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	MANNING N	OVERBANK/SURCHARGE DEPTH (FT)	JK
200	300	0	4	CHANNEL	5.0	2435.	.0220	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2435.	.0220	20.0	20.0	.056	10.00	
201	300	0	4	CHANNEL	5.0	3615.	.0150	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3615.	.0150	20.0	20.0	.056	10.00	
202	302	0	4	CHANNEL	8.0	2615.	.0160	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2615.	.0160	20.0	20.0	.044	10.00	
203	303	0	4	CHANNEL	8.0	1580.	.0200	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	1580.	.0200	20.0	20.0	.056	10.00	
204	303	0	4	CHANNEL	8.0	2250.	.0190	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2250.	.0190	20.0	20.0	.044	10.00	
205	1025	0	4	CHANNEL	8.0	3240.	.0160	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3240.	.0160	20.0	20.0	.044	10.00	

Table A9. UDSWM Basin and Conveyance Parameters, Outfall System

Bullhead Gulch/Prince Tributary

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	MANNING N	OVERBANK/SURCHARGE DEPTH (FT)	JK
206	1026	0	4	CHANNEL	8.0	3365.	.0150	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3365.	.0150	20.0	20.0	.044	10.00	
207	1026	0	4	CHANNEL	8.0	3675.	.0130	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3675.	.0130	20.0	20.0	.044	10.00	
208	307	0	4	CHANNEL	5.0	2160.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2160.	.0140	20.0	20.0	.056	10.00	
209	306	0	4	CHANNEL	10.0	1810.	.0190	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1810.	.0190	20.0	20.0	.056	10.00	
210	308	0	4	CHANNEL	8.0	1100.	.0170	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	1100.	.0170	20.0	20.0	.056	10.00	
211	308	0	4	CHANNEL	10.0	1550.	.0070	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1550.	.0070	20.0	20.0	.056	10.00	
212	310	0	4	CHANNEL	5.0	2100.	.0210	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2100.	.0210	20.0	20.0	.056	10.00	
213	1028	0	4	CHANNEL	8.0	1820.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	1820.	.0140	20.0	20.0	.056	10.00	
215	312	0	4	CHANNEL	10.0	3635.	.0150	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	3635.	.0150	20.0	20.0	.056	10.00	
216	312	0	4	CHANNEL	8.0	2975.	.0210	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2975.	.0210	20.0	20.0	.044	10.00	
217	1029	0	4	CHANNEL	5.0	3520.	.0280	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3520.	.0280	20.0	20.0	.056	10.00	
218	1029	0	4	CHANNEL	8.0	3185.	.0230	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3185.	.0230	20.0	20.0	.044	10.00	
219	313	0	4	CHANNEL	10.0	2140.	.0130	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	2140.	.0130	20.0	20.0	.056	10.00	
220	313	0	4	CHANNEL	5.0	1400.	.0300	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	1400.	.0300	20.0	20.0	.056	10.00	
101	102	0	4	CHANNEL	8.0	1300.	.0260	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1300.	.0260	20.0	20.0	.044	10.00	
102	1030	0	4	CHANNEL	5.0	1350.	.0310	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	1350.	.0310	20.0	20.0	.056	10.00	
221	315	0	4	CHANNEL	5.0	1255.	.0130	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	1255.	.0130	20.0	20.0	.056	10.00	
222	315	0	4	CHANNEL	5.0	4670.	.0220	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	4670.	.0220	20.0	20.0	.056	10.00	
235	320	0	4	CHANNEL	8.0	4545.	.0270	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4545.	.0270	20.0	20.0	.044	10.00	
236	321	0	4	CHANNEL	8.0	1691.	.0140	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1691.	.0140	20.0	20.0	.044	10.00	
237	322	0	4	CHANNEL	10.0	2560.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2560.	.0140	20.0	20.0	.056	10.00	
238	323	0	4	CHANNEL	10.0	2050.	.0060	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2050.	.0060	20.0	20.0	.056	10.00	
240	318	0	4	CHANNEL	5.0	2895.	.0080	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2895.	.0080	20.0	20.0	.056	10.00	
241	318	0	4	CHANNEL	5.0	2945.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2945.	.0140	20.0	20.0	.056	10.00	
242	319	0	4	CHANNEL	10.0	1820.	.0070	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1820.	.0070	20.0	20.0	.056	10.00	
243	940	0	4	CHANNEL	10.0	2865.	.0030	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2865.	.0030	20.0	20.0	.056	10.00	
300	301	0	3		.0	0.	.0001	.0	.0	.001	.01	0
302	203	0	3		.0	0.	.0001	.0	.0	.001	.01	0
303	1027	0	3		.0	0.	.0001	.0	.0	.001	.01	0
305	209	0	3		.0	0.	.0001	.0	.0	.001	.01	0
306	211	0	3		.0	0.	.0001	.0	.0	.001	.01	0
308	309	0	3		.0	0.	.0001	.0	.0	.001	.01	0
310	213	0	3		.0	0.	.0001	.0	.0	.001	.01	0
311	215	0	3		.0	0.	.0001	.0	.0	.001	.01	0
312	219	0	3		.0	0.	.0001	.0	.0	.001	.01	0
313	314	0	3		.0	0.	.0001	.0	.0	.001	.01	0
315	1031	0	3		.0	0.	.0001	.0	.0	.001	.01	0
317	318	0	3		.0	0.	.0001	.0	.0	.001	.01	0
318	242	0	3		.0	0.	.0001	.0	.0	.001	.01	0
319	243	0	3		.0	0.	.0001	.0	.0	.001	.01	0
320	236	0	3		.0	0.	.0001	.0	.0	.001	.01	0
321	237	0	3		.0	0.	.0001	.0	.0	.001	.01	0
322	1032	0	3		.0	0.	.0001	.0	.0	.001	.01	0
323	317	0	3		.0	0.	.0001	.0	.0	.001	.01	0
940	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
301	303	0	4	CHANNEL	8.0	1010.	.0200	3.0	3.0	.038	2.00	0
				OVERFLOW	20.0	1010.	.0200	20.0	20.0	.056	10.00	
304	305	0	4	CHANNEL	8.0	1600.	.0140	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1600.	.0140	20.0	20.0	.044	10.00	
307	308	0	4	CHANNEL	5.0	1690.	.0220	3.0	3.0	.038	3.00	0
				OVERFLOW	23.0	1690.	.0220	20.0	20.0	.056	10.00	
309	311	0	4	CHANNEL	10.0	900.	.0120	3.0	3.0	.038	1.50	0
				OVERFLOW	19.0	900.	.0120	20.0	20.0	.056	10.00	
314	315	0	4	CHANNEL	10.0	800.	.0130	3.0	3.0	.038	1.50	0
				OVERFLOW	19.0	800.	.0130	20.0	20.0	.056	10.00	
316	317	0	4	CHANNEL	10.0	2735.	.0100	3.0	3.0	.038	1.50	0
				OVERFLOW	19.0	2735.	.0100	20.0	20.0	.056	10.00	
1021	322	0	4	CHANNEL	10.0	1600.	.0110	3.0	3.0	.038	1.50	0
				OVERFLOW	19.0	1600.	.0110	20.0	20.0	.056	10.00	

Table A9. UDSWM Basin and Conveyance Parameters, Outfall System

Bullhead Gulch/Prince Tributary

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	MANNING N	OVERBANK/SURCHARGE DEPTH (FT)	JK
1025	305	5	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	.7 30.0	2.1	60.0	4.5	108.0	5.0	200.0		
1026	210	10	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	.5 18.0	2.2	26.0	5.1	32.0	7.4	35.0	8.9 106.0	
		11.0 300.0		13.1 494.0	13.5	777.0	13.8	1060.0				
1027	304	5	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	5.2 100.0	14.4	200.0	23.6	264.0	35.0	400.0		
1028	311	7	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	3.4 40.0	7.8	80.0	10.0	96.5	12.0	150.0	14.1 240.0	
		16.0 400.0										
1029	312	7	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	6.8 40.0	15.6	80.0	20.0	96.5	24.0	150.0	28.2 240.0	
		32.0 400.0										
1030	221	7	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	3.4 40.0	7.8	80.0	10.0	96.5	12.0	150.0	14.1 240.0	
		16.0 400.0										
1031	316	4	3		.0	0.	.0001	.0	.0	.001	.01	103
		DIVERSION TO GUTTER NUMBER 103 - TOTAL Q VS DIVERTED Q IN CFS										
		.0	.0	500.0 500.0	1000.0	500.0	5000.0	500.0				
103	318	0	4	CHANNEL	10.0	2600.	.0130	3.0	3.0	.044	4.00	0
				OVERFLOW	26.0	2600.	.0130	20.0	20.0	.056	10.00	
601	700	0	4	CHANNEL	8.0	1720.	.0060	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1720.	.0060	20.0	20.0	.044	10.00	
602	951	0	4	CHANNEL	8.0	2280.	.0060	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	2280.	.0060	20.0	20.0	.056	10.00	
700	602	0	3		.0	0.	.0001	.0	.0	.001	.01	0
951	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
1032	325	4	3		.0	0.	.0001	.0	.0	.001	.01	104
		DIVERSION TO GUTTER NUMBER 104 - TOTAL Q VS DIVERTED Q IN CFS										
		.0	.0	1000.0 1000.0	2000.0	1000.0	5000.0	1000.0				
104	324	0	4	CHANNEL	20.0	2400.	.0090	4.0	4.0	.044	6.00	0
				OVERFLOW	26.0	2400.	.0090	20.0	20.0	.056	10.00	
324	601	0	3		.0	0.	.0001	.0	.0	.001	.01	0
325	238	0	3		.0	0.	.0001	.0	.0	.001	.01	0
1020	1021	17	3		.0	0.	.0001	.0	.0	.001	.01	-1
		TIME IN HRS VS INFLOW IN CFS										
		.0	.0	.3 12.8	.4	62.4	.8	1355.5	1.2	3612.7	1.3 3753.8	
		1.3 3746.0		1.4 3612.7	1.8	2523.5	2.0	1799.9	2.5	948.0	3.0 565.2	
		3.5 365.8		4.0 277.2	5.0	161.6	6.0	71.6	8.0	.0		

Boulder Creek Tributaries

SUBAREA NUMBER	GUTTER OR MANHOLE	WIDTH (FT)	AREA (AC)	PERCENT IMPERV.	SLOPE (FT/FT)	RESISTANCE FACTOR IMPERV.	PERV.	SURFACE STORAGE(IN) IMPERV.	PERV.	INFILTRATION RATE(IN/HR) MAXIMUM	MINIMUM	DECAY RATE	GAGE NO
-1	0	2.	.0	1.0	1.0000	1.000	1.000	1.000	1.000	1.00	1.00	1.00000	
600	600	6156.	93.3	2.0	.0240	.020	.200	.100	.300	3.84	.56	.00180	1
603	603	6968.	103.6	5.6	.0200	.020	.200	.100	.300	3.42	.53	.00180	1
604	604	2203.	25.6	2.0	.0220	.020	.200	.100	.300	4.16	.58	.00180	1
605	605	9475.	116.8	6.8	.0210	.020	.200	.100	.300	3.98	.57	.00180	1
606	606	10579.	45.7	2.0	.0030	.020	.200	.100	.300	3.00	.50	.00180	1
607	607	4428.	25.4	4.9	.0110	.020	.200	.100	.300	4.50	.60	.00180	1
608	608	12037.	129.9	5.5	.0080	.020	.200	.100	.300	3.41	.53	.00180	1
609	609	4309.	75.5	2.0	.0010	.020	.200	.100	.300	3.17	.51	.00180	1
610	610	14382.	95.1	13.2	.0280	.020	.200	.100	.300	4.02	.57	.00180	1
611	611	10352.	65.9	19.9	.0290	.020	.200	.100	.300	3.63	.54	.00180	1
612	612	3132.	29.1	10.1	.0140	.020	.200	.100	.300	3.15	.51	.00180	1
613	613	10944.	67.2	46.6	.0120	.020	.200	.100	.300	4.50	.60	.00180	1
614	614	9967.	102.2	42.3	.0260	.020	.200	.100	.300	4.50	.60	.00180	1
615	615	12069.	95.9	40.0	.0190	.020	.200	.100	.300	4.50	.60	.00180	1
616	616	5832.	66.9	40.5	.0300	.020	.200	.100	.300	4.50	.60	.00180	1
617	617	15768.	114.8	42.7	.0190	.020	.200	.100	.300	4.50	.60	.00180	1
618	618	5544.	52.1	28.8	.0100	.020	.200	.100	.300	4.50	.60	.00180	1
619	619	4626.	28.8	28.8	.0260	.020	.200	.100	.300	4.50	.60	.00180	1
620	620	11713.	81.9	14.0	.0060	.020	.200	.100	.300	4.50	.60	.00180	1
621	621	12859.	65.5	18.5	.0040	.020	.200	.100	.300	4.50	.60	.00180	1
622	622	7339.	76.0	6.8	.0050	.020	.200	.100	.300	3.14	.51	.00180	1
623	623	2747.	44.6	2.0	.0070	.020	.200	.100	.300	3.00	.50	.00180	1
624	624	13334.	51.9	9.0	.0060	.020	.200	.100	.300	3.26	.52	.00180	1
627	627	5472.	105.4	4.2	.0050	.020	.200	.100	.300	3.59	.54	.00180	1
628	628	6782.	30.7	2.0	.0060	.020	.200	.100	.300	3.53	.54	.00180	1
629	629	5621.	80.6	5.1	.0230	.020	.200	.100	.300	3.65	.54	.00180	1
630	630	15503.	129.9	2.0	.0110	.020	.200	.100	.300	3.08	.51	.00180	1
631	631	6599.	59.6	2.0	.0120	.020	.200	.100	.300	3.96	.56	.00180	1
633	633	6955.	76.8	16.8	.0110	.020	.200	.100	.300	4.10	.57	.00180	1
634	634	8424.	46.7	4.5	.0090	.020	.200	.100	.300	3.32	.52	.00180	1
638	638	4486.	49.7	37.0	.0180	.020	.200	.100	.300	4.50	.60	.00180	1

Table A9. UDSWM Basin and Conveyance Parameters, Outfall System

Boulder Creek Tributaries

SUBAREA NUMBER	GUTTER OR MANHOLE	WIDTH (FT)	AREA (AC)	PERCENT IMPERV.	SLOPE (FT/FT)	RESISTANCE FACTOR IMPERV.	PERV.	SURFACE STORAGE(IN) IMPERV.	PERV.	INFILTRATION RATE(IN/HR) MAXIMUM	MINIMUM	DECAY RATE	GAGE NO
639	639	8554.	89.4	34.8	.0090	.020	.200	.100	.300	4.50	.60	.00180	1
640	640	9007.	79.4	17.6	.0090	.020	.200	.100	.300	3.78	.55	.00180	1
641	641	6786.	29.5	5.4	.0020	.020	.200	.100	.300	3.00	.50	.00180	1
645	645	11952.	103.5	13.8	.0280	.020	.200	.100	.300	3.65	.54	.00180	1
646	646	2682.	41.5	3.1	.0050	.020	.200	.100	.300	3.15	.51	.00180	1
647	647	9090.	105.1	2.0	.0060	.020	.200	.100	.300	3.00	.50	.00180	1
648	648	8203.	80.4	2.0	.0020	.020	.200	.100	.300	3.14	.51	.00180	1
650	650	14058.	80.0	3.7	.0190	.020	.200	.100	.300	3.11	.51	.00180	1
651	651	6626.	87.6	10.1	.0220	.020	.200	.100	.300	3.56	.54	.00180	1
652	652	7956.	51.9	2.0	.0030	.020	.200	.100	.300	3.00	.50	.00180	1
655	655	11275.	121.5	2.0	.0080	.020	.200	.100	.300	3.26	.52	.00180	1
658	658	7258.	72.9	2.0	.0060	.020	.200	.100	.300	3.02	.50	.00180	1
659	659	12280.	130.0	2.0	.0180	.020	.200	.100	.300	3.15	.51	.00180	1
660	660	10546.	45.9	2.0	.0040	.020	.200	.100	.300	3.00	.50	.00180	1
661	661	10584.	41.9	2.0	.0040	.020	.200	.100	.300	3.00	.50	.00180	1
656	966	1620.	58.4	2.0	.0020	.020	.200	.100	.300	3.00	.50	.00180	1
657	967	540.	15.9	2.0	.0070	.020	.200	.100	.300	3.00	.50	.00180	1
150	150	7200.	44.1	28.8	.0060	.020	.200	.100	.300	4.50	.60	.00180	1

TOTAL TRIBUTARY AREA (ACRES), 3512.50

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	MANNING N	OVERBANK/SURCHARGE DEPTH (FT)	JK
600	950	0	4	CHANNEL	8.0	2850.	.0240	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2850.	.0240	20.0	20.0	.044	10.00	
603	952	0	4	CHANNEL	5.0	2765.	.0270	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	2765.	.0270	20.0	20.0	.056	10.00	
604	701	0	4	CHANNEL	8.0	1020.	.0220	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1020.	.0220	20.0	20.0	.044	10.00	
605	953	0	4	CHANNEL	8.0	3290.	.0230	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	3290.	.0230	20.0	20.0	.056	10.00	
606	954	0	4	CHANNEL	5.0	3265.	.0030	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3265.	.0030	20.0	20.0	.056	10.00	
607	702	0	4	CHANNEL	8.0	1230.	.0110	3.0	3.0	.035	3.00	0
				OVERFLOW	11.0	1230.	.0110	20.0	20.0	.056	10.00	
608	703	0	4	CHANNEL	8.0	3715.	.0080	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	3715.	.0080	20.0	20.0	.056	10.00	
609	955	0	4	CHANNEL	10.0	1995.	.0010	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1995.	.0010	20.0	20.0	.056	10.00	
610	956	0	4	CHANNEL	5.0	3995.	.0250	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3995.	.0250	20.0	20.0	.056	10.00	
611	704	0	4	CHANNEL	5.0	3195.	.0290	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3195.	.0290	20.0	20.0	.056	10.00	
612	957	0	4	CHANNEL	8.0	870.	.0140	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	870.	.0140	20.0	20.0	.056	10.00	
613	705	0	4	CHANNEL	8.0	3040.	.0120	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3040.	.0120	20.0	20.0	.044	10.00	
614	707	0	4	CHANNEL	5.0	3955.	.0260	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3955.	.0260	20.0	20.0	.056	10.00	
615	707	0	4	CHANNEL	8.0	3725.	.0190	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3725.	.0190	20.0	20.0	.044	10.00	
616	706	0	4	CHANNEL	8.0	2700.	.0300	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2700.	.0300	20.0	20.0	.044	10.00	
617	706	0	4	CHANNEL	8.0	4380.	.0190	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4380.	.0190	20.0	20.0	.044	10.00	
618	708	0	4	CHANNEL	8.0	2200.	.0100	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2200.	.0100	20.0	20.0	.044	10.00	
619	708	0	4	CHANNEL	8.0	1285.	.0260	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1285.	.0260	20.0	20.0	.044	10.00	
620	709	0	4	CHANNEL	5.0	3615.	.0060	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3615.	.0060	20.0	20.0	.056	10.00	
621	709	0	4	CHANNEL	8.0	4465.	.0040	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4465.	.0040	20.0	20.0	.044	10.00	
622	710	0	4	CHANNEL	10.0	2265.	.0050	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2265.	.0050	20.0	20.0	.056	10.00	
623	958	0	4	CHANNEL	10.0	1090.	.0070	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1090.	.0070	20.0	20.0	.056	10.00	
624	959	0	4	CHANNEL	8.0	4630.	.0060	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4630.	.0060	20.0	20.0	.044	10.00	
627	712	0	4	CHANNEL	10.0	1900.	.0050	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1900.	.0050	20.0	20.0	.056	10.00	
628	711	0	4	CHANNEL	8.0	3140.	.0060	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3140.	.0060	20.0	20.0	.044	10.00	
629	713	0	4	CHANNEL	10.0	1735.	.0230	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	1735.	.0230	20.0	20.0	.056	10.00	
630	713	0	4	CHANNEL	5.0	4785.	.0110	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	4785.	.0110	20.0	20.0	.056	10.00	
631	713	0	4	CHANNEL	5.0	3055.	.0120	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3055.	.0120	20.0	20.0	.056	10.00	
633	714	0	4	CHANNEL	10.0	2415.	.0110	3.0	3.0	.038	3.00	0
				OVERFLOW	28.0	2415.	.0110	20.0	20.0	.056	10.00	
634	960	0	4	CHANNEL	10.0	2340.	.0090	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2340.	.0090	20.0	20.0	.056	10.00	
638	715	0	4	CHANNEL	8.0	1780.	.0180	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1780.	.0180	20.0	20.0	.044	10.00	

Table A9. UDSWM Basin and Conveyance Parameters, Outfall System

Boulder Creek Tributaries

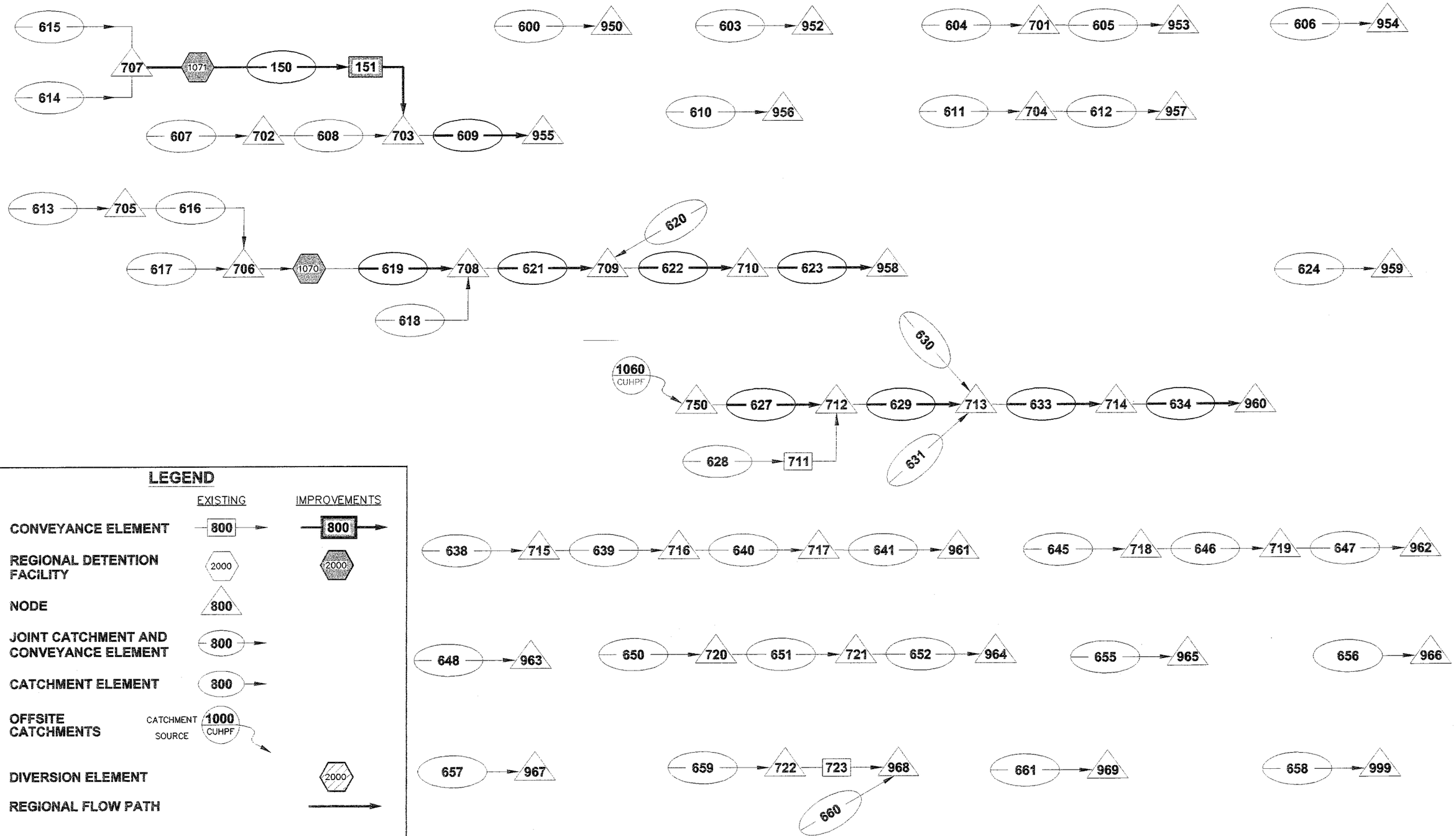
GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	MANNING N	OVERBANK/SURCHARGE DEPTH (FT)	JK
639	716	0	4	CHANNEL	8.0	2640.	.0090	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2640.	.0090	20.0	20.0	.044	10.00	
640	717	0	4	CHANNEL	10.0	2780.	.0090	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2780.	.0090	20.0	20.0	.056	10.00	
641	961	0	4	CHANNEL	10.0	1885.	.0020	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	1885.	.0020	20.0	20.0	.056	10.00	
645	718	0	4	CHANNEL	5.0	3320.	.0280	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3320.	.0280	20.0	20.0	.056	10.00	
646	719	0	4	CHANNEL	8.0	745.	.0050	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	745.	.0050	20.0	20.0	.056	10.00	
647	962	0	4	CHANNEL	10.0	2525.	.0060	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2525.	.0060	20.0	20.0	.056	10.00	
648	963	0	4	CHANNEL	5.0	3255.	.0020	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3255.	.0020	20.0	20.0	.056	10.00	
650	720	0	4	CHANNEL	5.0	3905.	.0190	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3905.	.0190	20.0	20.0	.056	10.00	
651	721	0	4	CHANNEL	8.0	2045.	.0220	3.0	3.0	.044	3.00	0
				OVERFLOW	26.0	2045.	.0220	20.0	20.0	.056	10.00	
652	964	0	4	CHANNEL	10.0	2210.	.0030	3.0	3.0	.044	3.00	0
				OVERFLOW	28.0	2210.	.0030	20.0	20.0	.056	10.00	
655	965	0	4	CHANNEL	5.0	3915.	.0080	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3915.	.0080	20.0	20.0	.056	10.00	
658	999	0	4	CHANNEL	8.0	3360.	.0060	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	3360.	.0060	20.0	20.0	.044	10.00	
659	722	0	4	CHANNEL	8.0	5685.	.0180	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	5685.	.0180	20.0	20.0	.044	10.00	
660	968	0	4	CHANNEL	5.0	3255.	.0040	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3255.	.0040	20.0	20.0	.056	10.00	
661	969	0	4	CHANNEL	8.0	4900.	.0040	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	4900.	.0040	20.0	20.0	.044	10.00	
150	151	0	4	CHANNEL	8.0	2000.	.0060	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	2000.	.0060	20.0	20.0	.044	10.00	
151	703	0	4	CHANNEL	5.0	3400.	.0060	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	3400.	.0060	20.0	20.0	.056	10.00	
701	605	0	3		.0	0.	.0001	.0	.0	.001	.01	0
702	608	0	3		.0	0.	.0001	.0	.0	.001	.01	0
703	609	0	3		.0	0.	.0001	.0	.0	.001	.01	0
704	612	0	3		.0	0.	.0001	.0	.0	.001	.01	0
705	616	0	3		.0	0.	.0001	.0	.0	.001	.01	0
706	1070	0	3		.0	0.	.0001	.0	.0	.001	.01	0
707	1071	0	3		.0	0.	.0001	.0	.0	.001	.01	0
708	621	0	3		.0	0.	.0001	.0	.0	.001	.01	0
709	622	0	3		.0	0.	.0001	.0	.0	.001	.01	0
710	623	0	3		.0	0.	.0001	.0	.0	.001	.01	0
712	629	0	3		.0	0.	.0001	.0	.0	.001	.01	0
713	633	0	3		.0	0.	.0001	.0	.0	.001	.01	0
714	634	0	3		.0	0.	.0001	.0	.0	.001	.01	0
715	639	0	3		.0	0.	.0001	.0	.0	.001	.01	0
716	640	0	3		.0	0.	.0001	.0	.0	.001	.01	0
717	641	0	3		.0	0.	.0001	.0	.0	.001	.01	0
718	646	0	3		.0	0.	.0001	.0	.0	.001	.01	0
719	647	0	3		.0	0.	.0001	.0	.0	.001	.01	0
720	651	0	3		.0	0.	.0001	.0	.0	.001	.01	0
721	652	0	3		.0	0.	.0001	.0	.0	.001	.01	0
722	723	0	3		.0	0.	.0001	.0	.0	.001	.01	0
750	627	0	3		.0	0.	.0001	.0	.0	.001	.01	0
950	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
952	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
953	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
954	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
955	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
956	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
957	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
958	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
959	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
960	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
961	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
962	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
963	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
964	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
965	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
966	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
967	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
968	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
969	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
999	1500	0	3		.0	0.	.0001	.0	.0	.001	.01	0
711	712	0	4	CHANNEL	5.0	1815.	.0120	3.0	3.0	.044	3.00	0
				OVERFLOW	23.0	1815.	.0120	20.0	20.0	.056	10.00	
723	968	0	4	CHANNEL	8.0	1925.	.0050	3.0	3.0	.020	.50	0
				OVERFLOW	11.0	1925.	.0050	20.0	20.0	.044	10.00	
1070	619	7	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	2.0	60.0	13.0	120.0	32.0	180.0	44.0	215.0	46.0	240.0
		55.0	470.0									

Table A9. UDSWM Basin and Conveyance Parameters, Outfall System

Boulder Creek Tributaries

GUTTER NUMBER	GUTTER CONNECTION	NDP	NP		WIDTH OR DIAM (FT)	LENGTH (FT)	INVERT SLOPE (FT/FT)	SIDE SLOPES HORIZ TO VERT L	R	MANNING N	OVERBANK/SURCHARGE DEPTH (FT)	JK
1071	150	7	2	PIPE	.0	0.	.0001	.0	.0	.001	.01	0
		RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW										
		.0	.0	1.0	40.0	3.0	80.0	8.0	120.0	15.0	160.0	24.5	200.0
		26.0	240.0									
1060	750	17	3		.0	0.	.0001	.0	.0	.001	.01	-1
		TIME IN HRS VS INFLOW IN CFS										
		.0	.0	.4	1.2	.5	58.6	.8	646.5	1.0	1240.4	1.2	1421.0
		1.3	1439.7	1.3	1414.2	1.8	1071.6	2.0	856.3	2.5	557.3	3.0	365.2
		3.5	239.4	4.0	157.0	5.0	67.5	6.0	29.0	8.0	.0		

BOULDER CREEK TRIBUTARIES



LEGEND

	EXISTING	IMPROVEMENTS
CONVEYANCE ELEMENT	800	800
REGIONAL DETENTION FACILITY	2000	2000
NODE	800	
JOINT CATCHMENT AND CONVEYANCE ELEMENT	800	
CATCHMENT ELEMENT	800	
OFFSITE CATCHMENTS	CATCHMENT 1000 SOURCE CUHPF	
DIVERSION ELEMENT		2000
REGIONAL FLOW PATH		

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DRAWN:	DM
CHECKED:	DJL
DATE:	01-01

TOWN OF ERIE
BOULDER COUNTY
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

SWMM FLOW CHARTS
DRAINAGE FACILITIES
OUTFALL PLAN

Figure A5

DATE: JANUARY 9, 2001
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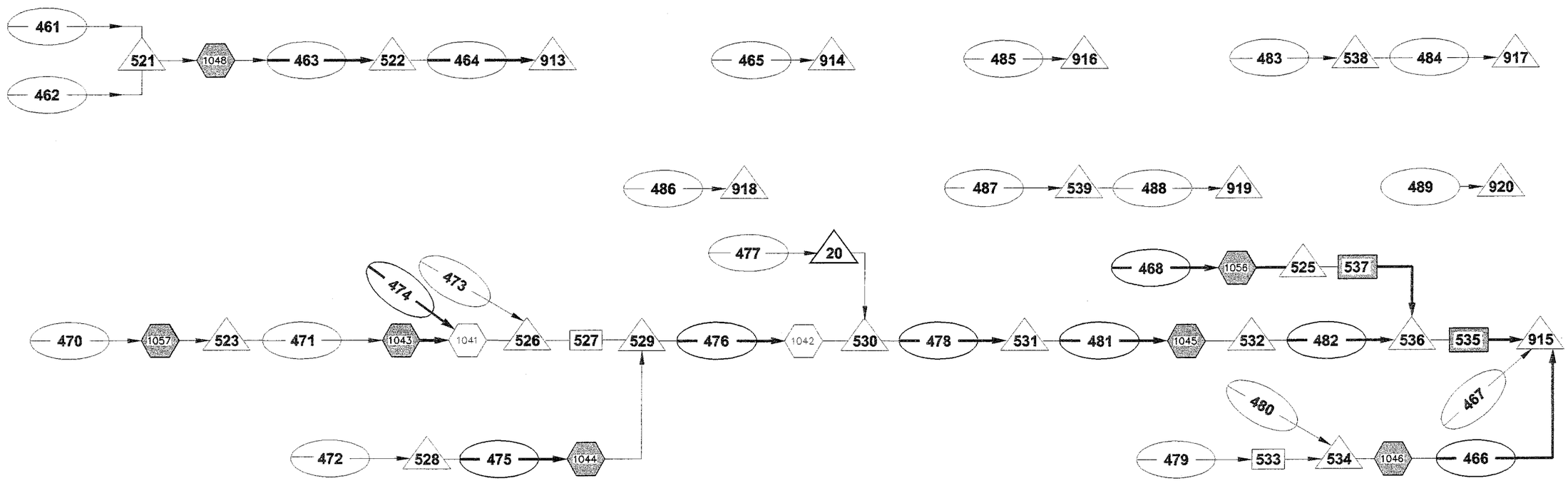
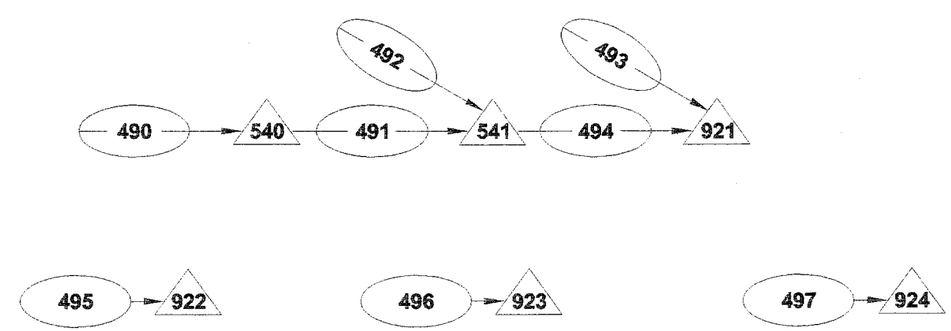
COAL CREEK TRIBUTARIES



LEGEND

	EXISTING	IMPROVEMENTS
CONVEYANCE ELEMENT	800	800
REGIONAL DETENTION FACILITY	2000	2000
NODE	800	
JOINT CATCHMENT AND CONVEYANCE ELEMENT	800	
CATCHMENT ELEMENT	800	
OFFSITE CATCHMENTS	CATCHMENT 1000 / SOURCE CUHPF	
DIVERSION ELEMENT		2000
REGIONAL FLOW PATH		



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TOWN OF ERIE
BOULDER COUNTY
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

SWMM FLOW CHARTS
DRAINAGE FACILITIES
OUTFALL PLAN

Figure A6

DATE: JANUARY 9, 2001
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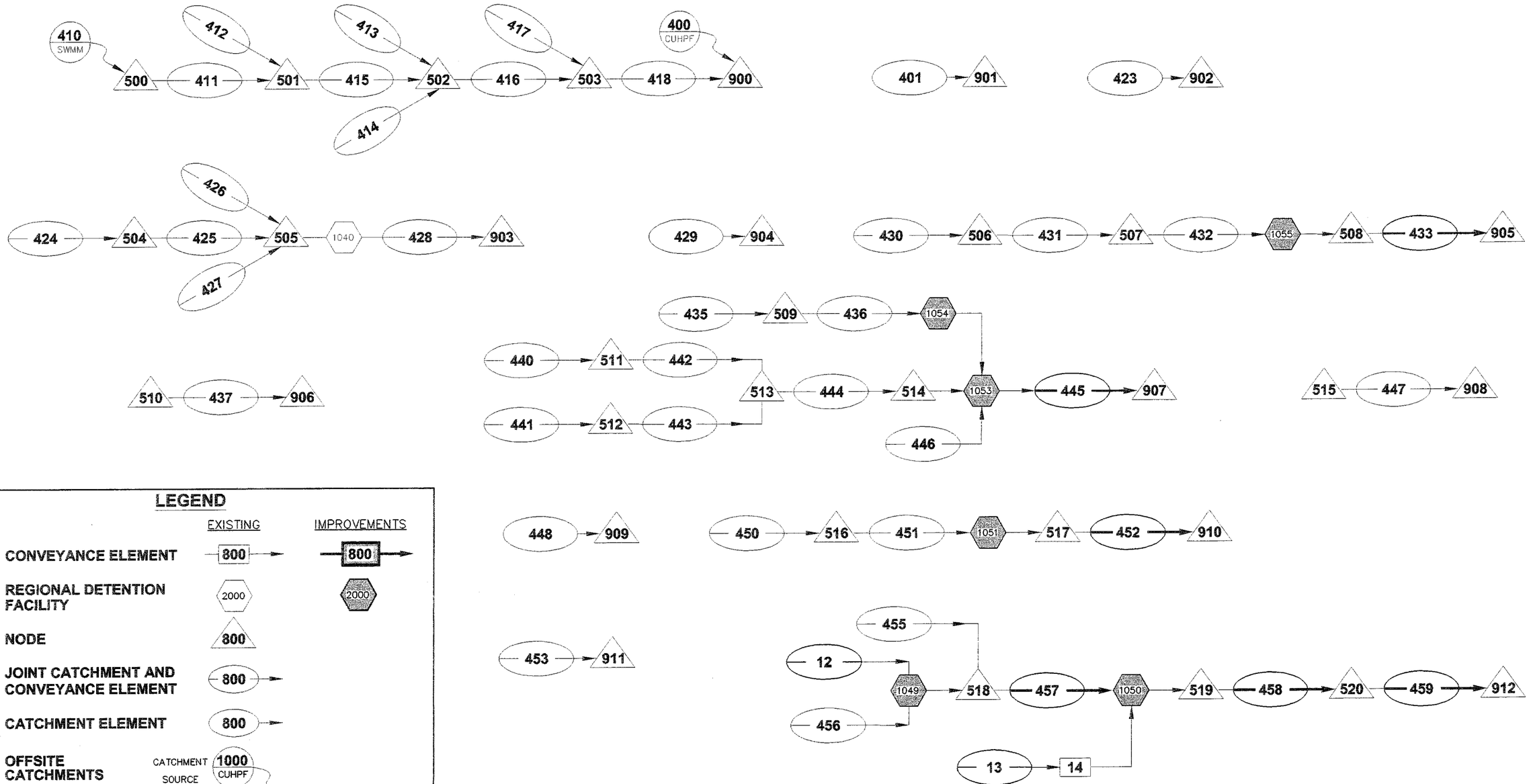
COAL CREEK TRIBUTARIES



LEGEND

	EXISTING	IMPROVEMENTS
CONVEYANCE ELEMENT	800	800
REGIONAL DETENTION FACILITY	2000	2000
NODE	800	
JOINT CATCHMENT AND CONVEYANCE ELEMENT	800	
CATCHMENT ELEMENT	800	
OFFSITE CATCHMENTS	CATCHMENT 1000 SOURCE CUHPF	
DIVERSION ELEMENT		2000
REGIONAL FLOW PATH		

DATE: JANUARY 9, 2001
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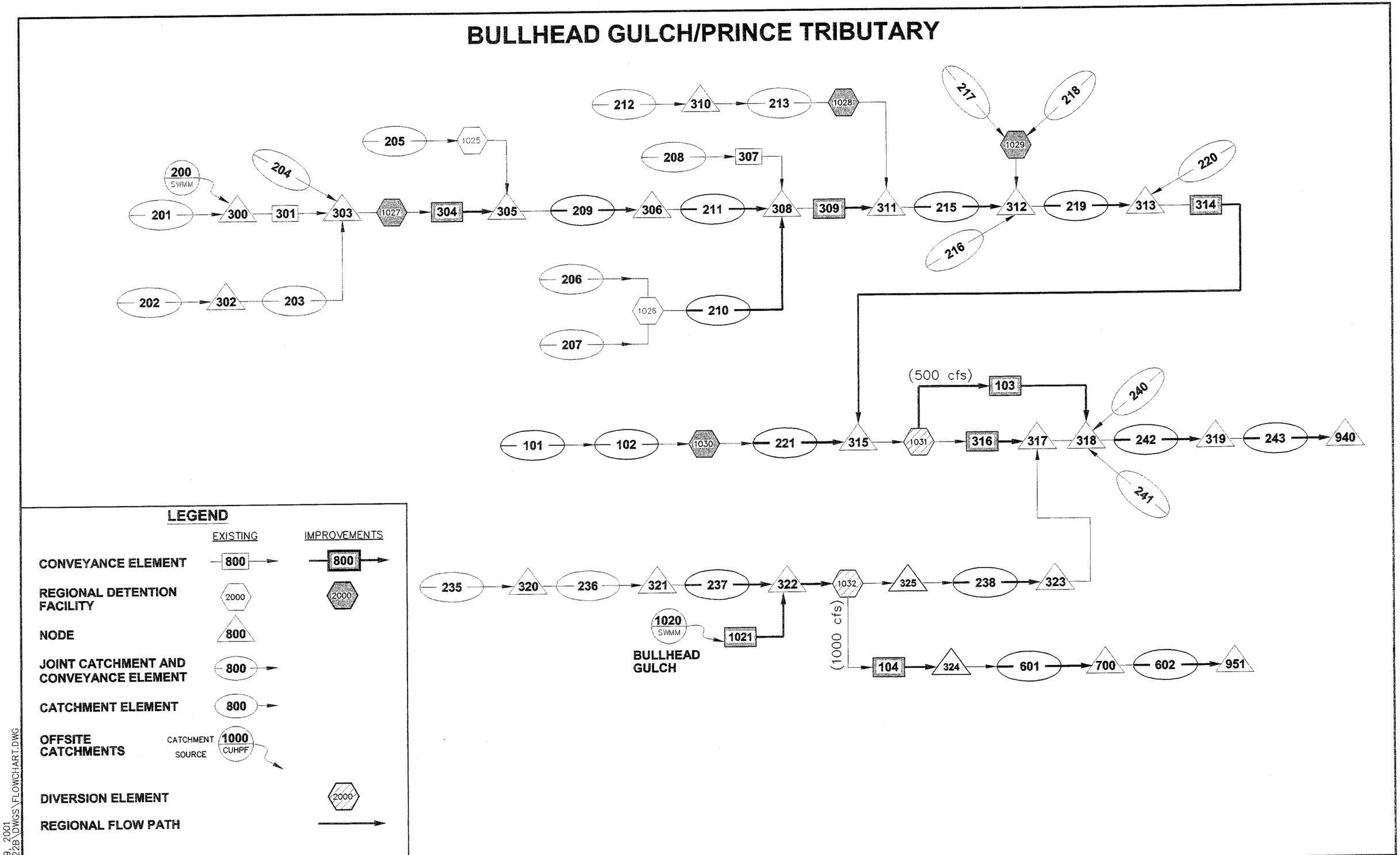
TOWN OF ERIE
BOULDER COUNTY
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

SWMM FLOW CHARTS
DRAINAGE FACILITIES
OUTFALL PLAN

Figure A7

BULLHEAD GULCH/PRINCE TRIBUTARY



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TOWN OF ERIE
BOULDER COUNTY
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

SWMM FLOW CHARTS
DRAINAGE FACILITIES
OUTFALL PLAN

Figure A-8

DATE: JANUARY 9, 2001
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APPENDIX A3

UDSWM OUTPUT SUMMARY TABLES
OUTFALL SYSTEM

Tables

A10 Coal Creek Tributaries
A11 Bullhead Gulch/Prince Tributary
A12 Boulder Creek Tributaries

Table A10. Coal Creek Tributaries

0.4-inch event

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
470	13.	.3		0 38.
1057	4.	.0	.3	1 14.
523	4.	(DIRECT FLOW)		1 14.
471	19.	.4		0 40.
472	2.	.3		0 40.
1043	7.	.0	.6	1 24.
474	8.	.3		0 42.
528	2.	(DIRECT FLOW)		0 40.
1041	5.	.0	.8	2 22.
473	4.	.2		0 36.
475	26.	.9		0 42.
526	5.	(DIRECT FLOW)		2 20.
1044	19.	.0	.3	0 56.
527	5.	.5		2 26.
529	23.	(DIRECT FLOW)		0 58.
476	35.	.8		1 4.
477	9.	.2		0 38.
410	33.	1.1		0 46.
1042	35.	.0	.1	1 6.
20	9.	(DIRECT FLOW)		0 38.
441	0.	.0		1 0.
440	3.	.3		0 38.
430	7.	.4		0 42.
500	33.	(DIRECT FLOW)		0 46.
530	39.	(DIRECT FLOW)		1 4.
12	11.	.3		0 40.
456	28.	.5		0 40.
512	0.	(DIRECT FLOW)		1 0.
511	3.	(DIRECT FLOW)		0 38.
506	7.	(DIRECT FLOW)		0 42.
412	16.	.3		0 36.
411	44.	.5		0 50.
478	50.	1.2		1 6.
1049	15.	.0	1.2	1 16.
455	15.	.3		0 40.
435	0.	.1		1 0.
443	0.	.0		1 10.
442	3.	.2		1 0.
431	5.	.3		1 12.
424	18.	.4		0 36.
501	55.	(DIRECT FLOW)		0 44.
531	50.	(DIRECT FLOW)		1 6.
462	22.	.8		0 42.
13	15.	.3		0 34.
518	23.	(DIRECT FLOW)		1 0.
509	0.	(DIRECT FLOW)		1 0.
513	3.	(DIRECT FLOW)		1 0.
507	5.	(DIRECT FLOW)		1 12.
504	18.	(DIRECT FLOW)		0 36.
415	61.	.9		0 50.
414	22.	.4		0 38.
413	6.	.4		0 40.
468	11.	.3		0 36.
481	56.	.8		1 8.
1047	22.	.0		0 42.
461	16.	.6		0 40.
14	13.	.4		0 38.
457	25.	.8		1 0.
450	4.	.3		0 38.
436	6.	.4		1 2.
446	38.	.6		0 42.
444	22.	.5		0 46.
432	17.	.5		0 44.
427	12.	.3		0 40.
426	19.	.2		0 34.
425	10.	.5		1 2.
502	84.	(DIRECT FLOW)		0 44.
490	15.	.4		0 42.
1056	5.	.0	.1	0 52.
1045	37.	.0	2.0	1 36.
479	15.	.4		0 40.
521	37.	(DIRECT FLOW)		0 42.
1050	17.	.0	1.5	1 40.
516	4.	(DIRECT FLOW)		0 38.
1054	4.	.0	.2	1 34.
514	59.	(DIRECT FLOW)		0 44.
1055	12.	.0	.4	1 14.
505	34.	(DIRECT FLOW)		0 38.
417	16.	.4		0 42.
416	92.	1.4		0 56.
540	15.	(DIRECT FLOW)		0 42.
525	5.	(DIRECT FLOW)		0 52.
532	37.	(DIRECT FLOW)		1 36.
533	15.	.3		0 42.
480	18.	.4		0 36.
1048	13.	.0	1.3	1 20.

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
519	17.	(DIRECT FLOW)		1 40.
451	43.	.6		0 44.
515	0.	(DIRECT FLOW)		0 0.
1053	41.	.0	1.4	1 10.
510	0.	(DIRECT FLOW)		0 0.
508	12.	(DIRECT FLOW)		1 14.
1040	11.	.0	1.4	1 30.
503	105.	(DIRECT FLOW)		0 54.
492	13.	.8		0 58.
491	14.	.8		1 10.
487	20.	.5		0 48.
537	5.	.2		0 56.
483	10.	.5		0 42.
482	38.	1.3		1 42.
534	31.	(DIRECT FLOW)		0 38.
463	19.	.7		1 2.
458	24.	.7		1 10.
1051	29.	.0	.9	1 8.
447	8.	.4		0 36.
445	43.	.5		1 10.
437	9.	.2		0 34.
433	14.	.5		1 12.
428	11.	.5		1 32.
400	97.	(DIRECT FLOW)		0 46.
418	93.	.9		1 10.
541	26.	(DIRECT FLOW)		1 4.
539	20.	(DIRECT FLOW)		0 48.
538	14.	(DIRECT FLOW)		0 46.
536	38.	(DIRECT FLOW)		1 42.
1046	16.	.0	.6	1 4.
522	19.	(DIRECT FLOW)		1 2.
520	24.	(DIRECT FLOW)		1 10.
517	29.	(DIRECT FLOW)		1 8.
909	11.	(DIRECT FLOW)		0 34.
908	8.	(DIRECT FLOW)		0 36.
907	43.	(DIRECT FLOW)		1 10.
906	9.	(DIRECT FLOW)		0 34.
905	14.	(DIRECT FLOW)		1 12.
904	6.	(DIRECT FLOW)		0 30.
903	11.	(DIRECT FLOW)		1 32.
902	4.	(DIRECT FLOW)		0 34.
901	3.	(DIRECT FLOW)		0 32.
900	162.	(DIRECT FLOW)		0 58.
494	26.	.8		1 8.
493	6.	.4		1 0.
488	32.	.6		0 54.
486	13.	.4		0 44.
484	23.	.6		1 0.
485	19.	.5		0 52.
535	35.	1.5		2 0.
467	0.	.1		1 0.
466	13.	.9		1 24.
465	5.	.4		0 40.
464	32.	.7		1 8.
459	34.	1.0		1 10.
453	15.	.4		0 38.
452	40.	.7		1 8.
1500	241.	(DIRECT FLOW)		1 2.
924	1.	(DIRECT FLOW)		0 30.
923	1.	(DIRECT FLOW)		0 30.
922	1.	(DIRECT FLOW)		0 30.
921	32.	(DIRECT FLOW)		1 6.
920	6.	(DIRECT FLOW)		0 34.
919	32.	(DIRECT FLOW)		0 54.
918	13.	(DIRECT FLOW)		0 44.
917	23.	(DIRECT FLOW)		1 0.
916	19.	(DIRECT FLOW)		0 52.
915	44.	(DIRECT FLOW)		1 52.
914	5.	(DIRECT FLOW)		0 40.
913	32.	(DIRECT FLOW)		1 8.
912	34.	(DIRECT FLOW)		1 10.
911	15.	(DIRECT FLOW)		0 38.
910	40.	(DIRECT FLOW)		1 8.

Table A10. Coal Creek Tributaries

2-year event

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
470	42.	.6		0 30.
1057	11.	.0	.9	0 54.
523	11.	(DIRECT FLOW)		0 54.
471	58.	.7		0 32.
472	9.	.6		0 30.
1043	28.	.0	1.5	0 58.
474	29.	.6		0 32.
528	9.	(DIRECT FLOW)		0 30.
1041	16.	.0	2.8	2 18.
473	15.	.3		0 26.
475	99.	1.7		0 30.
526	17.	(DIRECT FLOW)		1 52.
1044	48.	.0	1.4	0 46.
527	17.	.9		1 56.
529	59.	(DIRECT FLOW)		0 46.
476	105.	1.5		0 40.
477	31.	.5		0 28.
410	129.	2.1		0 32.
1042	94.	.0	.5	0 52.
20	31.	(DIRECT FLOW)		0 28.
441	1.	.1		0 32.
440	10.	.6		0 30.
430	25.	.9		0 32.
500	129.	(DIRECT FLOW)		0 32.
530	111.	(DIRECT FLOW)		0 34.
12	40.	.5		0 30.
456	84.	.8		0 32.
512	1.	(DIRECT FLOW)		0 32.
511	10.	(DIRECT FLOW)		0 30.
506	25.	(DIRECT FLOW)		0 32.
412	50.	.6		0 28.
411	157.	1.0		0 36.
478	158.	2.3		0 38.
1049	40.	.0	3.3	1 6.
455	50.	.7		0 32.
435	1.	.1		0 32.
443	1.	.1		0 42.
442	12.	.5		0 36.
431	16.	.6		0 48.
424	54.	.7		0 30.
501	197.	(DIRECT FLOW)		0 34.
531	158.	(DIRECT FLOW)		0 38.
462	81.	1.6		0 32.
13	47.	.6		0 26.
518	71.	(DIRECT FLOW)		0 36.
509	1.	(DIRECT FLOW)		0 32.
513	13.	(DIRECT FLOW)		0 36.
507	16.	(DIRECT FLOW)		0 48.
504	54.	(DIRECT FLOW)		0 30.
415	218.	1.8		0 36.
414	67.	.7		0 30.
413	23.	.8		0 30.
468	34.	.5		0 26.
481	175.	1.3		0 42.
1047	81.	.0		0 32.
461	58.	1.3		0 30.
14	41.	.8		0 30.
457	77.	1.5		0 38.
450	15.	.6		0 30.
436	23.	.8		0 36.
446	121.	1.0		0 32.
444	76.	.9		0 36.
432	56.	.9		0 36.
427	41.	.7		0 32.
426	64.	.5		0 26.
425	37.	1.0		0 42.
502	298.	(DIRECT FLOW)		0 34.
490	47.	.7		0 32.
1056	15.	.0	.5	0 38.
1045	109.	.0	5.8	1 26.
479	49.	.7		0 30.
521	138.	(DIRECT FLOW)		0 30.
1050	46.	.0	4.4	1 58.
516	15.	(DIRECT FLOW)		0 30.
1054	12.	.0	.8	1 22.
514	195.	(DIRECT FLOW)		0 34.
1055	37.	.0	1.1	1 0.
505	122.	(DIRECT FLOW)		0 30.
417	53.	.7		0 32.
416	325.	2.7		0 40.
540	47.	(DIRECT FLOW)		0 32.
525	15.	(DIRECT FLOW)		0 38.
532	109.	(DIRECT FLOW)		1 26.
533	48.	.6		0 32.
480	55.	.7		0 28.
1048	36.	.0	3.5	1 6.

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
519	46.	(DIRECT FLOW)		1 58.
451	158.	1.1		0 32.
515	0.	(DIRECT FLOW)		0 0.
1053	116.	.0	3.9	0 56.
510	0.	(DIRECT FLOW)		0 0.
508	37.	(DIRECT FLOW)		1 0.
1040	28.	.0	4.4	1 44.
503	371.	(DIRECT FLOW)		0 38.
492	47.	1.5		0 36.
491	47.	1.5		0 48.
487	64.	.9		0 36.
537	15.	.4		0 40.
483	39.	1.0		0 30.
482	114.	2.2		1 30.
534	101.	(DIRECT FLOW)		0 30.
463	63.	1.3		0 32.
458	71.	1.3		0 34.
1051	72.	.0	3.1	0 54.
447	28.	.7		0 26.
445	120.	.9		0 56.
437	32.	.5		0 26.
433	41.	.9		1 4.
428	28.	.8		1 46.
400	313.	(DIRECT FLOW)		0 46.
418	304.	1.6		0 50.
541	90.	(DIRECT FLOW)		0 42.
539	64.	(DIRECT FLOW)		0 36.
538	51.	(DIRECT FLOW)		0 32.
536	114.	(DIRECT FLOW)		1 30.
1046	52.	.0	1.6	0 44.
522	63.	(DIRECT FLOW)		0 32.
520	71.	(DIRECT FLOW)		0 34.
517	72.	(DIRECT FLOW)		0 54.
909	42.	(DIRECT FLOW)		0 30.
908	28.	(DIRECT FLOW)		0 26.
907	120.	(DIRECT FLOW)		0 56.
906	32.	(DIRECT FLOW)		0 26.
905	41.	(DIRECT FLOW)		1 4.
904	20.	(DIRECT FLOW)		0 24.
903	28.	(DIRECT FLOW)		1 46.
902	14.	(DIRECT FLOW)		0 24.
901	12.	(DIRECT FLOW)		0 24.
900	609.	(DIRECT FLOW)		0 46.
494	89.	1.6		0 46.
493	19.	.7		0 40.
488	103.	1.1		0 38.
486	42.	.8		0 34.
484	73.	1.1		0 42.
485	62.	1.0		0 38.
535	111.	2.5		1 48.
467	1.	.2		0 32.
466	41.	1.6		1 4.
465	19.	.9		0 30.
464	99.	1.2		0 44.
459	112.	1.9		0 42.
453	49.	.7		0 30.
452	106.	1.1		0 42.
1500	820.	(DIRECT FLOW)		0 46.
924	3.	(DIRECT FLOW)		0 24.
923	3.	(DIRECT FLOW)		0 24.
922	2.	(DIRECT FLOW)		0 24.
921	108.	(DIRECT FLOW)		0 44.
920	20.	(DIRECT FLOW)		0 24.
919	103.	(DIRECT FLOW)		0 38.
918	42.	(DIRECT FLOW)		0 34.
917	73.	(DIRECT FLOW)		0 42.
916	62.	(DIRECT FLOW)		0 38.
915	138.	(DIRECT FLOW)		1 36.
914	19.	(DIRECT FLOW)		0 30.
913	99.	(DIRECT FLOW)		0 44.
912	112.	(DIRECT FLOW)		0 42.
911	49.	(DIRECT FLOW)		0 30.
910	106.	(DIRECT FLOW)		0 42.

Table A10. Coal Creek Tributaries

5-year event

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
470	60.	.7		0 28.
1057	16.	.0	1.4	1 6.
523	16.	(DIRECT FLOW)		1 6.
471	84.	.9		0 30.
472	13.	.7		0 30.
1043	50.	.0	1.9	0 54.
474	42.	.8		0 30.
528	13.	(DIRECT FLOW)		0 30.
1041	25.	.0	5.4	2 18.
473	23.	.4		0 26.
475	148.	2.1		0 30.
526	27.	(DIRECT FLOW)		2 0.
1044	63.	.0	2.3	0 48.
527	27.	1.1		2 2.
529	82.	(DIRECT FLOW)		0 52.
476	155.	1.8		0 36.
477	43.	.6		0 26.
410	198.	2.6		0 32.
1042	144.	.0	1.1	0 46.
20	43.	(DIRECT FLOW)		0 26.
441	5.	.2		0 48.
440	15.	.8		0 30.
430	40.	1.1		0 32.
500	198.	(DIRECT FLOW)		0 32.
530	160.	(DIRECT FLOW)		0 44.
12	56.	.6		0 30.
456	123.	.9		0 32.
512	5.	(DIRECT FLOW)		0 48.
511	15.	(DIRECT FLOW)		0 30.
506	40.	(DIRECT FLOW)		0 32.
412	71.	.7		0 28.
411	244.	1.2		0 34.
478	216.	2.7		0 34.
1049	62.	.0	5.3	1 18.
455	73.	.8		0 30.
435	7.	.4		0 50.
443	8.	.2		0 50.
442	26.	.7		0 42.
431	36.	1.0		0 50.
424	77.	.8		0 30.
501	307.	(DIRECT FLOW)		0 34.
531	216.	(DIRECT FLOW)		0 34.
462	122.	1.9		0 30.
13	68.	.7		0 26.
518	104.	(DIRECT FLOW)		0 36.
509	7.	(DIRECT FLOW)		0 50.
513	33.	(DIRECT FLOW)		0 44.
507	36.	(DIRECT FLOW)		0 50.
504	77.	(DIRECT FLOW)		0 30.
415	345.	2.2		0 36.
414	97.	.9		0 30.
413	35.	1.0		0 30.
468	49.	.6		0 26.
481	246.	1.5		0 40.
1047	122.	.0		0 30.
461	86.	1.5		0 28.
14	58.	.9		0 30.
457	114.	1.8		0 36.
450	24.	.8		0 32.
436	39.	1.0		0 38.
446	178.	1.1		0 32.
444	117.	1.1		0 34.
432	86.	1.1		0 34.
427	61.	.8		0 30.
426	88.	.6		0 26.
425	65.	1.4		0 42.
502	464.	(DIRECT FLOW)		0 34.
490	70.	.9		0 32.
1056	23.	.0	.7	0 38.
1045	165.	.0	9.0	1 36.
479	71.	.8		0 30.
521	207.	(DIRECT FLOW)		0 30.
1050	71.	.0	8.1	2 6.
516	24.	(DIRECT FLOW)		0 32.
1054	25.	.0	1.7	1 36.
514	292.	(DIRECT FLOW)		0 32.
1055	62.	.0	1.9	1 10.
505	190.	(DIRECT FLOW)		0 32.
417	75.	.8		0 30.
416	489.	3.2		0 40.
540	70.	(DIRECT FLOW)		0 32.
525	23.	(DIRECT FLOW)		0 38.
532	165.	(DIRECT FLOW)		1 36.
533	70.	.7		0 32.
480	81.	.8		0 26.

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
1048	51.	.0	5.5	1 22.
519	71.	(DIRECT FLOW)		2 6.
451	238.	1.3		0 32.
515	0.	(DIRECT FLOW)		0 0.
1053	175.	.0	6.0	0 58.
510	0.	(DIRECT FLOW)		0 0.
508	62.	(DIRECT FLOW)		1 10.
1040	44.	.0	9.0	2 0.
503	551.	(DIRECT FLOW)		0 38.
492	74.	1.9		0 34.
491	76.	1.9		0 48.
487	97.	1.1		0 34.
537	23.	.5		0 40.
483	59.	1.3		0 30.
482	174.	2.7		1 36.
534	146.	(DIRECT FLOW)		0 30.
463	94.	1.6		0 32.
458	108.	1.6		0 32.
1051	98.	.0	4.9	0 56.
447	42.	.9		0 26.
445	182.	1.1		1 0.
437	44.	.6		0 26.
433	69.	1.2		1 12.
428	44.	1.0		2 0.
400	532.	(DIRECT FLOW)		0 46.
418	480.	1.9		0 50.
541	142.	(DIRECT FLOW)		0 40.
539	97.	(DIRECT FLOW)		0 34.
538	74.	(DIRECT FLOW)		0 30.
536	174.	(DIRECT FLOW)		1 36.
1046	71.	.0	2.3	0 44.
522	94.	(DIRECT FLOW)		0 32.
520	108.	(DIRECT FLOW)		0 32.
517	98.	(DIRECT FLOW)		0 56.
909	67.	(DIRECT FLOW)		0 24.
908	42.	(DIRECT FLOW)		0 26.
907	182.	(DIRECT FLOW)		1 0.
906	44.	(DIRECT FLOW)		0 26.
905	69.	(DIRECT FLOW)		1 12.
904	30.	(DIRECT FLOW)		0 24.
903	44.	(DIRECT FLOW)		2 0.
902	21.	(DIRECT FLOW)		0 24.
901	18.	(DIRECT FLOW)		0 24.
900	1001.	(DIRECT FLOW)		0 46.
494	143.	2.1		0 44.
493	28.	.9		0 38.
488	154.	1.3		0 36.
486	63.	.9		0 34.
484	108.	1.3		0 40.
485	93.	1.1		0 36.
535	170.	3.1		1 54.
467	5.	.5		1 8.
466	66.	2.0		1 4.
465	29.	1.1		0 30.
464	147.	1.5		0 42.
459	172.	2.4		0 38.
453	71.	.8		0 30.
452	149.	1.2		0 38.
1500	1327.	(DIRECT FLOW)		0 50.
924	5.	(DIRECT FLOW)		0 24.
923	4.	(DIRECT FLOW)		0 24.
922	3.	(DIRECT FLOW)		0 22.
921	170.	(DIRECT FLOW)		0 42.
920	32.	(DIRECT FLOW)		0 24.
919	154.	(DIRECT FLOW)		0 36.
918	63.	(DIRECT FLOW)		0 34.
917	108.	(DIRECT FLOW)		0 40.
916	93.	(DIRECT FLOW)		0 36.
915	221.	(DIRECT FLOW)		1 28.
914	29.	(DIRECT FLOW)		0 30.
913	147.	(DIRECT FLOW)		0 42.
912	172.	(DIRECT FLOW)		0 38.
911	71.	(DIRECT FLOW)		0 30.
910	149.	(DIRECT FLOW)		0 38.

Table A10. Coal Creek Tributaries

10-year event

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
470	77.	.8		0 28.
1057	23.	.0	1.9	1 8.
523	23.	(DIRECT FLOW)		1 8.
471	111.	1.0		0 32.
472	19.	.9		0 32.
1043	72.	.0	2.3	0 52.
474	55.	.8		0 30.
528	19.	(DIRECT FLOW)		0 32.
1041	53.	.0	6.4	1 52.
473	29.	.5		0 26.
475	194.	2.4		0 28.
526	56.	(DIRECT FLOW)		1 52.
1044	75.	.0	3.3	0 52.
527	56.	1.7		1 54.
529	116.	(DIRECT FLOW)		1 40.
476	206.	2.1		0 36.
477	55.	.7		0 28.
410	262.	2.9		0 32.
1042	192.	.0	1.4	0 44.
20	55.	(DIRECT FLOW)		0 28.
441	13.	.3		0 46.
440	23.	.9		0 32.
430	59.	1.3		0 32.
500	262.	(DIRECT FLOW)		0 32.
530	222.	(DIRECT FLOW)		0 42.
12	74.	.7		0 32.
456	164.	1.1		0 32.
512	13.	(DIRECT FLOW)		0 46.
511	23.	(DIRECT FLOW)		0 32.
506	59.	(DIRECT FLOW)		0 32.
412	97.	.8		0 30.
411	331.	1.4		0 34.
478	294.	3.1		0 42.
1049	82.	.0	7.5	1 20.
455	95.	.9		0 32.
435	20.	.8		0 46.
443	22.	.4		0 46.
442	52.	1.1		0 46.
431	71.	1.4		0 52.
424	102.	.9		0 30.
501	421.	(DIRECT FLOW)		0 34.
531	294.	(DIRECT FLOW)		0 42.
462	161.	2.2		0 30.
13	84.	.7		0 26.
518	137.	(DIRECT FLOW)		0 36.
509	20.	(DIRECT FLOW)		0 46.
513	74.	(DIRECT FLOW)		0 46.
507	71.	(DIRECT FLOW)		0 52.
504	102.	(DIRECT FLOW)		0 30.
415	481.	2.7		0 36.
414	128.	1.0		0 30.
413	49.	1.2		0 30.
468	62.	.7		0 26.
481	331.	1.7		0 44.
1047	161.	.0		0 30.
461	112.	1.8		0 28.
14	72.	1.0		0 30.
457	154.	2.1		0 38.
450	37.	1.0		0 32.
436	67.	1.4		0 50.
446	231.	1.3		0 32.
444	161.	1.3		0 36.
432	120.	1.2		0 38.
427	80.	.9		0 30.
426	116.	.7		0 30.
425	103.	1.8		0 44.
502	643.	(DIRECT FLOW)		0 34.
490	93.	1.0		0 32.
1056	30.	.0	.9	0 40.
1045	214.	.0	12.3	1 36.
479	91.	.9		0 30.
521	271.	(DIRECT FLOW)		0 30.
1050	91.	.0	11.1	2 8.
516	37.	(DIRECT FLOW)		0 32.
1054	45.	.0	3.0	1 36.
514	387.	(DIRECT FLOW)		0 32.
1055	99.	.0	3.1	1 18.
505	269.	(DIRECT FLOW)		0 32.
417	95.	.9		0 30.
416	661.	3.6		0 40.
540	93.	(DIRECT FLOW)		0 32.
525	30.	(DIRECT FLOW)		0 40.
532	214.	(DIRECT FLOW)		1 36.
533	90.	.8		0 32.
480	103.	.9		0 26.
1048	64.	.0	7.3	1 20.

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
519	91.	(DIRECT FLOW)		2 8.
451	312.	1.5		0 32.
515	0.	(DIRECT FLOW)		0 0.
1053	237.	.0	8.6	1 6.
510	0.	(DIRECT FLOW)		0 0.
508	99.	(DIRECT FLOW)		1 18.
1040	126.	.0	10.9	1 16.
503	735.	(DIRECT FLOW)		0 38.
492	102.	2.2		0 34.
491	107.	2.2		0 48.
487	128.	1.2		0 34.
537	29.	.6		0 42.
483	77.	1.5		0 28.
482	223.	3.0		1 38.
534	186.	(DIRECT FLOW)		0 30.
463	122.	1.9		0 30.
458	142.	1.9		0 32.
1051	116.	.0	6.7	1 0.
447	54.	1.1		0 26.
445	246.	1.2		1 6.
437	56.	.6		0 26.
433	107.	1.5		1 16.
428	126.	1.8		1 18.
400	728.	(DIRECT FLOW)		0 46.
418	659.	2.2		0 50.
541	197.	(DIRECT FLOW)		0 40.
539	128.	(DIRECT FLOW)		0 34.
538	95.	(DIRECT FLOW)		0 30.
536	223.	(DIRECT FLOW)		1 38.
1046	81.	.0	3.1	0 46.
522	122.	(DIRECT FLOW)		0 30.
520	142.	(DIRECT FLOW)		0 32.
517	116.	(DIRECT FLOW)		1 0.
909	88.	(DIRECT FLOW)		0 24.
908	54.	(DIRECT FLOW)		0 26.
907	246.	(DIRECT FLOW)		1 6.
906	56.	(DIRECT FLOW)		0 26.
905	107.	(DIRECT FLOW)		1 16.
904	38.	(DIRECT FLOW)		0 24.
903	126.	(DIRECT FLOW)		1 18.
902	28.	(DIRECT FLOW)		0 24.
901	24.	(DIRECT FLOW)		0 24.
900	1373.	(DIRECT FLOW)		0 46.
494	201.	2.5		0 42.
493	37.	1.0		0 38.
488	204.	1.4		0 36.
486	84.	1.1		0 34.
484	142.	1.4		0 38.
485	123.	1.3		0 36.
535	218.	3.3		2 0.
467	13.	.8		1 14.
466	87.	2.3		1 8.
465	39.	1.3		0 30.
464	193.	1.6		0 40.
459	232.	2.8		0 38.
453	92.	.9		0 30.
452	189.	1.4		0 36.
1500	1806.	(DIRECT FLOW)		0 50.
924	7.	(DIRECT FLOW)		0 24.
923	5.	(DIRECT FLOW)		0 24.
922	4.	(DIRECT FLOW)		0 24.
921	237.	(DIRECT FLOW)		0 42.
920	41.	(DIRECT FLOW)		0 24.
919	204.	(DIRECT FLOW)		0 36.
918	84.	(DIRECT FLOW)		0 34.
917	142.	(DIRECT FLOW)		0 38.
916	123.	(DIRECT FLOW)		0 36.
915	293.	(DIRECT FLOW)		1 32.
914	39.	(DIRECT FLOW)		0 30.
913	193.	(DIRECT FLOW)		0 40.
912	232.	(DIRECT FLOW)		0 38.
911	92.	(DIRECT FLOW)		0 30.
910	189.	(DIRECT FLOW)		0 36.

Table A10. Coal Creek Tributaries

50-year event

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
470	142.	1.0		0 32.
1057	45.	.0	3.7	1 6.
523	45.	(DIRECT FLOW)		1 6.
471	214.	1.3		0 36.
472	50.	1.5		0 40.
1043	133.	.0	4.5	1 4.
474	100.	1.1		0 34.
528	50.	(DIRECT FLOW)		0 40.
1041	100.	.0	10.5	1 50.
473	52.	.7		0 32.
475	356.	3.1		0 32.
526	103.	(DIRECT FLOW)		1 48.
1044	105.	.0	8.5	1 12.
527	103.	2.4		1 50.
529	206.	(DIRECT FLOW)		1 18.
476	388.	2.9		0 40.
477	103.	.9		0 32.
410	444.	3.5		0 36.
1042	324.	.0	3.4	0 54.
20	103.	(DIRECT FLOW)		0 32.
441	51.	.7		0 48.
440	69.	1.6		0 42.
430	158.	2.2		0 42.
500	444.	(DIRECT FLOW)		0 36.
530	379.	(DIRECT FLOW)		0 46.
12	143.	1.0		0 36.
456	313.	1.4		0 36.
512	51.	(DIRECT FLOW)		0 48.
511	69.	(DIRECT FLOW)		0 42.
506	158.	(DIRECT FLOW)		0 42.
412	200.	1.1		0 36.
411	608.	1.8		0 40.
478	533.	3.8		0 44.
1049	135.	.0	15.3	1 18.
455	178.	1.2		0 36.
435	81.	1.6		0 46.
443	77.	.8		0 50.
442	186.	2.1		0 50.
431	245.	2.7		0 52.
424	196.	1.2		0 34.
501	798.	(DIRECT FLOW)		0 38.
531	533.	(DIRECT FLOW)		0 44.
462	302.	2.9		0 34.
13	136.	.9		0 30.
518	254.	(DIRECT FLOW)		0 42.
509	81.	(DIRECT FLOW)		0 46.
513	263.	(DIRECT FLOW)		0 50.
507	245.	(DIRECT FLOW)		0 52.
504	196.	(DIRECT FLOW)		0 34.
415	929.	3.5		0 42.
414	242.	1.3		0 34.
413	101.	1.7		0 34.
468	112.	.9		0 32.
481	619.	2.2		0 46.
1047	302.	.0		0 34.
461	208.	2.4		0 32.
14	118.	1.2		0 34.
457	305.	2.9		0 42.
450	96.	1.7		0 36.
436	213.	2.5		0 52.
446	411.	1.7		0 34.
444	368.	1.9		0 48.
432	323.	1.9		0 54.
427	144.	1.2		0 34.
426	246.	.9		0 34.
425	274.	2.9		0 48.
502	1226.	(DIRECT FLOW)		0 40.
490	180.	1.3		0 40.
1056	40.	.0	1.8	0 50.
1045	327.	.0	27.2	1 58.
479	161.	1.2		0 34.
521	509.	(DIRECT FLOW)		0 32.
1050	154.	.0	19.6	2 2.
516	96.	(DIRECT FLOW)		0 36.
1054	111.	.0	8.0	1 30.
514	728.	(DIRECT FLOW)		0 38.
1055	271.	.0	7.1	1 12.
505	571.	(DIRECT FLOW)		0 38.
417	158.	1.1		0 34.
416	1289.	4.5		0 46.
540	180.	(DIRECT FLOW)		0 40.
525	40.	(DIRECT FLOW)		0 50.
532	327.	(DIRECT FLOW)		1 58.
533	158.	1.0		0 36.
480	179.	1.1		0 32.

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
1048	105.	.0	13.0	1 10.
519	154.	(DIRECT FLOW)		2 2.
451	565.	1.9		0 34.
515	0.	(DIRECT FLOW)		0 0.
1053	513.	.0	18.3	1 10.
510	0.	(DIRECT FLOW)		0 0.
508	271.	(DIRECT FLOW)		1 12.
1040	384.	.0	14.6	1 0.
503	1401.	(DIRECT FLOW)		0 44.
492	202.	3.0		0 40.
491	224.	3.2		0 54.
487	239.	1.6		0 40.
537	40.	.7		0 52.
483	140.	2.0		0 32.
482	335.	3.5		2 0.
534	324.	(DIRECT FLOW)		0 32.
463	219.	2.5		0 32.
458	253.	2.5		0 34.
1051	189.	.0	13.2	1 4.
447	96.	1.4		0 30.
445	522.	1.7		1 10.
437	101.	.8		0 32.
433	281.	2.5		1 14.
428	386.	3.1		1 2.
400	1155.	(DIRECT FLOW)		0 46.
418	1327.	3.0		0 54.
541	408.	(DIRECT FLOW)		0 44.
539	239.	(DIRECT FLOW)		0 40.
538	166.	(DIRECT FLOW)		0 32.
536	335.	(DIRECT FLOW)		2 0.
1046	120.	.0	6.0	0 54.
522	219.	(DIRECT FLOW)		0 32.
520	253.	(DIRECT FLOW)		0 34.
517	189.	(DIRECT FLOW)		1 4.
909	164.	(DIRECT FLOW)		0 30.
908	96.	(DIRECT FLOW)		0 30.
907	522.	(DIRECT FLOW)		1 10.
906	101.	(DIRECT FLOW)		0 32.
905	281.	(DIRECT FLOW)		1 14.
904	68.	(DIRECT FLOW)		0 30.
903	386.	(DIRECT FLOW)		1 2.
902	49.	(DIRECT FLOW)		0 30.
901	42.	(DIRECT FLOW)		0 30.
900	2388.	(DIRECT FLOW)		0 50.
494	419.	3.4		0 48.
493	72.	1.3		0 44.
488	376.	1.9		0 40.
486	165.	1.4		0 42.
484	263.	1.9		0 42.
485	231.	1.7		0 40.
535	331.	3.8		2 14.
467	51.	1.6		0 58.
466	160.	3.0		1 6.
465	83.	1.9		0 36.
464	360.	2.1		0 44.
459	410.	3.5		0 42.
453	171.	1.2		0 34.
452	317.	1.7		0 38.
1500	3575.	(DIRECT FLOW)		0 50.
924	13.	(DIRECT FLOW)		0 30.
923	10.	(DIRECT FLOW)		0 30.
922	10.	(DIRECT FLOW)		1 4.
921	490.	(DIRECT FLOW)		0 48.
920	73.	(DIRECT FLOW)		0 30.
919	376.	(DIRECT FLOW)		0 40.
918	165.	(DIRECT FLOW)		0 42.
917	263.	(DIRECT FLOW)		0 42.
916	231.	(DIRECT FLOW)		0 40.
915	463.	(DIRECT FLOW)		1 26.
914	83.	(DIRECT FLOW)		0 36.
913	360.	(DIRECT FLOW)		0 44.
912	410.	(DIRECT FLOW)		0 42.
911	171.	(DIRECT FLOW)		0 34.
910	317.	(DIRECT FLOW)		0 38.

Table A10. Coal Creek Tributaries

100-year event

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
470	172.	1.1		0 34.
1057	59.	.0	4.5	1 6.
523	59.	(DIRECT FLOW)		1 6.
471	265.	1.4		0 36.
472	66.	1.7		0 40.
1043	149.	.0	6.3	1 12.
474	120.	1.2		0 34.
528	66.	(DIRECT FLOW)		0 40.
1041	109.	.0	13.1	2 6.
473	62.	.7		0 32.
475	424.	3.3		0 34.
526	112.	(DIRECT FLOW)		2 0.
1044	117.	.0	11.6	1 16.
527	112.	2.5		2 2.
529	223.	(DIRECT FLOW)		1 8.
476	454.	3.1		0 40.
477	125.	1.0		0 34.
410	530.	3.7		0 36.
1042	399.	.0	4.5	0 54.
20	125.	(DIRECT FLOW)		0 34.
441	70.	.8		0 48.
440	95.	1.9		0 44.
430	210.	2.5		0 42.
500	530.	(DIRECT FLOW)		0 36.
530	462.	(DIRECT FLOW)		0 52.
12	176.	1.1		0 36.
456	385.	1.6		0 36.
512	70.	(DIRECT FLOW)		0 48.
511	95.	(DIRECT FLOW)		0 44.
506	210.	(DIRECT FLOW)		0 42.
412	253.	1.2		0 36.
411	734.	1.9		0 40.
478	626.	4.0		0 48.
1049	162.	.0	19.2	1 18.
455	218.	1.3		0 36.
435	113.	1.9		0 44.
443	105.	.9		0 50.
442	258.	2.5		0 48.
431	331.	3.1		0 54.
424	240.	1.3		0 34.
501	975.	(DIRECT FLOW)		0 38.
531	626.	(DIRECT FLOW)		0 48.
462	353.	3.1		0 34.
13	155.	1.0		0 30.
518	304.	(DIRECT FLOW)		0 42.
509	113.	(DIRECT FLOW)		0 44.
513	362.	(DIRECT FLOW)		0 48.
507	331.	(DIRECT FLOW)		0 54.
504	240.	(DIRECT FLOW)		0 34.
415	1138.	3.7		0 42.
414	295.	1.4		0 36.
413	126.	1.9		0 34.
468	132.	1.0		0 32.
481	739.	2.4		0 46.
1047	353.	.0		0 34.
461	245.	2.5		0 32.
14	136.	1.3		0 34.
457	371.	3.2		0 44.
450	126.	1.9		0 36.
436	290.	2.9		0 52.
446	491.	1.8		0 36.
444	482.	2.1		0 50.
432	431.	2.2		0 54.
427	173.	1.3		0 34.
426	307.	1.0		0 34.
425	347.	3.2		0 50.
502	1498.	(DIRECT FLOW)		0 40.
490	223.	1.4		0 40.
1056	45.	.0	2.2	0 52.
1045	385.	.0	33.5	1 50.
479	192.	1.3		0 34.
521	590.	(DIRECT FLOW)		0 32.
1050	193.	.0	22.8	1 50.
516	126.	(DIRECT FLOW)		0 36.
1054	133.	.0	11.4	1 32.
514	890.	(DIRECT FLOW)		0 38.
1055	365.	.0	9.2	1 12.
505	721.	(DIRECT FLOW)		0 38.
417	183.	1.2		0 34.
416	1582.	4.9		0 46.
540	223.	(DIRECT FLOW)		0 40.
525	45.	(DIRECT FLOW)		0 52.
532	385.	(DIRECT FLOW)		1 50.
533	188.	1.1		0 36.
480	208.	1.2		0 32.

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
1048	136.	.0	15.8	1 10.
519	193.	(DIRECT FLOW)		1 50.
451	674.	2.0		0 34.
515	0.	(DIRECT FLOW)		0 0.
1053	613.	.0	24.1	1 14.
510	0.	(DIRECT FLOW)		0 0.
508	365.	(DIRECT FLOW)		1 12.
1040	492.	.0	17.0	1 2.
503	1713.	(DIRECT FLOW)		0 46.
492	239.	3.2		0 42.
491	274.	3.4		0 56.
487	290.	1.7		0 40.
537	45.	.7		0 54.
483	164.	2.2		0 32.
482	392.	3.6		1 56.
534	381.	(DIRECT FLOW)		0 34.
463	258.	2.7		0 34.
458	299.	2.7		0 34.
1051	227.	.0	16.1	1 6.
447	111.	1.6		0 30.
445	621.	1.8		1 14.
437	121.	.9		0 32.
433	375.	2.8		1 12.
428	496.	3.4		1 2.
400	1382.	(DIRECT FLOW)		0 46.
418	1639.	3.3		0 54.
541	494.	(DIRECT FLOW)		0 48.
539	290.	(DIRECT FLOW)		0 40.
538	191.	(DIRECT FLOW)		0 32.
536	392.	(DIRECT FLOW)		1 56.
1046	129.	.0	7.4	0 58.
522	258.	(DIRECT FLOW)		0 34.
520	299.	(DIRECT FLOW)		0 34.
517	227.	(DIRECT FLOW)		1 6.
909	192.	(DIRECT FLOW)		0 30.
908	111.	(DIRECT FLOW)		0 30.
907	621.	(DIRECT FLOW)		1 14.
906	121.	(DIRECT FLOW)		0 32.
905	375.	(DIRECT FLOW)		1 12.
904	82.	(DIRECT FLOW)		0 30.
903	496.	(DIRECT FLOW)		1 2.
902	57.	(DIRECT FLOW)		0 30.
901	50.	(DIRECT FLOW)		0 30.
900	2891.	(DIRECT FLOW)		0 50.
494	511.	3.7		0 52.
493	89.	1.4		0 46.
488	454.	2.0		0 42.
486	206.	1.6		0 44.
484	316.	2.0		0 42.
485	281.	1.9		0 40.
535	383.	4.0		2 8.
467	73.	2.0		0 58.
466	187.	3.2		1 6.
465	107.	2.1		0 36.
464	434.	2.3		0 44.
459	489.	3.7		0 44.
453	206.	1.3		0 34.
452	371.	1.8		0 38.
1500	4377.	(DIRECT FLOW)		0 54.
924	18.	(DIRECT FLOW)		1 4.
923	15.	(DIRECT FLOW)		1 4.
922	15.	(DIRECT FLOW)		1 4.
921	598.	(DIRECT FLOW)		0 50.
920	85.	(DIRECT FLOW)		0 30.
919	454.	(DIRECT FLOW)		0 42.
918	206.	(DIRECT FLOW)		0 44.
917	316.	(DIRECT FLOW)		0 42.
916	281.	(DIRECT FLOW)		0 40.
915	546.	(DIRECT FLOW)		1 28.
914	107.	(DIRECT FLOW)		0 36.
913	434.	(DIRECT FLOW)		0 44.
912	489.	(DIRECT FLOW)		0 44.
911	206.	(DIRECT FLOW)		0 34.
910	371.	(DIRECT FLOW)		0 38.

Table A11. Bullhead Gulch/Prince Tributary

0.4-inch event

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
201	1.	.2		1 0.
200	16.	.7		0 40.
202	6.	.2		0 38.
300	17.	(DIRECT FLOW)		0 40.
302	6.	(DIRECT FLOW)		0 38.
301	16.	.5		0 46.
204	13.	.3		0 38.
203	9.	.4		0 42.
303	37.	(DIRECT FLOW)		0 42.
205	16.	.4		0 40.
1027	19.	.0	1.0	1 14.
1025	11.	.0	.2	0 58.
304	18.	.4		1 18.
305	28.	(DIRECT FLOW)		1 10.
209	27.	.7		1 16.
207	17.	.4		0 42.
206	17.	.4		0 40.
212	16.	.7		0 42.
208	1.	.1		0 44.
306	27.	(DIRECT FLOW)		1 16.
1026	19.	.0	.7	1 8.
310	16.	(DIRECT FLOW)		0 42.
307	0.	.1		1 12.
211	27.	.9		1 24.
210	21.	.7		1 2.
213	26.	.8		0 46.
308	47.	(DIRECT FLOW)		1 20.
1028	11.	.0	.9	1 22.
309	46.	1.0		1 24.
235	1.	.0		1 0.
218	22.	.4		0 40.
217	20.	.7		0 42.
311	57.	(DIRECT FLOW)		1 24.
320	1.	(DIRECT FLOW)		1 0.
1029	10.	.0	1.7	1 28.
216	0.	.0		1 0.
215	57.	1.0		1 30.
236	1.	.1		0 42.
312	67.	(DIRECT FLOW)		1 30.
101	17.	.3		0 36.
1020	113.	(DIRECT FLOW)		1 24.
321	1.	(DIRECT FLOW)		0 42.
220	5.	.3		0 36.
219	67.	1.2		1 34.
102	30.	.9		0 40.
1021	109.	1.6		1 30.
237	1.	.1		1 8.
313	68.	(DIRECT FLOW)		1 34.
1030	10.	.0	.8	1 16.
322	110.	(DIRECT FLOW)		1 30.
314	67.	1.2		1 36.
222	8.	.5		0 46.
221	10.	.6		1 12.
1032	110.	(DIRECT FLOW)		1 30.
315	80.	(DIRECT FLOW)		1 32.
325	0.	(DIRECT FLOW)		0 0.
1031	80.	(DIRECT FLOW)		1 32.
238	4.	.3		0 52.
316	0.	.0		0 0.
323	4.	(DIRECT FLOW)		0 52.
104	107.	1.3		1 40.
103	78.	1.4		1 40.
317	4.	(DIRECT FLOW)		0 52.
241	16.	.8		0 46.
240	0.	.1		1 2.
324	107.	(DIRECT FLOW)		1 40.
318	84.	(DIRECT FLOW)		1 36.
601	105.	1.2		1 50.
242	83.	1.7		1 42.
700	105.	(DIRECT FLOW)		1 50.
319	83.	(DIRECT FLOW)		1 42.
602	103.	2.1		2 0.
243	78.	2.1		2 0.
951	103.	(DIRECT FLOW)		2 0.
940	78.	(DIRECT FLOW)		2 0.
1500	181.	(DIRECT FLOW)		2 0.

2-year event

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
201	4.	.4		0 32.
200	59.	1.4		0 30.
202	23.	.5		0 28.
300	63.	(DIRECT FLOW)		0 30.
302	23.	(DIRECT FLOW)		0 28.
301	60.	1.1		0 34.
204	44.	.6		0 30.
203	35.	.9		0 32.
303	139.	(DIRECT FLOW)		0 32.
205	52.	.7		0 32.
1027	53.	.0	2.8	0 54.
1025	32.	.0	.8	0 46.
304	52.	.7		1 0.
305	82.	(DIRECT FLOW)		0 56.
209	81.	1.3		1 0.
207	53.	.7		0 32.
206	53.	.7		0 32.
212	59.	1.4		0 30.
208	2.	.3		0 32.
306	81.	(DIRECT FLOW)		1 0.
1026	28.	.0	3.0	1 14.
310	59.	(DIRECT FLOW)		0 30.
307	2.	.2		0 46.
211	82.	1.7		1 6.
210	39.	1.0		0 32.
213	99.	1.7		0 32.
308	116.	(DIRECT FLOW)		1 6.
1028	30.	.0	2.6	1 6.
309	115.	1.6		1 10.
235	2.	.1		0 32.
218	70.	.7		0 32.
217	75.	1.5		0 30.
311	145.	(DIRECT FLOW)		1 10.
320	2.	(DIRECT FLOW)		0 32.
1029	27.	.0	4.6	1 24.
216	1.	.1		0 32.
215	153.	1.8		1 16.
236	5.	.2		0 32.
312	180.	(DIRECT FLOW)		1 16.
101	55.	.6		0 28.
1020	492.	(DIRECT FLOW)		1 20.
321	5.	(DIRECT FLOW)		0 32.
220	18.	.7		0 26.
219	184.	2.0		1 20.
102	104.	1.7		0 30.
1021	483.	2.8		1 26.
237	5.	.3		0 42.
313	187.	(DIRECT FLOW)		1 20.
1030	26.	.0	2.2	0 56.
322	486.	(DIRECT FLOW)		1 26.
314	186.	1.9		1 22.
222	31.	1.0		0 32.
221	29.	1.1		1 0.
1032	486.	(DIRECT FLOW)		1 26.
315	223.	(DIRECT FLOW)		1 20.
325	0.	(DIRECT FLOW)		0 0.
1031	223.	(DIRECT FLOW)		1 20.
238	17.	.7		0 34.
316	0.	.0		0 12.
323	17.	(DIRECT FLOW)		0 34.
104	479.	2.9		1 30.
103	221.	2.4		1 26.
317	17.	(DIRECT FLOW)		0 34.
241	59.	1.5		0 32.
240	2.	.3		0 34.
324	479.	(DIRECT FLOW)		1 30.
318	241.	(DIRECT FLOW)		1 22.
601	471.	2.3		1 36.
242	241.	2.9		1 28.
700	471.	(DIRECT FLOW)		1 36.
319	241.	(DIRECT FLOW)		1 28.
602	455.	3.9		1 46.
243	231.	3.4		1 46.
951	455.	(DIRECT FLOW)		1 46.
940	231.	(DIRECT FLOW)		1 46.
1500	686.	(DIRECT FLOW)		1 46.

Table A11. Bullhead Gulch/Prince Tributary

5-year event

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
201	10.	.6		0 44.
200	88.	1.7		0 30.
202	32.	.6		0 28.
300	96.	(DIRECT FLOW)		0 30.
302	32.	(DIRECT FLOW)		0 28.
301	93.	1.4		0 32.
204	64.	.7		0 30.
203	53.	1.1		0 30.
303	207.	(DIRECT FLOW)		0 32.
205	75.	.8		0 30.
1027	86.	.0	4.5	0 58.
1025	41.	.0	1.2	0 50.
304	86.	.9		1 6.
305	125.	(DIRECT FLOW)		1 0.
209	130.	1.7		1 6.
207	77.	.9		0 32.
206	76.	.9		0 30.
212	88.	1.7		0 30.
208	5.	.4		0 42.
306	130.	(DIRECT FLOW)		1 6.
1026	33.	.0	5.9	1 46.
310	88.	(DIRECT FLOW)		0 30.
307	5.	.3		0 58.
211	136.	2.2		1 12.
210	53.	1.2		0 30.
213	152.	2.1		0 32.
308	182.	(DIRECT FLOW)		1 12.
1028	46.	.0	4.0	1 20.
309	181.	1.9		1 16.
235	11.	.3		0 50.
218	102.	.9		0 30.
217	114.	1.8		0 30.
311	227.	(DIRECT FLOW)		1 16.
320	11.	(DIRECT FLOW)		0 50.
1029	44.	.0	7.7	1 40.
216	6.	.2		0 48.
215	248.	2.3		1 20.
236	15.	.4		0 54.
312	295.	(DIRECT FLOW)		1 20.
101	82.	.8		0 26.
1020	1172.	(DIRECT FLOW)		1 24.
321	15.	(DIRECT FLOW)		0 54.
220	28.	.9		0 26.
219	306.	2.6		1 22.
102	153.	2.0		0 28.
1021	1128.	3.8		1 28.
237	19.	.6		1 6.
313	312.	(DIRECT FLOW)		1 22.
1030	40.	.0	3.4	1 12.
322	1146.	(DIRECT FLOW)		1 28.
314	312.	2.3		1 24.
222	49.	1.2		0 32.
221	45.	1.4		1 8.
1032	1146.	(DIRECT FLOW)		1 28.
315	376.	(DIRECT FLOW)		1 22.
325	146.	(DIRECT FLOW)		1 28.
1031	376.	(DIRECT FLOW)		1 22.
238	122.	2.2		1 34.
316	0.	.0		0 0.
323	122.	(DIRECT FLOW)		1 34.
104	1000.	4.2		1 46.
103	373.	3.1		1 28.
317	122.	(DIRECT FLOW)		1 34.
241	91.	1.9		0 32.
240	5.	.5		0 56.
324	1000.	(DIRECT FLOW)		1 46.
318	520.	(DIRECT FLOW)		1 32.
601	1001.	3.2		1 46.
242	505.	3.8		1 38.
700	1001.	(DIRECT FLOW)		1 46.
319	505.	(DIRECT FLOW)		1 38.
602	996.	5.0		1 52.
243	471.	4.3		1 50.
951	996.	(DIRECT FLOW)		1 52.
940	471.	(DIRECT FLOW)		1 50.
1500	1466.	(DIRECT FLOW)		1 52.

10-year event

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
201	22.	.9		0 46.
200	117.	1.9		0 30.
202	43.	.6		0 30.
300	131.	(DIRECT FLOW)		0 30.
302	43.	(DIRECT FLOW)		0 30.
301	128.	1.6		0 32.
204	82.	.8		0 30.
203	75.	1.3		0 32.
303	283.	(DIRECT FLOW)		0 32.
205	98.	.9		0 32.
1027	120.	.0	7.0	1 16.
1025	53.	.0	1.7	0 52.
304	120.	1.1		1 20.
305	168.	(DIRECT FLOW)		1 6.
209	185.	2.0		1 12.
207	101.	1.0		0 32.
206	101.	1.0		0 32.
212	115.	1.9		0 30.
208	12.	.7		0 54.
306	185.	(DIRECT FLOW)		1 12.
1026	62.	.0	8.0	1 26.
310	115.	(DIRECT FLOW)		0 30.
307	12.	.6		1 4.
211	196.	2.6		1 14.
210	69.	1.3		1 28.
213	202.	2.4		0 32.
308	273.	(DIRECT FLOW)		1 22.
1028	60.	.0	5.6	1 22.
309	272.	2.2		1 24.
235	30.	.5		0 48.
218	132.	1.0		0 30.
217	153.	2.1		0 30.
311	332.	(DIRECT FLOW)		1 24.
320	30.	(DIRECT FLOW)		0 48.
1029	58.	.0	10.7	1 36.
216	16.	.3		0 46.
215	355.	2.7		1 26.
236	40.	.6		0 58.
312	422.	(DIRECT FLOW)		1 26.
101	106.	.9		0 26.
1020	1758.	(DIRECT FLOW)		1 20.
321	40.	(DIRECT FLOW)		0 58.
220	36.	1.0		0 26.
219	435.	3.1		1 28.
102	198.	2.3		0 28.
1021	1699.	4.4		1 26.
237	52.	1.1		1 8.
313	442.	(DIRECT FLOW)		1 28.
1030	53.	.0	4.8	1 20.
322	1747.	(DIRECT FLOW)		1 26.
314	442.	2.6		1 30.
222	69.	1.5		0 32.
221	61.	1.6		1 14.
1032	1747.	(DIRECT FLOW)		1 26.
315	526.	(DIRECT FLOW)		1 22.
325	747.	(DIRECT FLOW)		1 26.
1031	526.	(DIRECT FLOW)		1 22.
238	689.	4.3		1 32.
316	18.	.6		1 36.
323	689.	(DIRECT FLOW)		1 32.
104	1000.	4.2		1 56.
103	500.	3.6		1 44.
317	706.	(DIRECT FLOW)		1 32.
241	121.	2.2		0 32.
240	13.	.8		0 56.
324	1000.	(DIRECT FLOW)		1 58.
318	1249.	(DIRECT FLOW)		1 32.
601	1005.	3.2		1 40.
242	1224.	5.1		1 38.
700	1005.	(DIRECT FLOW)		1 40.
319	1224.	(DIRECT FLOW)		1 38.
602	1012.	5.1		1 56.
243	1132.	5.7		1 50.
951	1012.	(DIRECT FLOW)		1 56.
940	1132.	(DIRECT FLOW)		1 50.
1500	2143.	(DIRECT FLOW)		1 52.

Table A11. Bullhead Gulch/Prince Tributary

50-year event

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
201	78.	1.7		0 48.
200	231.	2.6		0 34.
202	91.	.9		0 36.
300	277.	(DIRECT FLOW)		0 36.
302	91.	(DIRECT FLOW)		0 36.
301	269.	2.3		0 40.
204	154.	1.1		0 34.
203	172.	2.0		0 40.
303	585.	(DIRECT FLOW)		0 38.
205	185.	1.2		0 36.
1027	230.	.0	18.7	1 18.
1025	95.	.0	3.9	1 0.
304	230.	1.4		1 24.
305	317.	(DIRECT FLOW)		1 14.
209	379.	2.9		1 12.
207	189.	1.3		0 36.
206	190.	1.3		0 36.
212	219.	2.6		0 32.
208	53.	1.5		0 52.
306	379.	(DIRECT FLOW)		1 12.
1026	225.	.0	10.2	0 58.
310	219.	(DIRECT FLOW)		0 32.
307	52.	1.2		0 58.
211	401.	3.5		1 16.
210	248.	2.6		1 0.
213	372.	3.2		0 36.
308	674.	(DIRECT FLOW)		1 4.
1028	122.	.0	11.0	1 12.
309	670.	3.1		1 8.
235	118.	.9		0 54.
218	243.	1.3		0 34.
217	303.	2.8		0 34.
311	791.	(DIRECT FLOW)		1 8.
320	118.	(DIRECT FLOW)		0 54.
1029	101.	.0	20.3	1 30.
216	60.	.7		0 48.
215	816.	3.8		1 16.
236	166.	1.2		0 58.
312	948.	(DIRECT FLOW)		1 16.
101	196.	1.1		0 32.
1020	3157.	(DIRECT FLOW)		1 20.
321	166.	(DIRECT FLOW)		0 58.
220	76.	1.4		0 32.
219	975.	4.1		1 20.
102	370.	3.0		0 32.
1021	3038.	5.5		1 22.
237	209.	2.3		1 2.
313	989.	(DIRECT FLOW)		1 18.
1030	100.	.0	10.1	1 16.
322	3211.	(DIRECT FLOW)		1 22.
314	987.	3.5		1 22.
222	148.	2.1		0 38.
221	112.	2.1		1 4.
1032	3211.	(DIRECT FLOW)		1 22.
315	1148.	(DIRECT FLOW)		1 18.
325	2211.	(DIRECT FLOW)		1 22.
1031	1148.	(DIRECT FLOW)		1 18.
238	2155.	6.3		1 28.
316	618.	3.1		1 28.
323	2155.	(DIRECT FLOW)		1 28.
104	1000.	4.2		1 46.
103	500.	3.6		1 42.
317	2772.	(DIRECT FLOW)		1 28.
241	234.	2.9		0 36.
240	53.	1.7		0 52.
324	1000.	(DIRECT FLOW)		1 48.
318	3358.	(DIRECT FLOW)		1 28.
601	1023.	3.2		1 20.
242	3326.	7.1		1 32.
700	1023.	(DIRECT FLOW)		1 20.
319	3326.	(DIRECT FLOW)		1 32.
602	1042.	5.1		1 34.
243	3135.	8.0		1 42.
951	1042.	(DIRECT FLOW)		1 34.
940	3135.	(DIRECT FLOW)		1 42.
1500	4175.	(DIRECT FLOW)		1 42.

100-year event

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
201	106.	2.0		0 46.
200	285.	2.9		0 34.
202	115.	1.0		0 36.
300	356.	(DIRECT FLOW)		0 36.
302	115.	(DIRECT FLOW)		0 36.
301	344.	2.5		0 40.
204	189.	1.2		0 36.
203	222.	2.3		0 40.
303	745.	(DIRECT FLOW)		0 38.
205	226.	1.4		0 36.
1027	284.	.0	25.3	1 18.
1025	140.	.0	4.7	0 56.
304	283.	1.5		1 22.
305	382.	(DIRECT FLOW)		1 18.
209	473.	3.1		1 6.
207	231.	1.4		0 38.
206	234.	1.4		0 36.
212	265.	2.8		0 34.
208	75.	1.7		0 52.
306	473.	(DIRECT FLOW)		1 6.
1026	306.	.0	11.1	0 56.
310	265.	(DIRECT FLOW)		0 34.
307	74.	1.4		0 58.
211	503.	3.8		1 10.
210	341.	3.0		0 56.
213	447.	3.4		0 36.
308	882.	(DIRECT FLOW)		1 4.
1028	184.	.0	12.8	1 8.
309	878.	3.4		1 6.
235	165.	1.1		0 54.
218	295.	1.4		0 36.
217	365.	3.1		0 34.
311	1061.	(DIRECT FLOW)		1 6.
320	165.	(DIRECT FLOW)		0 54.
1029	153.	.0	24.2	1 20.
216	83.	.8		0 48.
215	1087.	4.2		1 12.
236	237.	1.4		0 58.
312	1290.	(DIRECT FLOW)		1 12.
101	233.	1.2		0 32.
1020	3862.	(DIRECT FLOW)		1 16.
321	237.	(DIRECT FLOW)		0 58.
220	94.	1.6		0 32.
219	1320.	4.6		1 16.
102	435.	3.2		0 34.
1021	3720.	5.9		1 20.
237	301.	2.8		1 4.
313	1338.	(DIRECT FLOW)		1 16.
1030	155.	.0	12.1	1 10.
322	3967.	(DIRECT FLOW)		1 20.
314	1335.	3.9		1 18.
222	186.	2.4		0 38.
221	172.	2.6		1 8.
1032	3967.	(DIRECT FLOW)		1 20.
315	1567.	(DIRECT FLOW)		1 16.
325	2967.	(DIRECT FLOW)		1 20.
1031	1567.	(DIRECT FLOW)		1 16.
238	2910.	6.9		1 26.
316	1016.	3.7		1 24.
323	2910.	(DIRECT FLOW)		1 26.
104	1000.	4.2		1 44.
103	500.	3.6		1 42.
317	3922.	(DIRECT FLOW)		1 26.
241	278.	3.1		0 36.
240	74.	2.0		0 52.
324	1000.	(DIRECT FLOW)		1 44.
318	4527.	(DIRECT FLOW)		1 26.
601	1035.	3.2		1 14.
242	4495.	7.8		1 30.
700	1035.	(DIRECT FLOW)		1 14.
319	4495.	(DIRECT FLOW)		1 30.
602	1062.	5.1		1 26.
243	4261.	8.8		1 40.
951	1062.	(DIRECT FLOW)		1 26.
940	4261.	(DIRECT FLOW)		1 40.
1500	5315.	(DIRECT FLOW)		1 40.

Table A12. Boulder Creek Tributaries

0.4-inch event

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
613	15.	.4		0 40.
705	15.	(DIRECT FLOW)		0 40.
617	23.	.4		0 40.
616	26.	.4		0 42.
1060	0.	(DIRECT FLOW)		0 0.
706	49.	(DIRECT FLOW)		0 40.
628	0.	.0		1 2.
750	0.	(DIRECT FLOW)		0 0.
1070	28.	.0	.9	1 4.
711	0.	.0		2 8.
627	1.	.1		1 0.
619	30.	.5		1 4.
618	7.	.3		0 40.
615	18.	.4		0 40.
614	16.	.7		0 44.
712	1.	(DIRECT FLOW)		1 0.
708	34.	(DIRECT FLOW)		1 2.
707	34.	(DIRECT FLOW)		0 40.
638	10.	.3		0 38.
631	0.	.1		1 2.
630	0.	.1		1 4.
629	2.	.1		0 42.
621	27.	.7		1 24.
620	3.	.4		1 2.
1071	23.	.0	.6	1 2.
607	0.	.1		0 40.
715	10.	(DIRECT FLOW)		0 38.
713	3.	(DIRECT FLOW)		1 0.
709	29.	(DIRECT FLOW)		1 20.
150	24.	.6		1 10.
702	0.	(DIRECT FLOW)		0 40.
650	1.	.1		1 0.
645	5.	.4		0 40.
639	21.	.5		0 44.
633	6.	.3		0 52.
622	28.	1.0		1 36.
611	5.	.3		0 40.
151	20.	1.1		1 30.
608	2.	.2		1 2.
604	0.	.0		0 36.
720	1.	(DIRECT FLOW)		1 0.
718	5.	(DIRECT FLOW)		0 40.
716	21.	(DIRECT FLOW)		0 44.
714	6.	(DIRECT FLOW)		0 52.
710	28.	(DIRECT FLOW)		1 36.
704	5.	(DIRECT FLOW)		0 40.
703	21.	(DIRECT FLOW)		1 30.
701	0.	(DIRECT FLOW)		0 36.
659	0.	.0		1 2.
651	4.	.2		0 40.
646	5.	.4		0 50.
640	19.	.7		1 0.
634	5.	.3		1 14.
624	1.	.1		1 2.
623	27.	.9		1 42.
612	6.	.3		0 44.
610	4.	.3		0 42.
609	17.	1.2		1 52.
606	0.	.1		1 10.
605	2.	.2		0 44.
603	2.	.2		0 40.
600	1.	.0		0 40.
722	0.	(DIRECT FLOW)		1 2.
721	4.	(DIRECT FLOW)		0 40.
719	5.	(DIRECT FLOW)		0 50.
717	19.	(DIRECT FLOW)		1 0.
960	5.	(DIRECT FLOW)		1 14.
959	1.	(DIRECT FLOW)		1 2.
958	27.	(DIRECT FLOW)		1 42.
957	6.	(DIRECT FLOW)		0 44.
956	4.	(DIRECT FLOW)		0 42.
955	17.	(DIRECT FLOW)		1 52.
954	0.	(DIRECT FLOW)		1 10.
953	2.	(DIRECT FLOW)		0 44.
952	2.	(DIRECT FLOW)		0 40.
950	1.	(DIRECT FLOW)		0 40.
700	0.	(DIRECT FLOW)		0 0.
658	0.	.0		1 2.
661	0.	.0		1 10.
723	0.	.1		1 30.
660	0.	.1		1 10.
655	0.	.1		1 2.
652	2.	.3		1 16.
648	0.	.1		1 12.
647	4.	.3		1 16.

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
641	15.	.9		1 18.
1500	51.	(DIRECT FLOW)		1 40.
602	0.	(DIRECT FLOW)		0 0.
999	0.	(DIRECT FLOW)		1 2.
969	0.	(DIRECT FLOW)		1 10.
968	0.	(DIRECT FLOW)		1 26.
967	0.	(DIRECT FLOW)		0 30.
966	1.	(DIRECT FLOW)		0 30.
965	0.	(DIRECT FLOW)		1 2.
964	2.	(DIRECT FLOW)		1 16.
963	0.	(DIRECT FLOW)		1 12.
962	4.	(DIRECT FLOW)		1 16.
961	15.	(DIRECT FLOW)		1 18.

Table A12. Boulder Creek Tributaries

2-year event

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
613	46.	.7		0 32.
705	46.	(DIRECT FLOW)		0 32.
617	68.	.8		0 32.
616	81.	.7		0 32.
1060	13.	(DIRECT FLOW)		1 20.
706	149.	(DIRECT FLOW)		0 32.
628	0.	.1		1 4.
750	13.	(DIRECT FLOW)		1 20.
1070	66.	.0	3.1	0 58.
711	0.	.1		1 54.
627	12.	.6		1 30.
619	69.	.7		1 0.
618	24.	.6		0 30.
615	57.	.7		0 32.
614	61.	1.3		0 32.
712	13.	(DIRECT FLOW)		1 32.
708	82.	(DIRECT FLOW)		0 40.
707	117.	(DIRECT FLOW)		0 32.
638	35.	.6		0 28.
631	1.	.1		0 40.
630	2.	.3		1 16.
629	14.	.4		1 38.
621	72.	1.1		1 24.
620	9.	.7		0 36.
1071	60.	.0	2.0	0 50.
607	2.	.2		0 30.
715	35.	(DIRECT FLOW)		0 28.
713	16.	(DIRECT FLOW)		1 38.
709	76.	(DIRECT FLOW)		1 20.
150	62.	1.0		1 0.
702	2.	(DIRECT FLOW)		0 30.
650	3.	.3		0 50.
645	20.	.7		0 30.
639	66.	.9		0 34.
633	23.	.7		0 34.
622	77.	1.8		1 32.
611	19.	.7		0 30.
151	56.	1.8		1 18.
608	6.	.4		0 40.
604	1.	.1		0 26.
720	3.	(DIRECT FLOW)		0 50.
718	20.	(DIRECT FLOW)		0 30.
716	66.	(DIRECT FLOW)		0 34.
714	23.	(DIRECT FLOW)		0 34.
710	77.	(DIRECT FLOW)		1 32.
704	19.	(DIRECT FLOW)		0 30.
703	60.	(DIRECT FLOW)		1 16.
701	1.	(DIRECT FLOW)		0 26.
659	2.	.1		1 4.
651	15.	.5		0 30.
646	20.	.9		0 34.
640	62.	1.4		0 42.
634	20.	.7		1 54.
624	4.	.2		0 40.
623	77.	1.6		1 36.
612	22.	.8		0 32.
610	15.	.6		0 32.
609	55.	2.3		1 38.
606	1.	.2		1 50.
605	10.	.4		0 32.
603	8.	.4		0 32.
600	2.	.1		0 30.
722	2.	(DIRECT FLOW)		1 4.
721	15.	(DIRECT FLOW)		0 30.
719	20.	(DIRECT FLOW)		0 34.
717	62.	(DIRECT FLOW)		0 42.
960	20.	(DIRECT FLOW)		1 54.
959	4.	(DIRECT FLOW)		0 40.
958	77.	(DIRECT FLOW)		1 36.
957	22.	(DIRECT FLOW)		0 32.
956	15.	(DIRECT FLOW)		0 32.
955	55.	(DIRECT FLOW)		1 38.
954	1.	(DIRECT FLOW)		1 50.
953	10.	(DIRECT FLOW)		0 32.
952	8.	(DIRECT FLOW)		0 32.
950	2.	(DIRECT FLOW)		0 30.
700	0.	(DIRECT FLOW)		0 0.
658	1.	.1		1 4.
661	1.	.1		1 50.
723	2.	.2		1 20.
660	1.	.2		1 46.
655	2.	.3		1 4.
652	9.	.6		0 54.
648	1.	.2		1 50.
647	14.	.7		0 52.

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
641	49.	1.8		0 58.
1500	168.	(DIRECT FLOW)		1 38.
602	0.	(DIRECT FLOW)		0 0.
999	1.	(DIRECT FLOW)		1 4.
969	1.	(DIRECT FLOW)		1 50.
968	3.	(DIRECT FLOW)		1 22.
967	1.	(DIRECT FLOW)		0 24.
966	3.	(DIRECT FLOW)		0 24.
965	2.	(DIRECT FLOW)		1 4.
964	9.	(DIRECT FLOW)		0 54.
963	1.	(DIRECT FLOW)		1 50.
962	14.	(DIRECT FLOW)		0 52.
961	49.	(DIRECT FLOW)		0 58.

Table A12. Boulder Creek Tributaries

5-year event

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
613	66.	.8		0 32.
705	66.	(DIRECT FLOW)		0 32.
617	99.	.9		0 32.
616	119.	.9		0 32.
1060	318.	(DIRECT FLOW)		1 16.
706	218.	(DIRECT FLOW)		0 32.
628	4.	.2		1 4.
750	318.	(DIRECT FLOW)		1 16.
1070	81.	.0	5.8	1 18.
711	4.	.4		1 22.
627	301.	3.4		1 26.
619	87.	.8		1 14.
618	35.	.7		0 30.
615	83.	.8		0 30.
614	92.	1.6		0 30.
712	305.	(DIRECT FLOW)		1 26.
708	107.	(DIRECT FLOW)		0 34.
707	174.	(DIRECT FLOW)		0 30.
638	50.	.7		0 28.
631	5.	.5		1 10.
630	17.	.9		1 16.
629	311.	2.3		1 28.
621	103.	1.3		1 26.
620	16.	1.0		0 38.
1071	83.	.0	3.3	0 56.
607	4.	.3		0 38.
715	50.	(DIRECT FLOW)		0 28.
713	332.	(DIRECT FLOW)		1 28.
709	114.	(DIRECT FLOW)		1 22.
150	91.	1.1		1 8.
702	4.	(DIRECT FLOW)		0 38.
650	17.	.7		0 54.
645	36.	1.0		0 32.
639	97.	1.1		0 34.
633	337.	2.9		1 32.
622	121.	2.3		1 28.
611	33.	.9		0 32.
151	87.	2.3		1 24.
608	18.	.8		1 12.
604	3.	.1		0 40.
720	17.	(DIRECT FLOW)		0 54.
718	36.	(DIRECT FLOW)		0 32.
716	97.	(DIRECT FLOW)		0 34.
714	337.	(DIRECT FLOW)		1 32.
710	121.	(DIRECT FLOW)		1 28.
704	33.	(DIRECT FLOW)		0 32.
703	105.	(DIRECT FLOW)		1 22.
701	3.	(DIRECT FLOW)		0 40.
659	18.	.4		1 4.
651	31.	.8		0 56.
646	37.	1.3		0 38.
640	99.	1.7		0 42.
634	332.	3.2		1 42.
624	11.	.4		0 52.
623	125.	2.1		1 30.
612	39.	1.0		0 34.
610	28.	.9		0 36.
609	100.	3.1		1 42.
606	5.	.7		1 26.
605	19.	.6		0 42.
603	15.	.6		0 36.
600	9.	.2		0 46.
722	18.	(DIRECT FLOW)		1 4.
721	31.	(DIRECT FLOW)		0 56.
719	37.	(DIRECT FLOW)		0 38.
717	99.	(DIRECT FLOW)		0 42.
960	332.	(DIRECT FLOW)		1 42.
959	11.	(DIRECT FLOW)		0 52.
958	125.	(DIRECT FLOW)		1 30.
957	39.	(DIRECT FLOW)		0 34.
956	28.	(DIRECT FLOW)		0 36.
955	100.	(DIRECT FLOW)		1 42.
954	5.	(DIRECT FLOW)		1 26.
953	19.	(DIRECT FLOW)		0 42.
952	15.	(DIRECT FLOW)		0 36.
950	9.	(DIRECT FLOW)		0 46.
700	0.	(DIRECT FLOW)		0 0.
658	8.	.3		1 16.
661	6.	.3		1 20.
723	18.	.6		1 18.
660	6.	.7		1 20.
655	12.	.8		1 20.
652	35.	1.3		1 16.
648	5.	.7		1 50.
647	40.	1.2		0 58.

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
641	86.	2.4		0 56.
1500	622.	(DIRECT FLOW)		1 38.
602	0.	(DIRECT FLOW)		0 0.
999	8.	(DIRECT FLOW)		1 16.
969	6.	(DIRECT FLOW)		1 20.
968	24.	(DIRECT FLOW)		1 20.
967	1.	(DIRECT FLOW)		0 22.
966	5.	(DIRECT FLOW)		0 24.
965	12.	(DIRECT FLOW)		1 20.
964	35.	(DIRECT FLOW)		1 16.
963	5.	(DIRECT FLOW)		1 50.
962	40.	(DIRECT FLOW)		0 58.
961	86.	(DIRECT FLOW)		0 56.

Table A12. Boulder Creek Tributaries

10-year event

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
613	87.	.9		0 32.
705	87.	(DIRECT FLOW)		0 32.
617	132.	1.0		0 32.
616	157.	1.0		0 32.
1060	581.	(DIRECT FLOW)		1 16.
706	290.	(DIRECT FLOW)		0 32.
628	10.	.4		0 56.
750	581.	(DIRECT FLOW)		1 16.
1070	99.	.0	9.2	1 24.
711	9.	.6		1 12.
627	560.	4.2		1 24.
619	108.	.9		1 14.
618	45.	.7		0 30.
615	110.	1.0		0 32.
614	124.	1.9		0 32.
712	569.	(DIRECT FLOW)		1 24.
708	134.	(DIRECT FLOW)		0 32.
707	234.	(DIRECT FLOW)		0 32.
638	64.	.8		0 28.
631	14.	.8		1 6.
630	37.	1.3		1 14.
629	581.	3.1		1 26.
621	137.	1.5		1 22.
620	26.	1.2		0 46.
1071	98.	.0	5.3	1 8.
607	9.	.4		0 40.
715	64.	(DIRECT FLOW)		0 28.
713	629.	(DIRECT FLOW)		1 26.
709	159.	(DIRECT FLOW)		1 18.
150	114.	1.2		1 14.
702	9.	(DIRECT FLOW)		0 40.
650	36.	1.1		0 50.
645	59.	1.3		0 34.
639	128.	1.2		0 34.
633	630.	3.7		1 32.
622	175.	2.7		1 22.
611	52.	1.2		0 34.
151	110.	2.5		1 26.
608	39.	1.2		1 10.
604	7.	.2		0 38.
720	36.	(DIRECT FLOW)		0 50.
718	59.	(DIRECT FLOW)		0 34.
716	128.	(DIRECT FLOW)		0 34.
714	630.	(DIRECT FLOW)		1 32.
710	175.	(DIRECT FLOW)		1 22.
704	52.	(DIRECT FLOW)		0 34.
703	147.	(DIRECT FLOW)		1 20.
701	7.	(DIRECT FLOW)		0 38.
659	39.	.6		1 4.
651	65.	1.2		0 52.
646	64.	1.8		0 40.
640	142.	2.1		0 42.
634	622.	3.9		1 40.
624	21.	.6		0 56.
623	183.	2.5		1 24.
612	64.	1.4		0 36.
610	51.	1.2		0 38.
609	141.	3.5		1 44.
606	12.	1.0		1 18.
605	41.	.9		0 48.
603	31.	.9		0 46.
600	24.	.4		0 46.
722	39.	(DIRECT FLOW)		1 4.
721	65.	(DIRECT FLOW)		0 52.
719	64.	(DIRECT FLOW)		0 40.
717	142.	(DIRECT FLOW)		0 42.
960	622.	(DIRECT FLOW)		1 40.
959	21.	(DIRECT FLOW)		0 56.
958	183.	(DIRECT FLOW)		1 24.
957	64.	(DIRECT FLOW)		0 36.
956	51.	(DIRECT FLOW)		0 38.
955	141.	(DIRECT FLOW)		1 44.
954	12.	(DIRECT FLOW)		1 18.
953	41.	(DIRECT FLOW)		0 48.
952	31.	(DIRECT FLOW)		0 46.
950	24.	(DIRECT FLOW)		0 46.
700	0.	(DIRECT FLOW)		0 0.
658	18.	.5		1 16.
661	13.	.5		1 14.
723	38.	.8		1 18.
660	13.	1.0		1 16.
655	27.	1.2		1 16.
652	73.	2.0		1 10.
648	11.	1.1		1 36.
647	79.	1.7		0 58.

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
641	130.	2.9		0 56.
1500	1069.	(DIRECT FLOW)		1 36.
602	0.	(DIRECT FLOW)		0 0.
999	18.	(DIRECT FLOW)		1 16.
969	13.	(DIRECT FLOW)		1 14.
968	51.	(DIRECT FLOW)		1 18.
967	2.	(DIRECT FLOW)		1 14.
966	7.	(DIRECT FLOW)		0 24.
965	27.	(DIRECT FLOW)		1 16.
964	73.	(DIRECT FLOW)		1 10.
963	11.	(DIRECT FLOW)		1 36.
962	79.	(DIRECT FLOW)		0 58.
961	130.	(DIRECT FLOW)		0 56.

Table A12. Boulder Creek Tributaries

50-year event

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
613	165.	1.3		0 36.
705	165.	(DIRECT FLOW)		0 36.
617	256.	1.4		0 36.
616	302.	1.3		0 38.
1060	1178.	(DIRECT FLOW)		1 16.
706	558.	(DIRECT FLOW)		0 38.
628	32.	.7		0 56.
750	1178.	(DIRECT FLOW)		1 16.
1070	146.	.0	21.2	1 28.
711	30.	1.1		1 6.
627	1170.	5.3		1 22.
619	161.	1.1		1 4.
618	87.	1.0		0 36.
615	214.	1.3		0 36.
614	248.	2.6		0 36.
712	1196.	(DIRECT FLOW)		1 22.
708	236.	(DIRECT FLOW)		0 42.
707	462.	(DIRECT FLOW)		0 36.
638	120.	1.0		0 34.
631	56.	1.6		0 56.
630	124.	2.3		0 58.
629	1231.	4.1		1 24.
621	252.	1.9		1 10.
620	80.	2.2		0 52.
1071	153.	.0	13.8	1 16.
607	35.	.9		0 42.
715	120.	(DIRECT FLOW)		0 34.
713	1364.	(DIRECT FLOW)		1 22.
709	325.	(DIRECT FLOW)		1 4.
150	185.	1.5		1 6.
702	35.	(DIRECT FLOW)		0 42.
650	116.	2.0		0 48.
645	167.	2.1		0 42.
639	248.	1.6		0 40.
633	1375.	4.8		1 28.
622	365.	3.6		1 14.
611	133.	1.9		0 40.
151	176.	3.1		1 26.
608	134.	2.3		0 58.
604	29.	.5		0 42.
720	116.	(DIRECT FLOW)		0 48.
718	167.	(DIRECT FLOW)		0 42.
716	248.	(DIRECT FLOW)		0 40.
714	1375.	(DIRECT FLOW)		1 28.
710	365.	(DIRECT FLOW)		1 14.
704	133.	(DIRECT FLOW)		0 40.
703	295.	(DIRECT FLOW)		1 6.
701	29.	(DIRECT FLOW)		0 42.
659	124.	1.0		0 58.
651	212.	2.2		0 50.
646	188.	3.0		0 44.
640	313.	3.1		0 48.
634	1364.	5.1		1 34.
624	57.	.9		0 56.
623	388.	3.5		1 16.
612	171.	2.2		0 42.
610	156.	2.1		0 42.
609	282.	4.4		1 32.
606	39.	1.8		1 6.
605	151.	1.9		0 50.
603	104.	1.7		0 50.
600	88.	.8		0 52.
722	124.	(DIRECT FLOW)		0 58.
721	212.	(DIRECT FLOW)		0 50.
719	188.	(DIRECT FLOW)		0 44.
717	313.	(DIRECT FLOW)		0 48.
960	1364.	(DIRECT FLOW)		1 34.
959	57.	(DIRECT FLOW)		0 56.
958	388.	(DIRECT FLOW)		1 16.
957	171.	(DIRECT FLOW)		0 42.
956	156.	(DIRECT FLOW)		0 42.
955	282.	(DIRECT FLOW)		1 32.
954	39.	(DIRECT FLOW)		1 6.
953	151.	(DIRECT FLOW)		0 50.
952	104.	(DIRECT FLOW)		0 50.
950	88.	(DIRECT FLOW)		0 52.
658	54.	.9		1 6.
661	35.	.8		1 6.
723	117.	1.3		1 10.
660	43.	1.8		1 2.
655	93.	2.2		1 4.
652	222.	3.3		1 2.
648	39.	2.0		1 20.
647	246.	3.1		0 56.
641	295.	3.9		1 2.

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
1500	2338.	(DIRECT FLOW)		1 28.
999	54.	(DIRECT FLOW)		1 6.
969	35.	(DIRECT FLOW)		1 6.
968	159.	(DIRECT FLOW)		1 8.
967	7.	(DIRECT FLOW)		1 4.
966	14.	(DIRECT FLOW)		1 4.
965	93.	(DIRECT FLOW)		1 4.
964	222.	(DIRECT FLOW)		1 2.
963	39.	(DIRECT FLOW)		1 20.
962	246.	(DIRECT FLOW)		0 56.
961	295.	(DIRECT FLOW)		1 2.

Table A12. Boulder Creek Tributaries

100-year event

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
613	203.	1.4		0 36.
705	203.	(DIRECT FLOW)		0 36.
617	318.	1.5		0 38.
616	373.	1.5		0 38.
1060	1455.	(DIRECT FLOW)		1 16.
706	691.	(DIRECT FLOW)		0 38.
628	44.	.8		0 56.
750	1455.	(DIRECT FLOW)		1 16.
1070	165.	.0	27.3	1 26.
711	42.	1.3		1 4.
627	1458.	5.7		1 22.
619	187.	1.1		1 4.
618	109.	1.1		0 38.
615	265.	1.4		0 36.
614	310.	2.9		0 36.
712	1494.	(DIRECT FLOW)		1 20.
708	285.	(DIRECT FLOW)		0 42.
707	574.	(DIRECT FLOW)		0 36.
638	147.	1.1		0 34.
631	79.	1.8		0 54.
630	173.	2.7		0 58.
629	1540.	4.4		1 24.
621	315.	2.1		1 8.
620	110.	2.5		0 54.
1071	174.	.0	18.3	1 18.
607	48.	1.1		0 42.
715	147.	(DIRECT FLOW)		0 34.
713	1717.	(DIRECT FLOW)		1 20.
709	417.	(DIRECT FLOW)		1 4.
150	220.	1.7		1 4.
702	48.	(DIRECT FLOW)		0 42.
650	157.	2.3		0 46.
645	222.	2.5		0 42.
639	307.	1.8		0 40.
633	1736.	5.2		1 26.
622	473.	4.0		1 12.
611	172.	2.2		0 38.
151	204.	3.3		1 22.
608	189.	2.7		0 58.
604	40.	.6		0 44.
720	157.	(DIRECT FLOW)		0 46.
718	222.	(DIRECT FLOW)		0 42.
716	307.	(DIRECT FLOW)		0 40.
714	1736.	(DIRECT FLOW)		1 26.
710	473.	(DIRECT FLOW)		1 12.
704	172.	(DIRECT FLOW)		0 38.
703	374.	(DIRECT FLOW)		1 6.
701	40.	(DIRECT FLOW)		0 44.
659	171.	1.2		1 0.
651	289.	2.6		0 48.
646	250.	3.3		0 46.
640	394.	3.4		0 50.
634	1726.	5.5		1 32.
624	76.	1.0		0 56.
623	505.	3.8		1 14.
612	224.	2.6		0 40.
610	208.	2.4		0 42.
609	355.	4.7		1 28.
606	54.	2.1		1 4.
605	210.	2.2		0 50.
603	143.	2.0		0 50.
600	123.	.9		0 52.
722	171.	(DIRECT FLOW)		1 0.
721	289.	(DIRECT FLOW)		0 48.
719	250.	(DIRECT FLOW)		0 46.
717	394.	(DIRECT FLOW)		0 50.
960	1726.	(DIRECT FLOW)		1 32.
959	76.	(DIRECT FLOW)		0 56.
958	505.	(DIRECT FLOW)		1 14.
957	224.	(DIRECT FLOW)		0 40.
956	208.	(DIRECT FLOW)		0 42.
955	355.	(DIRECT FLOW)		1 28.
954	54.	(DIRECT FLOW)		1 4.
953	210.	(DIRECT FLOW)		0 50.
952	143.	(DIRECT FLOW)		0 50.
950	123.	(DIRECT FLOW)		0 52.
658	77.	1.0		1 6.
661	48.	.9		1 6.
723	162.	1.5		1 10.
660	60.	2.1		1 2.
655	133.	2.6		1 4.
652	302.	3.7		1 4.
648	56.	2.4		1 16.
647	327.	3.4		0 58.
641	379.	4.3		1 4.

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
1500	2991.	(DIRECT FLOW)		1 22.
999	77.	(DIRECT FLOW)		1 6.
969	48.	(DIRECT FLOW)		1 6.
968	220.	(DIRECT FLOW)		1 8.
967	11.	(DIRECT FLOW)		1 4.
966	21.	(DIRECT FLOW)		1 4.
965	133.	(DIRECT FLOW)		1 4.
964	302.	(DIRECT FLOW)		1 4.
963	56.	(DIRECT FLOW)		1 16.
962	327.	(DIRECT FLOW)		0 58.
961	379.	(DIRECT FLOW)		1 4.

APPENDIX B

CORRESPONDENCE

Union Pacific Railroad Company

Susan K. Grabler
Manager Industry & Public Projects

1400 West 52nd Avenue • Denver, Colorado 80221

Bus (303) 964-4099
Fax (303) 964-4097

December 13, 1999

Mr. Roger Peterson
Love & Associates, Inc.
541 Front Street
Louisville, CO 80027-1849

Dear Mr. Peterson:

Reference your correspondence dated December 9, 1999 wherein you requested Union Pacific Railroad's (UPRR) response on the potential storm water control alternatives for the Erie Outfall Master Plan study area by December 15, 1999.

I will pass this information onto our Bridge Department for further review and it is highly unlikely that you will have a response before your next scheduled meeting in January. I have made a quick review of the information you submitted and would say that Section III., 2. is totally unacceptable to UPRR. As soon as I have final review information from Omaha I will forward it to yourself and Wendo Palmer of the Town of Erie.

Sincerely,

Susan K. Grabler
Manager Industry & Public Projects

cc: Wendi Palmer - Town of Erie
David Hoden - Omaha
David E. Peterson - Omaha
Ed Smedley - Cheyenne
Jack Nelson - Omaha

Union Pacific Railroad Company

Susan K. Grabler
Manager Industry & Public Projects

1400 West 52nd Avenue • Denver, Colorado 80221

Bus (303) 964-4099
Fax (303) 964-4097

January 14, 2000

Ms. Wendi Palmer
Civil Engineer II
Town of Erie
P.O. Box 750
Erie, CO 80516-0100

SUBJECT: P99-102, UNION PACIFIC RAILROAD DRAINAGE PROJECT

Dear Wendi:

Union Pacific Railroad Company (UPRR) has reviewed your drainage plans proposed to be constructed on railroad property. The location of the proposed drainage project on existing UPRR property is unacceptable. All new drainage ditches should be constructed off of UPRR right of way.

On proposed culverts or existing bridges, UPRR requires a 50 year water surface elevation to be below the top of culvert or low chord of a railroad structure. And a 100 year surface elevation to be 2 feet below the base of rail. UPRR prefers that the 100 year velocity be less than 10 feet per second. If you have any questions, please give me a call.

Sincerely,

Susan K. Grabler
Manager Industry & Public Projects

cc: Roger Peterson - Love & Associates
Dave Hoden - Omaha
David E. Peterson - Omaha
Ed Smedley - Cheyenne

JAN 1

March 7, 2000

David J. Love, P.E.
Love & Associates, Inc.
841 Front Street
Louisville, Co. 80027-1849

Re.: 9922A – Erie Drainage Outfall Systems Master Plan

Dear Mr. Love:

I forwarded your correspondence to the Board of Directors of the Boulder and Weld County Ditch Company for their review and comment.

Please note that the mailing address for the Ditch Company is changed as indicated below.

Sincerely,

Dan Grant
Secretary/Treasurer
Boulder and Weld County Ditch Co.
(303) 678-4179
P.O. Box 1826
Longmont, Co. 80502-1826

MAR 08 2000

this copy.

Love & Associates, Inc.
water resource consultants
841 Front Street
Louisville, Colorado 80027-1849
Phone (303) 673-9795 FAX (303) 673-9796
E mail: loveassociates@tesser.com

February 21, 2000

Leyner Cottonwood Ditch Company
c/o Ms. Sara Wise
11497 Jasper Road
Lafayette, CO 80026

REF: 9922A – Erie Drainage Outfall Systems Master Plan

Dear Ms. Wise:

Love & Associates, Inc, in cooperation with the Town of Erie and the Urban Drainage and Flood Control District (UD&FCD) is in the process of preparing a drainage outfall system master plan for a significant portion of the Town of Erie. Our study limits are Highway 52 on the north, Baseline Road on the south, Highway 287 on the west and Coal Creek on the east.

We are currently in the Phase A – "Evaluation of Alternatives" phase of the drainage outfall system study. A draft report on Phase A is expected to be ready for review and comment in the next month or two.

We are currently proposing, as our recommendation for this study, to separate storm drainage outfall system flows from irrigation flows. Lands that currently sheet flow directly into irrigation ditches would continue to do so. Only major drainageways would be separated from irrigation ditch flows. Based upon our proposed recommendation, we would like to ask you to provide us feedback and/or information on the following questions. **PLEASE RETURN ONE COPY OF THIS LETTER (AND MARKED UP MAP, IF APPROPRIATE) TO LOVE & ASSOCIATES, INC. BY MARCH 13, 2000.**

From - Superintendent, Rod Dexter

1. As an irrigation ditch representative located within the drainage master plan study boundaries, does your irrigation ditch company support the current proposal to separate storm drainage outfall system flows from irrigation flows?

   RESPONSE: Yes X No_____

   Comments:_____

2. There are irrigation companies who currently intercept storm drainage outfall systems flows and who wish to have their ditches continue to intercept these flows. Is this your ditch company's desire?

   RESPONSE: Yes_____ No X

   Comments: We are currently getting outflow from Melody Homes on Hwy 119 and it is presenting problems for the ditch.

3. We received the attached irrigation ditch map from Boulder County and superimposed their map onto the recently generated topographic map prepared for this study in 1999. It appears that some irrigation ditches are incomplete and some irrigation laterals are shown. Could you please review the location and flow path of your ditch as shown on the attached map for accuracy. We want to be able to pin point all locations where outfall system storm drainage flows need to be separated from irrigation ditch flows.

   RESPONSE: X Location of our ditch is accurately shown.

   _____ Location of our ditch is inaccurately shown and we have marked its correct location on the attached map. (If you made corrections to the attached map, please return to us with your corrections.)

   Comments: The waste ditch of the upper Leyner-Cotton goes thru Brownsville with some shareholders using this ditch for irrigation. This waste ditch thru Brownsville is grossly overgrown and not capable of carrying anymore storm waste (waste ditch marked on map in yellow)

Your prompt attention to this request would be greatly appreciated. Please feel free to give us any other comments you might have that would affect the conclusions and recommendations of this Master Plan.

Sincerely,

LOVE & ASSOCIATES, INC.

By David J. Love
David J. Love, P.E.

RECEIVED
FEB 28 2000

Love & Associates, Inc.
water resource consultants
841 Front Street
Louisville, Colorado 80027-1849
Phone (303) 673-9795 FAX (303) 673-9796
E mail: loveassociates@tesser.com

February 21, 2000

Lower Boulder Ditch
c/o Northern Colorado Water Conservancy District (NCWCD)
Attn: Mr. Jerry Westbrook
P.O. Box 679
Loveland, CO 80539

REF: 9922A – Erie Drainage Outfall Systems Master Plan

Dear Mr. Westbrook:

Love & Associates, Inc, in cooperation with the Town of Erie and the Urban Drainage and Flood Control District (UD&FCD) is in the process of preparing a drainage outfall system master plan for a significant portion of the Town of Erie. Our study limits are Highway 52 on the north, Baseline Road on the south, Highway 287 on the west and Coal Creek on the east.

We are currently in the Phase A – "Evaluation of Alternatives" phase of the drainage outfall system study. A draft report on Phase A is expected to be ready for review and comment in the next month or two.

We are currently proposing, as our recommendation for this study, to separate storm drainage outfall system flows from irrigation flows. Lands that currently sheet flow directly into irrigation ditches would continue to do so. Only major drainageways would be separated from irrigation ditch flows. Based upon our proposed recommendation, we would like to ask you to provide us feedback and/or information on the following questions. **PLEASE RETURN ONE COPY OF THIS LETTER (AND MARKED UP MAP, IF APPROPRIATE) TO LOVE & ASSOCIATES, INC. BY MARCH 13, 2000.**

1. As an irrigation ditch representative located within the drainage master plan study boundaries, does your irrigation ditch company support the current proposal to separate storm drainage outfall system flows from irrigation flows?

   RESPONSE: Yes X No_____

   Comments: No foreign water, surface or subsurface, will be discharged into the South Platte Supply Canal (Lower Boulder Ditch). All foreign drainage must be bypassed either under or over the canal through a properly designed conveyance conduit or via the natural drainage course.

2. There are irrigation companies who currently intercept storm drainage outfall systems flows and who wish to have their ditches continue to intercept these flows. Is this your ditch company's desire?

   RESPONSE: Yes_____ No X

   Comments:_____

3. We received the attached irrigation ditch map from Boulder County and superimposed their map onto the recently generated topographic map prepared for this study in 1999. It appears that some irrigation ditches are incomplete and some irrigation laterals are shown. Could you please review the location and flow path of your ditch as shown on the attached map for accuracy. We want to be able to pin point all locations where outfall system storm drainage flows need to be separated from irrigation ditch flows.

   RESPONSE: X Location of our ditch is accurately shown.

   _____ Location of our ditch is inaccurately shown and we have marked its correct location on the attached map. (If you made corrections to the attached map, please return to us with your corrections.)

   Comments: The South Platte Supply Canal (Lower Boulder Ditch), a feature of the Colorado-Big Thompson Project, conveys irrigation water from the Boulder Creek Diversion Dam located in Section 16, T-1-N, R-69-W to a point on the South Platte River located in Section 19, T-2-N, R-66-W for a distande of approximately 32 miles.

Your prompt attention to this request would be greatly appreciated. Please feel free to give us any other comments you might have that would affect the conclusions and recommendations of this Master Plan.

Sincerely,

LOVE & ASSOCIATES, INC.

By David J. Love
David J. Love, P.E.

this copy

Love & Associates, Inc.
water resource consultants
841 Front Street
Louisville, Colorado 80027-1849
Phone (303) 673-9795 FAX (303) 673-9796
E mail: loveassociates@tesser.com

February 21, 2000

Goodhue Ditch Company
C/o Mr. Rich Koopman
Parks and Open Space Department
Boulder County
P.O. Box 491
Boulder, CO 80306

REF: 9922A – Erie Drainage Outfall Systems Master Plan

Dear Rich:

Love & Associates, Inc, in cooperation with the Town of Erie and the Urban Drainage and Flood Control District (UD&FCD) is in the process of preparing a drainage outfall system master plan for a significant portion of the Town of Erie. Our study limits are Highway 52 on the north, Baseline Road on the south, Highway 287 on the west and Coal Creek on the east.

We are currently in the Phase A – "Evaluation of Alternatives" phase of the drainage outfall system study. A draft report on Phase A is expected to be ready for review and comment in the next month or two.

We are currently proposing, as our recommendation for this study, to separate storm drainage outfall system flows from irrigation flows. Lands that currently sheet flow directly into irrigation ditches would continue to do so. Only major drainageways would be separated from irrigation ditch flows. Based upon our proposed recommendation, we would like to ask you to provide us feedback and/or information on the following questions. **PLEASE RETURN ONE COPY OF THIS LETTER (AND MARKED UP MAP, IF APPROPRIATE) TO LOVE & ASSOCIATES, INC. BY MARCH 13, 2000.**

1. As an irrigation ditch representative located within the drainage master plan study boundaries, does your irrigation ditch company support the current proposal to separate storm drainage outfall system flows from irrigation flows?

   RESPONSE: Yes ✓ No_____

   Comments:_____

FEB 29 2000

2. There are irrigation companies who currently intercept storm drainage outfall systems flows and who wish to have their ditches continue to intercept these flows. Is this your ditch company's desire?

   RESPONSE: Yes_____ No ✓

   Comments: We have had too many capacity problems where storm flows tend to show up at the same time we are running our direct flow decrees. The current policy of the ditch company is to accept NO new stormwater into the ditch.

3. We received the attached irrigation ditch map from Boulder County and superimposed their map onto the recently generated topographic map prepared for this study in 1999. It appears that some irrigation ditches are incomplete and some irrigation laterals are shown. Could you please review the location and flow path of your ditch as shown on the attached map for accuracy. We want to be able to pin point all locations where outfall system storm drainage flows need to be separated from irrigation ditch flows.

   RESPONSE: _____ Location of our ditch is accurately shown.

   ✓ Location of our ditch is inaccurately shown and we have marked its correct location on the attached map. (If you made corrections to the attached map, please return to us with your corrections.)

   Comments: The Goodhue Ditch showed reach Coal Creek in the NW 1/4 of S. 31, T1N, R68W. Additional section of ditch shown on the attached map.

Your prompt attention to this request would be greatly appreciated. Please feel free to give us any other comments you might have that would affect the conclusions and recommendations of this Master Plan.

Sincerely,

LOVE & ASSOCIATES, INC.

By David B. Love for
David J. Love, P.E.

Thank you
Rich Koopman

FEB 29 2000

APPENDIX C

MEETING MINUTES

MEETING MINUTES

PROGRESS MEETING NO. 1
TOWN OF ERIE
OUTFALL SYSTEMS PLANNING

Held on Monday, August 16, 1999 @ 1:00 PM
At the Town of Erie Offices

The following persons were in attendance at this meeting:

Dave Stahl	Town of Erie	303-926-2700
Wendi Palmer	Town of Erie	303-926-2875
Dennis Drumm	Town of Erie	303-926-2771
Ben Urbonas	Urban Drainage and Flood Control District	303-455-6277
David Love	Love & Associates, Inc.	303-673-9795
Roger Peterson	Love & Associates, Inc.	303-673-9795

These Minutes generally summarize the issues, decisions, and information generated during this meeting. Please advise Love & Associates, Inc. (303-673-9795, fax 303-673-9796) with any additions or corrections to these minutes prior to August 31, 1999.

1. Key Agencies/Individuals (names of contacts to be determined)
   - Town of Erie (administrators, planning, public works, water, sanitary)
   - UDFCD
   - Boulder County (invite)
   - State Engineer (invite)
   - Water Quality Control Division (send copy of report at end of study)
   - US West (phone, fiber) (Love coordinates)
   - Natural Gas Companies (Love coordinates)
   - Electric Companies (Love coordinates)
   - CDOT (invite, Greeley)
   - UPRR (invite)

   - Water/Sewer Districts (Brownsville WS, Left Hand Water – coordinate)
   - Irrigation Companies (invite after alternatives)
   - Brownsville Representative

2. Town will own and maintain detention facilities, channels, etc.

3. Irrigation ditches are not intended to transport stormwater. Only agreement is Meadow Sweet Farms.

4. Town to provide: updated FIS (dike about town) and study, RMC Master Plan (Bill Schuller or Mark in RMC Denver office) possible sewer in drainageway easement in Brownsville), existing and proposed subdivisions on CAD (note: section lines do not match on mapping).

5. Town provided Love with an updated land use map.

6. Love to contact Boulder County and Lafayette and obtain copies of their land use maps.

7. Love to pick up FHAD and outfall plan for Bullhead Gulch and Tributaries at UDFCD.

8. Brownsville has shallow groundwater problems, probably from irrigation ditches.

9. Use Project Reuse names and numbering system for catchments.

10. Erie has contacts in UPRR – planning <100-year channel south of tracks (need to check on legal with Ed Krisor).

11. Elmwood Reservoir to become another filing of Meadow Sweet Farms.

12. Bullhead Gulch/Prince Tributary – studied by Taggart for FEMA.

13. Highway 287 (too small culvert by CDOT) and nearby water supply reservoir for Lafayette causes flooding over 287 on Bullhead Gulch.

14. Isabelle Road has been renamed Leon Wurl Parkway

15. Town to provide information on drainage in old town.

16. As-builts were not received for detention ponds – use drainage reports for study hydrology.

17. Possible detention above RR tracks in Elmwood Basin, Prince Trib. U/S of Brownsville.

18. Use "catchment" not "basin" when describing tributary areas.

19. Town to evaluate multifunctions in pond: Ben suggested active recreation should be located above 2-year storm levels. Low flow channel needed in BMP basin bottoms.

20. Nancy to obtain Assessors data and property lines from Boulder Co. (FIS).

21. Northern pipeline through new filing of Meadow Sweet Farms.

22. Ben described what various municipalities use as detention criteria. City will need to select its own criteria. He suggested three level detention: WQ, 5- or 10-year and 10-year. Erie needs mechanism to reserve land for regional detention basins.

23. Benchmark doing topo – need to check on status.

24. Nancy to prepare schedule for project.

25. Meetings – Planning Commission (1st and 3rd Thurs.) and Town Board (2nd and 4th Thurs). Ten (10) days will be required for Town for Commission Reviews, draft on alternates, then do final alternates.

26. Town has worked with State Engineer on Prince 1 & 2.

27. Brownsville channel – wetlands issues may dictate what and how enhancements can be made.

Next meeting: **September 8, 1999 @ 9:00 AM** Product: Hydrology;
September 29, 1999 Product: Present initial alternates.

MEETING MINUTES

PROGRESS MEETING NO. 2
TOWN OF ERIE
OUTFALL SYSTEMS PLANNING

Held on Wednesday, September 8, 1999 @ 9:00 AM
At the Town of Erie Offices

The following persons were in attendance at this meeting:

Wendi Palmer	Town of Erie	303-926-2875
Ben Urbonas	Urban Drainage and Flood Control District	303-455-6277
David Love	Love & Associates, Inc.	303-673-9795
Roger Peterson	Love & Associates, Inc.	303-673-9795

These Minutes generally summarize the issues, decisions, and information generated during this meeting. Please advise Love & Associates, Inc. (Love) fax 303-673-9796) with any additions or corrections to these minutes prior to September 21, 1999.

1. The Minutes from the previous meeting were reviewed.

2. Love reviewed information requested, received, and not yet received from the Town and UDFCD required to complete the hydrologic model.

3. Wendi indicated she had been working with Paul Tesser at the County for GIS information.

4. Love discussed the information on existing reservoirs obtained from the State Engineer and the potential impact of the reservoirs on stormwater flows. Spillway elevations of the three spillways of Panama Reservoir indicate the reservoir will spill to the northeast, not into the study area. None of the reservoirs will be incorporated into the model. The Town noted RMC is working on enlarging Prince Reservoir and will provide Love the name of the contact individual at RMC.

5. The Town noted Prince No. 1 and 2 and Erie Lake (water supply) are isolated from stormwater runoff. The Town noted Thomas Reservoir may eventually be made into a recreation and/or water supply facility.

6. Love discussed the field review of existing detention facilities and provided the Town with photos of the facilities taken during the field review. Love discussed the modeling method used for the facilities and provided storage/discharge relationships

incorporated in UDSWMM, based on information provided in the drainage reports by the Town, for review.

7. Love noted the model will be UDSWMM calibrated to CUHP. Love produced and discussed the base map on USGS topography showing subbasin delineation's and flow paths, and discussed point precipitation in the study area and the conceptual hydrologic model output for Boulder Creek Tributaries, Coal Creek Tributaries, and Bullhead Gulch/Prince Tributary containing dummy variables.

8. Ben indicated the abandoned BNRR spur along the southeast and eastern part of the study area is to be modeled assuming it is breached for existing conditions. Detention upgradient of the spur should be reviewed in the alternative analysis.

9. The Town indicated there is a possibility there will be a recreational area south of Old Town.

10. The Town met with UPRR who indicated the construction of a parallel open channel located along the south side of the UPRR tracks near the school and Old Town is possible.

11. The Town indicated Old Town drainage storm sewers were sized for 2-year event using Haestad's Storm CADD.

12. Ben indicated stormwater flows upgradient of Old Town could be routed around the Town either along the UPRR or along the basin divide to the north.

13. The old water treatment plant is being updated; backwash operations currently supplying water to downstream basins will largely be eliminated.

14. Arapahoe Filing 2 detention facility holds water and may be subject to action by the State Engineer if it does not have an adjudicated water right to hold the water.

15. Limited mapping along Coal Creek was supplied to Love on CD. The remainder of the mapping is not expected for 2 to 3 more weeks.

16. Love to call CDOT to obtain as-built along Highway 287 at the Bullhead spill area and check the datum used for the plans.

17. Love to call Dena at UDFCD to check on the status of copying the Bullhead Gulch Outfall Study.

18. Ben will research aerial photos and bring to next meeting.

19. The next meeting will be held when there is enough information to discuss possible design alternatives. This discussion requires a working hydrologic model. The model cannot be completed until the information previously requested by Love is incorporated into the model. The next meeting is tentatively scheduled for September 29th at Erie Town Offices. Love will confirm or re-schedule meeting next week.

Next meeting: **September 29, 1999 @ 9:00 AM** (tentative)
October 21, 1999 (tentative).

MEETING MINUTES

PROGRESS MEETING NO. 3
TOWN OF ERIE
OUTFALL SYSTEMS PLANNING

Held on Tuesday, October 19, 1999 @ 1:30 PM
At the Town of Erie Offices

The following persons were in attendance at this meeting:

Judy Ding	Town of Erie Public Works	303-926-2871
Wendi Palmer	Town of Erie Public Works	303-926-2875
Deborah Bachelder	Town of Erie Community Development	303-926-2775
Ben Urbonas	Urban Drainage and Flood Control District	303-455-6277
Dave Moores	CDOT Region 4 Hydraulics	970-350-2280
Dave Webster	Boulder County	303-441-3900
David Love	Love & Associates, Inc.	303-673-9795
Roger Peterson	Love & Associates, Inc.	303-673-9795

These Minutes generally summarize the issues, decisions, and information generated during this meeting. Please advise Love & Associates, Inc. (Love) (fax 303-673-9796) with any additions or corrections to these minutes prior to November 1, 1999.

1. Love reviewed information provided to date with the committee.

2. Love provided the Town and UDFCD a new handout package which included: (1) land use % impervious, offsite and onsite, existing and future, (2) CUHPF calibration model, existing conditions, (3) Bullhead Gulch offsite UDSWM, existing and proposed land use, (4) onsite UDSWM, preliminary models, existing and proposed land use, (6) UDSWM summary tables, existing and proposed onsite, and (7) basin, land use, and soils maps.

3. Ben gave the Town and Love additional topographic information from two additional flight lines on compact disc. One flight line is required to complete the topographic mapping of the study area. We understand this last flight line should be ready in approximately one week.

4. Information still required for the project include (1) the remaining flight line, (2) TEA text for the Bullhead Gulch FIRM update, (3) information requested from the Town of Erie on 9/21/99, and (4) CDOT as-builts for US Highway 287 near Goosehaven Reservoir.

5. Love discussed UDSWM calibration to CUHP using basin width. Love indicated preliminary estimates of channel depth will be revised in UDSWM and CUHP calibration basins will be revised from those shown in the handout.

6. Ben indicated all catchment areas should be less than 130 acres.

7. Offsite area modeling was discussed. Two basins were modeled with CUHPF and hydrographs input into the onsite models. Bullhead Gulch upgradient of the study area was modeled using the model developed for the Outfall study by Advanced Sciences, Inc. The Bullhead Gulch CUHP and UDSWM model was updated in the offsite areas by; (1) land use (percent impervious) was modified to reflect existing and future land use conditions, and, (2) the regional detention facility for Indian Peaks subdivision, which was included in the TEA update of the Bullhead Gulch FIRM was included in UDSWM as node 400 (volume discharge relationship for this pond was obtained from a model provided to David Love by Hurst and Associates, Inc.).

8. Flows into the study area from Bullhead Gulch was discussed. TEA developed a rating curve for the spill assuming inflow into Goosehaven Reservoir and ignored US Highway 287 improvements. Ben indicated the rating curve should be revised using US Highway 287 improvements and stormwater discharges into Goosehaven Reservoir are unlikely because it is a water supply reservoir. Love will check on the status of Reservoir improvements with Lafayette.

9. UDSWM hydrograph input problems were discussed. Ben indicated hydrograph input should be limited to about 20 coordinate pairs.

10. The preliminary onsite hydrologic analysis indicates some of the existing detention facilities will overtop and could fail during a 100-year flood event or greater. Onsite flood peaks for existing and future conditions were discussed. Catchment areas and flood peaks are subject to change once all topographic data is obtained.

11. Wendi indicated proposed land use in the Erie influence area may be changed and will forward Love the changes.

12. Town will forward wetland location areas to Love, and Dave Webster will aid Love in locating wetland maps.

13. Ben suggested including spillway-driven storage and off channel linear detention facilities as part of the alternative evaluation.

14. Wendi indicated a regional pond is planned near Thomas Reservoir, Catchment 481, at Leon Wurl Parkway and 119th Street.

15. Ben suggested the Town examine Arapahoe County criteria addressing certification of detention facilities.

16. Wendi will provide Love with property ownership maps for the study area.

17. Wendi will provide Love with typical lot layouts for various subdivisions. Love will report percent impervious parameters to UDFCD.

18. Love will contact CTL Thompson, who is conducting a study of a mine shaft in the study area, to identify the advantages and disadvantages of retention storage in the vicinity of mine shafts.

19. Ben indicated Love should submit an updated project schedule at the next meeting.

20. Wendi will mark on a map critical catchment areas and possible detention areas, right of way acquisitions, and other drainage related items now being planned by the Town and developers.

21. The Town will provide Love guidance on drainage facility design criteria, such as allowable road drainage capacities and road overtopping, in the study area. Ben suggested the Town look at adopting UDFCD criteria.

22. CDOT indicated US Highway 287 should be designed to pass the 100-year event. Love will provide Dave Moores a copy of the models used for flood peak predication at US Highway 287. Dave Moores suggested two-stage detention be used to reduce flood peaks at the Highway for more frequent flood events.

Next meeting: **November 9, 1999, at 9 AM** (tentative).

MEETING MINUTES

PROGRESS MEETING NO. 4
TOWN OF ERIE
OUTFALL SYSTEMS PLANNING

Held on Monday, November 23, 1999 @ 2:00 PM
At the Town of Erie Offices

The following persons were in attendance at this meeting:

Wendi Palmer	Town of Erie Public Works	303-926-2875
Deborah Bachelder	Town of Erie Community Development	303-926-2775
Ben Urbonas	Urban Drainage and Flood Control District	303-455-6277
Sue Grabler	UPRR	303-964-4099
Brent Moore	UPRR	307-778-3350
Dave Webster	Boulder County	303-441-3900
David Love	Love & Associates, Inc.	303-673-9795
Roger Peterson	Love & Associates, Inc.	303-673-9795

These Minutes generally summarize the issues, decisions, and information generated during this meeting. Please advise Love & Associates, Inc. (Love) (fax 303-673-9796) with any additions or corrections to these minutes prior to December 15, 1999.

1. Love provided the committee an updated hydrologic analysis for final review for the 100-year event within the study area. This analysis uses the newly generated topographic information obtained from recent aerial photography of the study area. Love distributed maps, including Soils, Catchment Areas, Offsite Catchments, Existing Land Use, Proposed Land Use, Calibration Catchment Areas; and handouts, including calibration results (CUHPF, UDSWM, summary table, hydrograph comparison), % impervious table based on site plans, soils and land use summaries, UDSWM existing and future and summary tables, detention and storm sewer summary table, and schedule.

2. Wendi was given a preliminary sanitary sewer location map for review.

3. Discussion concerning the UPRR line through the study area:
   a. Love identified the preliminary magnitude of 100-year flood peaks at various points along the UPRR tracks for existing and future land use.
   b. Photos of some washout areas and flooding along the UPRR tracks were presented.
   c. The width of the railroad right-of-way is 100-feet.
   d. Wendi and Sue discussed a proposed channel adjacent to the UPRR designed for frequent events meant to prevent frequent flooding of school facilities. Wendi had discussed the channel with Rod Troager from the UPRR Omaha office. Wendi is to provide copies of the plans for the channel to Sue (to be sent directly to her), Brent (to be sent to Ed Smiln, bridge manager in Cheyenne), and Love.
   e. Wendi indicated the Town is trying to buy the south 50-feet of the 100-feet UPRR right-of-way east of County Line Road.
   f. Sue noted detention facilities located adjacent to the tracks are not acceptable to UPRR because ponded water deteriorates track subgrade. UPRR is also concerned with

discharge from and washouts of detention facilities located immediately upgradient of the tracks.

g. Existing bridges may need to be extended and/or new crossings may be required to accommodate flood flows. UPRR needs to review hydrology before commenting on these possible improvements.
h. Sue requested Love forward basin maps, hydrologic calculations for the 100-year event, and supporting information to her for review by UPRR. The committee agreed the preliminary hydrologic analysis could be released to Sue for review by UPRR.
i. Open cuts are allowed on the track while it is out of service.
j. Brent provided the committee information on existing crossings of the UPRR in the study area. He indicated the crossings are identified on the bridge and by mile markers. 23.66 is the Coal Creek bridge, 25.72 is a 24- x 12-inch timber culvert, 26.58 is a 15-ft 3-span wooden bridge, 28.18 is a 2 span bridge.

4. Love indicated Lafayette may wish to close the historic stormwater flow path of Bullhead Gulch through Goosehaven Reservoir to prevent stormwater from entering the reservoir. Ben indicated this modification may adversely impact others in the County. Dave Webster indicated he would discuss this change with Lafayette. Love assumes all offsite flows from Bullhead Gulch will enter the study area at this time.
5. Love indicated Lafayette stated there were no plans for regional detention in the affected area at this time. This means, other than existing regional detention, future land use hydrologic predictions for lands within Lafayette should assume there will be no additional detention facilities in these areas.
6. Love will forward a review package to the County and UDSWM flow charts to Erie and UDFCD.
7. Love reported the urban land use (high) density percent impervious was approximately 46% for single family residential areas from the information provided Love by Erie. Love indicated a 50% impervious was used in the hydrologic model for this land use condition to reflect 70% residential, 20% multi-unit detached, and 10% multi-unit attached. The committee agreed with these assumptions.
8. Love reviewed the calibration methods used for UDSWM and presented the results.
9. Love reviewed status of existing detention ponds and conceptual level pipe capacity for the 54-inch RCP installed in Leon Wurl Parkway.
10. Love requested Erie perform a thorough review of the proposed land use map, including floodplain locations, to determine if the percent imperviousness assumed in the model is accurate.
11. Love left a marked copy of a map identifying known developments with the Town for review and acknowledgement.
12. Wendi indicated RMC is examining an expansion of Prince Lake from 80- to 200 ac-ft, and needs a place to spoil excess dirt. She asked if the Arapahoe Ridge Filing 2 detention facility may be partially filled. Love indicated they would review the hydrologic analysis in this area, and Ben indicated it was premature to fill the pond at this time. Wendi indicated she will provide Love as-builts of this detention facility.
13. Love indicated the alternative analysis would not address open space areas not affected or only slightly impacted by development. Ben indicated channel stabilization recommendations for areas slightly impacted by development may be needed. Love indicated these areas would be identified.
14. Love indicated alternative analysis will focus on regional detention, culverts at existing road crossings possibly coupled with detention to reduce culvert sizes and costs, and increasing

conveyance. Existing flow paths will be maintained when possible. Recommendations will be made to prevent stormwater flows from entering irrigation structures.

15. Dave Webster will assist Love in obtaining wetland maps for the study area.
16. Love will contact the county for property ownership information in the study area.
17. Wendi will provide Love information on wetland areas and property ownership in the study area, and a copy of the TEA Leyner/Cottonwood Ditch report.
18. Ben indicated he would like Love to aim for a draft report by the end of February and completing the job in 12 months.
19. Basic alternates with viability and costs will be provided for the next meeting. Public participation for the study will also be discussed.

Next meeting: **January 4, 2000, at 1:30 PM.**

MEETING MINUTES

PROGRESS MEETING NO. 5
TOWN OF ERIE
OUTFALL SYSTEMS PLANNING

Held on Monday, January 4, 2000 @ 1:30 PM
At the Town of Erie Offices

The following persons were in attendance at this meeting:

Judy Ding	Town of Erie Public Works	303-926-2871
Wendi Palmer	Town of Erie Public Works	303-926-2875
Deborah Bachelder	Town of Erie Community Development	303-926-2775
John Doerfer	Urban Drainage and Flood Control District	303-455-6277
Dave Webster	Boulder County	303-441-3900
David Love	Love & Associates, Inc.	303-673-9795
Roger Peterson	Love & Associates, Inc.	303-673-9795

These Minutes generally summarize the issues, decisions, and information generated during this meeting. Please advise Love & Associates, Inc. (Love) (fax 303-673-9796) with any additions or corrections to these minutes prior to January 15, 2000.

1. Love provided the committee copies of a preliminary hydrologic analysis report of the study area. This study and UDSWM files were sent to Sue Grabler at UPRR for review by UPRR. Love distributed maps showing locations of irrigation ditches and reservoirs and property blocks, and documents outlining possible stormwater control alternatives and alternative recommendations. Love also provided the Town with stormwater control work maps for Catchments discharging into the schools located near Old Town Erie.

2. The Town provided Love a copy of the revised work maps and hard copy of HEC-2 model for Bullhead Gulch by Taggart Engineering Associates, Inc. and Concept 5 for Wise Homestead (dated 9/24/99).

3. The Town indicated there will be no change in the proposed land use map due to the recent vote in the Town on the proposed Northfield annexation.

4. The Town will review the preliminary sanitary sewer location map given to the Town at the last meeting. The Town will also provide Love the elevation adjustment required between the current study and the FIS caused by datum discrepancies between the two studies.

5. Boulder County agreed to discuss stormwater flows near Goose Haven Reservoir with the City of Lafayette.

6. The wetlands map electronic file received by Love from the County cannot be opened. Wendi will E-mail Love their copy of these maps.

7. The irrigation facilities map will be sent to Jeff Kahn of District 6 to determine which ditches will require stormwater separation structures. In addition, the map will be edited to show the appropriate level of detail (i.e. laterals) useful for this study.

8. Love reviewed the stormwater control alternatives handout and asked for review and comment on the handout.

9. Love reviewed stormwater control alternatives in the Catchment upstream of the schools near County Line Road near Old Town Erie which the Town has indicated is an area of major concern. Constraints on the analysis included: the presence of two on-line detention facilities in Orchard Glen and Canyon Creek subdivisions (Canyon Creek detention is severely undersized for existing land use and both are undersized for proposed land use), existing development (limits detention to undeveloped areas only), detention facility location limited to property blocks and to locations effective in reducing 100-year flood peaks downstream, and the need to reduce 100-year flows to manageable rates at the UPRR. The analysis indicated 100-year flood peaks could be reduced if the Orchard Glen detention facility was doubled in volume, the Canyon Creek detention facility quadrupled in volume, and an off-line pond with a storage volume of approximately 16 ac-ft was installed near the UPRR to effectively reduce 100-year flood peaks upstream of the schools. Problems in existing developed areas were identified. The Town indicated a commercial site was planned near the Orchard Glen detention facility and residential development was planned near the Canyon Creek detention facility. The Town will provide possible alternative detention locations to Love for discussion by the next meeting, and Love will examine the effectiveness of these locations and relative costs.

10. John Doerfer indicated water quality capture volume can be used to detain frequent storms. He suggested using headwater ponds on-line and off-line downstream ponds. He suggested we consider using the Brighton Master Plan recommendations, which included release rates of 0.1 cfs/ac for Catchments without significant increases in capacity of existing undersized outfalls, 0.5 cfs/ac for Catchments with appropriately sized new outfalls, and 5-year storm event detention with 48-hour release rates.

11. Love will present an analysis of stormwater control in the Prince Tributary catchment within the study area for the next meeting.

Next meeting: **February 3, 2000, at 1:30 PM at Erie Town Hall**

MEETING MINUTES

PROGRESS MEETING NO. 6
TOWN OF ERIE
OUTFALL SYSTEMS PLANNING

Held on Thursday, February 3, 2000 @ 1:30 PM
At the Town of Erie Offices

The following persons were in attendance at this meeting:

Judy Ding	Town of Erie Public Works	303-926-2871
Wendi Palmer	Town of Erie Public Works	303-926-2875
Deborah Bachelder	Town of Erie Community Development	303-926-2775
Ben Urbonas	Urban Drainage and Flood Control District	303-455-6277
Dave Webster	Boulder County	303-441-3900
David Love	Love & Associates, Inc.	303-673-9795
Roger Peterson	Love & Associates, Inc.	303-673-9795

These Minutes generally summarize the issues, decisions, and information generated during this meeting. Please advise Love & Associates, Inc. (Love) (fax 303-673-9796) with any additions or corrections to these minutes prior to February 15, 2000.

1. Love provided the committee copies of wetlands/open space maps obtained from Boulder County.
2. The Town indicated the water storage reservoir south of Arapahoe Road is being expanded from 80 ac-ft to 200 ac-ft.
3. In review of the preliminary hydrology report, Ben indicated the basin maps for report should show only the 10-foot contour lines for clarity. Ben has provided Love with other review comments on the report which will be incorporated into the final draft document.
4. Love indicated the updated topographic mapping resulted in different Catchment area boundaries and a change in the percent impervious parameters of the Catchments, compared to earlier hydrology reports within the study area.
5. The Town asked how stormwater conveyance should be addressed for developers who wish to develop prior to completion of the Stormwater Master Plan. Ben suggested the Town

could use future land use condition flood peak predictions for stormwater conveyance system design in these developments. He indicated many factors could change the recommendations in the Master Plan before the community adopts it.

6. Conflicts between the Boulder County open space areas, existing developments, and the Lafayette 1997 land use planning maps were discussed. Ben indicated worst case percent impervious should be used in the hydrologic models.
7. The Town will verify the sanitary sewer location map provided by Love. Utilities in East County Line Road are not known at this time. The location of sanitary lines, fiber optic cable, natural gas lines, and oil pumps are of particular concern.
8. Wendi asked Love to verify impact of any trans-basin diversion on Coal Creek 100-year flood peaks to ensure they did not impact Old Town area. Ben indicated this was beyond the scope of work, but, because of the relatively small size of the basins in the study area compared to Coal Creek basin, diversions should not impact flood peaks along the Creek.
9. Ben indicated trans-basin diversions are effective only for the design storm. Events larger than the design storm will inundate the historic flow path. This flooding can be addressed by floodproofing or elevating homes. Trans-basin diversions are not UDFCD first choice.
10. Wendi indicated Erie may purchase more right-of-way along the UPRR.
11. Love summarized the alternates used for control of the 100-year flood within Coal Creek Tributaries and Bullhead Gulch/Prince Tributary. For the no action alternate, flood peaks will be increased significantly by development. The remaining alternates presented by Love use regional detention for flood peak control. One maintains existing flow paths. One modifies existing flow paths. Love distributed flood peak summary sheets and detention pond information for existing conditions and the three alternates.
12. Flooding occurs in the Catchment discharging through the pre-school, and the Catchment has undersized detention facilities, existing storm sewers, and undersized culverts coupled with grading problems which must be considered in the design. One alternate suggests modifying the outlet of two existing ponds, adding an off-channel pond (1) by UPRR, adding a pond (2) by East County Line Road, and constructing a channel to divert flows south of UPRR. Another alternate suggests adding a trans-basin diversion near 119th Street, modifying the outlet of two existing ponds, adding an on-channel pond (8) by Leon Wurl Parkway, adding an on-channel pond (21) by UPRR, diverting Catchments 479 & 480 (and adding a pond (2)) east below East County Line Road, constructing a channel for Catchments 479 & 480 in community center area, and constructing a channel to divert flows south of UPRR. The second alternate will require more land, ponds, and culverts, and will likely be more costly, than the first. Ben suggested adding a second flow path extending from UPRR northward to the alternate evaluation.
13. Bullhead Gulch/Prince Tributary could currently experience flooding from offsite un-detained flows. The onsite area includes poorly defined flow paths and undersized detention facilities. One alternate suggests expanding existing Arapahoe Ridge Filing 2 detention facility 1025, channelizing flows to the pond, maintaining (with improvements) pond 1026, adding an off-channel pond 100. This alternate will maintain existing 100 year flood-peaks from Prince Tributary through Brownsville. Another alternate suggests maintaining flow paths to and slightly enlarging pond 1025, maintaining (with improvements) pond 1026, capturing residential flows from Lafayette in pond 105, adding off-channel ponds 100, 106, and 107. This alternate will reduce existing 100-year peaks from Prince Tributary through

Brownsville by 350 cfs. The greatest impact on Brownsville comes from development within Bullhead Gulch Catchment west of the study area.

14. To achieve required volumes, ponds upstream of roads could have depths as much as 7 feet and include berms adjacent to the roads.
15. Attenuation of frequent flood events and water quality will be addressed primarily using neighborhood detention facilities.
16. Passing 10-year flood peaks and overtopping 100-year flood peaks at East County Line Road was discussed. Since the road may become a six-lane road and a major arterial, this approach will not be pursued.
17. Dave Webster will determine whether a detention facility could be constructed on County Open Space area, in the southeast corner of Arapahoe Road and 111th Street. If the land is used as a detention pond, the open space area will need to be replaced.
18. Ben indicated Boulder County and Brownsville may have legal recourse if Lafayette prevents stormwater inflow into Goosehaven Reservoir shown in the FIS prepared by Taggart.
19. Ben indicated alternates could be fine-tuned, to add the northern flow path from UPRR to the analysis, and to continue with the analysis.
20. The next meeting will be scheduled after the Draft Alternative report is delivered.

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

L. Scott Tucker, Executive Director

Board of Directors

Executive Committee:

Cathy Reynolds, Chairman, City/County of Denver
Debra Vickrey, Chairman Pro-Tem, Arapahoe County
Paul Danish, Secretary, Boulder County
Gretchen Cerveny, Treasurer, City of Wheat Ridge
Elaine Valente, Member at Large, Adams County

Members:

Bill Berens, City of Broomfield
Steve Burkholder, City of Lakewood
Ken Fellman, City of Arvada
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Nancy Heil, City of Westminster
B. H. Hoffmaster, Engineer
Michelle Lawrence, Jefferson County
Bob LeGare, City of Aurora
Kathleen MacKenzie, City/County of Denver
W. Mike Maxwell, Douglas County
Jim McShane, Town of Columbine Valley
Deborah Ortega, City/County of Denver
Art Patton, Engineer

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TELEPHONE 303-455-6277 • FAX 303-455-7880 • www.udfcd@udfcd.org

October 11, 2000

Nancy Love
Love & Associates
841 Front Street
Louisville, CO 80027-1849

Subject: Town of Erie and Adjacent Areas Outfall Systems Planning Study
Selected Plan and Notice to Proceed with Phase 2

Dear Nancy:

The Urban Drainage and Flood Control District and the Town of Erie have evaluated the recommendations contained in the Alternatives Development and Evaluation Report for the Town of Erie and Adjacent Boulder and Weld County Areas. The project sponsors have selected an alternative for each drainageway reach to be developed further and to be shown in the final preliminary design report. The selected plan is described in the accompanying document titled *Selected Plan for Town of Erie and Adjacent Areas Outfall Systems Planning Study – Preliminary Design Report* dated October 10, 2000.

This letter will constitute your notice to proceed, effective October 23, 2000, with the preliminary design portion of this outfall systems planning study. In accordance with Paragraph 6, Time of Performance, of our agreement, your firm has thirty (30) calendar days from that date to deliver to the District four (4) copies of the draft outfall planning and preliminary design report.

Please schedule the first progress meeting at the District offices some time within the next two weeks to give us a chance to discuss the selected plan and how you propose to finalize this project within the above-stated time of performance. Should you have any questions, please call me.

Sincerely,

Ben Urbonas, P.E.
Chief, Master Planning and
South Platte River Programs

BRU/gb
Enclosure
cc: Wendi Palmer, Town of Erie (w/encl.)

Selected Plan for
Town of Erie and Adjacent Areas
Outfall Systems Planning Study - Preliminary Design Report

October 10, 2000

The plan selected by the Town of Erie and the Urban Drainage and Flood Control District (hereinafter called "District")to be shown in the final Outfall Systems Planning Report (hereinafter called "Final Plan") is described in two parts that follow. The first part discusses the selected plan and the direction for the remainder of this project. The second part provides additional issues and topics that need to be addressed in the Final Plan by Love & Associates, Inc. (hereinafter referred to as "Engineer") in order to complete the Final Plan and the conceptual preliminary design that it will contain.

Selected Plan and Directly Related Issues

The Selected Plan, for the most part and unless directed otherwise by specific instruction contained herein or by the District at a later time, is the plan recommended by Engineer in the *Outfall System Planning Study - Alternatives Development and Evaluation Report, Erie and Adjacent Boulder and Weld County Areas*, dated May, 2000 (hereinafter called "Report"), namely, Alternate 2 which recommends a 100-year conveyance system for all major drainageways, along with regional and on-site detention facilities.

On-Site Detention Requirements When Regional Basins Are Not Constructed

- Implementation of regional detention basins can be problematic in that sufficient fiscal resources often are not available for them to be constructed ahead of development in a give sub-catchment tributary to the detention basin. The Final Plan should clearly state in the report text and on every drawing of the preliminary design that, if development occurs in any sub-catchment served by any of the regional detention basins before the regional detention basin is in existence on the ground, that development shall provide On-Site water quality and 10- and 100-year detention.
- Provide in the report, and refer by note on each drawing, that the storage volume and the allowable release rates for all On-Site detention basins shall be based on the equations (charts) for water quality capture volume contained in District's *Urban Storm Drainage Criteria Manual - Volume 3* (hereinafter referred to as "Volume 3") and for 10- and 100-year peak flow controls the equations developed by Engineer for this Final Plan. Provide a set of detention sizing and release rate equations (separate set for each major catchment, if need) for use by Erie and Boulder County in the implementation of the Final Plan.
- Provide a note stating on every drawing of the final plan the following: "All drainage facilities shall be sized to handle flows that are not reduced by upstream detention unless the detention facilities are physically in place at the time of design. Assuming detention will be built in the future is not valid and will not be accepted."

All Coal Creek Tributaries Except the U.P.R.R. Tributary

- Maintain all existing detention facilities built in the past.
- Provide new regional detention basins along the NE County Line Road and detention basins #1049 shown on Figure 11b to control the water quality and the 10- and 100-year peak runoff rates to predevelopment rates.
- For all areas east of NE County Line Road, provide On-Site detention basins in accordance with sizing requirements described above.
- Provide the recommended 100-year conveyance system to Coal Creek

U.P.R.R. Tributary to Coal Creek

- Maintain all existing detention facilities built in the past.
- Provide new regional detention basins shown on Figure 11b to control the water quality and the 10- and 100-year peak runoff rates to predevelopment rates. Note that regional detention facilities for water quality cannot be built in series. Thus, each regional facility downstream of #1044 will need to be located off-line and will have to intercept local-area drainage before it is released to the major drainageway. As an alternate, each land development parcel can provide its own on-site water quality facilities.
- Provide diversion of 100-year flows to Coal Creek along the U.P.R.R. The diversion channel should provide at least 1.5 feet of freeboard at the 100-year flood flow rates, which freeboard should extend through all culverts along the diversion channel. This more conservative freeboard is needed to avoid flooding of properties along the channel by flows that are diverted, should unforeseen loss in channel or culvert capacity occur.
- Provide for a zone along the approximate alignment of the channel that would have been installed for Alternative 2A that will permit floods exceeding the diversion channel system and overtop the U.P.R.R. during malfunction of system or during extreme events to flow to Coal Creek without flooding new structures. A flood-proofing approach, similar to one used by FEMA in shallow flood zones, such as elevating the first floor and window-well elevations a minimum of one-foot above adjacent street crowns should provide for such eventualities.

Bullhead Gulch – Prince Tributary to Boulder Creek

- Maintain all existing detention facilities built in the past.
- Provide new regional detention basins shown on Figure 11b to control the water quality and the 10- and 100-year peak runoff rates to predevelopment rates. Note that regional detention facilities for water quality cannot be built in series. Thus, each regional facility downstream of #1027 will need to be located off-line and will have

to intercept local-area drainage before it is released to the major drainageway. As an alternate, each land development parcel can provide its own on-site water quality facilities.

- For all areas north of the regional detention basins shown in Figure 11b, provide On-Site detention basins in accordance with sizing requirements described above.
- Provide the recommended 100-year and other conveyance systems to Boulder Creek

Boulder Creek Tributaries

- Maintain all existing detention facilities built in the past, if any.
- Provide new regional detention basins shown on Figure 11b to control the water quality and the 10- and 100-year peak runoff rates to predevelopment rates. Provide for On-Site detention basins in accordance with sizing requirements described above when regional facilities are not in place at time of development.
- Provide for On-Site detention basins for areas downstream of regional detention facilities shown in Figure 11bin accordance with sizing requirements described above.
- Provide the recommended 100-year and other conveyance systems to Boulder Creek

Executive Summary for Final Plan

Provide an Executive Summary in the Final Plan. Direct this summary at the general public and elected officials. This executive summary should, at the minimum, contain:

a. A summary of the planning process including the numbers of progress and public meetings.
b. Description of the decisions made by project sponsors during the development of this plan.
c. Summary of all design criteria specifically developed for this plan.
d. Summary of the following sections of the final report: Purpose, Study Area, Alternatives Analysis, and Preliminary Design.
e. A map showing the area and all major recommended improvements.
f. Tabulation of hydrology in sufficient detail to compare results of this plan to existing and historic conditions.
g. A tabular and verbal summary of costs showing costs for capital improvements, engineering/administrative/contingencies, land values, all sorted by drainageway reach, tributary, or specific outfall system. The reach length (miles), tributary catchment area (square miles), and their totals should also be included in the table.

Incorporate the following note on each drawing:

"This drawing is for master planning purposes and represents preliminary and conceptual engineering. Alternatives to this outfall system will be considered by local reviewing agencies and the Urban Drainage and Flood Control District provided the alternative offers equal hydrologic response,

hydraulic capacity and stream stability. The alternative must comply with all requirements of the local jurisdiction and the Urban Drainage and Flood Control District. This drawing shall not be used for construction purposes."

Other Items

1. Unit costs should be updated to reflect latest costs know and available.
2. Report costs for maintenance of detention basins, channels, and storm sewer systems.
3. Work with Town of Erie staff to develop suggested phasing of publicly funded improvements that minimize the potential for flooding and other flow-related damages to downstream and upstream parties when the recommended improvements are implemented in phases.
4. Insure that all figures contained in the alternatives evaluation report that are reproduced in the Final Plan report are clear and legible.
5. Show a note on each sheet making the following recommendation:

   "The Town of Erie and Boulder County manage and regulate all land development and redevelopment within the 100-year floodplains so as to prevent future flood damages by following the recommendations of this plan."

FILE COPY

TOWN OF ERIE
BOARD OF TRUSTEE AGENDA ITEM

MEETING DATE: October 10, 2000
Agenda Item Preparation Date: October 4, 2000

AGENDA TITLE: Outfall Systems Planning-Alternate Evaluation Report

REQUESTING DEPARTMENT: Public Works Department
Presenter: Wendi Palmer, PE

FISCAL INFORMATION
Cost as recommended: N/A
Budget Line Item: N/A — Balance Available: $0.00
New Appropriation Required: Yes ×No

PURPOSE/ANALYSIS:

The presentation of this agenda item is to provide information regarding the Outfall Systems Planning Alternative Evaluation Report, prepared by Love and Associates, for the Town of Erie and Urban Drainage and Flood Control District.

BACKGROUND:

The Town of Erie entered into an agreement with Urban Drainage and Flood Control District (UDFCD) to develop a storm drainage outfall system master plan. The study area encompasses Erie's planning area from SH52 to SH7 and from SH287 to Coal Creek.

The first phase of this project developed conceptual alternatives for the outfall system as determined by routing the 100-year storm. Town staff, including both Public Works and Community Development, has worked closely with the consultant and UCFCD throughout phase one of this project and is recommending one of these alternatives.

The recommended alternative is a conveyance system for all major drainageways, along with regional and on-site detention facilities. The location of the drainageways and facilities are in concert with the 1999 Comprehensive Plan. UDFCD and Love and Associates will present the recommended alternative at the Board meeting.

With the alternative selected, the second phase may begin. During the second phase, the consultant will prepare a preliminary design, which will be included in the final master plan report. We anticipate the completion of the final master plan report by May 2001.

PUBLIC INFORMATION AND PROCESS:

N/A

Post-it® Fax Note 7671	Date	# of pages ▶
To Love + Assoc.	From Wendi Palmer	
Co./Dept.	Co.	
Phone #	Phone #	
Fax #	Fax #	

STAFF RECOMMENDATION:

Staff recommends the consideration of the information presented and requests Board of Trustee support of the recommended alternative and authorization to proceed with the second phase of the Outfall Systems Plan.

Approved By:

Dennis Drumm
Acting Town Administrator

KICKOFF MEETING

PRELIMINARY DESIGN
TOWN OF ERIE
OUTFALL SYSTEMS PLANNING

Held on October 27, 2000
UDFCD Offices

The following persons were in attendance at this meeting:

Judy Ding	Town of Erie Public Works	303-926-2871
Wendi Palmer	Town of Erie Public Works	303-926-2875
Deborah Bachelder	Town of Erie Community Development	303-926-2775
Ben Urbonas	Urban Drainage and Flood Control District	303-455-6277
David Love	Love & Associates, Inc.	303-673-9795
Roger Peterson	Love & Associates, Inc.	303-673-9795

Love provided draft preliminary design drawings for the selected plan for review at the kickoff meeting. Comments were received on the draft documents.

REVIEW MEETING

PRELIMINARY DESIGN
TOWN OF ERIE
OUTFALL SYSTEMS PLANNING

Held on December 4, 2000
UDFCD Offices

The following persons were in attendance at this meeting:

Judy Ding	Town of Erie Public Works	303-926-2871
Wendi Palmer	Town of Erie Public Works	303-926-2875
Deborah Bachelder	Town of Erie Community Development	303-926-2775
Ben Urbonas	Urban Drainage and Flood Control District	303-455-6277
David Love	Love & Associates, Inc.	303-673-9795
Roger Peterson	Love & Associates, Inc.	303-673-9795

Love provided a complete set of draft preliminary design drawings for the selected plan for review at the kickoff meeting. Comments were received on the draft documents.

Erie requested the design be revised to include recent revisions in the Pre-School basin. Ben agreed and asked Love to submit a proposal for the additional work.

APPENDIX D

LEGAL OPINION

Edward J. Krisor
Attorney At Law
1666 South University Boulevard, Suite B
Denver, Colorado 80210
303 777-5501 Fax: 303 698-0919
ekrisor@ix.netcom.com

January 19, 1998

Mr. Ben Urbonas, P.E.
Chief, Master Planning Program
Urban Drainage And Flood Control District
2480 West 26th Avenue, Suite 156 B
Denver, Colorado 80211

BY HAND DELIVERY

Re: Legal opinion in regard to alternative and planned drainage facilities in general as contained in alternatives development and evaluation reports

Dear Ben:

You have asked me to provide you with a legal opinion that you may use to initially evaluate in general all alternatives development and evaluation reports for compliance with the law of the State of Colorado applicable to drainage. What follows is such an opinion which will need to be supplemented by a short legal opinion in regard to each report to either indicate that no further comment is necessary or that certain other factors, other than those noted herein, will need to be considered before proceeding to the selection and construction of drainage improvements contained in that specific report.

In order to properly evaluate these reports you first must take note of the following comments in regard to the law of drainage in Colorado:

I. GENERAL LEGAL DRAINAGE PRINCIPLES

Natural drainage conditions may be altered by an upper (dominant) owner provided the water is not sent down in a manner or quantity to do more harm than formerly to the lower (servient) owner, Hankins v. Borland, 163 Colo. 575, 431 P.2d 1007 (1967). Colorado follows the "rule of reasonableness" as related to drainage matters and in each drainage situation, the court will look at the relationship of the parties and at who is doing what to whom in order to determine "what is reasonable under the circumstances". Prior to the Hankins case, the Colorado Supreme Court ruled in Ambrosio v. Perl-Mack, 143 Colo. 49, 317 P.2d 803 (1960), that downstream owners had to accept additional runoff from an upstream developer.

As the engineering technology has become more precise in drainage matters, it is possible to determine from the actual development and from land use decisions that will determine future development what the additional (more than natural) runoff will be because landowners make their land impermeable.

The Colorado Legislature in 1973 recognized this and adopted Sec. 30-28-113(4)(b) which requires developers in unincorporated areas to detain greater than historical flows. As a matter of drainage practice, cities as well as counties and the Urban Drainage District work to identify with precision "who is doing what" to whom so that the cost of drainage solutions to problems created by future development can be placed on those who would change the use of land from permeable to impermeable. Runoff from existing development is also computed and the need, if any, to solve existing drainage problems can be determined and costs of solutions estimated.

Drainage matters historically were resolved between or among property owners. However, as urbanization (multiple property owners) has taken place, governments have become involved for several reasons. In some cases, the government itself helped create additional runoff by making improvements. In other cases, government approved land use changes without regard to the problems of additional runoff. In still other situations, government got involved because constituents (owners) wanted government help in the difficult and expensive field of determining (identifying) where the additional runoff was coming from and the paying of costs of solutions. For whatever the reason, whenever government gets involved, it can be expected to be treated like a private party. 2 Farnham, Water and Water Rights, pp. 975 and 977, adopted by the Colorado Supreme Court in City of Boulder v. Boulder and White Rock Ditch Co., 73 Colo. 426, 216 P. 553 (1923). A municipality can be held to its negligence. It can also determine whether to become involved at all, if it did not create the problem.

An update of these legal principles has yielded the conclusion that the law of drainage as set forth above has not really changed to any substantially degree over the years. Both the Hankins and Ambrosio cases continue to be cited by the Colorado courts when dealing with the law of drainage. In the case of Metro Docheff v. City of Broomfield, 623 P. 2d 69 (Colo. App. 1980) the Colorado Court of Appeals held that: "Although we recognize the right of the owner of higher land to a drainage easement over the lower land of others, . . . the discharge of water will be enjoined as a continuing trespass if the drain sends the water down 'in a manner or quantity to do more harm than formerly.'" In the case of Hoff v. Ehrlich, 511 P. 2d 523 (Colo. App. 1973) the Colorado Court of Appeals was faced with the question of the propriety of a servient owner blocking drainage from a dominant estate in order to protect the servient owner's land. The Court held that: "The owner of the dominant estate has a legal and natural easement or servitude in the lower or servient estate for the drainage of surface water flowing in its natural course and manner . . . When an interruption in the natural flow or passage of surface waters is caused by the servient owner to the detriment or injury of the estate of the dominant owner, the court should issue a mandatory injunction for the opening of the easement which has been blocked . . . [the servient owner] may not act to the extent that damage is caused thereby to the dominant landowner . . . in order for the owner of the servient estate to be afforded a remedy, it must be evident that the water was sent down in a manner or quantity causing more harm than it formerly had done."

If a government permits the development which in turn causes "more harm than formerly", then the government, as well as the developers, may be held liable. (Cases consistently move toward governmental,

as well as developers' liability.) See Metro Docheff, *supra*, which held as follows: "The trial court found that the city had accepted the streets and storm drains for maintenance and control and, therefore, had exclusive control over the water collected in the subdivision. It determined that by approving the subdivision and drainage plan and accepting control, the city interfered with the natural conditions and thereby caused surface water to be collected and discharged upon plaintiff's land 'in a greater quantity or in different manner than had previously occurred under natural conditions."

Recently, governmental entities have raised in their defense of drainage cases the Governmental Immunity Act. In two recent cases, that defense has not been successful. In Burnworth v. Adams County, 826 P. 2d 368 (Colo. App. 1991) the Colorado Court of Appeals held that actions ". . . against public entities arising from the maintenance of a sewer, a storm sewer, or a storm drainage system." were not prohibited by the Governmental Immunity Act. In the case of Scott v. City of Greeley, 931 P. 2d 525 (Colo. App. 1996), the Colorado Court of Appeals again denied protection under the Governmental Immunity Act to a public entity when it argued that the damage complained of was the result of a design flaw rather than from the operation of a facility. The facts were that the City designed and constructed a new storm water line which was 42" and connected it to a line which was only 15". This caused the water to back up, or surcharge, through the storm drains and manhole covers, overtopping the curb and flooding adjacent property. In addition to the denial of protection to the entity under the Governmental Immunity Act, the Court also rejected the City's defense that the connection to the smaller pipe was only temporary.

Any improvements upstream must be made taking into consideration the outlet capability downstream. (Long line of case law.) See Hankins, *supra*, which states: "The trial court has found that the water which these defendants have sent into the Borland drain is in greater quantity and more rapid in time — a finding fully justified by the evidence. Under such circumstances it is the court's duty to determine what the dominant owners must do in order to prevent their increased waste water from damaging the servient owner."

Colorado generally imposes strict liability on owners of dams (regional detention ponds). (Long line of cases.)

Interfering with natural drainageways or channels is generally looked upon with disfavor by Colorado Courts. However, builders of irrigation canals, railroads, and highways in other times were not aware or were unconcerned with the problems they might be creating in the future by artificially blocking natural drainageways. Sometimes the very passage of time (at least eighteen years) provides an argument that the blockage should be allowed to be continued because parties have relied and should be able to continue to rely on this "protection". Generally, the laws of nature prevail in these situations and artificial structures such as canals, railroads and highways do not rise to the status of permanent dams which require spillways and other features under the jurisdiction in the State of Colorado of the State Engineer.

With the enactment of federal environmental (including water quality) provisions, the quality of the runoff may also have an effect, as well as on other ecological matters.

Natural waters are subject to the doctrine of prior appropriation in Colorado and what may have become a water right must also be considered with any plan for the "handling" of surface runoff in natural waterways.

Finally, any drainage, "facility" built by a government must be maintained. "If you're not going to maintain it, then don't build it!" is the theme of a long line of cases.

II. GENERAL COMMENTS ON COMMONLY PROPOSED FACILITIES AND CONSTRUCTION TECHNIQUES

1. It is my understanding that the purpose of all reports in regard to this subject is to examine alternatives which will, if implemented, improve upon and/or formalize the drainage that is within the study area.

2. In general, consideration must be given to any potential adverse effects of the selected alternative on properties within the study area and downstream of the study area.

3. If any selected facilities would increase or materially change the direction of the flows across downstream property in a study area, the downstream property has a right to claim damages and/or protection from such a material increase or change in flow. Thus, care should be taken to make sure that increased flows from upstream facilities are accommodated by sufficiently increasing the size of the downstream channels and conduits. If in final design, the selected alternative still has the effect of placing water on the residents and land owners in the area that they either never had or in a quantity larger than what they have had previously, the same must be revised to eliminate that result or the selected alternative must not be constructed.

4. If re-alignment of a channel is the selected alternative, careful consideration should be given to the channel's geometry, alignment and ability to carry flood flows so as not to create additional potential damages to surrounding landowners.

5. If the selected alternative is the collection of overland flows from a specific area and returning those flows to a drainage structure of some kind, care should be taken not to adversely impact landowners in the area.

6. If a selected alternative involves the redirection of flows from their historic path, prior to its finalization in the design process, caution should be taken that this redirection will not cause any increase in damage to those adjacent or downstream of the proposed redirection.

7. If any selected alternative, when it is finalized in the design process, is changed to include a plan for the diversion of runoff from one watershed to another; extreme caution should be used in implementing that portion of the selected alternative since the participants may be faced with the imposition of strict liability for any damage that occurs from any size storm event if it can be shown that the same would not have been suffered if the diversion had not occurred.

8. If the construction of crossing structures over irrigation canals are part of the selected alternative for the project, caution must be taken in regard to the capacity of those crossing structures. The structures, when designed for the design event, should not cause any more water than presently exists to flow into those canals.

9. The intentional routing, as opposed to inadvertent inflows, of flood flows into an irrigation ditch should be eliminated from any plan if at all possible unless a written agreement from the owner of the irrigation ditch is obtained permitting the use of the ditch to carry those flood flows. The participants have no control over the available capacity of the ditch at the time it would be necessary to carry flood flows so the ditch cannot realistically be used to control the flows downstream.

10. If an alternative is being selected that relies upon inadvertent detention and the participants do not intend to formalize such detention by written agreement, it is my opinion that the effect of that non-formalized inadvertent detention cannot be taken into consideration in the final design.

11. If a selected alternative includes the formalization of inadvertent detention it will be necessary for at least one of the participants to formalize that detention by entering into a written agreement with the owner of the facility causing the detention. The agreement must prohibit the owner from operating or modifying the facility in a way that would have the effect of lessening the inadvertent detention of the facility necessary to implement the selected alternative. Further, the owner must either agree to maintain the facility so that the same does not lose its current inadvertent detention or agree to permit at least one of the participants to maintain the facility.

12. If the owner of the facility will not agree to maintain the inadvertent detention facility, at least one of the participants should confirm in writing to all of the participants that the participant is committed to maintaining the inadvertent detention facility in a manner that assures the necessary inadvertent detention to implement the alternative. This should be done prior to the implementation of any of the alternatives involving inadvertent detention. The level of maintenance must at least permit the facility to function as relied upon in flooding events and not fail structurally during the design and larger events.

13. Any formalized detention facilities that are utilized in the final design of a project will need to be the subject of a written agreement between the owner and at least one participant that the facility will be maintained in a manner that assures the necessary flood storage to implement the design and that adequate maintenance will be performed by either the owner or the participant so that the facility will function as designed in flooding events and that it will not fail structurally during the design and larger events.

The participating entities must agree amongst themselves, in writing, that any one of the participants may enforce the terms of the agreement with the owner of the facility if the responsible participant does not. This agreement must include the maintenance of no more than a certain level of water in the facility at any one time and that any one of the participants may, at their sole cost and expense, maintain the facility so that its effectiveness in the selected alternative will be continued in perpetuity.

14. The embankments of all detention facilities should be designed so that they will not fail during a design event.

15. If a potential wetland is involved in a design alternative, it will be necessary that a Section 404 Permit from the United States Army Corps of Engineers be applied for and obtained, if necessary. Such a Permit should be obtained before any construction is done on the recommended alternative.

16. During construction of the selected facilities, care should be taken in constructing those facilities so that downstream property is not adversely affected temporarily by such construction. Usually, with the exception of the construction of detention facilities, the best method to avoid that problem is construction from the downstream limit of the project in an upstream direction which would then have the effect of having the downstream facilities ready to accept any increased flows as a result of the project.

If you have any questions in regard to my comments and opinions contained in this letter, please feel free to telephone me to discuss the same.

Very truly yours,

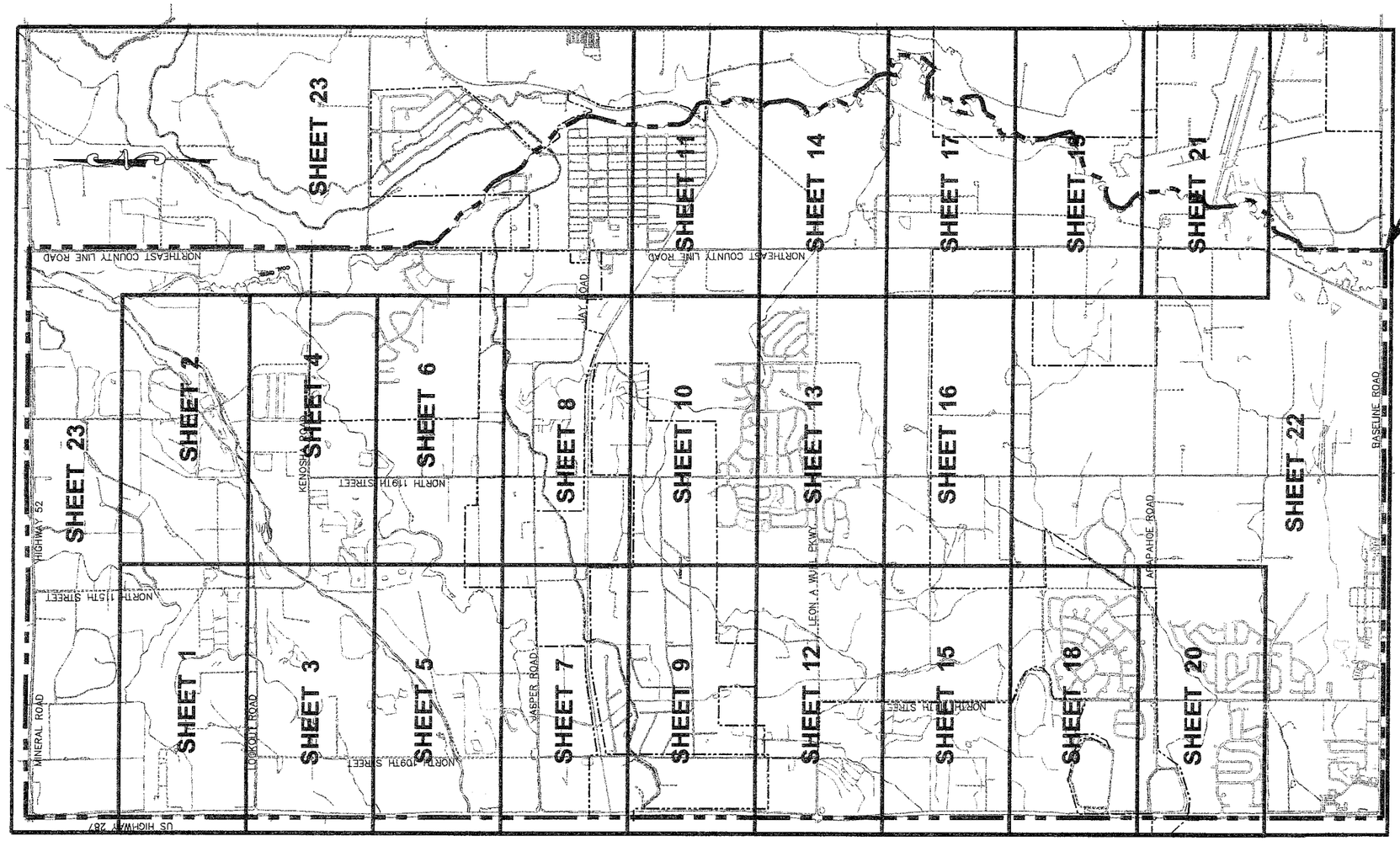
Edward J. Krisor

Edward J. Krisor

APPENDIX E

PRELIMINARY DESIGN DRAWINGS AND COMMENTARY

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING



STUDY AREA BOUNDARY

SCALE: 1" = 3000'

SHEET INDEX

SHEET No.	TITLE
T	TITLE SHEET
1 – 23	PLAN SHEETS
24 – 32	PROFILE SHEETS
33	OUTFALL SYSTEM IMPROVEMENT DETAILS

PRELIMINARY DESIGN REPORT

TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

MARCH 2001

Love & Associates, Inc.
water resource consultants
341 Front Street
Louisville, Colorado 80027-1849
Phone: 303-673-9795
Fax: 303-673-9796

DATE: FEBRUARY 28, 2001
D:\PROJECTS\9922B\DWGS\COVER.DWG

COMMENTARY ON SHEET 1

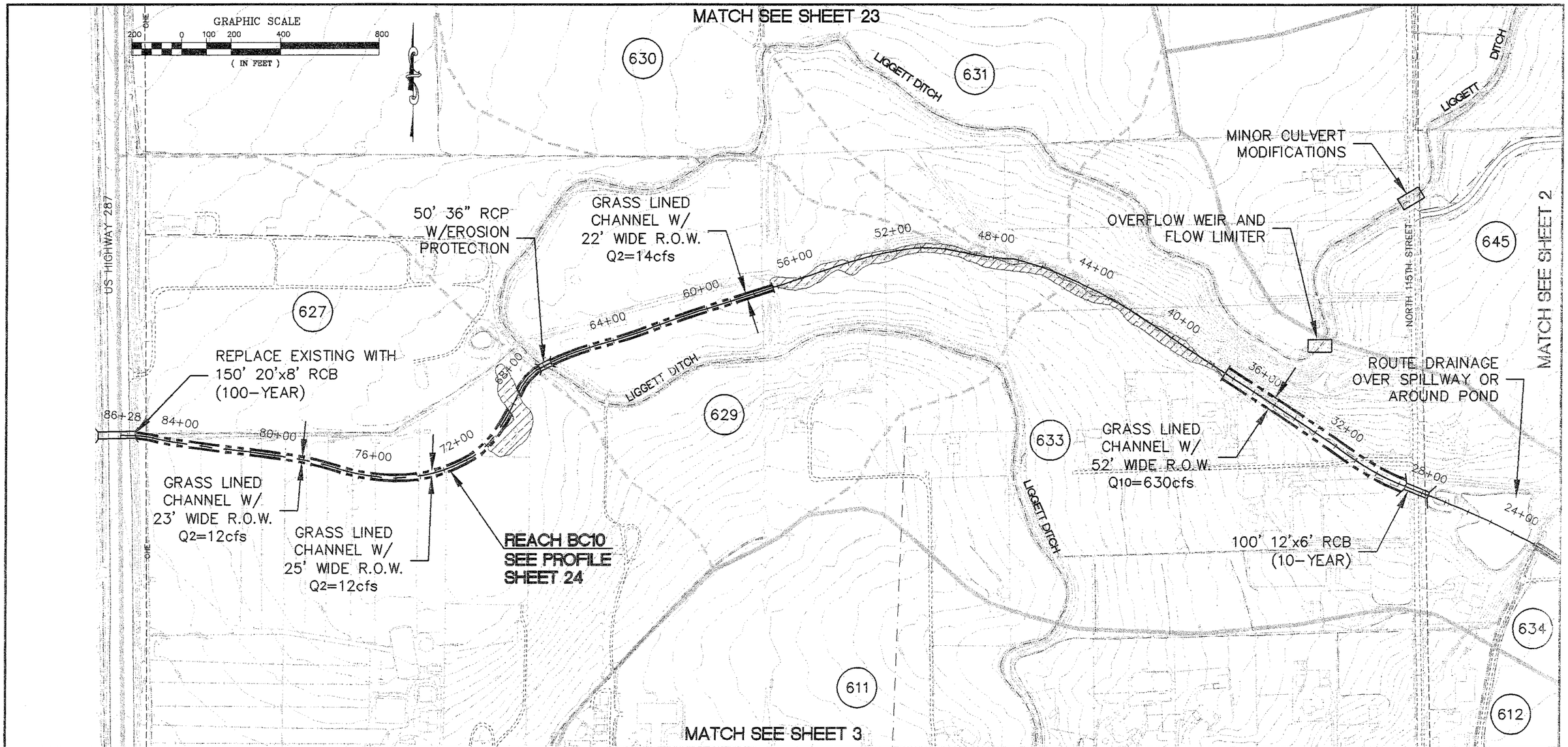
The improvements for outfall system BC10 includes a 3,631-foot grass lined channel with trickle channel, drop structures and grade control structures, a 50-foot 36" RCP culvert and 100-foot 12'x6' RCB. A proposed 150-foot 20' x 8' RCB culvert under US highway 287 is also presented on this sheet.

Irrigation modifications include an overflow weir and flow limiter, and minor culvert modifications on the Liggett Ditch.

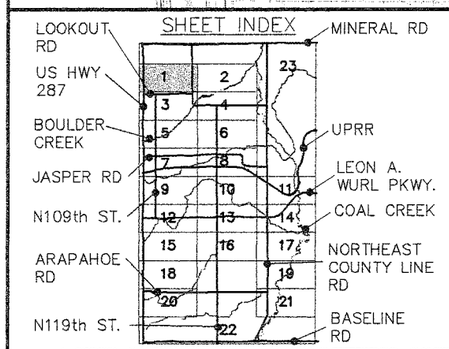
Improvements for outfall BC10 continue on Sheet 2.

Profiles for BC10 are shown on Sheet 24.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
1	BC10	Channel	3,631		$ 371,032
1	BC10	20'x8' Culvert	150	US 287	$ 386,400
1	BC10	36" Culvert	50	Liggett Ditch	$ 14,000
1	BC10	12'x6' Culvert	100	N. 115th ST.	$ 179,511
1		Overflow Weir/ Flow Limiter		Liggett Ditch	$ 28,000
1		Minor Culvert Modifications		Liggett Ditch	$ 7,000



SHEET INDEX



LEGEND

- CATCHMENT BOUNDARY
- SUB CATCHMENT BOUNDARY
- ERIE TOWN LIMITS
- CATCHMENT I.D. (000)
- CHANNEL CENTERLINE
- DRAINAGE R.O.W.
- DETENTION BASIN
- CULVERT
- STORM SEWER
- POTENTIAL WETLANDS

- OVERHEAD ELECTRIC
- BURIED ELECTRIC
- CABLE TV
- TELEPHONE
- GAS
- WATER
- SANITARY SEWER
- SEWER-UDR

DATUM:
VERTICAL: NAVD = 1988,
HORIZONTAL = COLORADO STATE PLANE COORDINATE SYSTEM NORTH ZONE.

CONTROL POINTS:
NGS CONTROL POINTS: ERIE
JR 53 5026, TRICO AND WANAKA

NOTES:

1. THIS DRAWING IS FOR MASTER PLANNING PURPOSES AND REPRESENTS PRELIMINARY AND CONCEPTUAL ENGINEERING. ALTERNATIVES TO THIS OUTFALL SYSTEM WILL BE CONSIDERED BY LOCAL REVIEWING AGENCIES AND THE URBAN DRAINAGE AND FLOOD CONTROL DISTRICT PROVIDED THE ALTERNATIVE OFFERS EQUAL HYDROLOGIC RESPONSE, HYDRAULIC CAPACITY AND STREAM STABILITY. THE ALTERNATIVE MUST COMPLY WITH ALL REQUIREMENTS OF THE LOCAL JURISDICTION AND THE URBAN DRAINAGE AND FLOOD CONTROL DISTRICT. THIS DRAWING SHALL NOT BE USED FOR CONSTRUCTION PURPOSES.
2. THE TOWN OF ERIE AND BOULDER COUNTY MANAGE AND REGULATE ALL LAND DEVELOPMENT AND REDEVELOPMENT WITHIN THE 100-YEAR FLOODPLAINS SO AS TO PREVENT FUTURE FLOOD DAMAGES BY FOLLOWING THE RECOMMENDATIONS OF THIS PLAN.
3. WHEN REGIONAL BASINS ARE NOT CONSTRUCTED:
   a. IF DEVELOPMENT OCCURS IN ANY SUB-CATCHMENT SERVED BY ANY OF THE REGIONAL DETENTION BASINS BEFORE THE REGIONAL DETENTION BASIN IS IN EXISTENCE ON THE GROUND, DEVELOPMENT SHALL PROVIDE ON-SITE WATER QUALITY AND 10- AND 100-YEAR DETENTION.
   b. STORAGE VOLUME AND THE ALLOWABLE RELEASE RATES FOR ALL ON-SITE DETENTION BASINS SHALL BE BASED ON THE EQUATIONS (CHARTS) FOR WATER QUALITY CAPTURE VOLUME CONTAINED IN UD&FCD URBAN STORM DRAINAGE CRITERIA MANUAL – VOLUME 3 AND FOR 10- AND 100-YEAR PEAK FLOW CONTROLS THE EQUATIONS DEVELOPED BY ENGINEER FOR THIS FINAL PLAN.
   c. ALL DRAINAGE FACILITIES SHALL BE SIZED TO HANDLE FLOWS THAT ARE NOT REDUCED BY UPSTREAM DETENTION UNLESS THE DETENTION FACILITIES ARE PHYSICALLY IN PLACE AT THE TIME OF DESIGN. ASSUMING DETENTION WILL BE BUILT IN THE FUTURE IS NOT VALID AND WILL NOT BE ACCEPTED.

Love & Associates, Inc
water resource consultants
841 Front Street
Louisville, Colorado 80027-1849
Phone: 303-673-9795
Fax: 303-673-9796

DESIGNED:	RJP
DRAWN:	DM
CHECKED:	DJL
DATE:	02-01

TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

PRELIMINARY
DESIGN PLAN

Original Date: Wednesday, December 12, 2000 - 10:28:35 PM By: D'Ann
Last Modification: Apr 30, 2001 - 11:22am
File Name: F:\PROJECTS\99225\DRAWINGS\SHEET1.dwg
Attachments: BASEMAP [F:\PROJECTS\99225\DRAWINGS\BASEMAP.dwg]

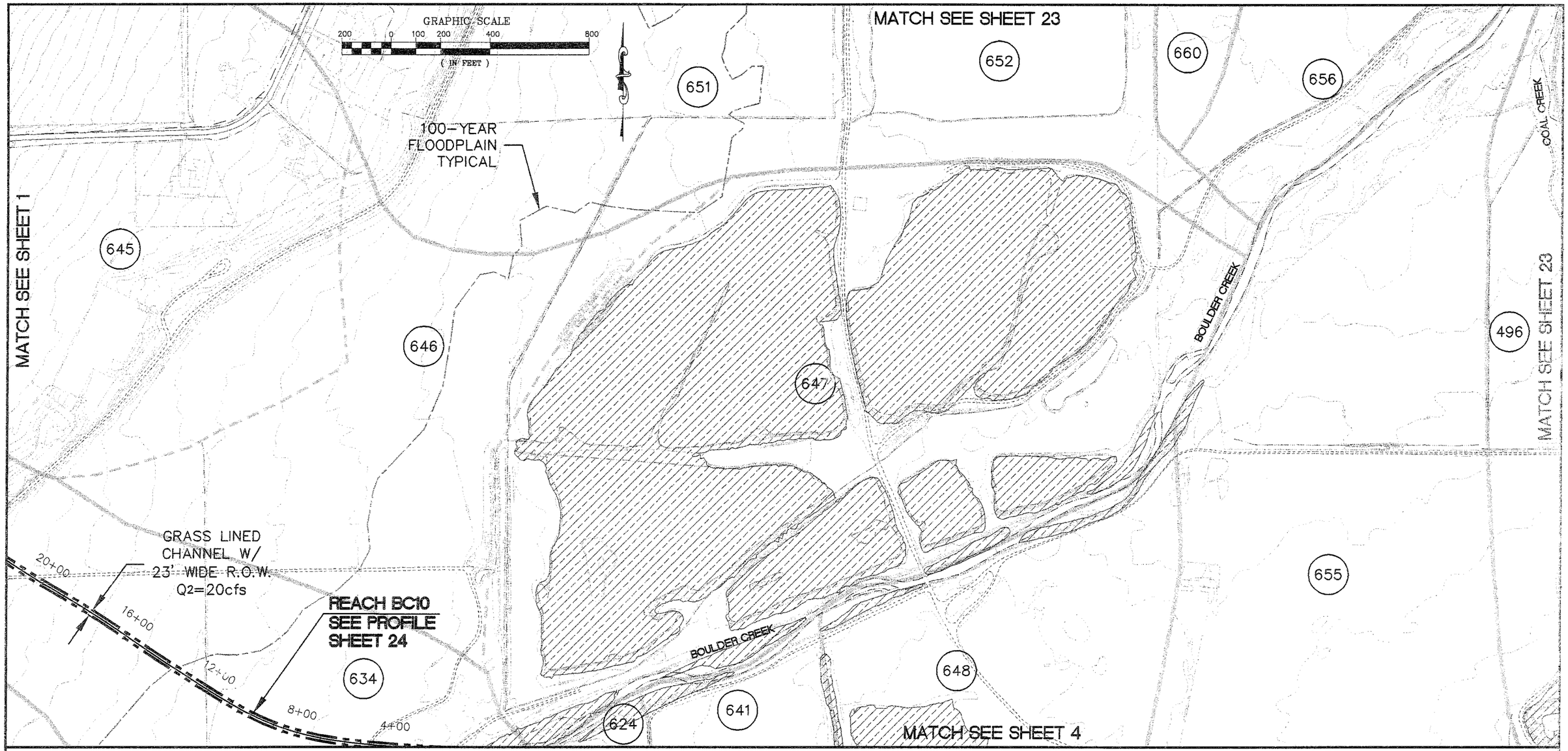
COMMENTARY ON SHEET 2

The improvements for outfall system BC10 includes a 1,780-foot grass lined channel with trickle channel.

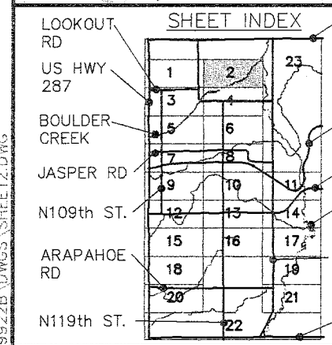
Improvements for outfall BC10 continue on Sheets 1 and 4.

Profiles for BC10 are shown on Sheet 24.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
2	BC10	Channel	1,780		$ 115,252



SHEET INDEX



LEGEND

- CATCHMENT BOUNDARY
- SUB CATCHMENT BOUNDARY
- ERIE TOWN LIMITS
- CATCHMENT I.D. (000)
- CHANNEL CENTERLINE
- DRAINAGE R.O.W.
- DETENTION BASIN
- CULVERT
- STORM SEWER
- POTENTIAL WETLANDS
- OVERHEAD ELECTRIC
- BURIED ELECTRIC
- CABLE TV
- TELEPHONE
- GAS
- WATER
- SANITARY SEWER
- SEWER-UDR

DATUM:
VERTICAL: NAVD = 1988,
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CONTROL POINTS:
NGS CONTROL POINTS: ERIE
JR 53 5026, TRICO AND WANAKA

NOTES:

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2. THE TOWN OF ERIE AND BOULDER COUNTY MANAGE AND REGULATE ALL LAND DEVELOPMENT AND REDEVELOPMENT WITHIN THE 100-YEAR FLOODPLAINS SO AS TO PREVENT FUTURE FLOOD DAMAGES BY FOLLOWING THE RECOMMENDATIONS OF THIS PLAN.

3. WHEN REGIONAL BASINS ARE NOT CONSTRUCTED:
   a. IF DEVELOPMENT OCCURS IN ANY SUB-CATCHMENT SERVED BY ANY OF THE REGIONAL DETENTION BASINS BEFORE THE REGIONAL DETENTION BASIN IS IN EXISTENCE ON THE GROUND, DEVELOPMENT SHALL PROVIDE ON-SITE WATER QUALITY AND 10- AND 100-YEAR DETENTION.
   b. STORAGE VOLUME AND THE ALLOWABLE RELEASE RATES FOR ALL ON-SITE DETENTION BASINS SHALL BE BASED ON THE EQUATIONS (CHARTS) FOR WATER QUALITY CAPTURE VOLUME CONTAINED IN UD&FCD URBAN STORM DRAINAGE CRITERIA MANUAL - VOLUME 3 AND FOR 10- AND 100-YEAR PEAK FLOW CONTROLS THE EQUATIONS DEVELOPED BY ENGINEER FOR THIS FINAL PLAN.
   c. ALL DRAINAGE FACILITIES SHALL BE SIZED TO HANDLE FLOWS THAT ARE NOT REDUCED BY UPSTREAM DETENTION UNLESS THE DETENTION FACILITIES ARE PHYSICALLY IN PLACE AT THE TIME OF DESIGN. ASSUMING DETENTION WILL BE BUILT IN THE FUTURE IS NOT VALID AND WILL NOT BE ACCEPTED.

Lowe & Associates, Inc
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DESIGNED:	RJP
DRAWN:	DM
CHECKED:	DJL
DATE:	02-01

TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

PRELIMINARY
DESIGN PLAN

DATE: FEBRUARY 1, 2001
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COMMENTARY ON SHEET 3

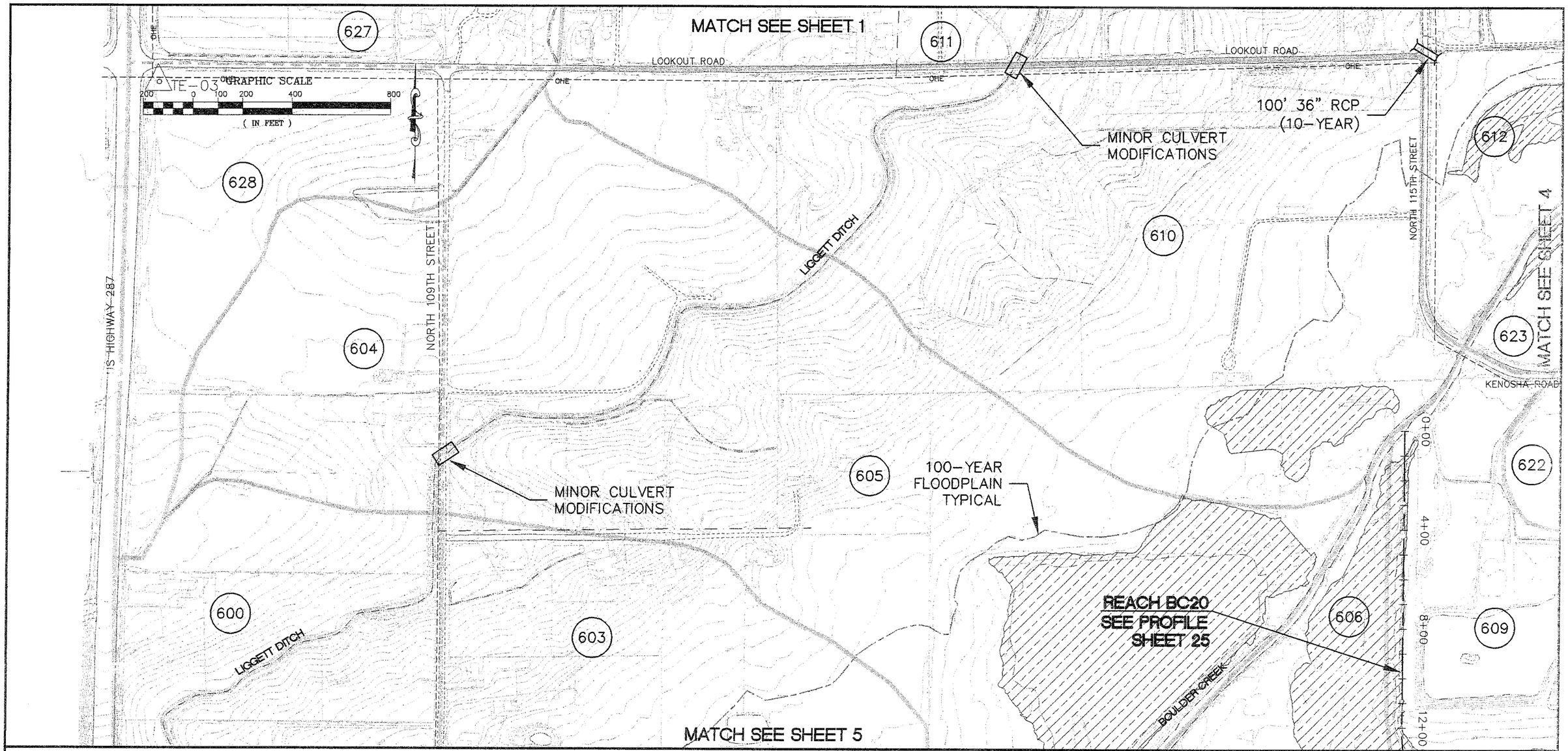
A proposed 100-foot 36" RCP culvert is presented on this sheet at the intersection of Lookout Road and North 115th street.

Irrigation modifications include minor culvert modifications on the Liggett Ditch.

Improvements for outfall BC20 continue on Sheet 5.

Profiles for BC20 are shown on Sheet 25.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
3		36" Culvert	100	N. 115TH ST.	$ 42,000
3		Minor Culvert Modifications		Liggett Ditch	$ 7,000
3		Minor Culvert Modifications		Liggett Ditch	$ 7,000



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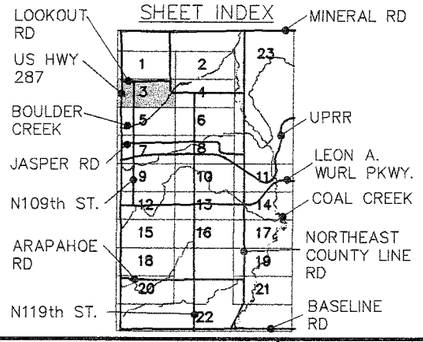

LEGEND

- CATCHMENT BOUNDARY
- SUB CATCHMENT BOUNDARY
- ERIE TOWN LIMITS
- CATCHMENT I.D. (000)
- CHANNEL CENTERLINE
- DRAINAGE R.O.W.
- DETENTION BASIN
- CULVERT
- STORM SEWER
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- OVERHEAD ELECTRIC
- BURIED ELECTRIC
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- TELEPHONE
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- SANITARY SEWER
- SEWER-UDR

DATUM:
VERTICAL: NAVD = 1988,
HORIZONTAL = COLORADO STATE PLANE COORDINATE SYSTEM NORTH ZONE.

CONTROL POINTS:
NGS CONTROL POINTS: ERIE
JR 53 5026, TRICO AND WANAKA

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3. WHEN REGIONAL BASINS ARE NOT CONSTRUCTED:
   a. IF DEVELOPMENT OCCURS IN ANY SUB-CATCHMENT SERVED BY ANY OF THE REGIONAL DETENTION BASINS BEFORE THE REGIONAL DETENTION BASIN IS IN EXISTENCE ON THE GROUND, DEVELOPMENT SHALL PROVIDE ON-SITE WATER QUALITY AND 10- AND 100-YEAR DETENTION.
   b. STORAGE VOLUME AND THE ALLOWABLE RELEASE RATES FOR ALL ON-SITE DETENTION BASINS SHALL BE BASED ON THE EQUATIONS (CHARTS) FOR WATER QUALITY CAPTURE VOLUME CONTAINED IN UD&FCD URBAN STORM DRAINAGE CRITERIA MANUAL - VOLUME 3 AND FOR 10- AND 100-YEAR PEAK FLOW CONTROLS THE EQUATIONS DEVELOPED BY ENGINEER FOR THIS FINAL PLAN.
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TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

PRELIMINARY
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DATE: FEBRUARY 1, 2001
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COMMENTARY ON SHEET 4

The improvements for outfall system BC10 includes a 296-foot grass lined channel with trickle channel.

Improvements for outfall BC10 continue on Sheet 2.

Profiles for BC10 are shown on Sheet 24.

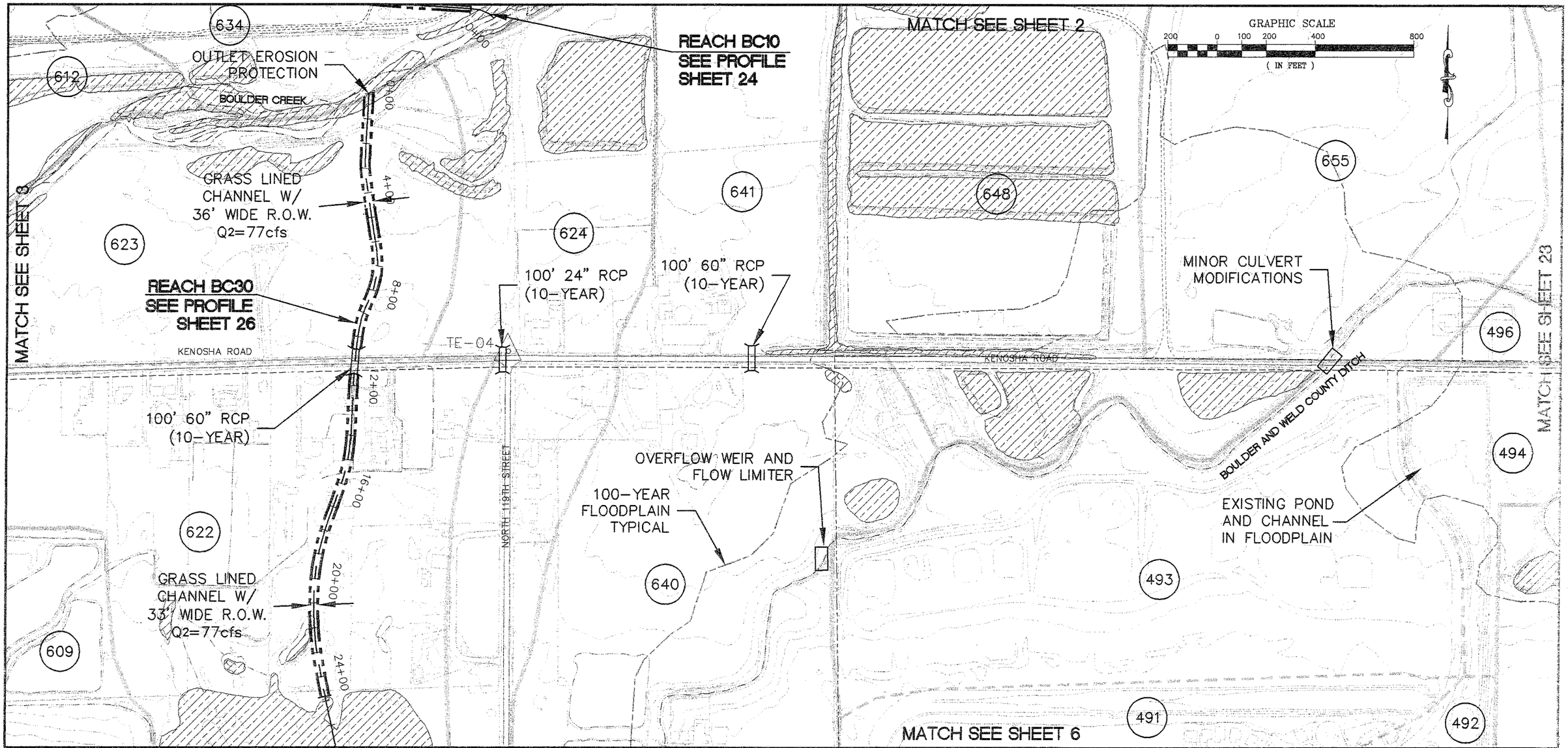
The improvements for outfall system BC30 includes a 2,383-foot grass lined channel with trickle channel and grade control structures and a 100-foot 60" RCP culvert. A proposed 100-foot 60" RCP culvert and a 100-foot 24" RCP culvert are also presented on this sheet under Kenosha Road.

Irrigation modifications include an overflow weir and flow limiter, and minor culvert modifications on the Boulder and Weld County Ditch.

Improvements for outfall BC30 continue on Sheet 6.

Profiles for BC30 are shown on Sheet 26.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
4	BC10	Channel	296		$ 19,166
4	BC30	Channel	2,383		$ 250,352
4	BC30	60" Culvert	100	Kenosha Rd.	$ 75,600
4		24" Culvert	100	Kenosha Rd.	$ 33,600
4		60" Culvert	100	Kenosha Rd.	$ 75,600
4		Minor Culvert Modifications		Boulder and Weld Co. Ditch	$ 7,000
4		Overflow Weir/ Flow Limiter		Boulder and Weld Co. Ditch	$ 28,000



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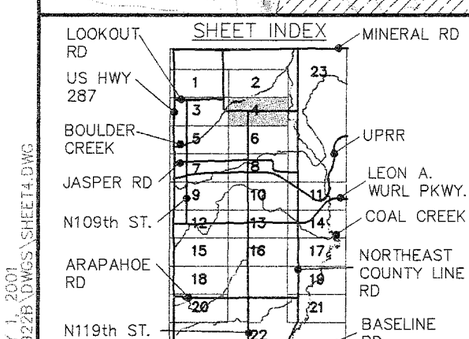

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TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
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PRELIMINARY
DESIGN PLAN

DATE: FEBRUARY 1, 2001
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COMMENTARY ON SHEET 5

The improvements for outfall system BP10 includes a 650-foot grass lined channel with trickle channel and grade control structures.

Improvements for outfall BP10 continue on Sheet 7.

Profiles for BP10 are shown on Sheet 27.

The improvements for outfall system BP20 includes a 240-foot grass lined channel with trickle channel and grade control structures.

Improvements for outfall BP20 continue on Sheet 7.

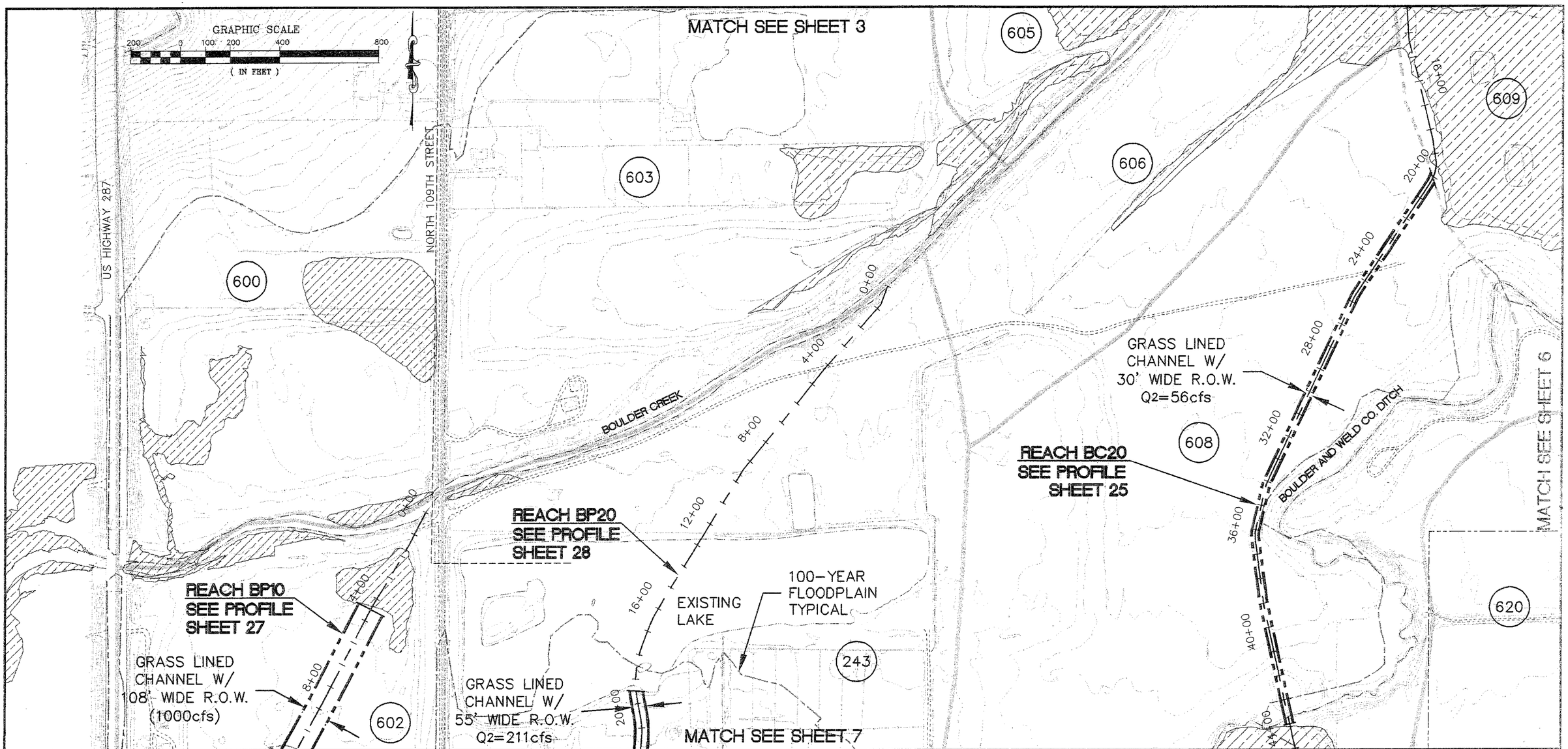
Profiles for BP20 are shown on Sheet 28.

The improvements for outfall system BC20 includes a 2,400-foot grass lined channel with trickle channel and grade control structures.

Improvements for outfall BC20 continue on Sheet 7.

Profiles for BC20 are shown on Sheet 25.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
5	BP10	Channel	650		$ 327,815
5	BP20	Channel	240		$ 47,950
5	BC20	Channel	2,400		$ 210,201



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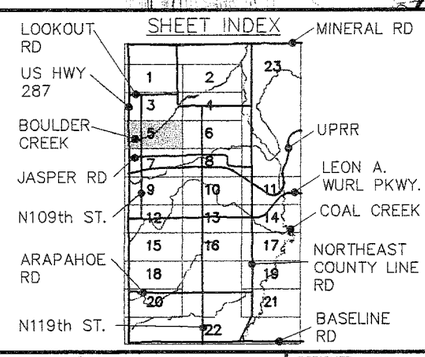

LEGEND

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- CHANNEL CENTERLINE
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- CULVERT
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DESIGNED:	RJP
DRAWN:	DM
CHECKED:	DJL
DATE:	02-01

TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

PRELIMINARY
DESIGN PLAN

DATE: FEBRUARY 1, 2001
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COMMENTARY ON SHEET 6

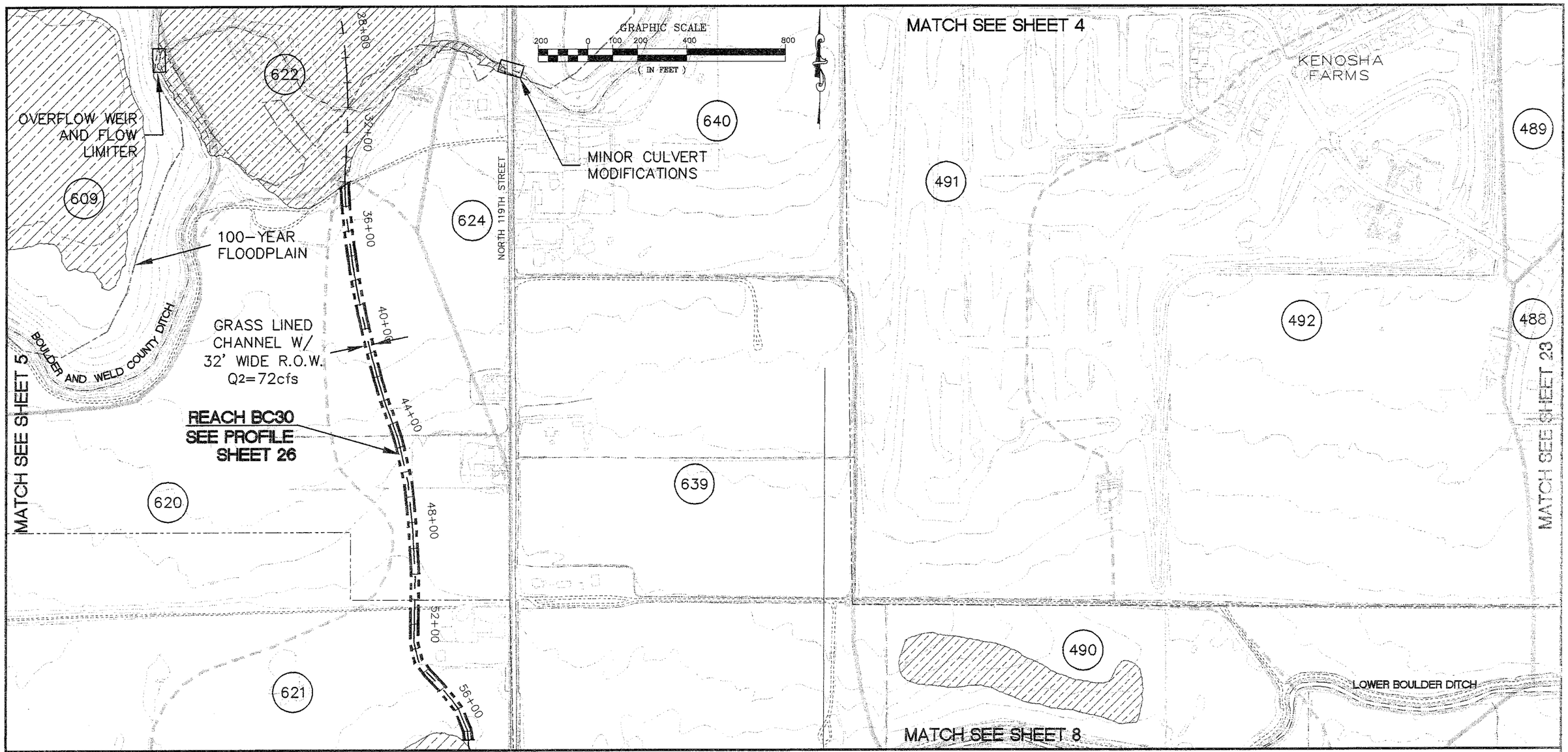
The improvements for outfall system BC30 includes a 2,269-foot grass lined channel with trickle channel, drop structures and grade control structures.

Irrigation modifications include minor culvert modifications on the Boulder and Weld County Ditch.

Improvements for outfall BC30 continue on Sheets 4 and 8.

Profiles for BC30 are shown on Sheet 26.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
6	BC30	Channel	2,269		$ 273,040
6		Minor Culvert Modifications		Boulder and Weld Co. Ditch	$ 7,000
6		Overflow Weir/ Flow Limiter		Boulder and Weld Co. Ditch	$ 28,000



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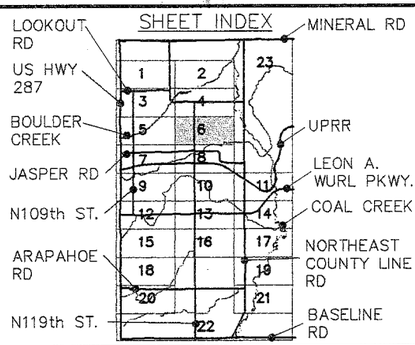

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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

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D:\PROJECTS\99228\DWGS\SHEET6.DWG

COMMENTARY ON SHEET 7

The improvements for outfall system BP10 includes a 3,050-foot grass lined channel with trickle channel and drop structures, and a 100-foot 12'x8' RCB culvert and a 50-foot 12'x8' RCB culvert.

Improvements for outfall BP10 continue on Sheets 5 and 9.

Profiles for BP10 are shown on Sheet 27.

The improvements for outfall system BP20 includes a 3,050-foot grass lined channel with trickle channel and drop structures and a 100-foot 14'x8' RCB culvert, a 50-foot 90'x10' bridge and a 50-foot 9'x6' RCB culvert.

Improvements for outfall BP20 continue on Sheets 5 and 9.

Profiles for BP20 are shown on Sheet 28.

The improvements for outfall system BC20 includes a 1,242-foot grass lined channel with trickle channel and a 100-foot 54" RCP culvert and a 50-foot 60" RCP culvert.

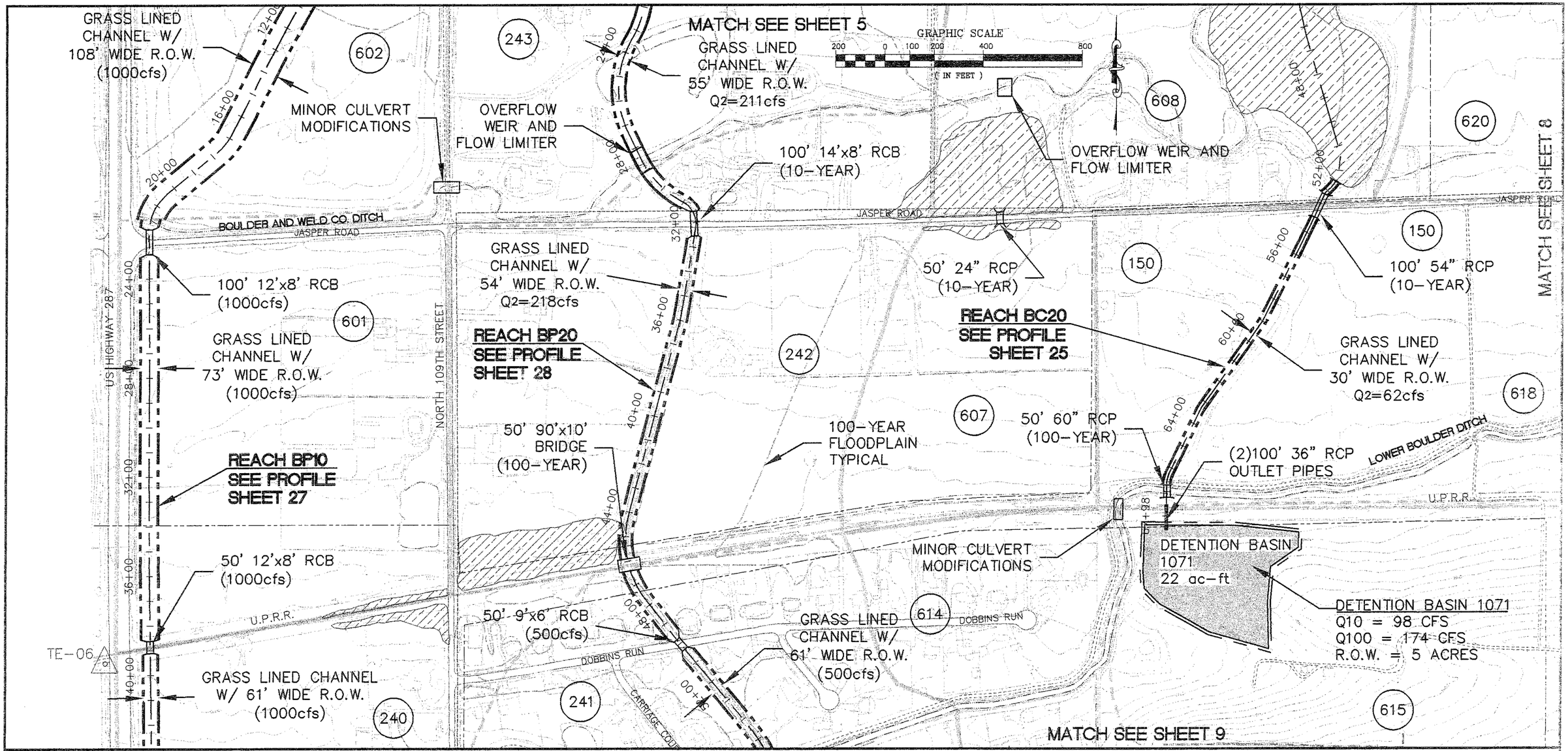
Improvements for outfall BC20 continue on Sheet 5.

Profiles for BC20 are shown on Sheet 25.

Irrigation modifications include an overflow weir and flow limiter, and minor culvert modifications on the Boulder and Weld County Ditch and Lower Boulder Ditch. A 50-foot 24" RCP culvert under Jasper Road.

Detention Basin 1071 with (2) 36-inch RCP outlets is also presented on this sheet.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
7	BP10	Channel	3050		$ 1,279,806
7	BP10	12'x8' Culvert	100	Jasper Road	$ 207,511
7	BP10	12'x8' Culvert	50	U.P.R.R.	$ 121,956
7	BP20	Channel	3,050		$ 661,811
7	BP20	14'x8' Culvert	100	Jasper Road	$ 223,067
7	BP20	90'x10' Bridge	50	U.P.R.R.	$ 448,000
7	BP20	9'x6' Culvert	50	Dobbins Run	$ 90,067
7	BC20	Channel	1,242		$ 108,779
7	BC20	54" Culvert	100	Jasper Road	$ 69,300
7	BC20	60" Culvert	50	Lower Boulder Ditch	$ 37,800
7	1071	Detention Basin and Outlet			$ 1,295,279
7		24" Culvert	50	Jasper Road	$ 16,800
7		Minor Culvert Modifications		Boulder and Weld Co. Ditch	$ 7,000
7		Overflow Weir/ Flow Limiter		Boulder and Weld Co. Ditch	$ 28,000
7		Overflow Weir/ Flow Limiter		Boulder and Weld Co. Ditch	$ 28,000
7		Minor Culvert Modifications		Lower Boulder Ditch	$ 7,000



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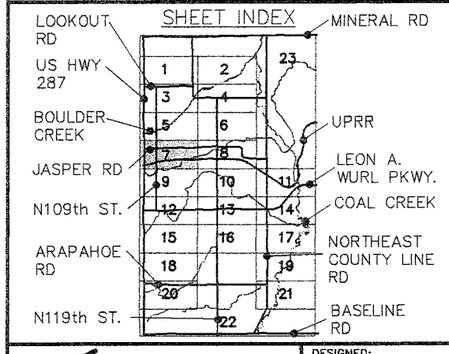

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DESIGNED:	RJP
DRAWN:	DM
CHECKED:	DJL
DATE:	02-01

TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

PRELIMINARY
DESIGN PLAN

Version Date: Wednesday, December 12, 2001 - 4:59:07 pm By: DAm
Last Modification: Apr 30, 2001 - 11:24am
File Name: F:\PROJECTS\98229\DRAWINGS\SHEET7.dwg
Attachments: BASEMAP [F:\PROJECTS\99226\DRAWINGS\BASEMAP.dwg]

COMMENTARY ON SHEET 8

The improvements for outfall system BC30 includes a 100-foot 54" RCP culvert and 1,241 feet of 48" Storm Sewer.

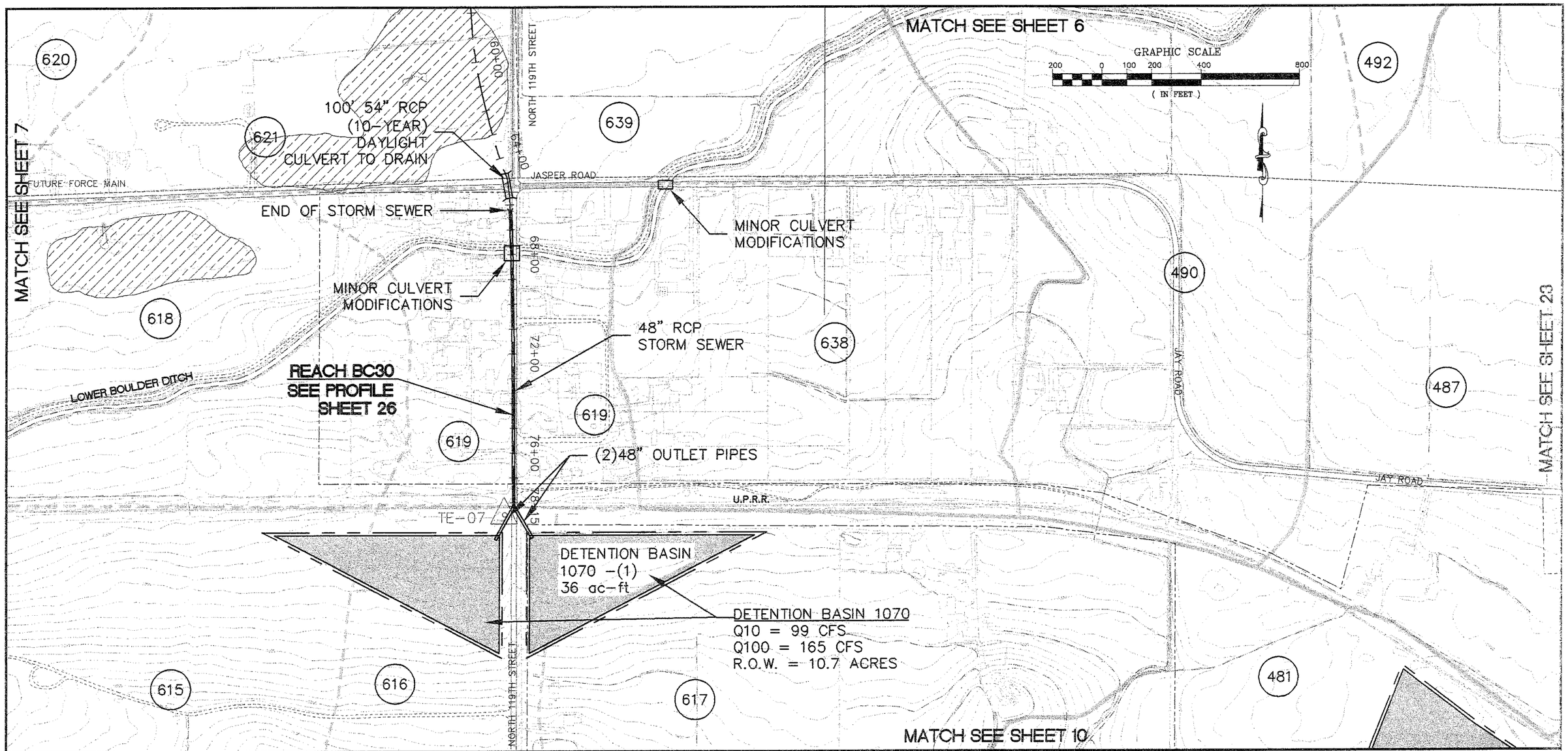
Detention Basin 1070 with (2)48-inch RCP outlets is also presented on this sheet.

Irrigation modifications include minor culvert modifications on the Lower Boulder Ditch.

Improvements for outfall BC30 continue on Sheet 6.

Profiles for BC30 are shown on Sheet 26.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
8	BC30	48" Storm Sewer	1,241		$ 243,236
8	BC30	54" Culvert	100	Jasper Road	$ 69,300
8	1070	Detention Basin and Outlet			$ 2,306,558
8		Minor Culvert Modifications		Lower Boulder Ditch	$ 7,000
8		Minor Culvert Modifications		Lower Boulder Ditch	$ 7,000



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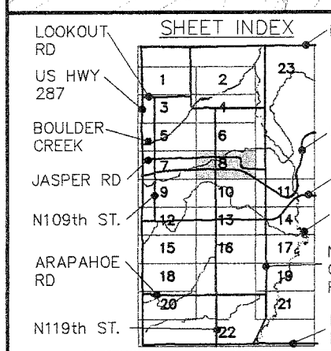

LEGEND

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- SUB CATCHMENT BOUNDARY
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JR 53 5026, TRICO AND WANAKA

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TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

PRELIMINARY
DESIGN PLAN

Date: Oct. 12, 2001 15:09
Last Modification: Apr 30, 2001 - 11:26am By: D'Ann
File Name: F:\PROJECTS\99226\DRAWINGS\SHEETS.dwg
Attachments: BASEMAP [F:\PROJECTS\99226\DRAWINGS\BASEMAP.dwg]

COMMENTARY ON SHEET 9

The improvements for outfall system BP10 includes a 2,950-foot grass lined channel with trickle channel and drop structures, and a 50-foot 12'x8' RCB culvert.

Improvements for outfall BP10 continue on Sheets 7 and 12.

Profiles for BP10 are shown on Sheet 27.

The improvements for outfall system BP20 includes a 3,200-foot grass lined channel with trickle channel and drop structures and a 50-foot 60" RCP culvert, a 50-foot 9'x6' RCB culvert and a Spreader.

Improvements for outfall BP20 continue on Sheets 7 and 12.

Profiles for BP20 are shown on Sheet 28.

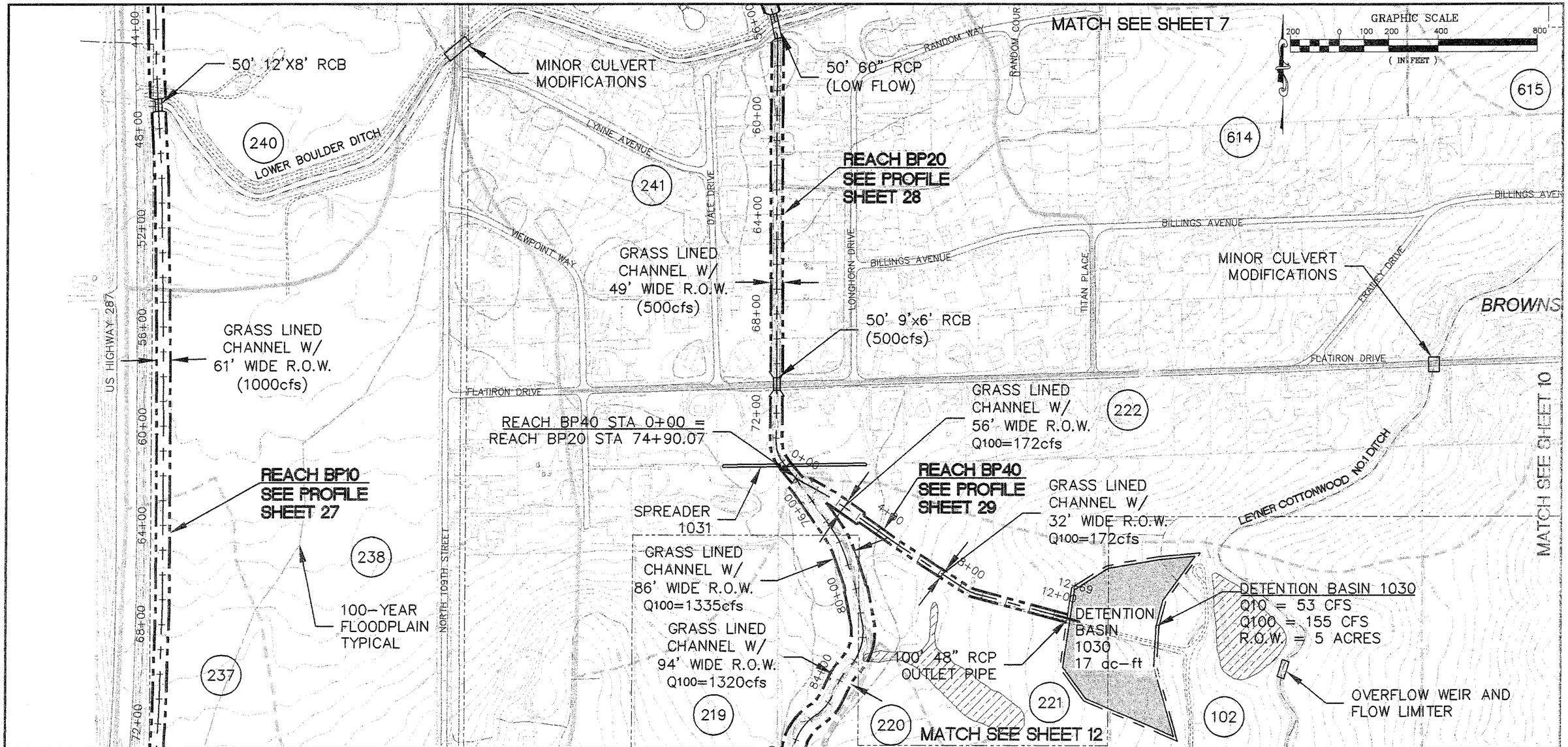
The improvements for outfall system BP40 includes a 1,269-foot grass lined channel with trickle channel and drop structures.

Profiles for BP40 are shown on Sheet 29.

Irrigation modifications include an overflow weir and flow limiter and minor culvert modifications on the Leyner Cottonwood No. 1 Ditch. And minor culvert modifications on Lower Boulder Ditch.

Detention Basin 1030 with a 48-inch RCP outlet is also presented on this sheet.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
9	BP10	Channel	2,950		$ 932,650
9	BP10	12'x8' Culvert	50	Lower Boulder Ditch	$ 121,956
9	BP20	Channel	3,200		$ 1,128,583
9	BP20	9'x6' Culvert	50	Flatiron Drive	$ 90,067
9	BP20	60" Culvert	50	Lower Boulder Ditch	$ 37,800
9	BP20	Spreader			$ 25,681
9	BP40	Channel	1,269		$ 239,127
9	1030	Detention Basin and Outlet			$ 819,610
9		Minor Culvert Modifications		Lower Boulder Ditch	$ 7,000
9		Minor Culvert Modifications		Leyner Cottonwood Ditch	$ 7,000
9		Overflow Weir/ Flow Limiter		Leyner Cottonwood Ditch	$ 28,000



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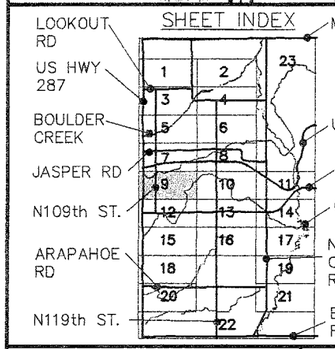

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DESIGNED:	RJP
DRAWN:	DM
CHECKED:	DJL
DATE:	02-01

TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

PRELIMINARY DESIGN PLAN

Date: 26 Dec 2001 - 11:25am
Last Modification: Apr 30, 2001 - 11:25am
File Name: F:\PROJECTS\99228\DRAWINGS\SHEET9.dwg
Attachments: BASEMAP [F:\PROJECTS\99228\DRAWINGS\BASEMAP.dwg]

COMMENTARY ON SHEET 10

The improvements for outfall system CC10 includes a 1,860-foot grass lined channel with trickle channel and drop structures.

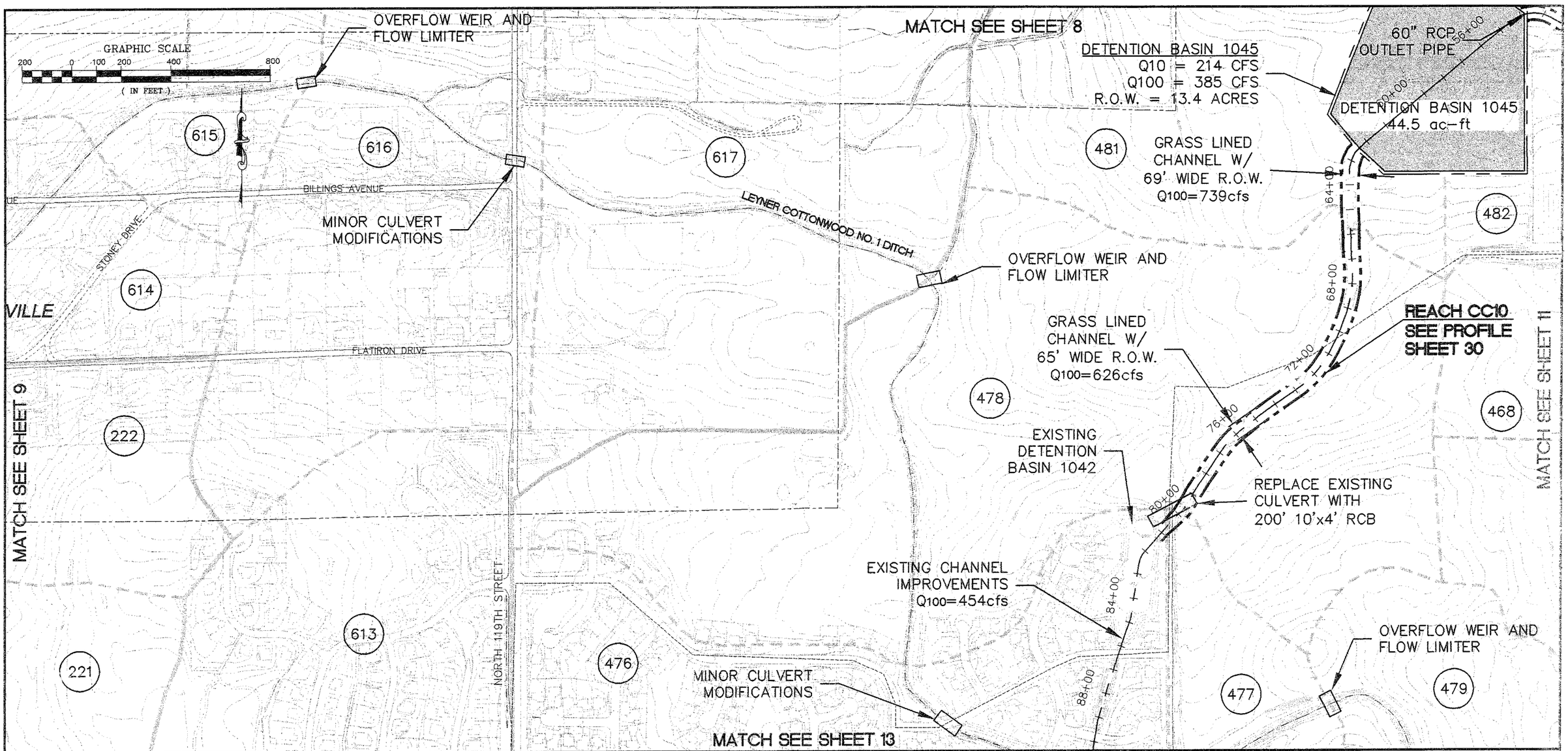
Irrigation modifications include overflow weirs and flow limiters, and minor culvert modifications on the Leyner Cottonwood No. 1 Ditch.

Improvements for outfall CC10 continue on Sheets 11 and 13.

Profiles for CC10 are shown on Sheet 30.

Proposed Detention Basin 1045 with a 60-inch RCP outlet and a 10'x4' RCB replacement outlet for existing Detention Basin 1042 are also presented on this sheet.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
10	CC10	Channel	1,860		$ 603,071
10	1045	Detention Basin and Outlet			$ 2,085,416
10	1042	Detention Basin Outlet 10'x4'			$ 179,926
10		Overflow Weir/ Flow Limiter		Leyner Cottonwood Ditch	$ 28,000
10		Minor Culvert Modifications		Leyner Cottonwood Ditch	$ 7,000
10		Overflow Weir/ Flow Limiter		Leyner Cottonwood Ditch	$ 28,000
10		Minor Culvert Modifications		Leyner Cottonwood Ditch	$ 7,000
10		Overflow Weir/ Flow Limiter		Leyner Cottonwood Ditch	$ 28,000



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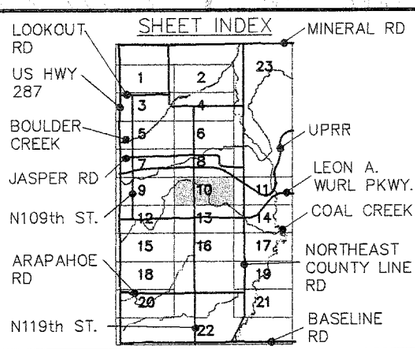

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TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

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PRELIMINARY
DESIGN PLAN

DATE: FEBRUARY 1, 2001
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COMMENTARY ON SHEET 11

The improvements for outfall system CC10 includes a 5,070-foot grass lined channel with trickle channel and drop structures, and a 150-foot 6'x6' RCB culvert. From station 0+00 to station 38+45 the 12' maintenance access is incorporated in the channel width.

Improvements for outfall CC10 continue on Sheet 10.

Profiles for CC10 are shown on Sheet 30.

The improvements for outfall system CC30 includes a 1,622-foot grass lined channel with trickle channel and 180-feet of double 36-inch RCP.

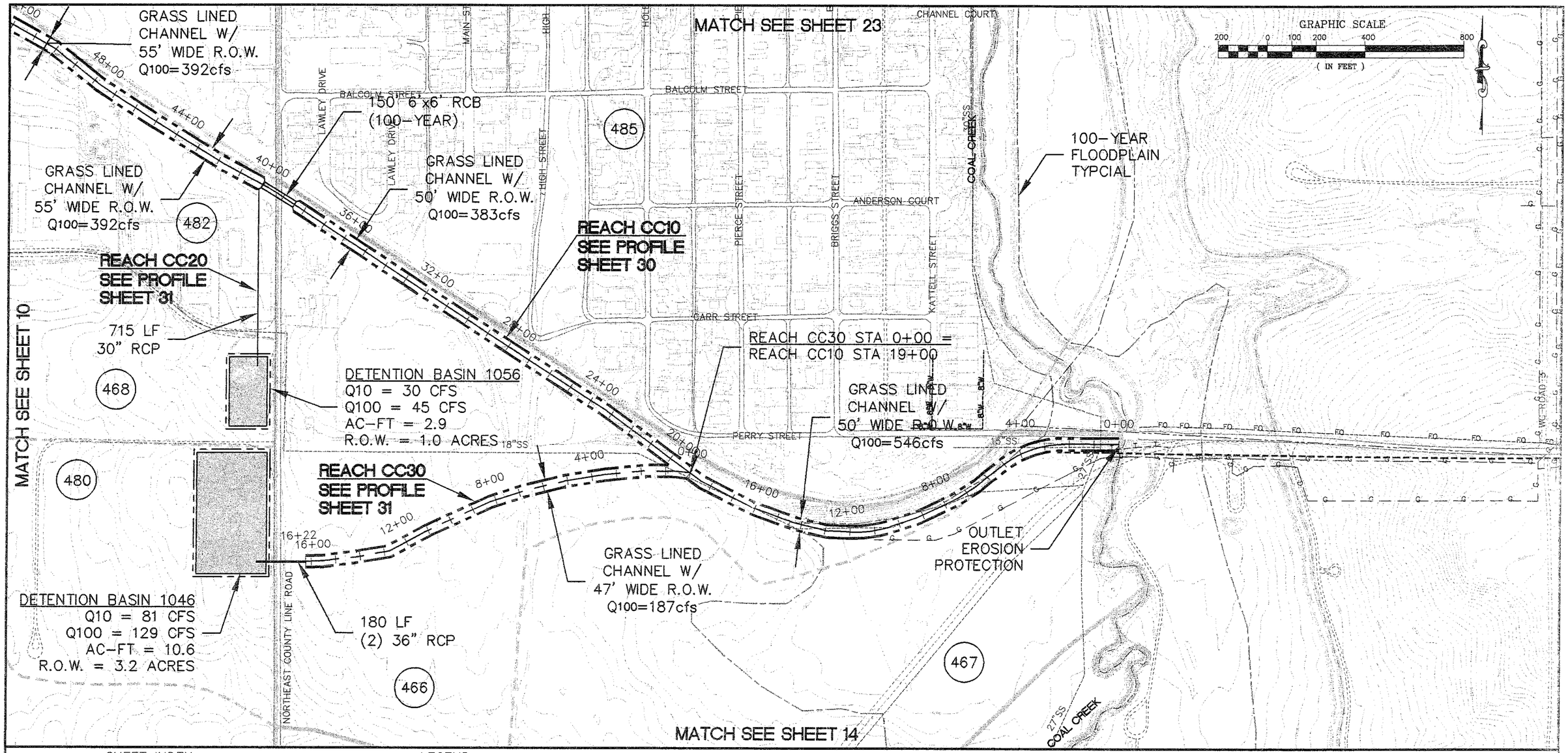
Profiles for CC30 are shown on Sheet 31.

The improvements for outfall system CC20 include 715-feet of 30" RCP.

Profiles for CC20 are shown on Sheet 31.

Detention Basin 1046 with (2)36-inch RCP outlets and Detention Basin 1056 with 30-inch RCP outlet are also presented on this sheet.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
11	CC10	Channel	5,070		$ 1,000,835
11	CC10	6'x6' Culvert	150	Northeast County Line Rd.	$ 187,289
11	CC20	30" RCP	715		$ 64,350
11	CC30	Channel	1,622		$ 266,119
11	1046	Detention Basin and Outlet			$ 605,354
11	1056	Detention Basin and Outlet			$ 218,639



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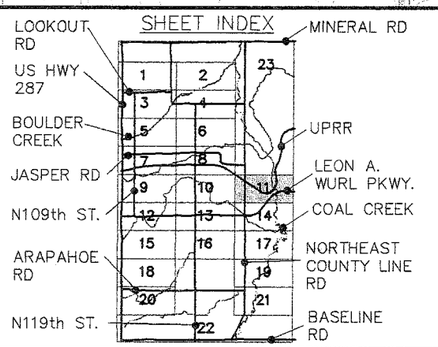

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COMMENTARY ON SHEET 12

The improvements for outfall system BP10 includes a 686- foot grass lined channel with trickle channel and drop structures and a Diversion Structure. A 150-foot 65'x12' bridge and 150-foot 72" RCP culvert are also presented on this sheet.

Improvements for outfall BP10 continue on Sheet 9.

Profiles for BP10 are shown on Sheet 27.

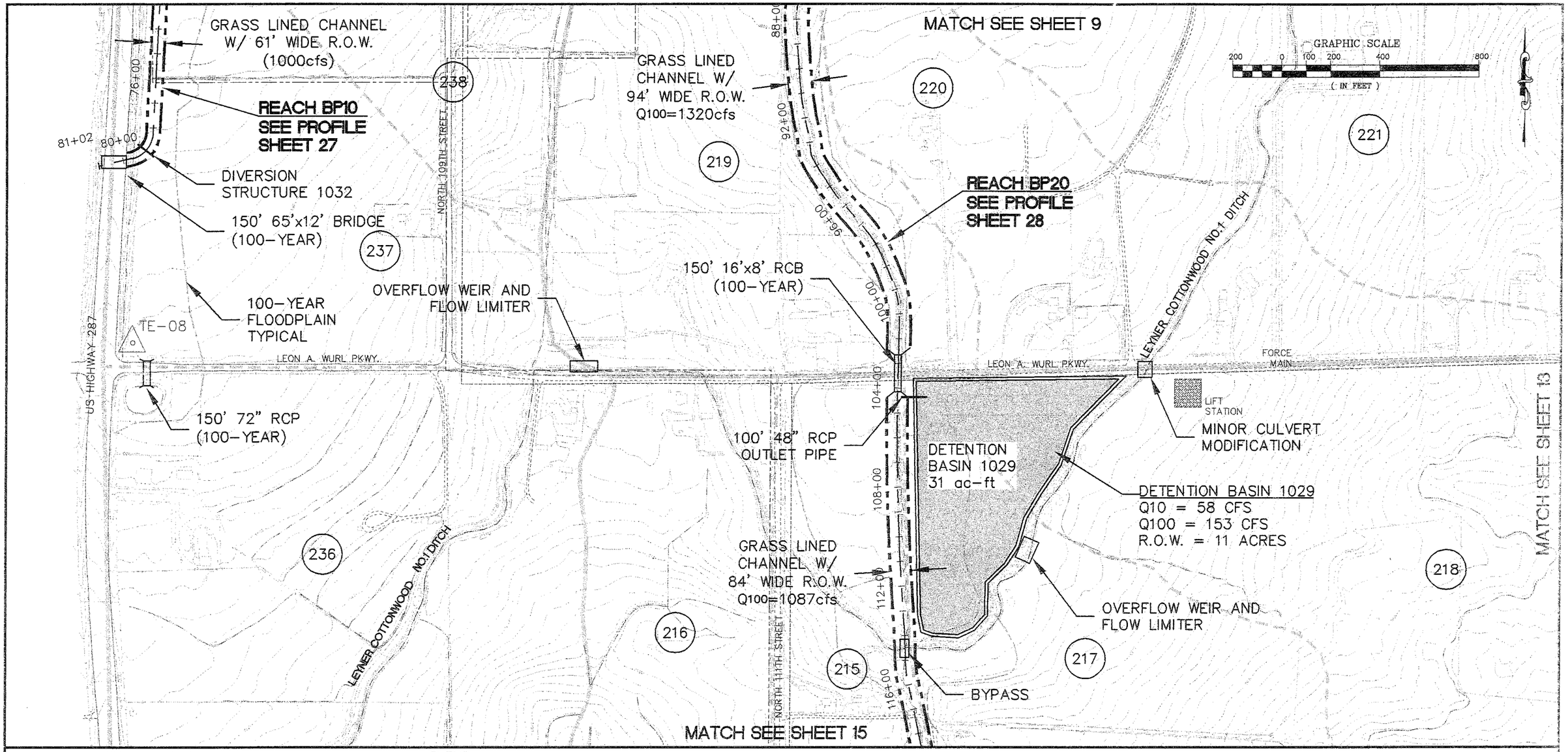
The improvements for outfall system BP20 includes a 2,961-foot grass lined channel with trickle channel and drop structures and a 150- foot 16'x8' RCB culvert and a Bypass at the Leyner Cottonwood No.1 Ditch.

Profiles for BP20 are shown on Sheet 28.

Detention Basin 1029 with a 48-inch RCP outlet is also presented on this sheet.

Irrigation modifications include overflow weirs and flow limiters and minor culvert modifications on the Leyner Cottonwood No.1 Ditch.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
12	BP10	Channel	686		$ 202,427
12	BP10	Diversion Structure			$ 25,681
12	BP20	Channel	2,961		$ 1,579,785
12	BP20	16'x8' Culvert	150		$ 339,733
12	1029	Detention Basin and Outlet			$ 1,665,053
12		Bypass		Leyner Cottonwood Ditch	$ 14,000
12		65'x12' Bridge	150	US Hwy. 287	$ 990,422
12		72" Culvert	150	Leon A. Wurl Pkwy.	$ 132,300
12		Overflow Weir/ Flow Limiter		Leyner Cottonwood Ditch	$ 28,000
12		Overflow Weir/ Flow Limiter		Leyner Cottonwood Ditch	$ 28,000
12		Minor Culvert Modifications		Leyner Cottonwood Ditch	$ 7,000



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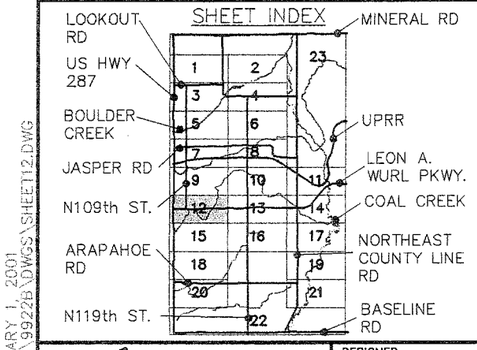

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- STORM SEWER
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CONTROL POINTS:
NGS CONTROL POINTS: ERIE
JR 53 5026, TRICO AND WANAKA

NOTES:

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   c. ALL DRAINAGE FACILITIES SHALL BE SIZED TO HANDLE FLOWS THAT ARE NOT REDUCED BY UPSTREAM DETENTION UNLESS THE DETENTION FACILITIES ARE PHYSICALLY IN PLACE AT THE TIME OF DESIGN. ASSUMING DETENTION WILL BE BUILT IN THE FUTURE IS NOT VALID AND WILL NOT BE ACCEPTED.

Love & Associates, Inc
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DESIGNED:	RJP
DRAWN:	DM
CHECKED:	DJL
DATE:	02-01

TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

PRELIMINARY
DESIGN PLAN

DATE: FEBRUARY 1, 2001
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COMMENTARY ON SHEET 13

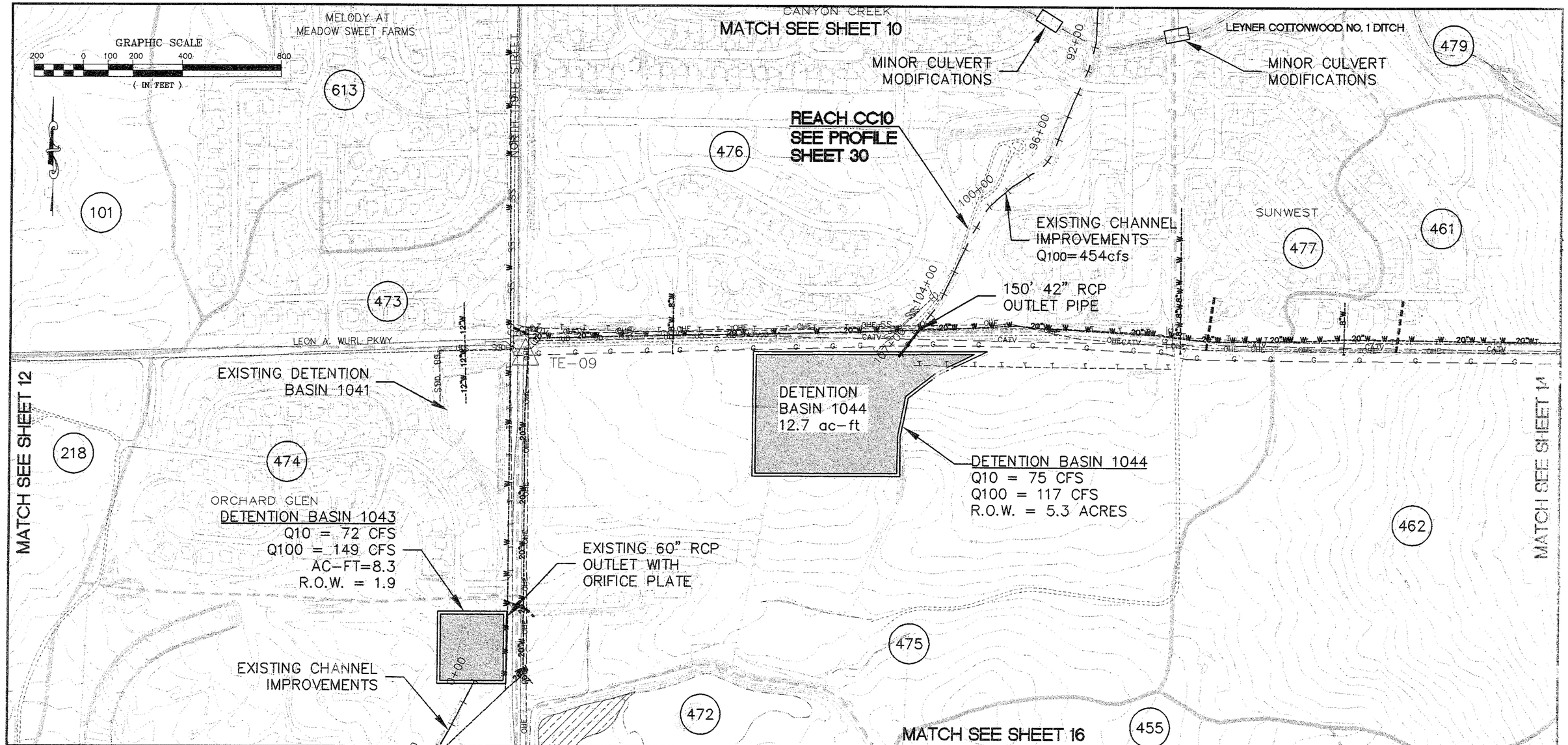
The improvements include Detention Basin 1044 with a 150' 42-inch RCP outlet to existing CC10 channel and Detention Basin 1043.

Improvements for outfall CC10 continue on Sheet 10.

Profiles for CC10 are shown on Sheet 30.

Irrigation modifications include minor culvert modifications on the Leyner Cottonwood No. 1 Ditch.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
13	1043	Detention Basin and Outlet			$ 454,213
13	1044	Detention Basin and Outlet			$ 874,751
13		Minor Culvert Modifications		Leyner Cottonwood Ditch	$ 7,000
13		Minor Culvert Modifications		Leyner Cottonwood Ditch	$ 7,000



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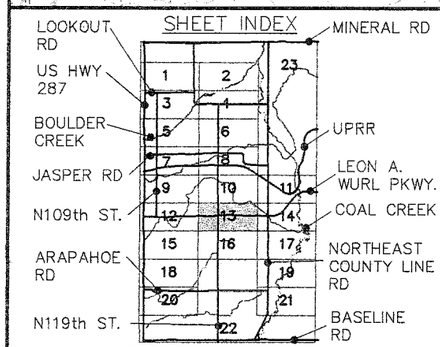

LEGEND

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- CHANNEL CENTERLINE
- DRAINAGE R.O.W.
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JR 53 5026, TRICO AND WANAKA

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CHECKED:	DJL
DATE:	02-01

TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

PRELIMINARY
DESIGN PLAN

Date: Friday, Feb 28, 2001 - 7:50am, By: D'Ann
Last Modification: Friday, Apr 06, 2001 - 2:03:0
File Name: F:\PROJECTS\98228\DRAWINGS\SHEET13.dwg
Attachments: BASEMAP [F:\PROJECTS\98228\DRAWINGS\BASEMAP.dwg]

COMMENTARY ON SHEET 14

The improvements for outfall system CC50 includes a 3,759-foot grass lined channel with trickle channel and drop structures and a 150-foot 72" RCP culvert.

Profiles for CC50 are shown on Sheet 31.

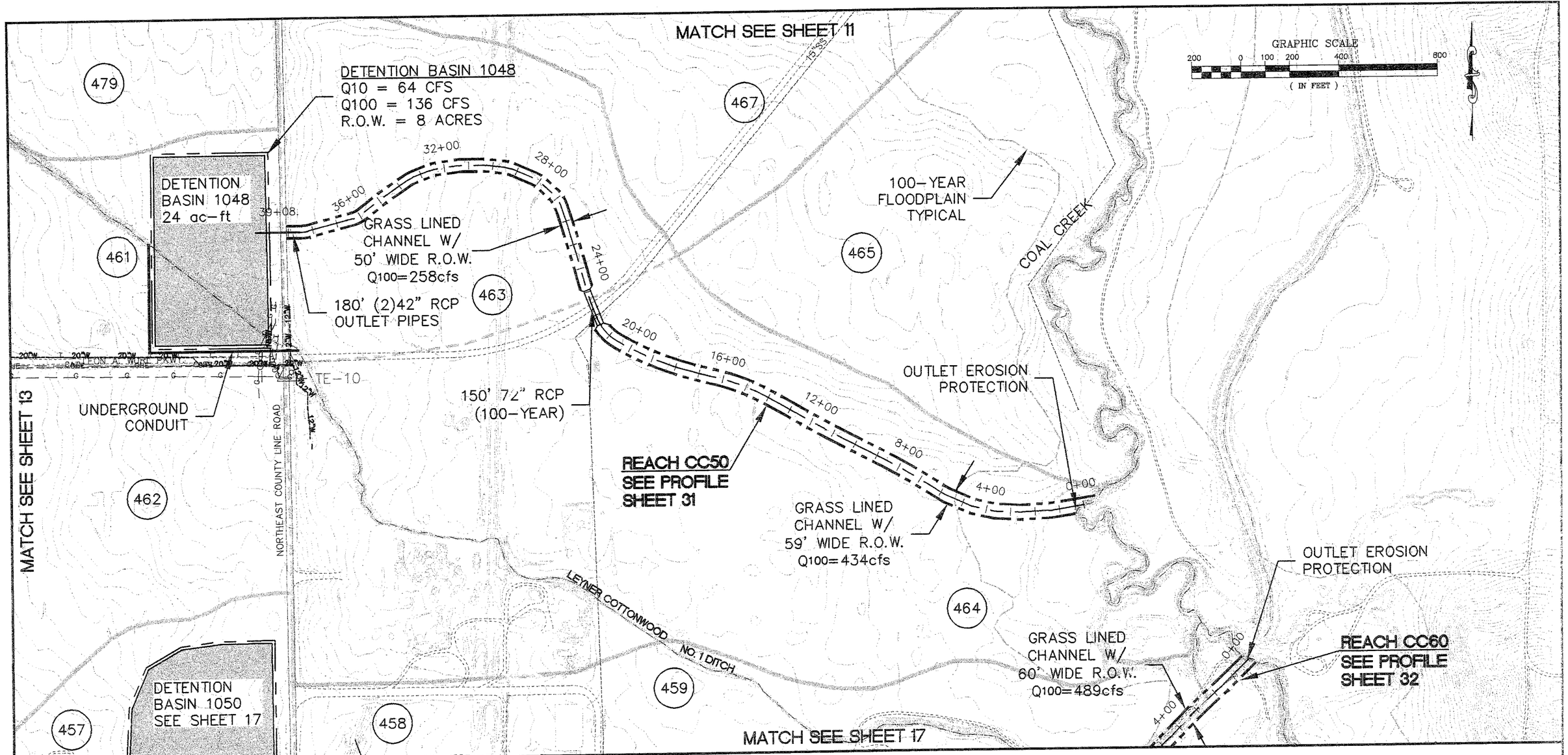
The improvements for outfall system CC60 includes a 510-foot grass lined channel with trickle channel and drop structures.

Profiles for CC60 are shown on Sheet 32.

Irrigation modifications include Underground Conduit on the Leyner Cottonwood No. 1 Ditch.

Detention Basin 1048 with a 42-inch outlet is also presented on this sheet.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
14	CC50	Channel	3,759		$ 801,975
14	CC50	72" Culvert	150		$ 132,300
14	CC60	Channel	510		$ 149,975
14	1048	Detention Basin and Outlet			$ 1,411,682
14		Underground Conduit		Leyner Cottonwood Ditch	$ 14,000



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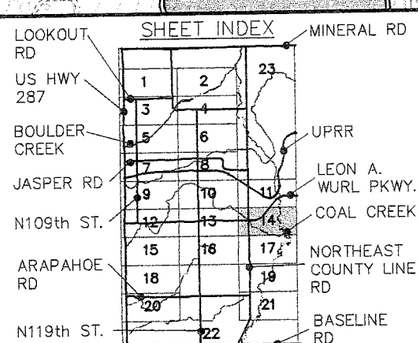

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DATE:	02-01

TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

PRELIMINARY
DESIGN PLAN

DATE: FEBRUARY 1, 2001
D:\PROJECTS\9922B\DWGS\SHEET14.DWG

COMMENTARY ON SHEET 15

The improvements for outfall system BP20 includes a 3,461-foot grass lined channel with trickle channel and drop structures.

Improvements for outfall BP20 continue on Sheets 12 and 18.

Profiles for BP20 are shown on Sheet 29.

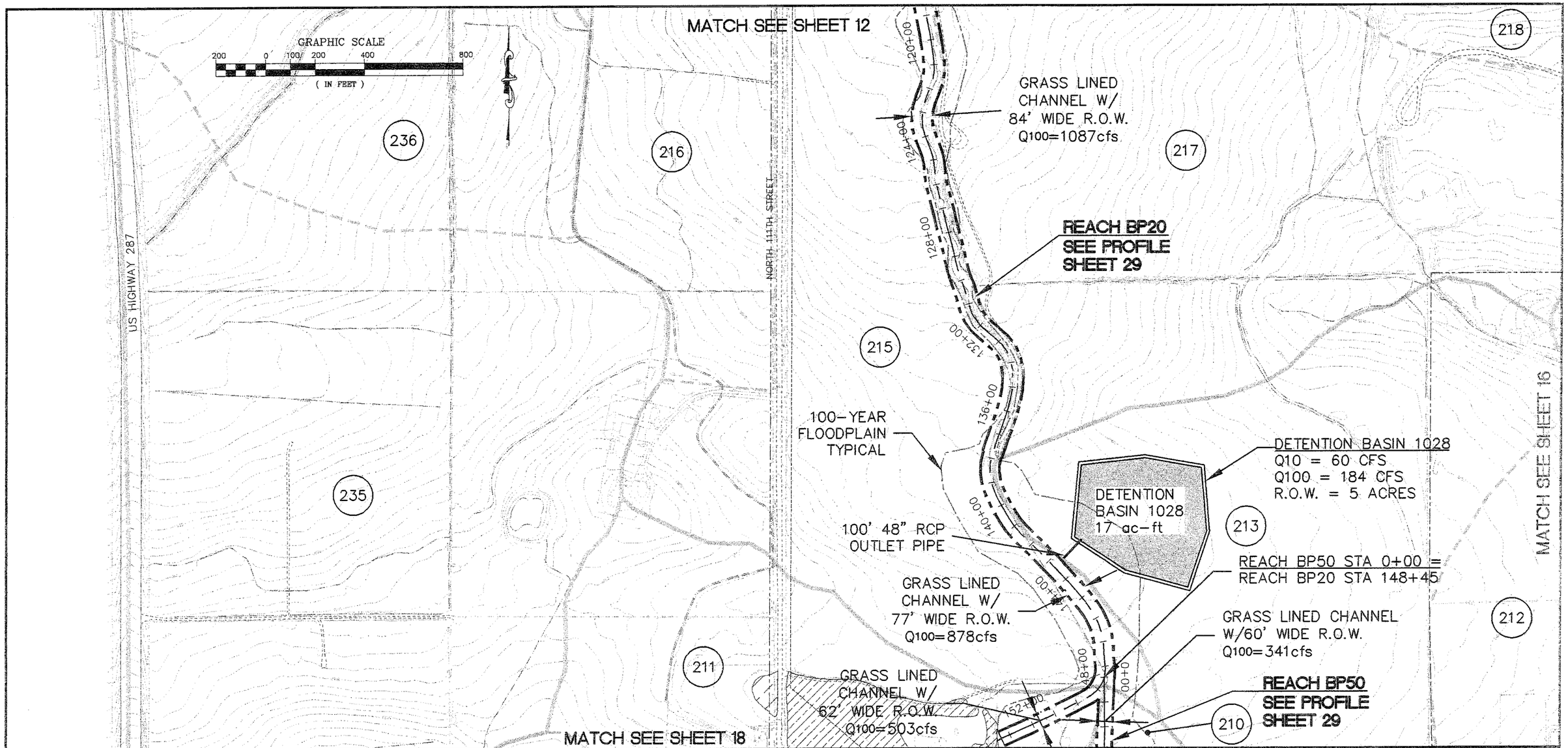
The improvements for outfall system BP50 includes a 250-foot grass lined channel with trickle channel.

Improvements for outfall BP50 continue on Sheet 18.

Profiles for BP50 are shown on Sheet 29.

Detention Basin 1028 with a 48-inch RCP outlet is also presented on this sheet.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
15	BP20	Channel	3,461		$ 1,544,544
15	BP50	Channel	250		$ 58,076
15	1028	Detention Basin and Outlet			$ 819,610



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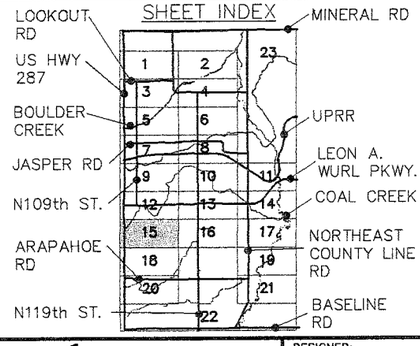

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Lowe & Associates, Inc
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Fax: 303-673-9796

DESIGNED:	RJP
DRAWN:	DM
CHECKED:	DJL
DATE:	02-01

TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

PRELIMINARY
DESIGN PLAN

DATE: FEBRUARY 1, 2001
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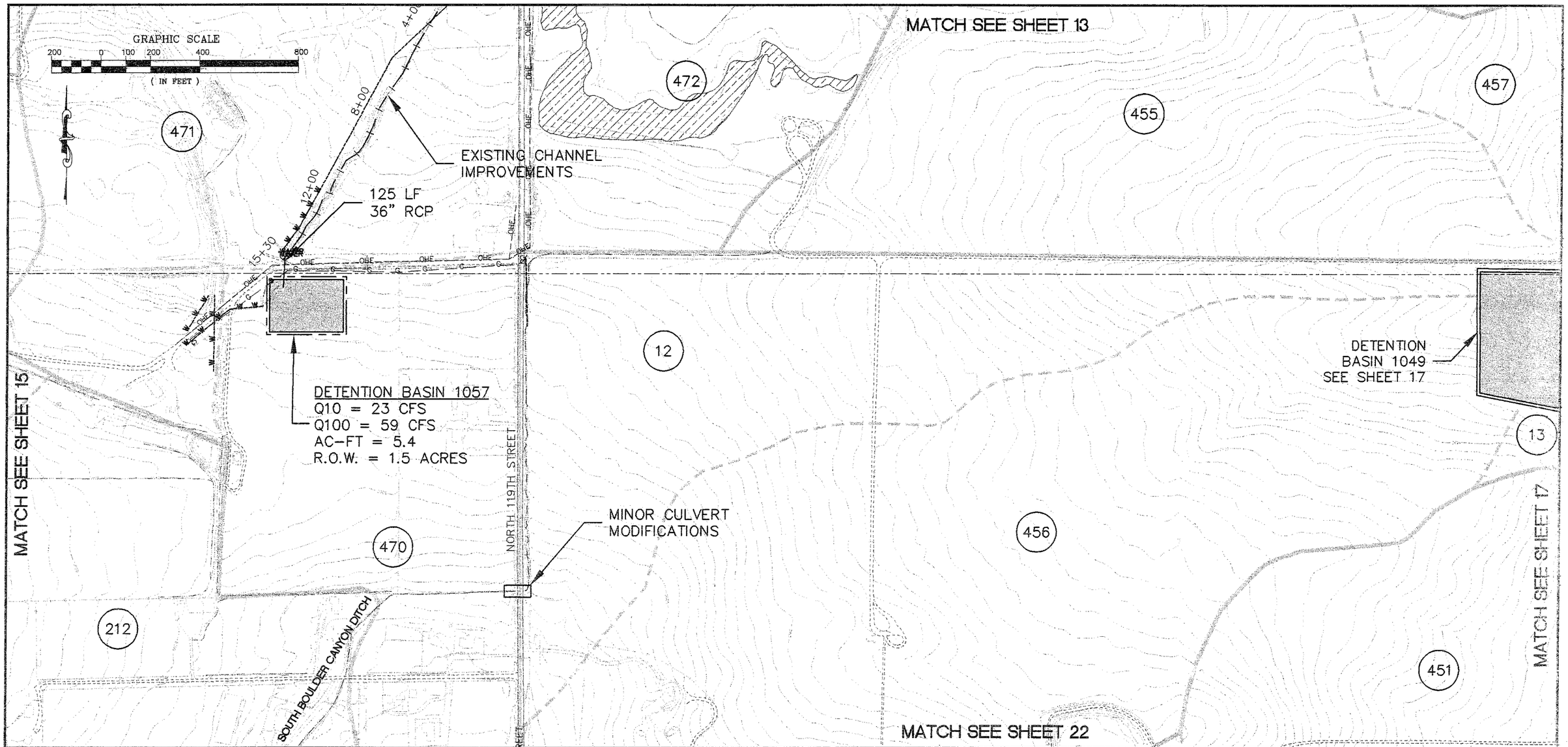
COMMENTARY ON SHEET 16

Detention Basin 1057 with a 36-inch RCP outlet is presented on this sheet.

Irrigation modifications include minor culvert modifications on the South Boulder Canyon Ditch.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
16		Minor Culvert Modifications		South Boulder Canyon Ditch	$ 7,000
16	1057	Detention Basin and Outlet			$ 342,705



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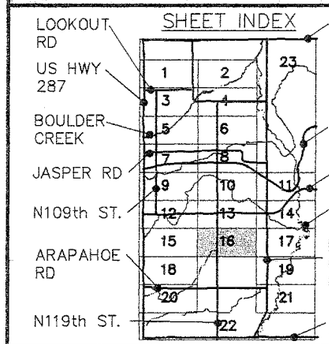

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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

PRELIMINARY
DESIGN PLAN

Date: Friday, October 05, 2001 - 2:05:41 pm
Modification: Feb 26, 2001 - 8:04am By: D'Ann
Name: F:\PROJECTS\99026\DRAWINGS\SHEET16.dwg
Attachments: BASEMAP [F:\PROJECTS\99026\DRAWINGS\BASEMAP.dwg]

COMMENTARY ON SHEET 17

The improvements for outfall system CC60 includes a 4,263-foot grass lined channel with trickle channel and drop structures.

Improvements for outfall CC60 continue on Sheet 14.

Profiles for CC60 are shown on Sheet 32.

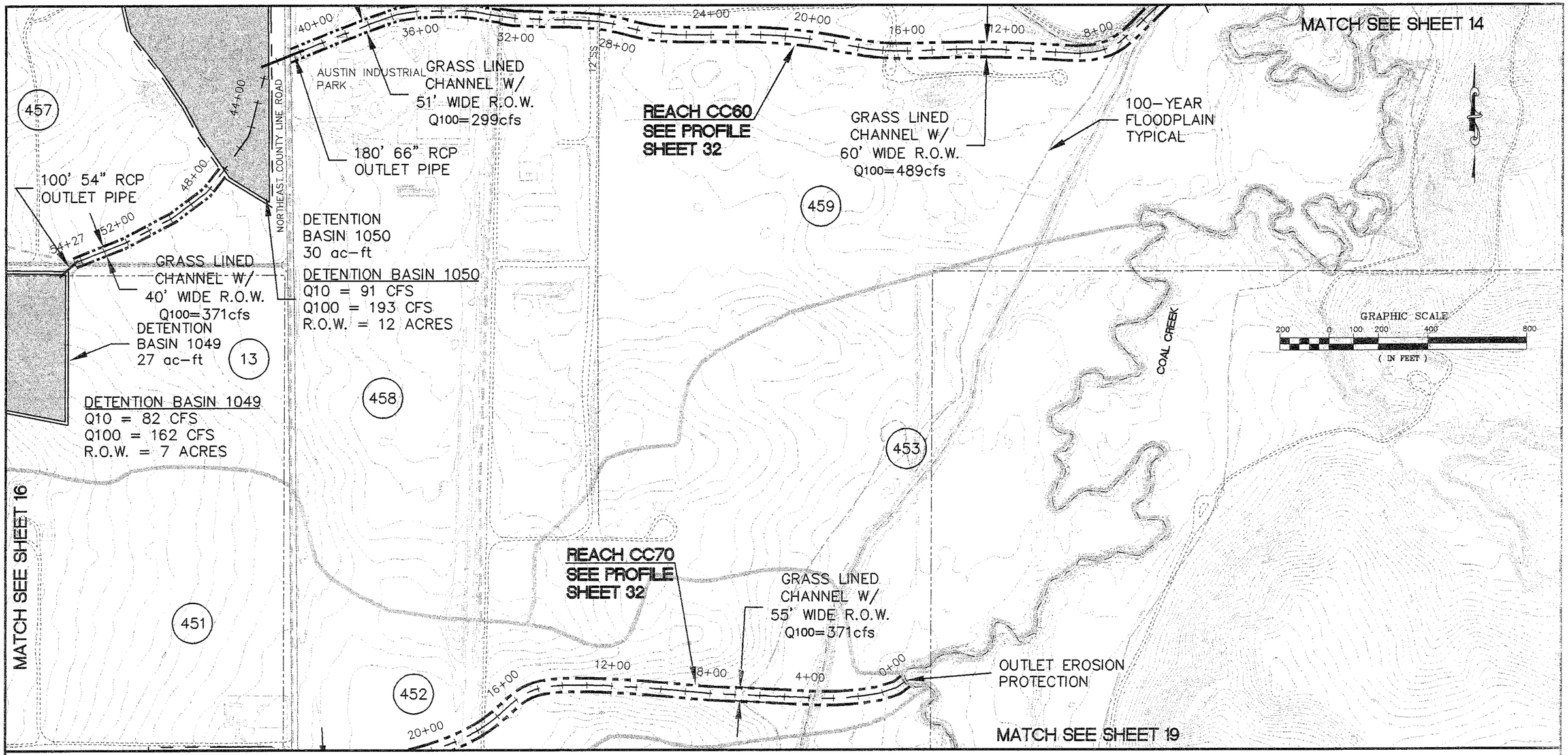
The improvements for outfall system CC70 includes a 2,100-foot grass lined channel with trickle channel and drop structures.

Improvements for outfall CC70 continue on Sheet 19.

Profiles for CC70 are shown on Sheet 32.

Detention Basin 1050 with a 66-inch RCP outlet and Detention Basin 1049 with a 54-inch RCP outlet are also presented on this sheet.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
17	CC60	Channel	4,263		$ 1,045,365
17	CC70	Channel	2,100		$ 536,491
17	1049	Detention Basin and Outlet			$ 1,297,523
17	1050	Detention Basin and Outlet			$ 2,325,558



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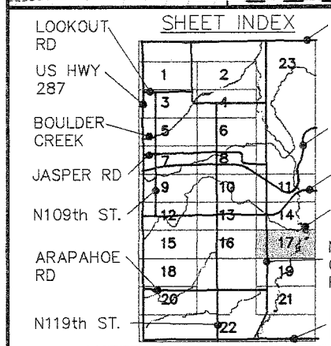

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DATE:	02-01

TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

PRELIMINARY
DESIGN PLAN

Date: Friday, Apr 08, 2011
Last Modification: Apr 30, 2001 - 11:35am By: D'Ann
File Name: F:\PROJECTS\99228\DRAWINGS\SHEET17.dwg
Attachments: BASEMAP [F:\PROJECTS\99228\DRAWINGS\BASEMAP.dwg]

COMMENTARY ON SHEET 18

The improvements for outfall system BP20 includes a 3,217-foot grass lined channel with trickle channel, drop structures and grade control structures and a 100-foot 8'x6' RCB.

Improvements for outfall BP20 continue on Sheets 15 and 20.

Profiles for BP20 are shown on Sheet 29.

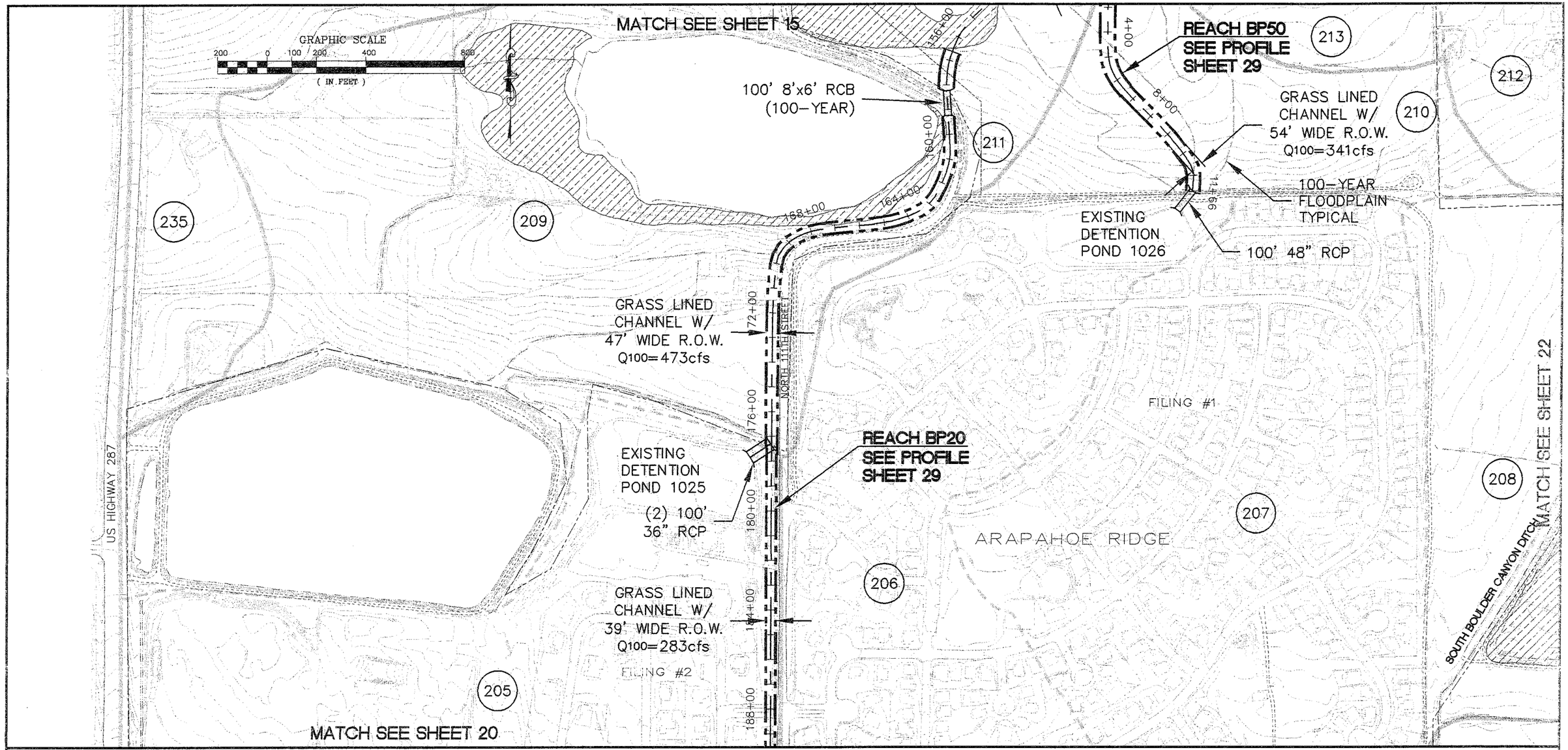
The improvements for outfall system BP50 includes a 916-foot grass lined channel with trickle channel and drop structures.

Improvements for outfall BP50 continue on Sheet 15.

Profiles for BP50 are shown on Sheet 29.

Existing Detention Basin 1025 with 2 proposed 100-foot 36" RCP outlets and existing Basin 1026 with a proposed 100-foot 48" RCP outlet are also presented on this sheet.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
18	BP20	Channel	3,217		$ 740,263
18	BP20	8'x6' Culvert	100	N. 111th ST.	$ 148,400
18	BP50	Channel	916		$ 236,714
18	1025	Detention Basin Outlet (2) 36" RCP	100		$ 28,000
18	1026	Detention Basin Outlet 48" RCP	100		$ 19,600



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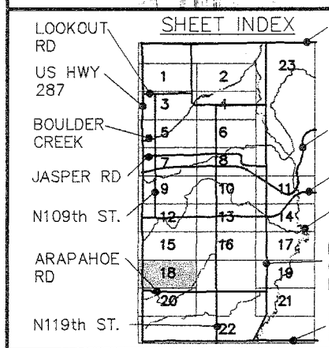

LEGEND

- CATCHMENT BOUNDARY
- SUB CATCHMENT BOUNDARY
- ERIE TOWN LIMITS
- CATCHMENT I.D. (000)
- CHANNEL CENTERLINE
- DRAINAGE R.O.W.
- DETENTION BASIN
- CULVERT
- STORM SEWER
- POTENTIAL WETLANDS
- OVERHEAD ELECTRIC
- BURIED ELECTRIC
- CABLE TV
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- GAS
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- SANITARY SEWER
- SEWER-UDR

DATUM:
VERTICAL: NAVD = 1988,
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CONTROL POINTS:
NGS CONTROL POINTS: ERIE
JR 53 5026, TRICO AND WANAKA

NOTES:

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   c. ALL DRAINAGE FACILITIES SHALL BE SIZED TO HANDLE FLOWS THAT ARE NOT REDUCED BY UPSTREAM DETENTION UNLESS THE DETENTION FACILITIES ARE PHYSICALLY IN PLACE AT THE TIME OF DESIGN. ASSUMING DETENTION WILL BE BUILT IN THE FUTURE IS NOT VALID AND WILL NOT BE ACCEPTED.

Love & Associates, Inc
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241 Front Street
Louisville, Colorado 80027-1849
Phone: 303-673-9795
Fax: 303-673-9796

DESIGNED:	RJP
DRAWN:	DM
CHECKED:	DJL
DATE:	02-01

TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

PRELIMINARY
DESIGN PLAN

Date: Apr 30, 2001 - 11:37am
Last Modification: Apr 30, 2001 - 11:37am
File Name: F:\PROJECTS\99228\DRAWINGS\SHEET18.dwg
Attachments: BASEMAP [F:\PROJECTS\99228\DRAWINGS\BASEMAP.dwg]
By: D'Ann

COMMENTARY ON SHEET 19

The improvements for outfall system CC70 includes a 542-foot grass lined channel with trickle channel.

Improvements for outfall CC70 continue on Sheet 17.

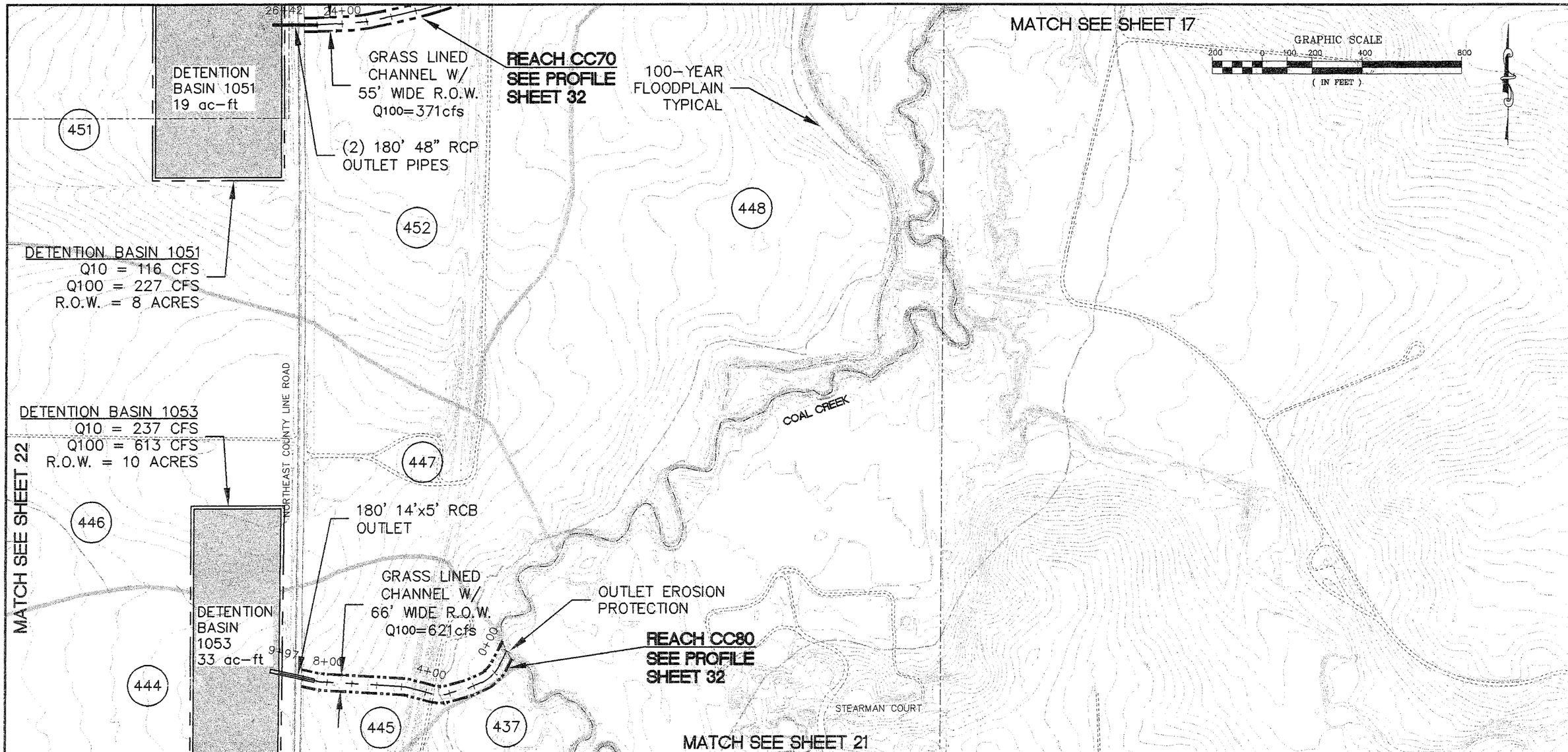
Profiles for CC70 are shown on Sheet 32.

The improvements for outfall system CC80 includes a 997-foot grass lined channel with trickle channel and drop structures.

Profiles for CC80 are shown on Sheet 32.

Detention Basins 1051 with (2)48-inch RCP outlets and Basin 1053 with a 14'x5' RCB outlet are also presented on this sheet.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
19	CC70	Channel	542		$ 111,366
19	CC80	Channel	997		$ 481,897
19	1051	Detention Basin and Outlet			$ 1,132,143
19	1053	Detention Basin and Outlet			$ 2,350,182



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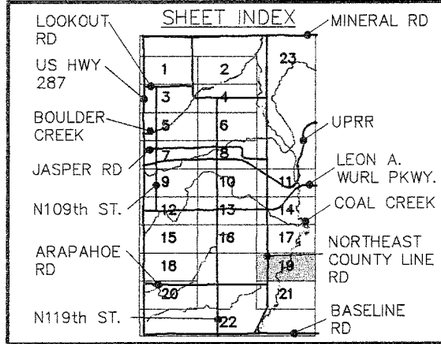

LEGEND

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JR 53 5026, TRICO AND WANAKA

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TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

PRELIMINARY
DESIGN PLAN

Date: Today
Last Modification: Apr 30, 2001 - 11:39am By: D'Ann
File Name: F:\PROJECTS\9922B\DRAWINGS\SHEET19.dwg
Attachments: BASEMAP (F:\PROJECTS\9922B\DRAWINGS\BASEMAP.dwg)

COMMENTARY ON SHEET 20

The improvements for outfall system BP20 includes a 386-foot grass lined channel with trickle channel and drop structures.

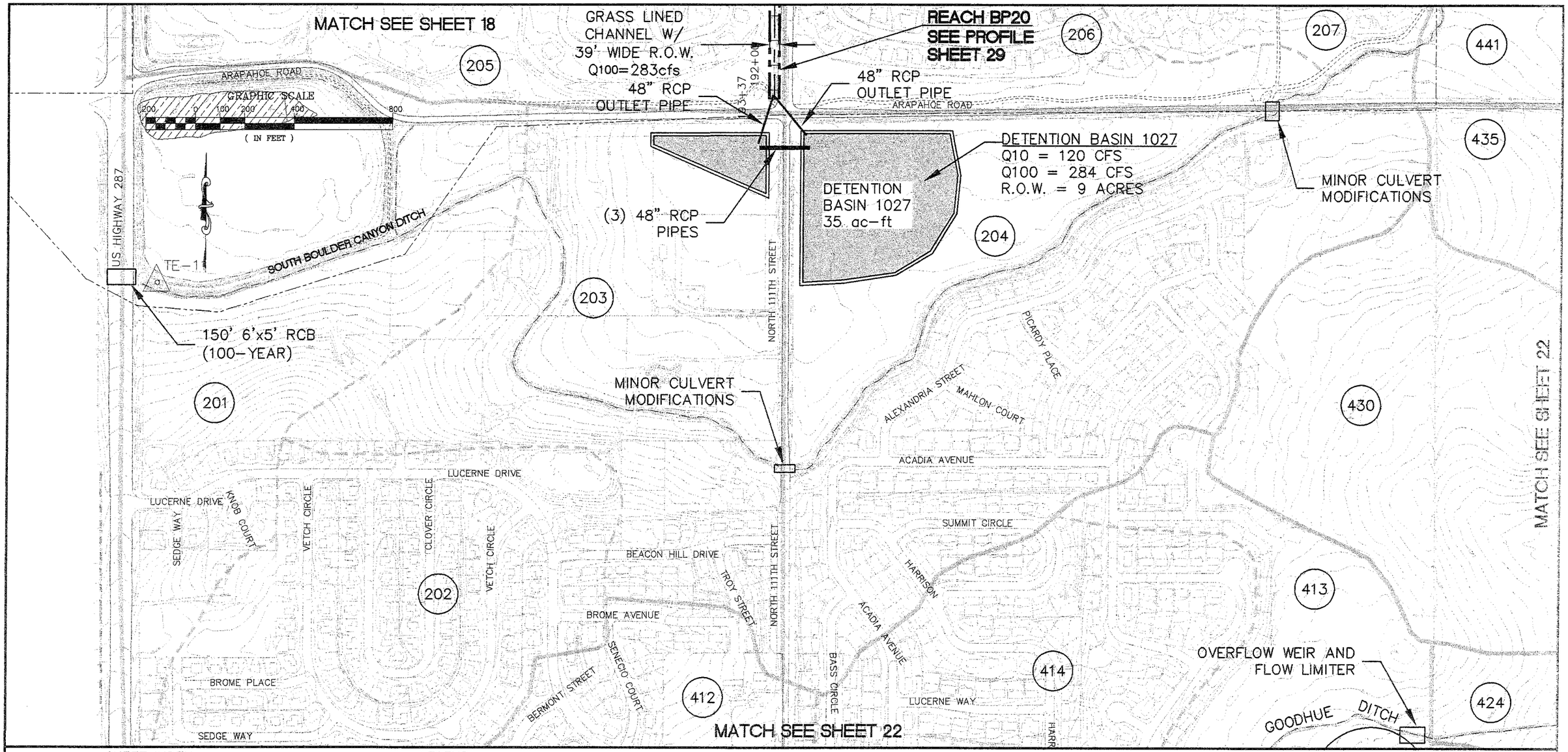
Improvements for outfall BP20 continue on Sheet 18.

Profiles for BP20 are shown on Sheet 29.

Irrigation modifications include an overflow weir and flow limiter on the Goodhue Ditch and minor culvert modifications on the South Boulder Canyon Ditch.

A proposed 150- foot 6'x5' RCB on Us Highway 287 and Detention Basin 1027 with (2)48-inch RCP outlets and (3)48-inch RCP connection pipes are also presented on this sheet.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
20	BP20	Channel	386		$ 67,887
20		6'x5' Culvert	150	US Hwy 287	$ 170,333
20	1027	Detention Basin and Outlet			$ 1,978,782
20		Minor Culvert Modifications		South Boulder Canyon Ditch	$ 7,000
20		Minor Culvert Modifications		South Boulder Canyon Ditch	$ 7,000
20		Overflow Weir/ Flow Limiter		Goodhue Ditch	$ 28,000



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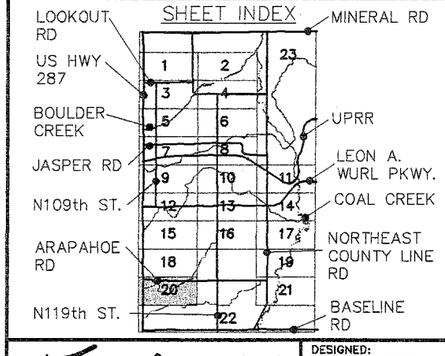

LEGEND

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JR 53 5026, TRICO AND WANAKA

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Fax: 303-673-9796

DESIGNED:	RJP
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CHECKED:	DJL
DATE:	02-01

TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

PRELIMINARY
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Date: Friday, Apr 30, 2021 - 11:41am By: G'Ann
Last Modification: Apr 05, 2021 - 11:41am By: G'Ann
File Name: F:\PROJECTS\99226\DRAWINGS\SHEET20.dwg
Attachments: BASEMAP [F:\PROJECTS\99226\DRAWINGS\BASEMAP.dwg]

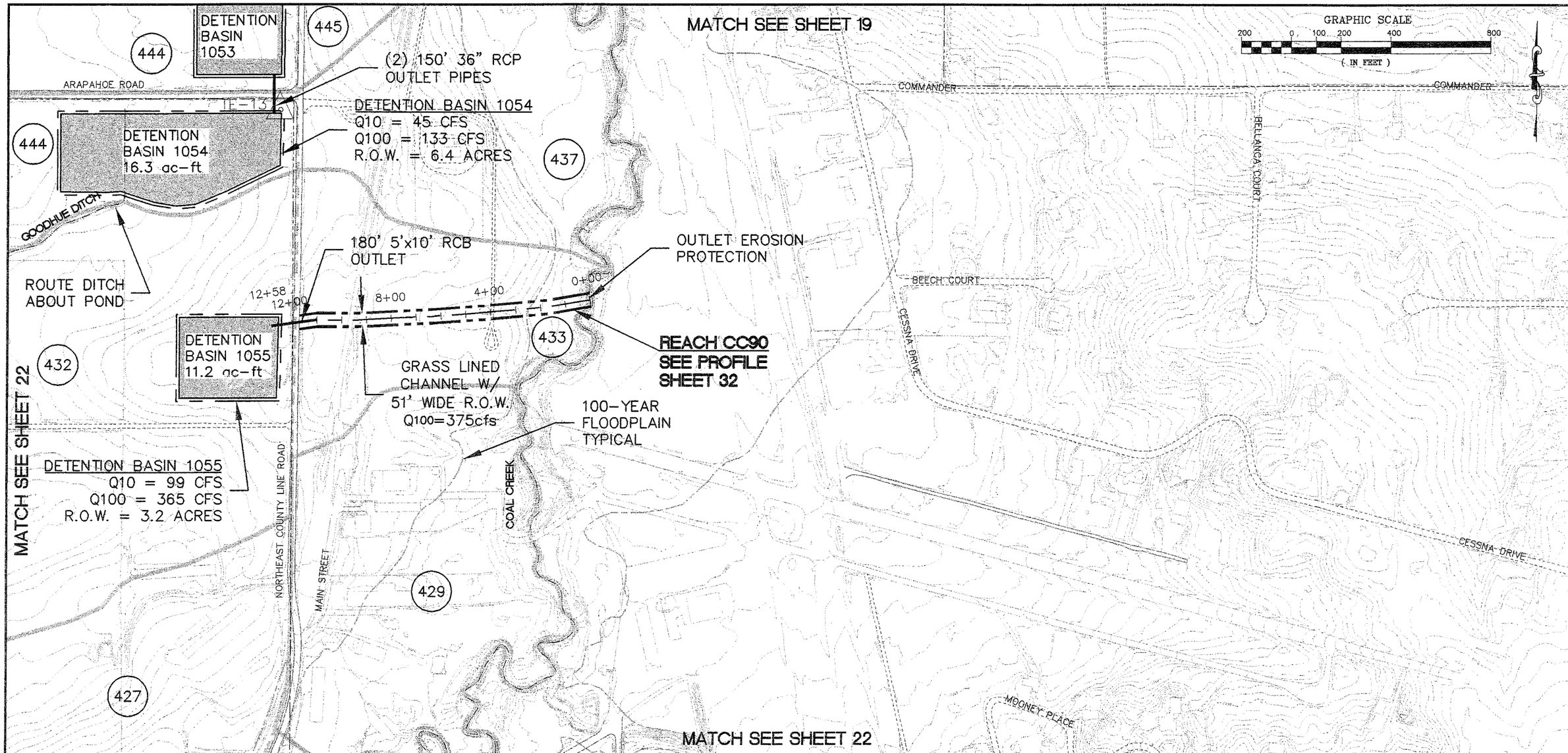
COMMENTARY ON SHEET 21

The improvements for outfall system CC90 includes a 1,258-foot grass lined channel with trickle channel and drop structures.

Profiles for CC90 are shown on Sheet 32.

Detention Basins 1054 with (2)36-inch RCP outlets and Basin 1055 with a 5'x10' RCB outlet are also presented on this sheet.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
21	CC90	Channel	1,258		$ 363,149
21	1054	Detention Basin and Outlet			$ 1,282,703
21	1055	Detention Basin and Outlet			$ 852,922
21		Conduit or Move Ditch		Goodhue Ditch	$ 14,000



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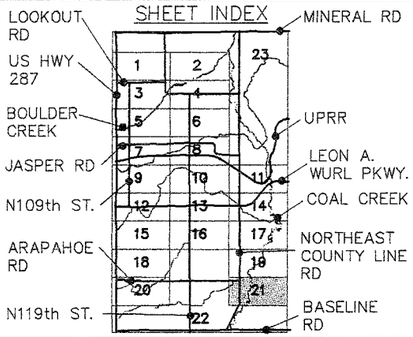

LEGEND

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DESIGNED:	RJP
DRAWN:	DM
CHECKED:	DJL
DATE:	02-01

TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

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DESIGN PLAN

DATE: FEBRUARY 1, 2001
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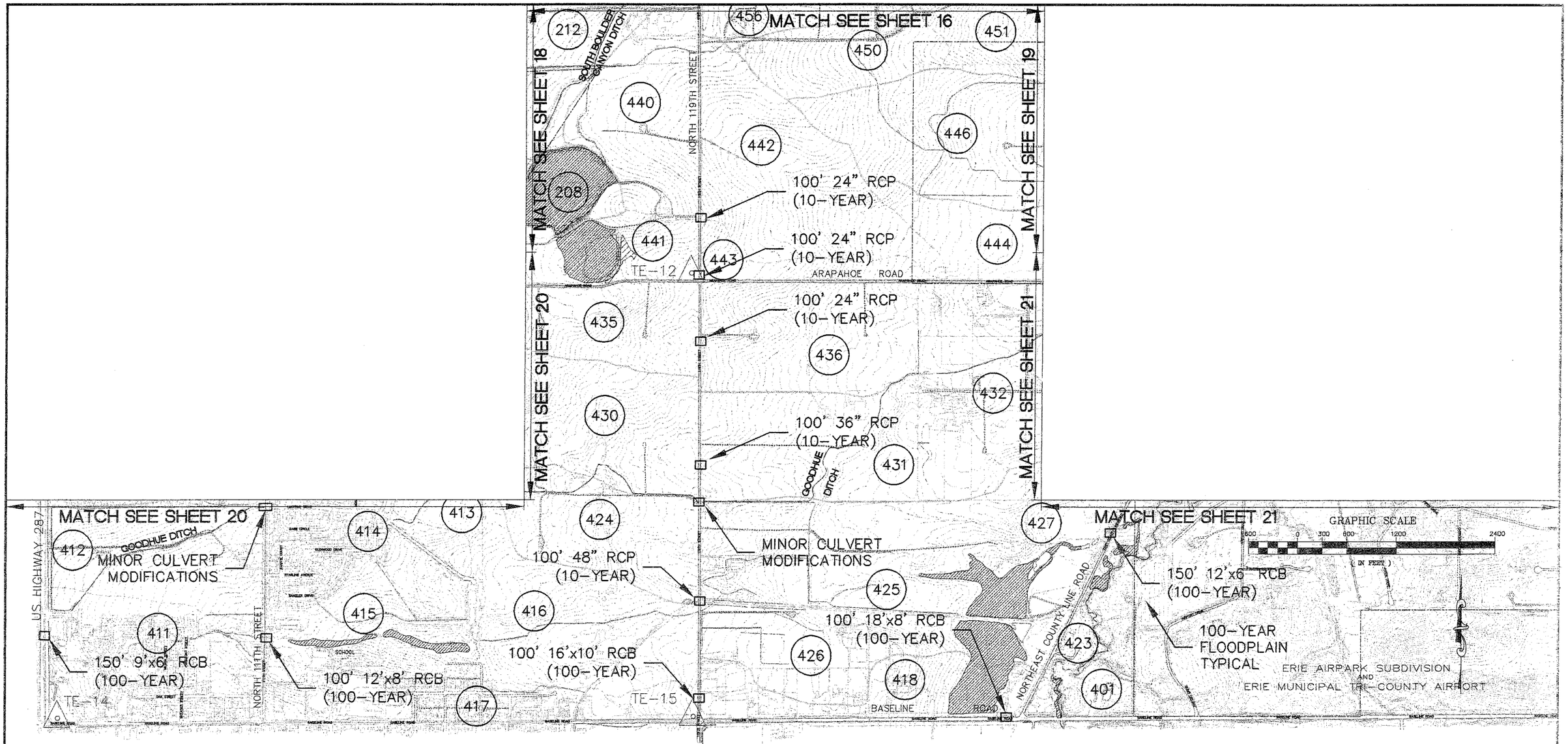
COMMENTARY ON SHEET 22

Irrigation modifications include minor culvert modifications on the Goodhue Ditch.

Proposed culvert improvements are presented on this sheet.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
22		9'x6' Culvert	150	US Highway 287	$ 222,289
22		12'x8' Culvert	100	N. 111TH St.	$ 207,511
22		16'x10' Culvert	100	N. 119TH St.	$ 269,111
22		48" Culvert	100	N. 119TH St.	$ 58,800
22		36" Culvert	100	N. 119TH St.	$ 42,000
22		24" Culvert	100	N. 119TH St.	$ 33,600
22		24" Culvert	100	N. 119TH St.	$ 33,600
22		24" Culvert	100	N. 119TH St.	$ 33,600
22		18'x8' Culvert	100	Baseline Road	$ 254,178
22		12'x6' Culvert	150	NE County Line Road	$ 257,289
22		Minor Culvert Modifications		Goodhue Ditch	$ 7,000
22		Minor Culvert Modifications		Goodhue Ditch	$ 7,000



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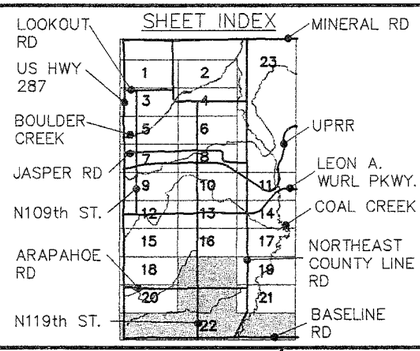

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CHECKED:	DJL
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DATE: FEBRUARY 1, 2001
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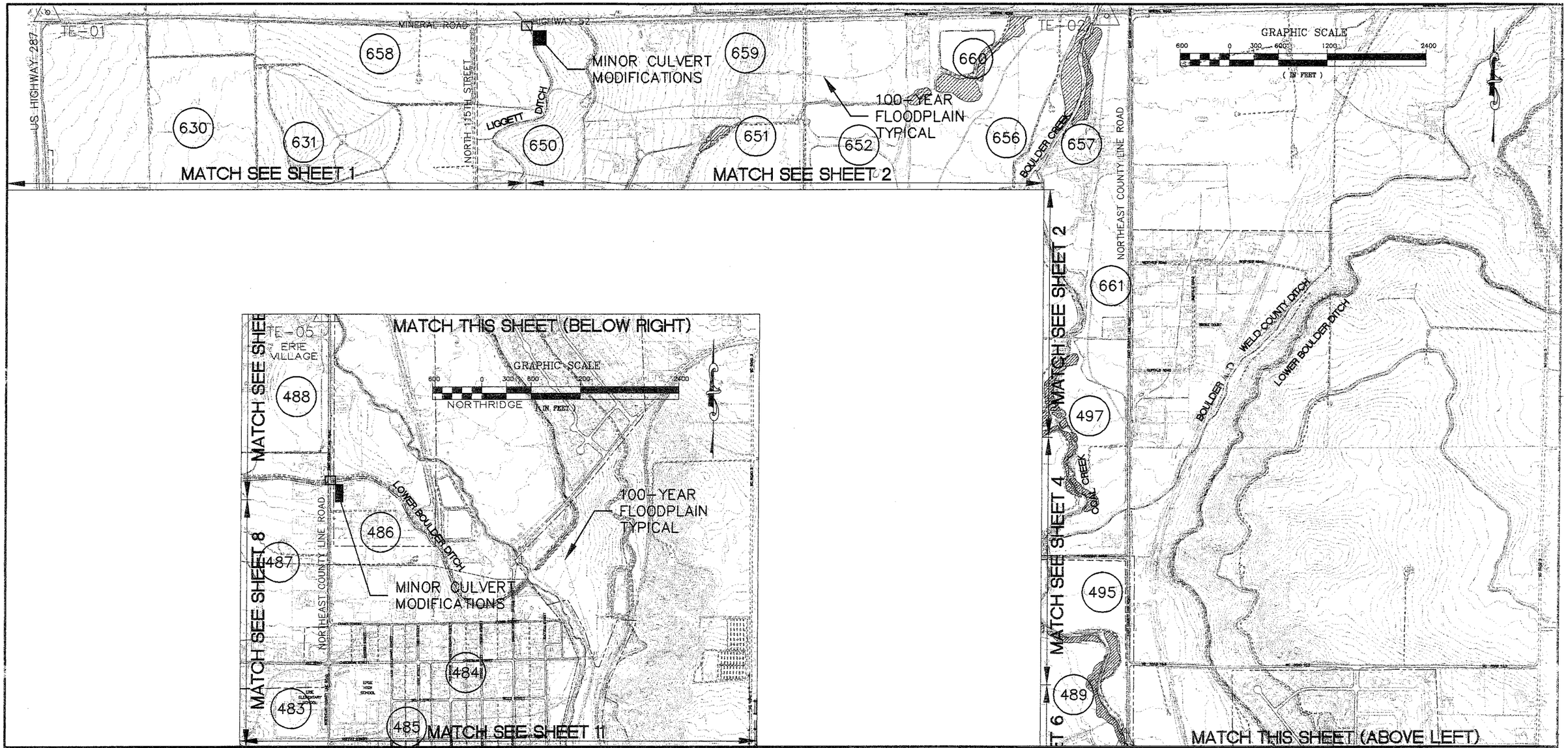
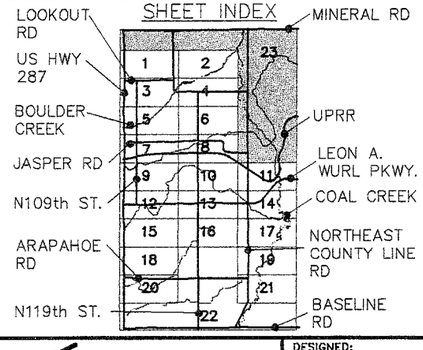
COMMENTARY ON SHEET 23

Irrigation modifications include minor culvert modifications on the Leggett Ditch and Lower Boulder Ditch.

Sheet No.	Outfall	Improvement	Linear Feet	Irrigation Modification	Cost
23		Minor Culvert Modifications		Liggett Ditch	$ 7,000
23		Minor Culvert Modifications		Lower Boulder Ditch	$ 7,000



SHEET INDEX



LEGEND

- CATCHMENT BOUNDARY
- SUB CATCHMENT BOUNDARY
- ERIE TOWN LIMITS
- CATCHMENT I.D. (000)
- CHANNEL CENTERLINE
- DRAINAGE R.O.W.
- DETENTION BASIN
- CULVERT
- STORM SEWER
- POTENTIAL WETLANDS

- OVERHEAD ELECTRIC
- BURIED ELECTRIC
- CABLE TV
- TELEPHONE
- GAS
- WATER
- SANITARY SEWER
- SEWER-UDR

DATUM:
VERTICAL: NAVD = 1988,
HORIZONTAL = COLORADO STATE PLANE COORDINATE SYSTEM NORTH ZONE.

CONTROL POINTS:
NGS CONTROL POINTS: ERIE
JR 53 5026, TRICO AND WANAKA

NOTES:

1. THIS DRAWING IS FOR MASTER PLANNING PURPOSES AND REPRESENTS PRELIMINARY AND CONCEPTUAL ENGINEERING. ALTERNATIVES TO THIS OUTFALL SYSTEM WILL BE CONSIDERED BY LOCAL REVIEWING AGENCIES AND THE URBAN DRAINAGE AND FLOOD CONTROL DISTRICT PROVIDED THE ALTERNATIVE OFFERS EQUAL HYDROLOGIC RESPONSE, HYDRAULIC CAPACITY AND STREAM STABILITY. THE ALTERNATIVE MUST COMPLY WITH ALL REQUIREMENTS OF THE LOCAL JURISDICTION AND THE URBAN DRAINAGE AND FLOOD CONTROL DISTRICT. THIS DRAWING SHALL NOT BE USED FOR CONSTRUCTION PURPOSES.

2. THE TOWN OF ERIE AND BOULDER COUNTY MANAGE AND REGULATE ALL LAND DEVELOPMENT AND REDEVELOPMENT WITHIN THE 100-YEAR FLOODPLAINS SO AS TO PREVENT FUTURE FLOOD DAMAGES BY FOLLOWING THE RECOMMENDATIONS OF THIS PLAN.

3. WHEN REGIONAL BASINS ARE NOT CONSTRUCTED:
   a. IF DEVELOPMENT OCCURS IN ANY SUB-CATCHMENT SERVED BY ANY OF THE REGIONAL DETENTION BASINS BEFORE THE REGIONAL DETENTION BASIN IS IN EXISTENCE ON THE GROUND, DEVELOPMENT SHALL PROVIDE ON-SITE WATER QUALITY AND 10- AND 100-YEAR DETENTION.
   b. STORAGE VOLUME AND THE ALLOWABLE RELEASE RATES FOR ALL ON-SITE DETENTION BASINS SHALL BE BASED ON THE EQUATIONS (CHARTS) FOR WATER QUALITY CAPTURE VOLUME CONTAINED IN UD&FCD URBAN STORM DRAINAGE CRITERIA MANUAL - VOLUME 3 AND FOR 10- AND 100-YEAR PEAK FLOW CONTROLS THE EQUATIONS DEVELOPED BY ENGINEER FOR THIS FINAL PLAN.
   c. ALL DRAINAGE FACILITIES SHALL BE SIZED TO HANDLE FLOWS THAT ARE NOT REDUCED BY UPSTREAM DETENTION UNLESS THE DETENTION FACILITIES ARE PHYSICALLY IN PLACE AT THE TIME OF DESIGN. ASSUMING DETENTION WILL BE BUILT IN THE FUTURE IS NOT VALID AND WILL NOT BE ACCEPTED.

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TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

PRELIMINARY
DESIGN PLAN

DATE: FEBRUARY 1, 2001
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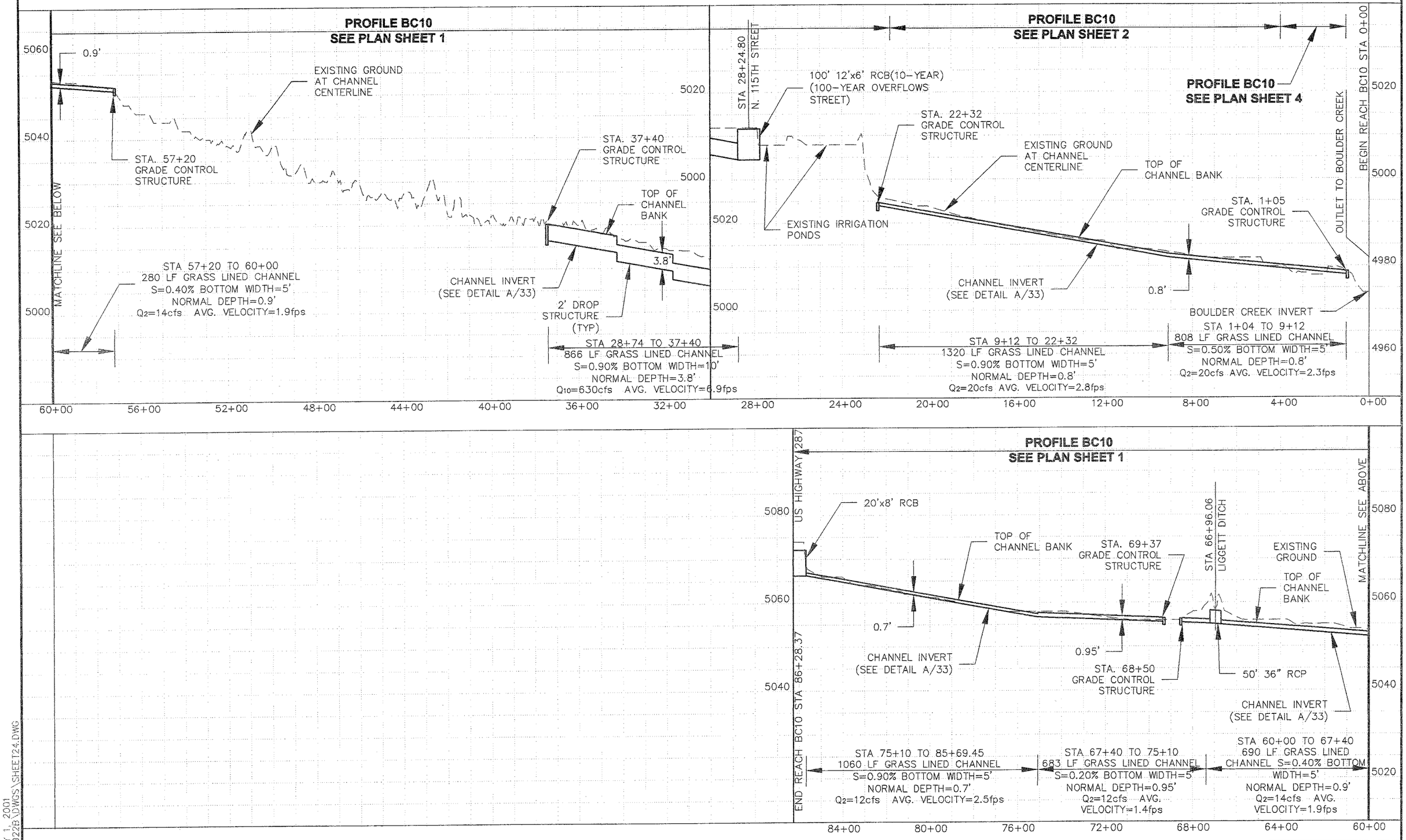

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TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

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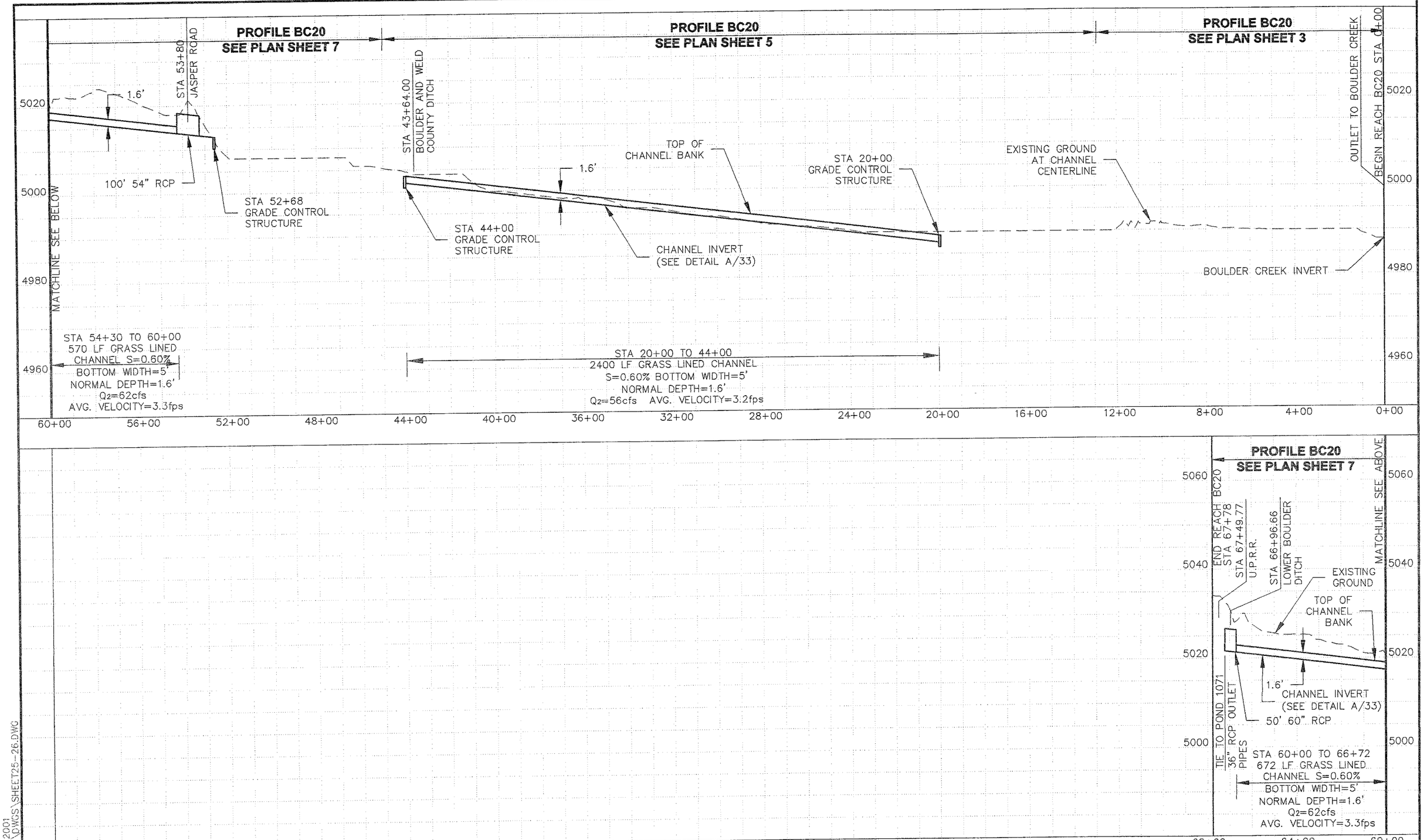

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TOWN OF ERIE
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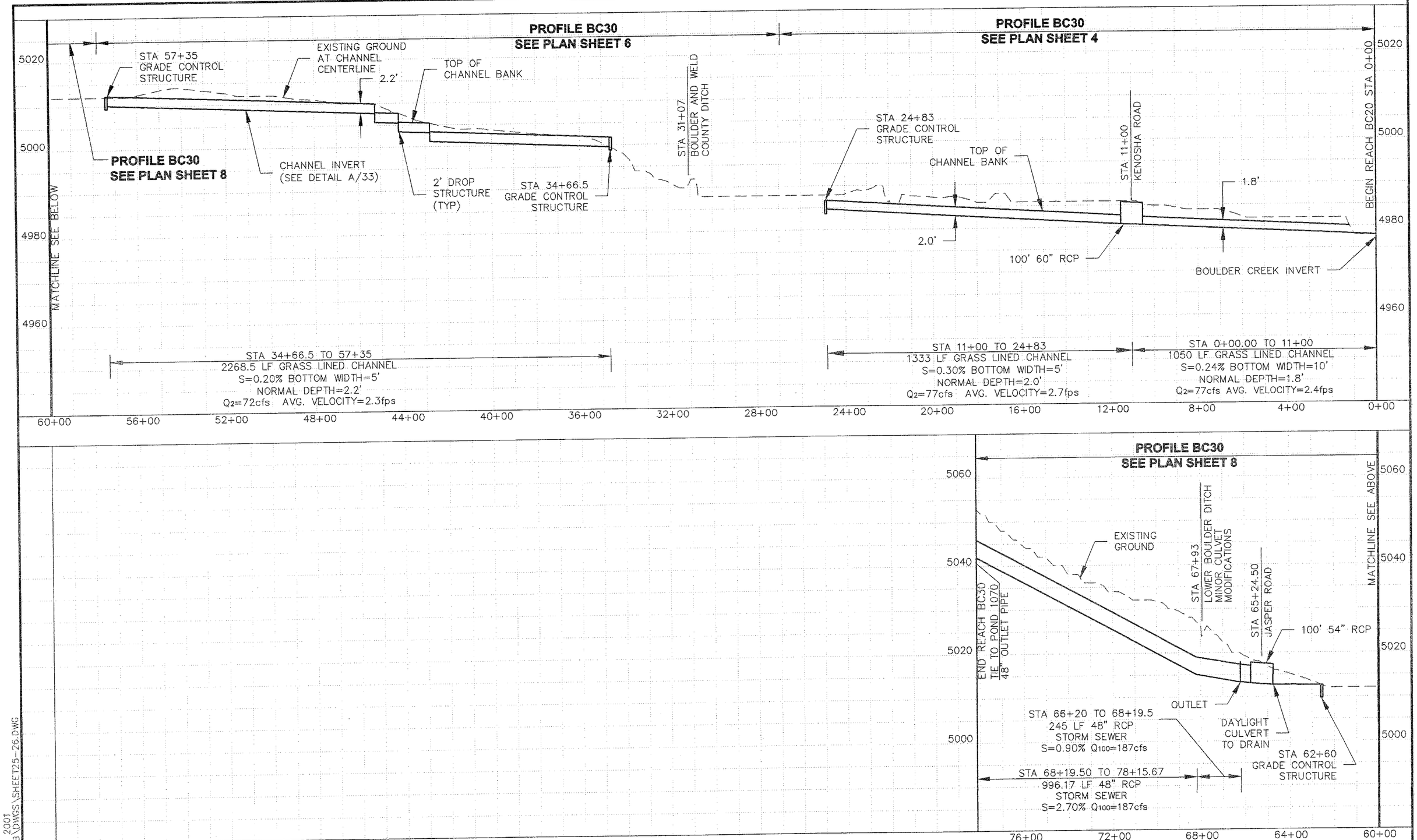

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TOWN OF ERIE
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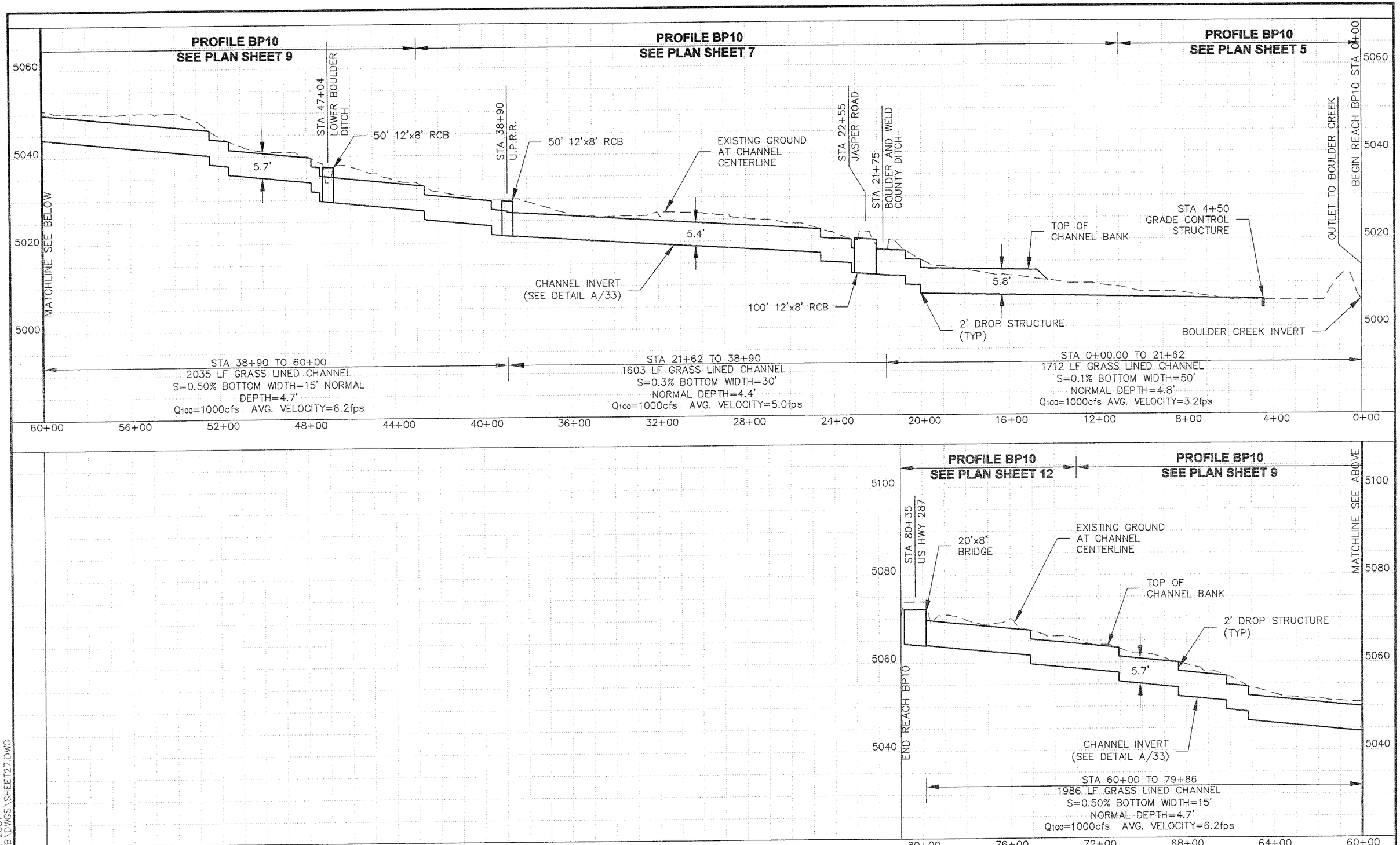

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TOWN OF ERIE
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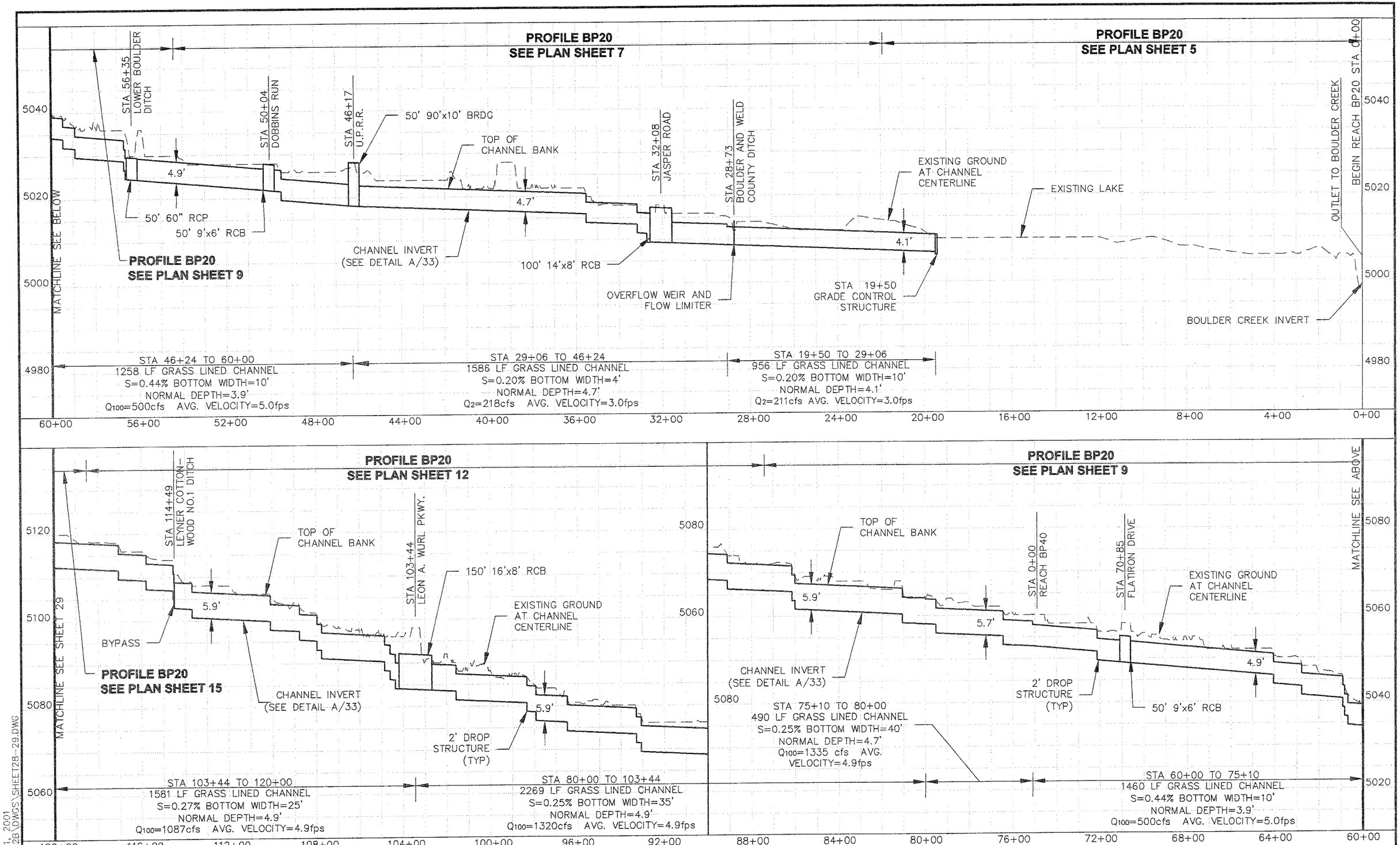

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DATE: FEBRUARY 1, 2001
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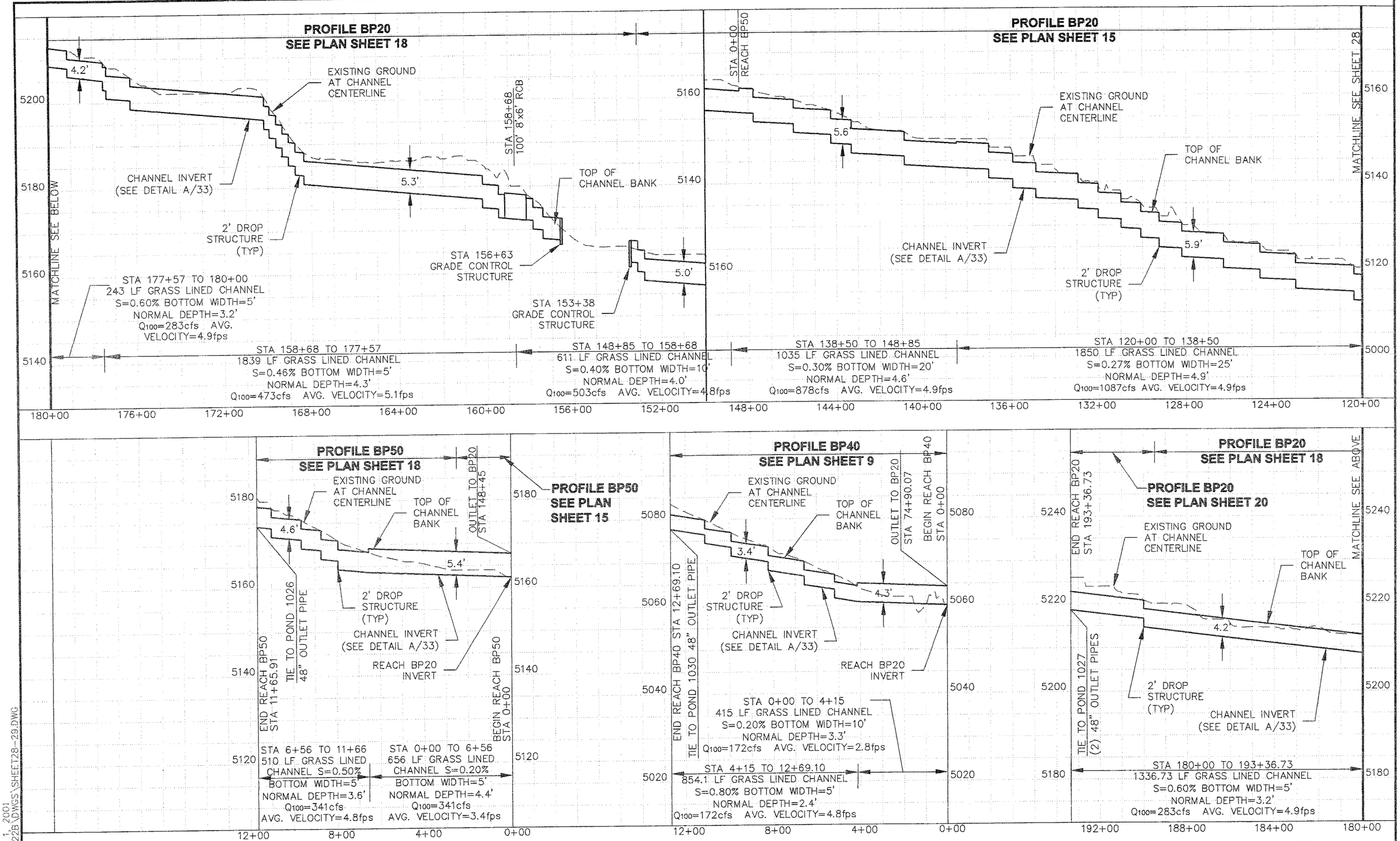

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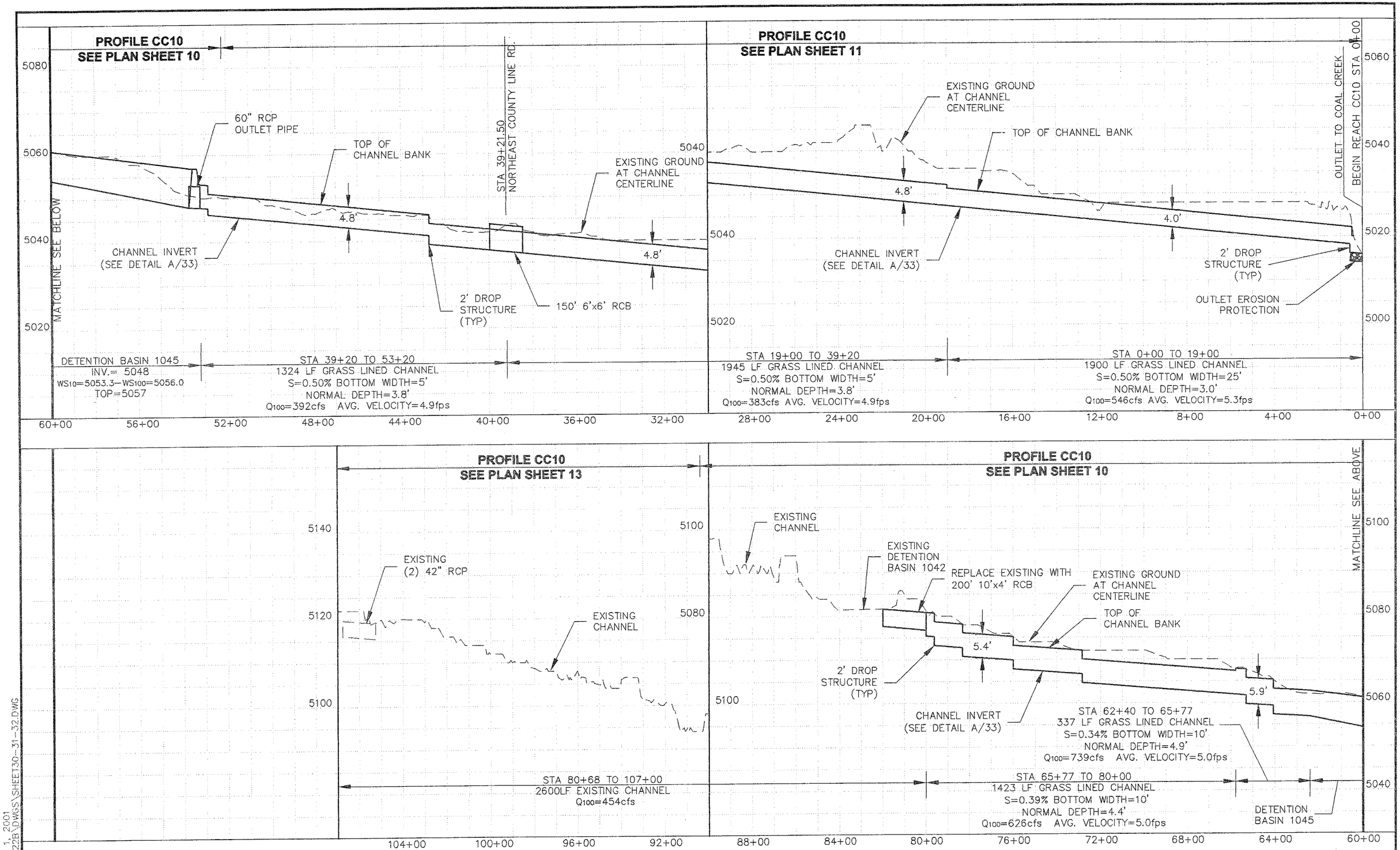

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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

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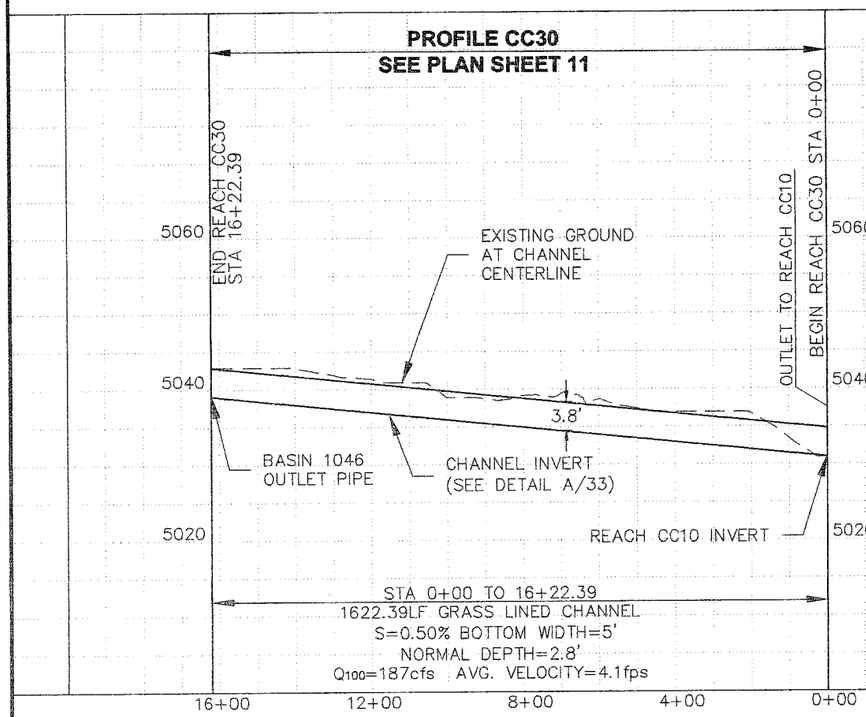
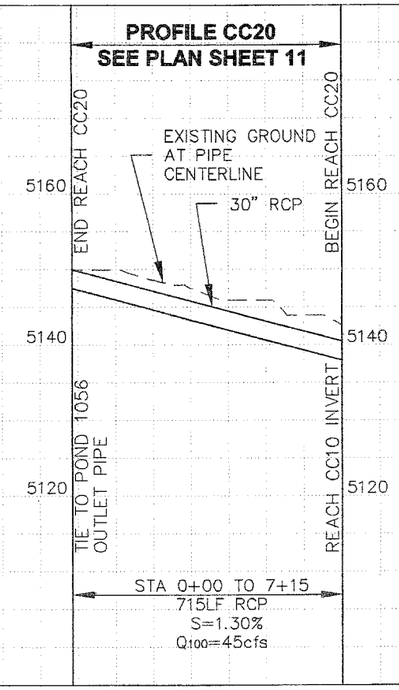
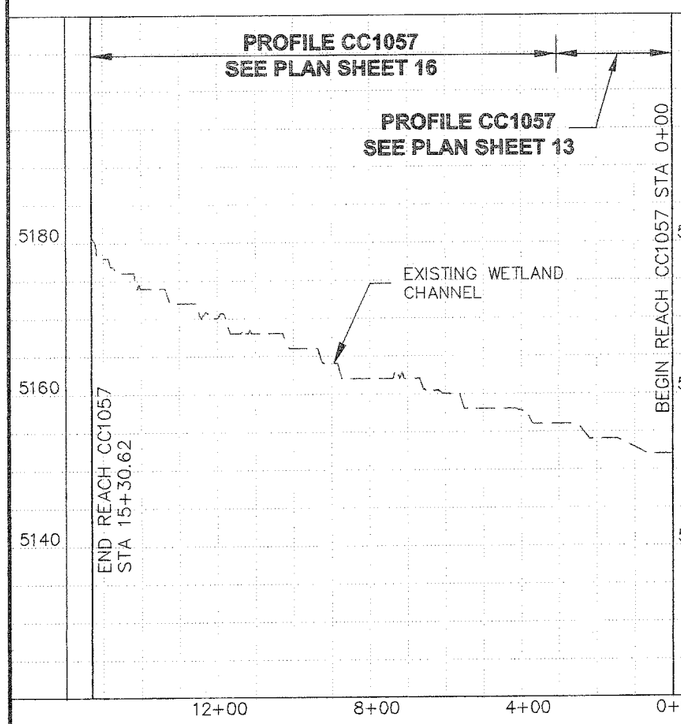
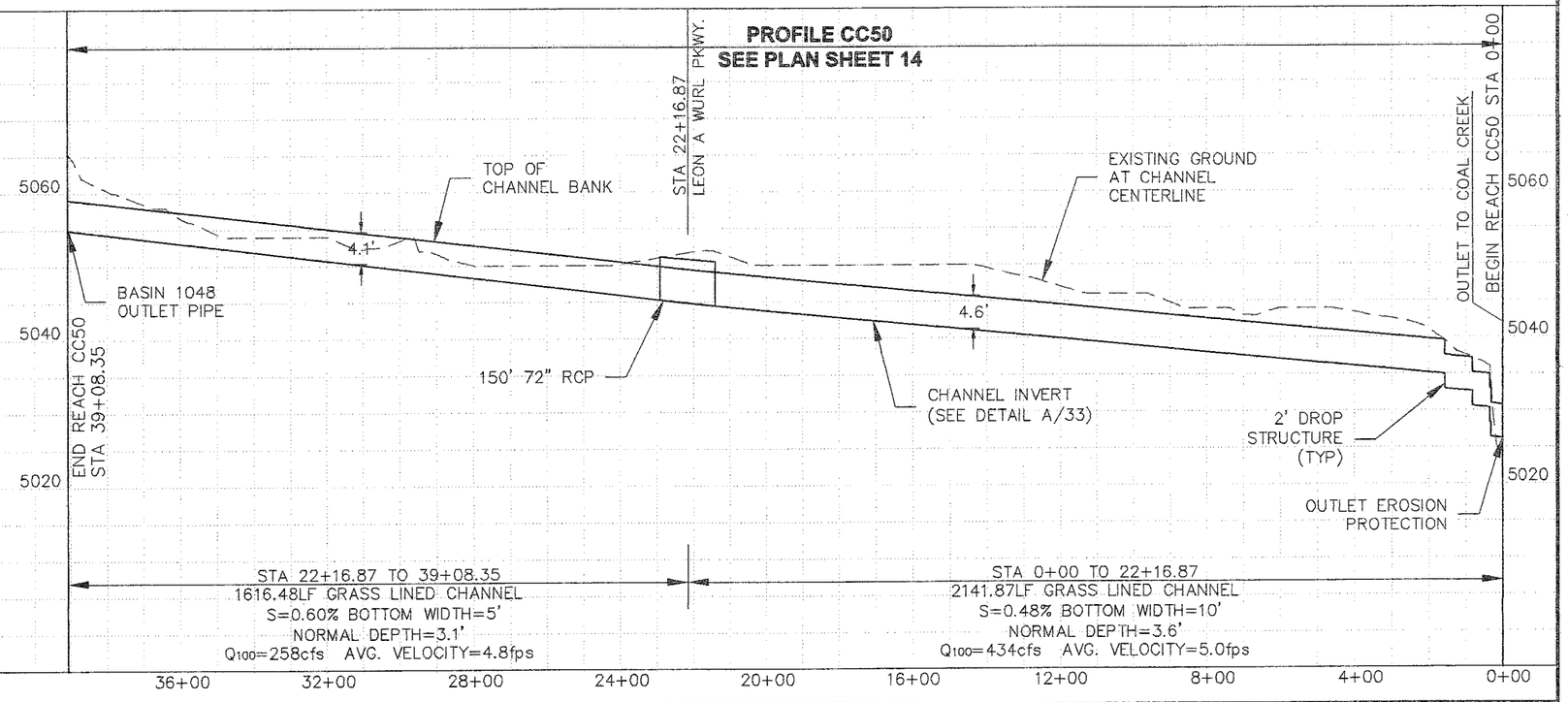
DESIGN PROFILE









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TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

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DESIGN PROFILE

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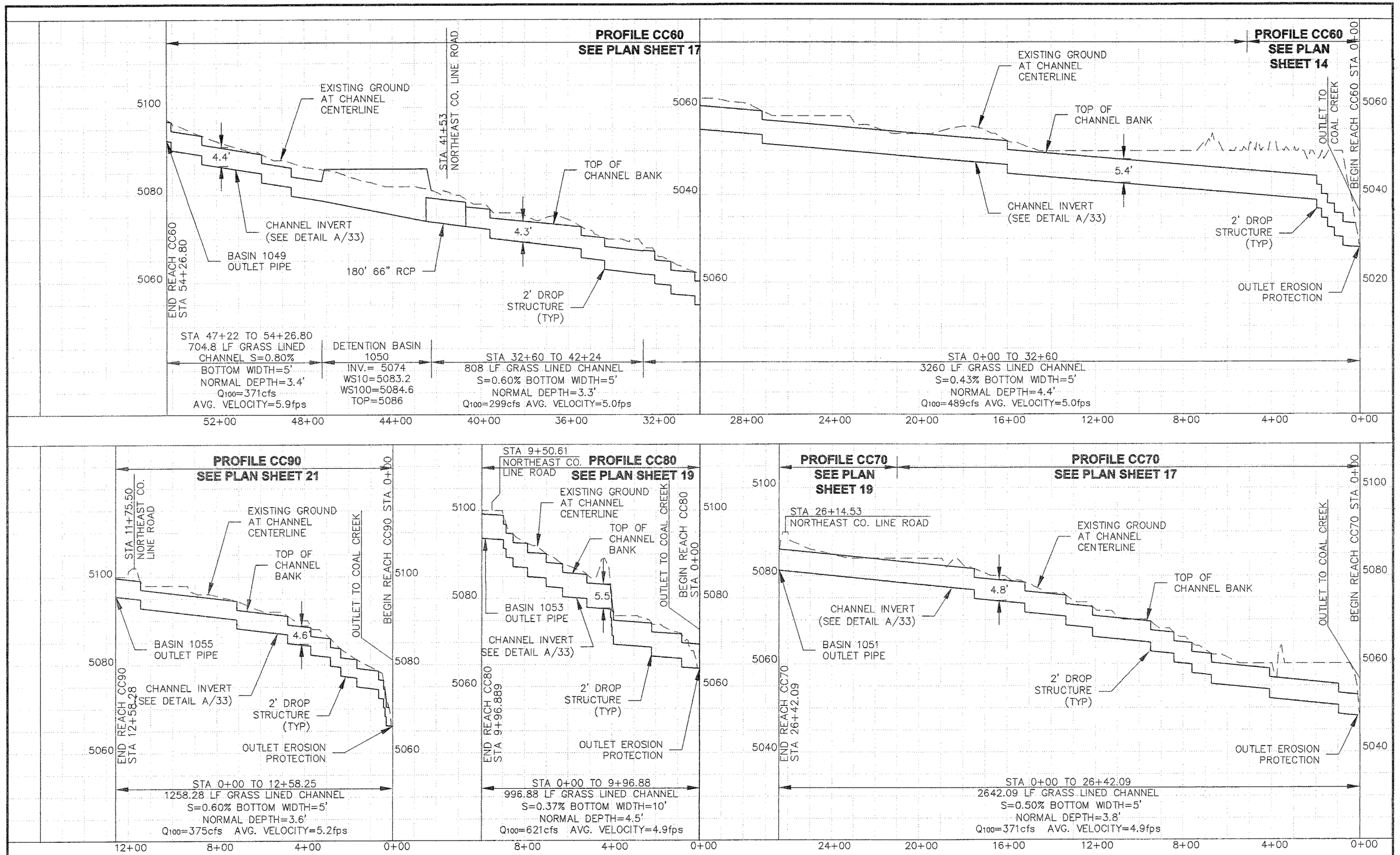

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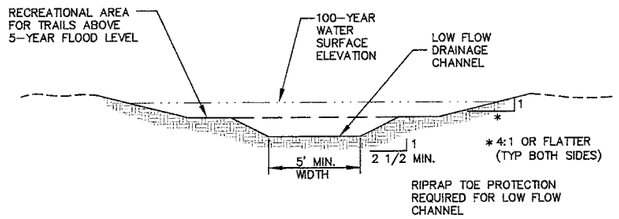
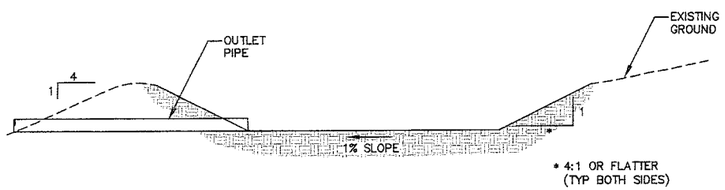


LOW FLOW DRAINAGE CHANNEL WITH OVERFLOW FOR MAJOR DRAINAGE RUNOFF

TYPICAL DRAINAGE CHANNEL — A
NTS



TYPICAL DETENTION POND — B
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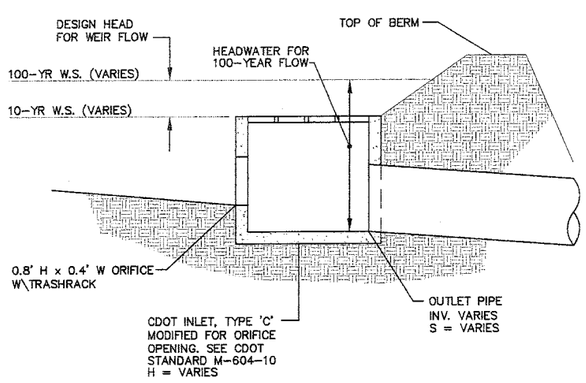

TYPICAL OUTLET STRUCTURE — C
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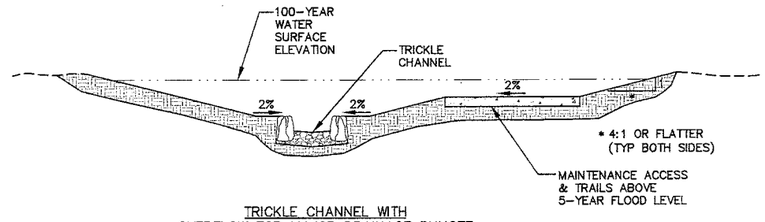

TRICKLE CHANNEL WITH OVERFLOW FOR MAJOR DRAINAGE RUNOFF

TYPICAL DRAINAGE CHANNEL — D
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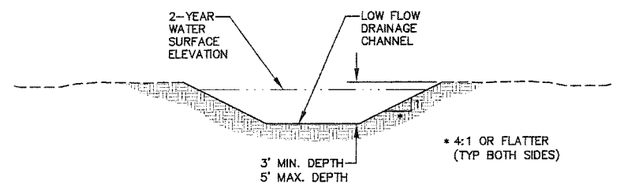

LOW FLOW CHANNEL
(OPEN SPACE AREAS ONLY) — E
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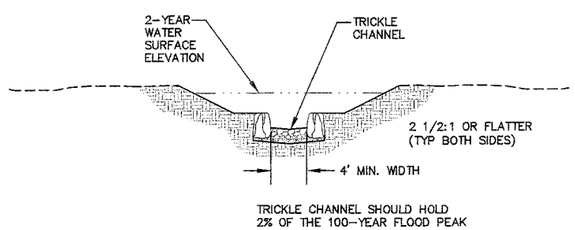

TRICKLE CHANNEL — F
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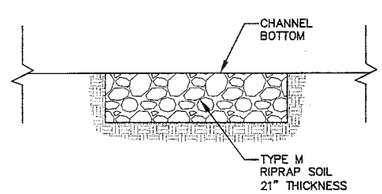

GRADE CONTROL STRUCTURE — G
(OPEN SPACE AREAS ONLY)
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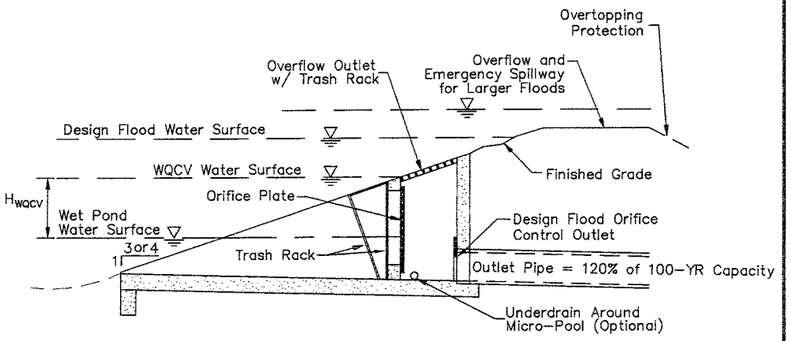

TYPICAL WATER QUALITY OUTLET — H
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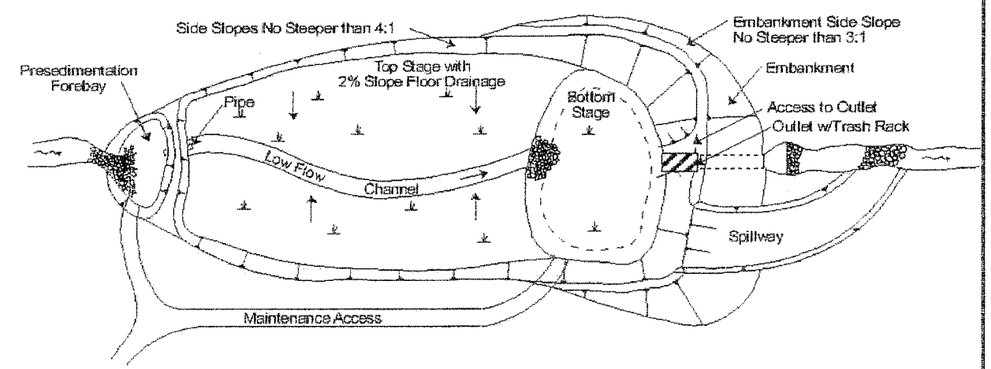
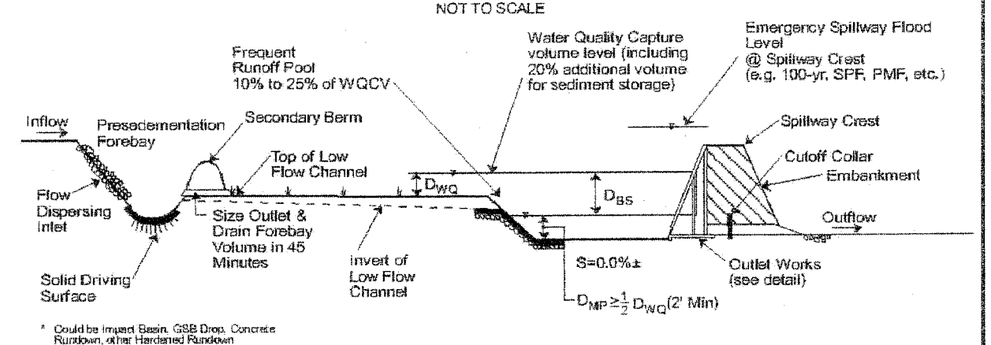


PLAN
NOT TO SCALE



SECTION
NOT TO SCALE

DRY EXTENDED DETENTION BASIN — J
NTS
UDFCD URBAN STORM DRAINAGE CRITERIA MANUAL (V.3) (UDFCD, 1999)

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TOWN OF ERIE
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ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

PRELIMINARY DESIGN DETAILS

DATE: FEBRUARY 2, 2001
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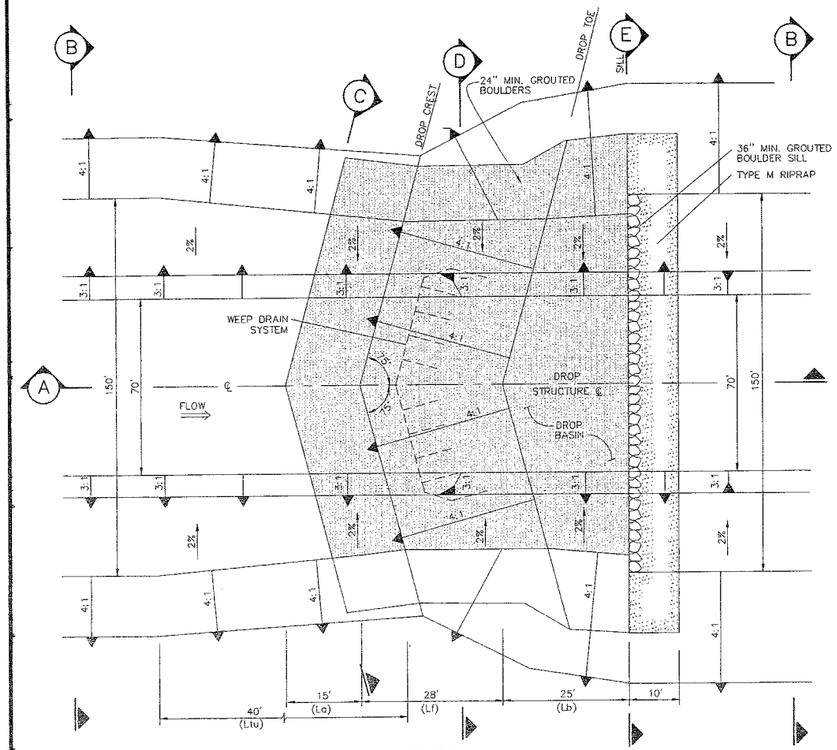
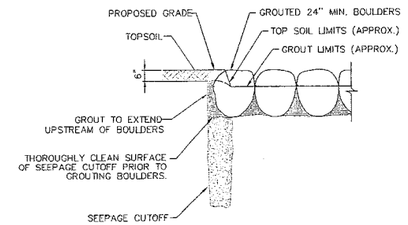


DROP STRUCTURE PLAN



SEEPAGE CUTOFF DETAIL (1)
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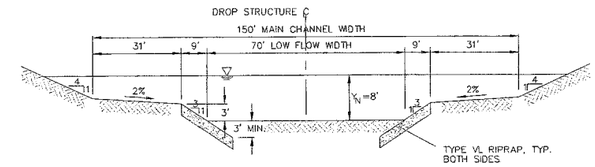

TYPICAL CHANNEL SECTION (UPSTREAM AND DOWNSTREAM OF DROP (B)
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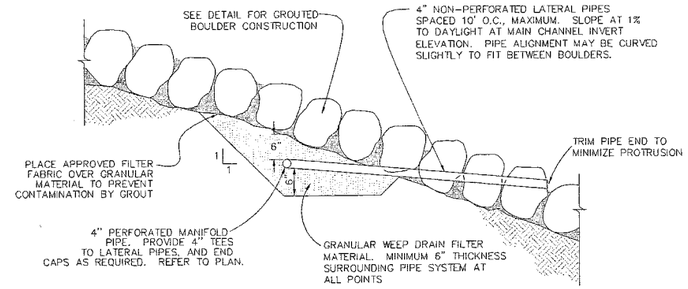

WEEP DRAIN SYSTEM DETAIL (2)
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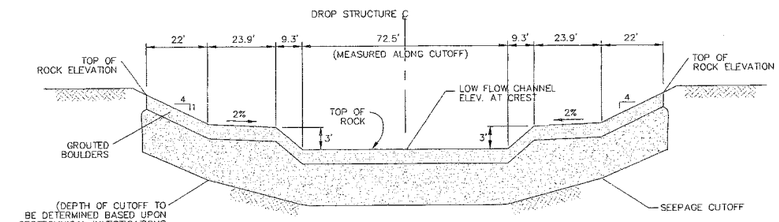

SEEPAGE CUTOFF SECTION (C)
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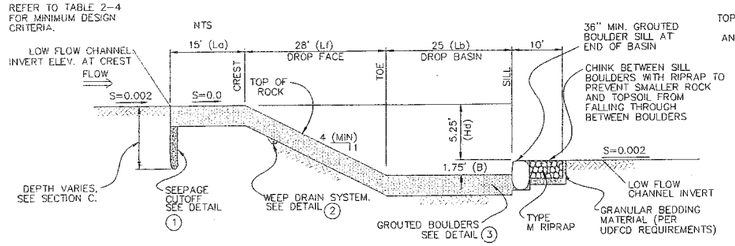
EXAMPLE:
Q=7,300 CFS
DROP HEIGHT= 5.25 FT.
REFER TO TABLE 2-4 FOR MINIMUM DESIGN CRITERIA.



DROP STRUCTURE PROFILE (A)
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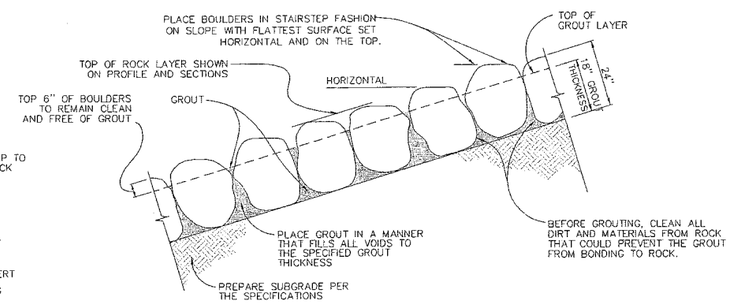

GROUTED BOULDER PLACEMENT DETAIL (3)
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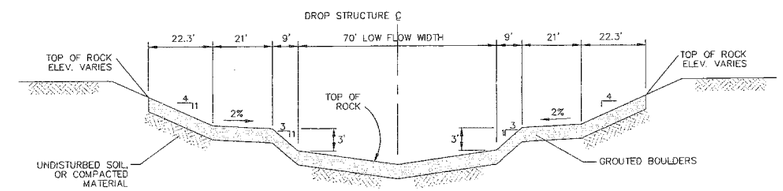

TYPICAL DROP FACE SECTION (D)
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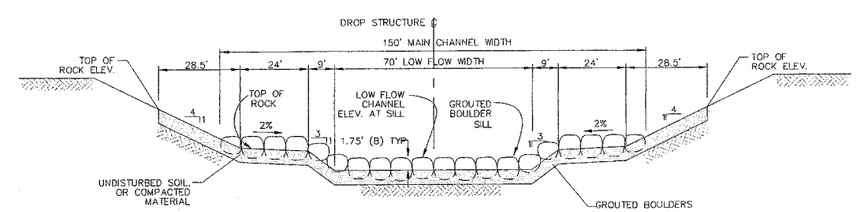

TYPICAL DROP BASIN SECTION AND SILL (E)
NTS

EXAMPLE CONSTRUCTION DETAILS – GROUTED SLOPING BOULDER DROP WITH LOW FLOW CHANNEL

GROUT NOTES

Material Specifications

1. All grout shall have a minimum 28-day compressive strength equal to 3000 psi.
2. One cubic yard of grout shall have a minimum of six (6) sacks of Portland cement.
3. Type II cement shall be used. A maximum of 25% fly ash may be substituted for the Portland cement.
4. The aggregate shall be comprised of 70% natural sand (fines) and 30% 3/8-inch rock (coarse).
5. The slump shall be 5-inches to 7-inches.
6. Air entrainment shall be 7 1/2 percent ± 1 1/2 percent.
7. To control shrinkage and cracking, 1.5 pounds of Fibermesh, or equivalent, shall be used per cubic yard of grout.

Placement Specifications

1. All grout shall be delivered by means of a low pressure (less that 10 psi) grout pump using a 2" diameter nozzle.
2. Full depth penetration of the grout into the boulders shall be required. To achieve this, grout shall be injected starting with the nozzle near the bottom and raising it as grout fills and is vibrated into place using a pencil vibrator.
3. After placement, exposed boulder faces shall be cleaned with a wet broom.
4. All grout between boulders shall be finished with a broom finish.
5. All grout shall be sprayed with a clear liquid membrane curing compound as specified in ASTM C-309.
6. Special procedures shall be required for grout placement when the air temperatures are less than 40°F or greater than 90°F. Contractor shall obtain prior approval from the design engineer of the procedures to be used for protecting the grout.

UDFCD URBAN STORM DRAINAGE CRITERIA MANUAL (UDFCD, 1996)

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ERIE AND ADJACENT AREAS
OUTFALL SYSTEMS PLANNING

PRELIMINARY
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