TABLE NO. 6

INVENTORY OF MINOR STRUCTURES

Flows >500 c.f.s

Location	Type	Existing Size	100-Yr. Design Flow (cfs)	Proposed Size	Costs	Comments
C&S Rd.- 2,900' west of Link Rd.	CMP	27"	2,200	50'x6'	$87,500	New Box Culvert
C&S Rd. - 1,975' west of Link Rd.	CMP	22"x14"	800	25'x5'	40,000	New Box Culvert
Link Rd. - 500' north of Kaine Rd.	CMP	24"	600	20'x5'	37,500	New Box Culvert
Marksheffel Rd. - 4,700' south of Peaceful Valley Rd.	CMP	40"x26"	3,550	---		To Be Abandoned
Marksheffel Rd. - 5,900' south of Peaceful Valley Rd.	CMP	36"	---	---		To Be Abandoned
Marksheffel Rd. - 1,400' east of Link Rd.	Box Culvert	----	3,550	50'x8'	116,250	New Crossing
Fontaine Rd. - 4,700' west of Marksheffel Rd.	Box Culvert	28'x12'	1,650	20'x8'	43,000	New Box Culvert
Fontaine Rd. - 5,100' west of Marksheffel Rd.	CMP	30"	800	----		Remove Existing, route flow to 20x8 B.C.
Marksheffel Rd. - 4,600' south of New Drennan Rd.	CMP	2-66"	2,550	32'x10'	340,000	New Box Culvert
Drennan Rd. - 1,500 west of Marksheffel Rd.	CMP	18"	850	16'x6'	35,750	New Box Culvert
Drennan Rd. 2,750' south of Meridian Rd.	CMP	60"	1,800	40'x6'	77,500	New Box Culvert
Meridian Rd. - 1,700' north of Drennan Rd.	CMP	2-43"x27"	2,500	75'x5'	115,000	New Box Culvert
Franceville Rd. - 1,700' south of SR94	CMP	2-60"	1,200	20'x6'	40,000	New Box Culvert
Franceville Rd. - 8,300' south of SR 94	CMP	2-24"	550	20'x5'	37,500	New Box Culvert
Pleasant Valley Rd. - 2,900' east of Marksheffel Rd.	CMP	48"	550	12'x6'	30,000	New Box Culvert
				TOTAL	$1,000,000	

DRAINAGE FACILITY ANALYSIS

GENERAL

The analysis of the proposed drainage facilities throughout the Jimmy Camp Creek Basin was based on factors such as feasibility, constructability and maintainability of the facilities. Environmental considerations were also examined. Passive or non-structural facilities were chosen wherever possible although numerous areas did require a more active or structural facility. Existing channels and floodplains were utilized where possible in an attempt to act with nature rather than trying to control it.

In general, the regional storm runoff detention concept was utilized to decrease the higher storm peaks produced by the developed runoff. Retention was only used where existing facilities could be utilized. Due to the great concerns over groundwater recharge in the region, the natural sand bottoms of the streams were left intact. This precluded the use of fully concrete lined channels in the main channel areas.

DESIGN CONCEPTS AND CRITERIA

The criteria used in developing the recommended channel improvements was based upon the information contained in the "El Paso County Areawide Runoff Control Manual" and the "City of Colorado Springs Determination of Storm Runoff Criteria" manual as well as the recommendeations set forth in the initial project conference held on January 8, 1986. The basin improvements outlined in this report were designed utilizing the 100-year, 24-hour, fully - developed, post-detention flow rates.

Specific channel improvement criteria was obtained from the "Drainage Criteria Manual" issued by the Urban Drainage and Flood Control District inconjunction with the Denver Regional Council of Governments. From these sources as well as other references listed in the bibliography section, Table No. 7 was developed, which addresses the design parameters and channel protection schemes.

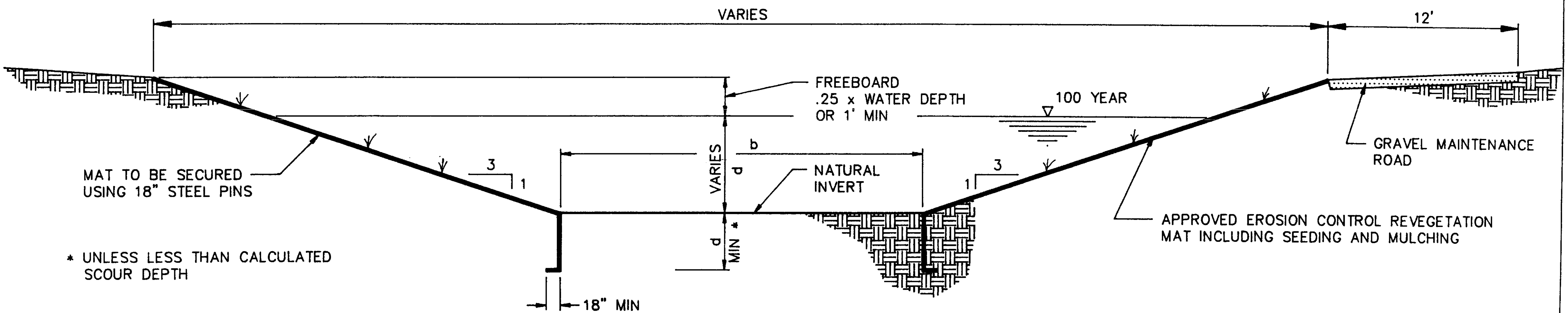
TABLE NO. 7

CHANNEL PROTECTION

V_{fps}	F_r	Side Slope	Type	Description
5	0.85	3:1	---	No Protection Required.
5.0-7.0	0.85	3:1	1	Place and maintain sod or other vegetation.
7.0-9.5	0.85	3:1	2	Use an Erosion Control Revegetation Mat in addition to reseeding the side slope. (Exhibit No. 10).
9.5-12.5 0.	85	3:1	3	Place 9" Gabion slope mattress (SM 9) or type VL or L riprap. (Exhibit No 11).
12.5-14.5	0.85	3:1	4	Place 12" Gabion slope protection (G12), type M or H riprap or soil cement. (Exhibit No. 12).
14.5	1.0	3:1	---	Place drop structures in channel to reduce velocities and Fr or widen channel. (Exhibit No. 13).

SPECIAL SITUATIONS

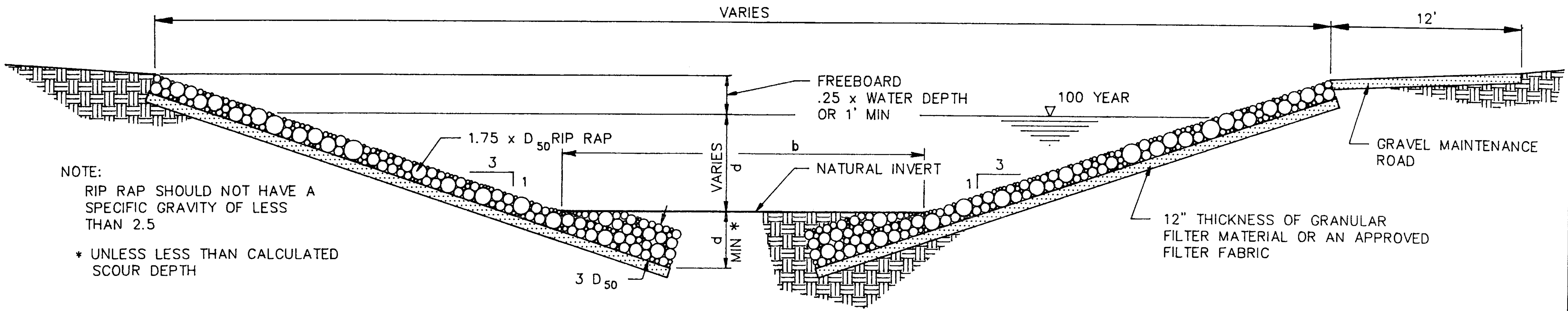
		Existing Banks		
---	---	Vertical 0-10 ft	---	Regrade side slopes to minimum of 3:1 and reseed.
---	---	Vertical 10 ft	5	Install vertical gabion or sheet wall or soil cement wall with minimum D = Depth of flow + free board. Re-grade remaining side slope at a 2.5:1 minimum. (Exhibit No. 14).



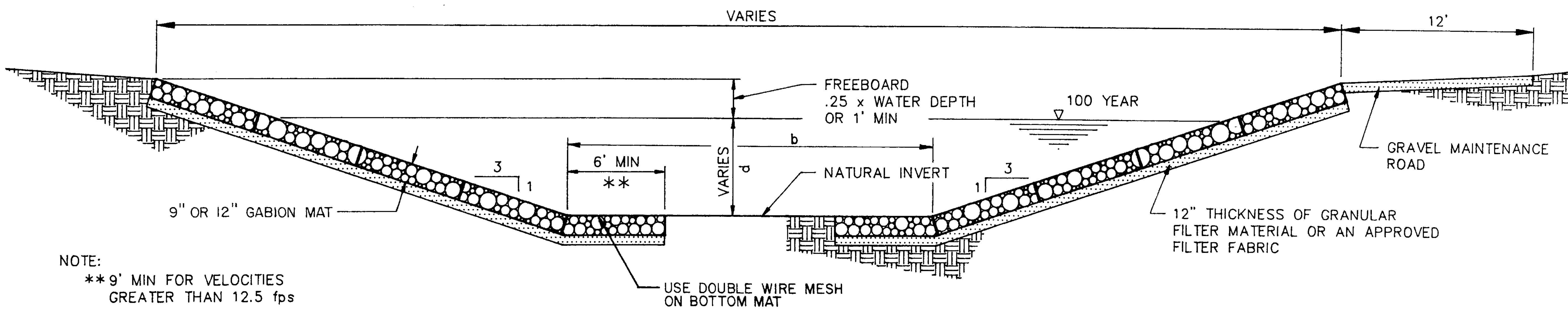
CHANNELIZED SECTION WITH EROSION CONTROL REVEGETATION MATS

MASTER DRAINAGE PLANNING STUDY
FOR JIMMY CAMP CREEK
TYPICAL CHANNEL SECTIONS

DESIGN	DRAWN	WILSON & COMPANY ENGINEERS	DATE:
			FILE NO. 85-832
			EXHIBIT NO. 10

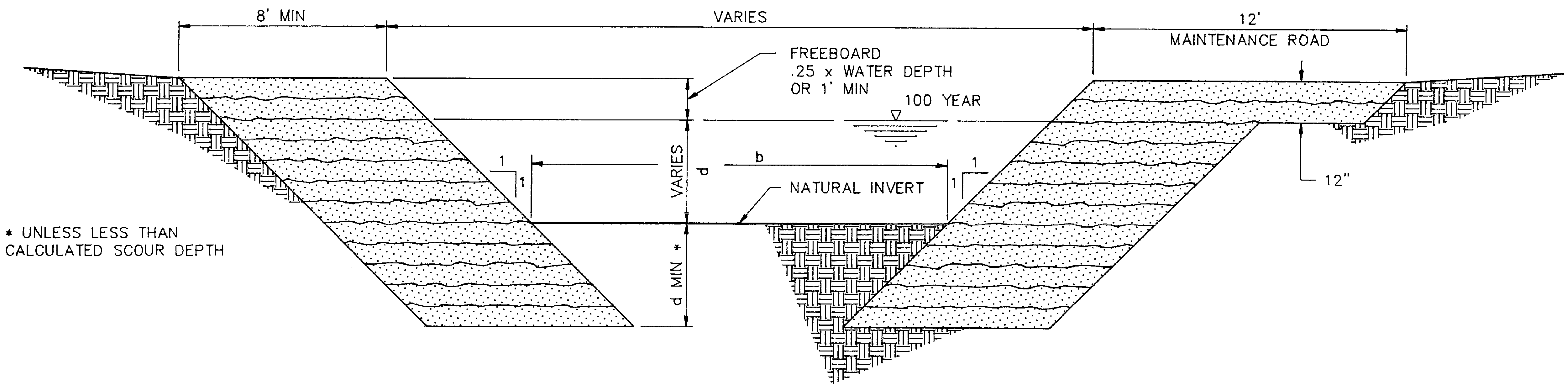


TYPICAL RIP-RAP CHANNELIZED SECTION



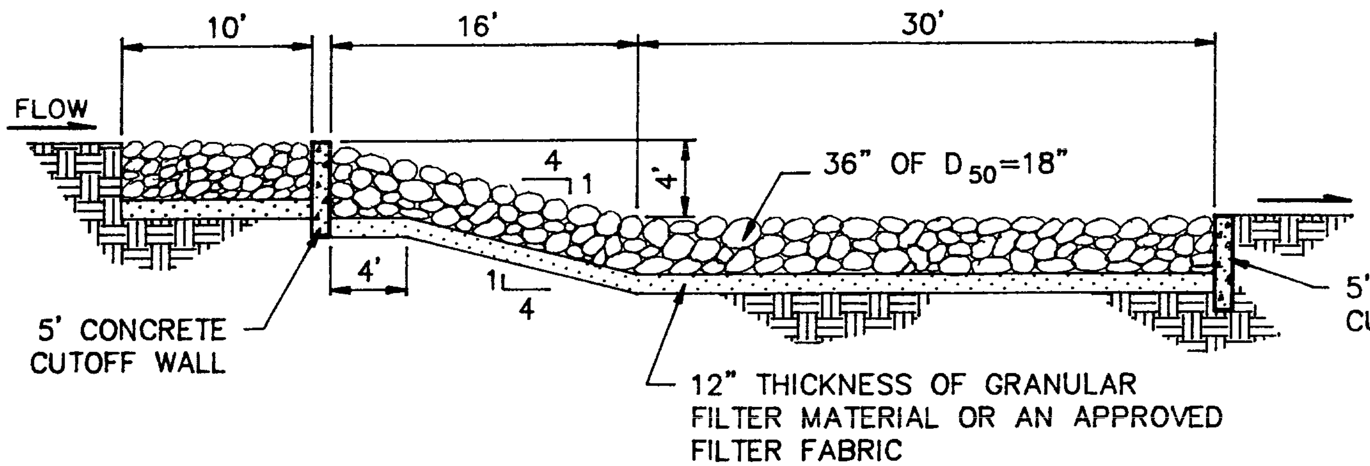
TYPICAL GABION MAT CHANNELIZED SECTION

MASTER DRAINAGE PLANNING STUDY FOR JIMMY CAMP CREEK TYPICAL CHANNEL SECTIONS		
DESIGN / DRAWN	WILSON & COMPANY ENGINEERS	DATE:
		FILE NO. 85-832
		EXHIBIT NO. 11

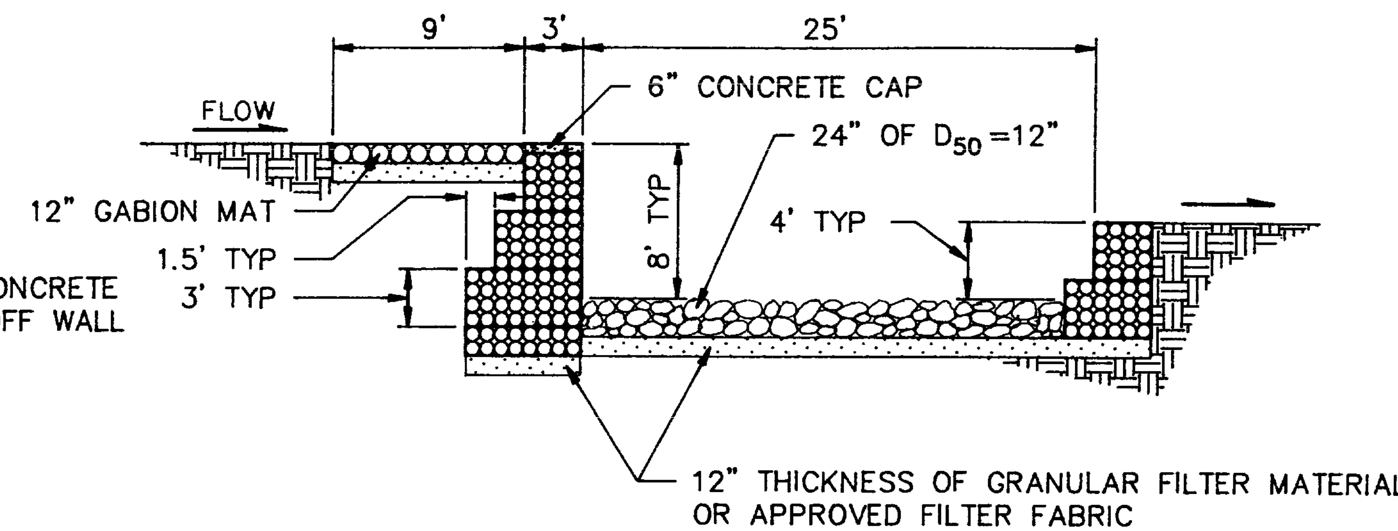


TYPICAL SOIL CEMENT SECTION

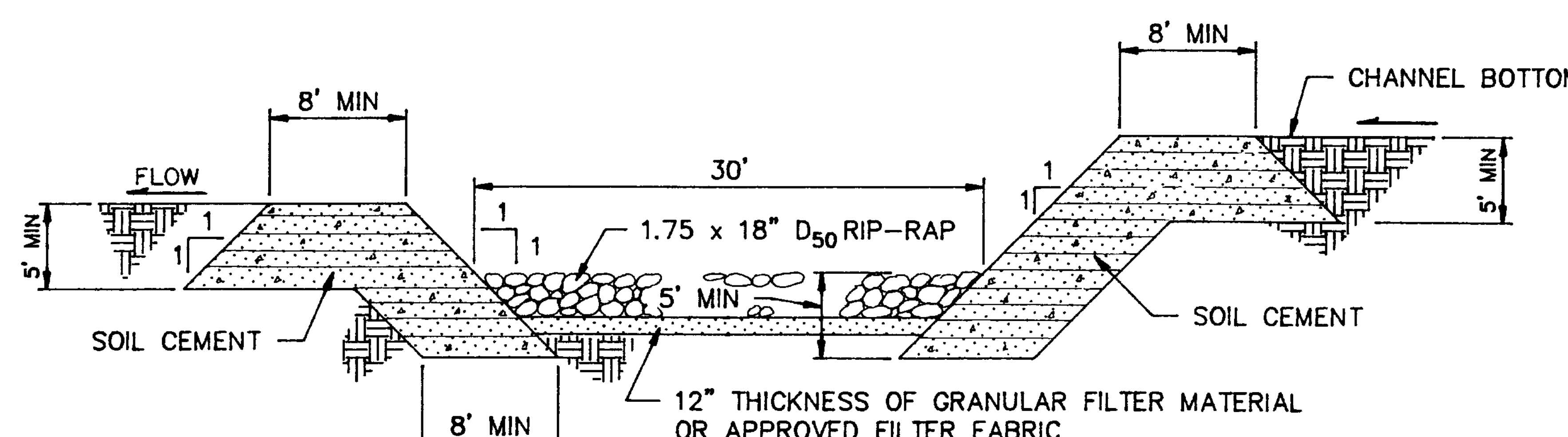
MASTER DRAINAGE PLANNING STUDY FOR JIMMY CAMP CREEK TYPICAL CHANNEL SECTIONS		
DESIGN / DRAWN	WILSON & COMPANY ENGINEERS	DATE: FILE NO. 85-832 EXHIBIT NO. 12



RIP–RAP DROP STRUCTURE



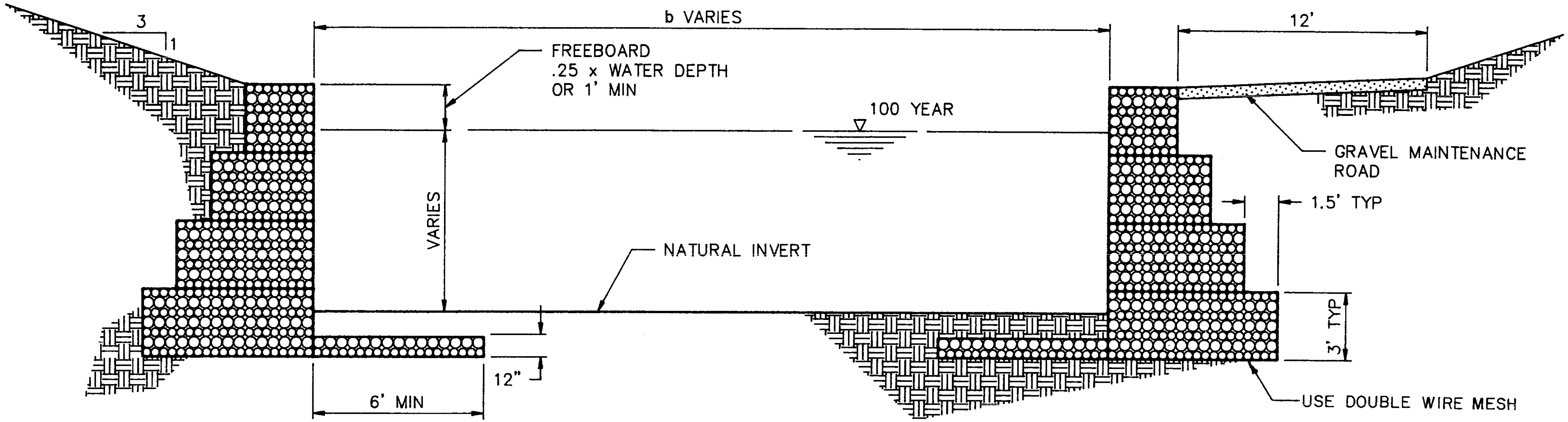
GABION DROP STRUCTURE



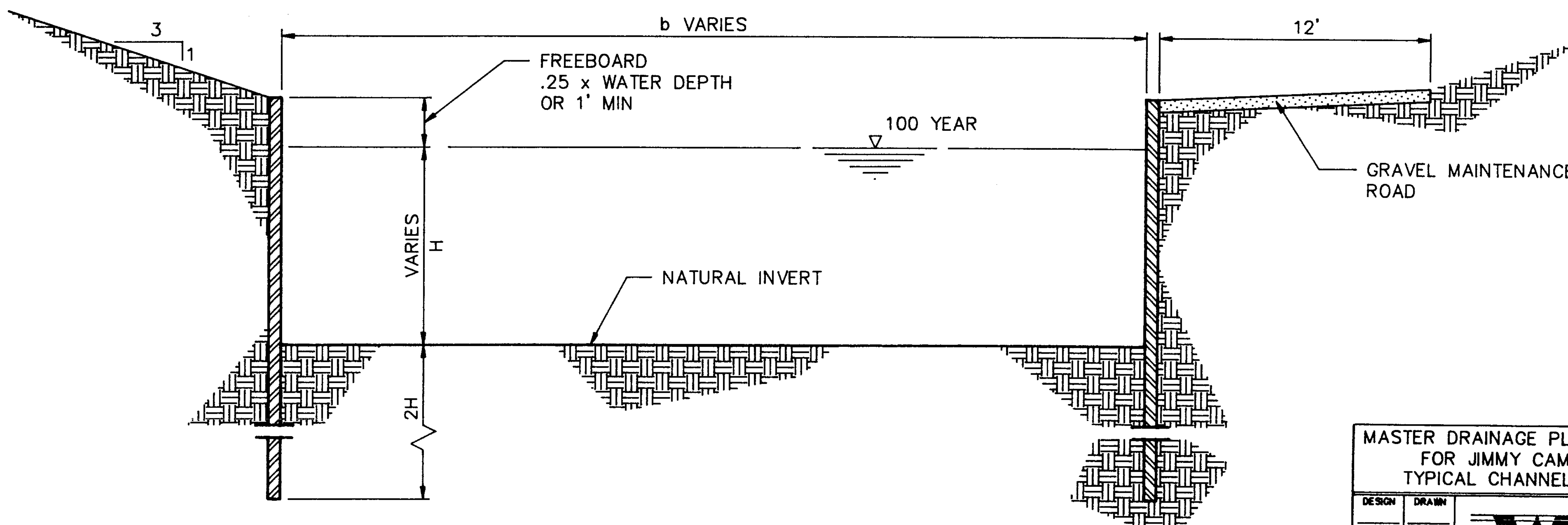
SOIL CEMENT DROP STRUCTURE

MASTER DRAINAGE PLANNING STUDY
FOR JIMMY CAMP CREEK
CHANNEL DROP STRUCTURES

DESIGN	DRAWN		DATE:
		WILSON & COMPANY ENGINEERS	FILE NO. 85–832
			EXHIBIT NO. 13



GABION WALL CHANNELIZED SECTION



SHEET PILE CHANNELIZED SECTION

MASTER DRAINAGE PLANNING STUDY
FOR JIMMY CAMP CREEK
TYPICAL CHANNEL SECTIONS

DESIGN	DRAWN		DATE:
		WILSON & COMPANY ENGINEERS	FILE NO. 85-832
			EXHIBIT NO. 14

IMPACT OF CANALS ON THE BASIN

At the present time there are two canal systems flowing through the basin, Fountain Ditch and Chilcotte Canal No. 27. The Chilcotte Canal is located in the very bottom of the basin and therefore has the least effect on the basin. The siphon crossing for this canal occurs approximately 4,000 feet north of Iowa Road on Jimmy Camp Creek.

The second canal, Fountain Ditch, flows out of the Big Johnson Reservoir and weaves through the basin for approximately 16 miles. It crosses several of the minor tributaries, Jimmy Camp Creek and East Tributary. The Jimmy Camp Creek crossing occurs approximately 8,400 ft. north of Peaceful Valley Road and the crossing of East Tributary occurrs just east of there.

In general, the effects of the canals on the overall drainage of the basin are negligible. The capacity of the canals varies from section to section but it is safe to assume that during a 100-year storm event the canals would be overtopped, allowing the subbasin flows to follow their natural routes. The canals affect the subbasin flows the most during the more frequent storm events such as the five year storm. At present, the exact impact on these areas is not known because the changing ditch section allows the flows from one subbasin to be intercepted and transported to a different subbasin where overflow occurs due to lack of flow capacity in the canal section. These occurrences cause local flooding problems which cannot be addressed to any large extent in this report. However, it is recommended that as development occurs, the capacity of the canal should be thoroughly examined and controlled overflow structures be constructed where feasible and where existing streams or swales can be sized to handle the flows. A number of recommended sites are shown on the major improvements map. These locations should be field verified and a site-specific structure designed for each area. An estimated cost of $10,000 has been included for each overflow structure. A total of $160,000 has been included in the Basin Fee cost summary.

Some concern has been expressed by El Paso County Soil Conservation District about the possibility of excess stormwater entering the canals from the main streams and causing flooding downstream outside of the Jimmy Camp Creek basin boundaries. It is recommended that overflow structures be constructed on the canals prior to their exiting the basin. These overflow structures should also be equipped with a manual diversion valve which would permit the total diversion of flows into Jimmy Camp Creek or one of its tributary streams, if additional water is not required further downstream.

ALTERNATIVES

In general, the storm runoff detention/retention concept was utilized to reduce the higher developed runoff peaks to a level which was either less than or equal to the historic peaks in the channels. This concept was implemented by placing regional detention facilities on or along the main tributary routes where the flow volumes were more manageable. Existing natural features and anticipated roadway crossings were some of the considerations in determining proposed detention facility locations.

Two types of outlet facilities are necessary: if a roadway embankment is utilized as a dam, then the outlet culverts are designed to accommodate all of the 100-year flows; if a separate embankment, not associated with a roadway, is used, an overflow spillway is provided to accomodate part of the anticipated 100-year flows.

Low flow channels are utilized to permit normal flows to pass through the detention basins. In addition, drop structures are used to lower stream velocities as they enter the detention facility.

Although specific detention basin sizes and locations are shown in this report, they are not the only facilities which can produce the desired effect of reducing the developed storm peaks. Detailed detention basin modeling should be undertaken at the time of final design for any facility proposed for construction. This report is to serve as a guideline for design since it addresses the general behavior of the whole drainage basin under specific conditions.

Due to the concern over groundwater recharge in the region, the natural sand bottoms of the streams were left intact, where possible. Concrete lined channels were not considered economically feasible since most major tributaries are over 100 ft. in width. Channel velocities were used to determine the extent and the type of bank protection recommended within a specific reach. Some sections of channel are to be left in their natural state, except for the regrading of side slopes to a 3:1 minimum and reseeding. This option was only considered where the existing channel was in a relatively stable condition and the floodplains were wide enough to provide an adequate buffer zone against possible erosion. A minimum 100 - ft. buffer zone is suggested, beginning at the edge of the floodway.

A number of bank protection alternatives are detailed in this report. These include: riprap, gabions, soil cement and erosion control revegetation mats. A specific recommendation of protection types should be based on cost, availability of materials, aesthetics, performance, and compatibility with adjacent treatments of the channel. The use of the erosion control revegetation mats is suggested only in areas of low velocities. The use of this product in higher velocity areas would only be recommended if the growth of vegetation could be guaranteed.

GRADE CONTROL STRUCTURES

The calculation of existing bed slope, velocity, and depth of flow was performed for the entire Jimmy Camp Creek Basin. Areas where proposed channel improvements resulted in an increase in slope were evaluated in greater depth. In general, the concept of grade control was employed with the following intentions:

1. To reduce stream velocity and maintain Froude Number at .87 or less upstream of existing bridge structures.
2. To minimize local scour around supporting piers and abutments of existing bridges.
3. In reaches where alignment corrections are proposed, grade control is employed to the extent that the new slope would not be greater than the existing slope.
4. To maintain a reasonable grade where new channel construction was proposed.

More than one type of grade control structure is shown in this report, any one of which would accomplish the intended purpose. It should be noted that only the minimum amount of grade control is suggested in this report. Additional structures may be required to protect specific areas of interest, such as bridge piers and abutments.

ECONOMIC ANALYSIS

GENERAL

The economic analysis of the channel improvements listed in this report were derived from current construction prices for materials and labor in the Colorado Springs, El Paso County area. In addition, the 1985 edition of the Colorado Department of Highways "Cost Data" was utilized. Costs were determined for each protection alternative for a range of channel depths and the most economic alternative was used to determine the channel protection costs. Table No. 8, Unit Construction Costs, lists the specific unit prices used in determining the channel protection construction costs:

TABLE NO. 8

Unit Construction Costs

Item Description	Unit	Unit Price
Rock Riprap	Cubic Yards	(cy) $ 30
Gabion Baskets (G36)	Cubic Yards	(cy) $ 75
Gabion Baskets (G12)	Cubic Yards	(cy) $ 85
Gabion Slope Mattress(SM9)	Cubic Yards	(cy) $ 90
Granular Filter Material	Cubic Yards	(cy) $ 9
Filter Fabric	Square Yards	(sy) $ 1.50
Class 6 Gravel (Maintenance Rd.)	Cubic Yards	(cy) $ 20
Soil Cement	CubicYards	(cy) $ 30
Reinforced Concrete	Cubic Yards	(cy) $ 200
Non-Reinforced Concrete	Cubic Yards	(cy) $ 150
Erosion Control Revegetation Mat (Including Seeding)	Square Yards	(sy) $ 12
Sheet Piling (Type 1)	Square Foot	(sf) $ 15
Dam Embankment	Cubic Yards	(cy) $ 5
Excavation and Embankment	Cubic Yards	(cy) $ 1.50
Seeding (Native)	Acre	(ac.) $ 500
Sod	Square Yards	(sy) $ 4.00

Table No. 9, Annual Maintenance Costs, lists costs for operations and maintenance which were developed from information obtained from the City of Colorado Springs Department of Engineering, the El Paso County Department of Transportation and the Denver Urban Drainage and Flood Control District Maintenance Section.

TABLE NO 9

Annual Maintenance Costs

Description	Unit	Unit Price
Lined Channels	Linear Foot (lf)	$0.85
Natural Channels with Buffer Zones	Linear Foot (lf)	$0.25
In-Channel Detention Facilities	Each (ea.)	$5,000.00
Off-Channel Detention Facilities	Each (ea.)	$1,000.00

Costs for bridge structures were determined based on current structure costs in the region. The cost per square foot of bridge deck used in this report includes construction of abutments, piers and other structural components. The estimated cost of structures used is $55 per square foot.

IMPROVEMENT COSTS

Due to the variations in channel widths throughout the Jimmy Camp Creek Basin and the corresponding variation in flow depths, channel improvement costs were determined for various design parameters. Table 10, Channel Protection Costs, lists the prices used to determine the cost per linear foot for each channel protection type (See Table No. 7 for the definition of protection types).

TABLE NO. 10

CHANNEL PROTECTION COSTS (Per Linear Foot)

Water Depth d(ft.)	Protection Type *				
	Type 1	Type 2	Type 3	Type 4	Type 5
≤ 3	$6	$42	$110	$130	$130
> 3 to 4	$7	$53	$130	$160	$165
> 4 to 5	$9	$66	$160	$210	$210
> 5 to 6	$10.50	$80	$180	$235	$245
> 6	$11.75	$90	$200	$255	$280

* Type 1 - Sod
Type 2 - Erosion Control Revegetation Mat
Type 3 - Gabion Slope Mattress (SM9), Riprap (VL or L)
Type 4 - Gabion Baskets (G12), Riprap (M or H)
Type 5 - Soil Cement, Gabion Baskets (G36), sheet piling (Type 1)

Costs were determined for 3 types of drop structures. The least expensive alternative was chosen for the cost estimates contained within this report. They are all viable alternatives and should be considered at the time of final design of any improvements. Table No. 11, Drop Structure Cost Comparison, is a comparison of those alternatives.

TABLE NO. 11

Drop Structure Cost Comparison

Channel Width b (ft.)	Drop Structure Type		
	Riprap	Gabion	SoilCement
50	$15,000	$20,000	$27,500
75	$22,500	$28,000	$37,000
100	$29,500	$36,500	$46,000

Minor Tributary channel costs were determined by dividing the storm flows into 3 categories: 500-1000 CFS, 1000-2000 CFS, and 2000-3000 CFS. The alternative types of protection included concrete lining, soil cement, riprap or gabions. Table No. 12, Subtributary Channel Costs, depicts the various alternatives and related costs as determined for this report.

TABLE NO. 12

Subtributary Channel Costs

Channel Flow (CFS)	Channel Width b (ft.)	Protection Description	Cost per ft.
500 - 1000	6	6" reinforced concrete	$80
1000 - 2000	40	Gabion Slope Mattress (SM9) or Riprap (Type VL or L)	$140
2000 - 3000	50	Gabion Slope Mattress (SM9) or Riprap (Type VL or L)	$145

Minor systems, i.e., improvements which convey less than 500 CFS, were not considered in this report since they should be determined when the land develops. They are not considered to be part of the Master Drainage Study.

DRAINAGE BASIN FEES

Presently drainage basin fees are determined by dividing the total number of unplatted acres into the total cost of all estimated drainage facilities within a drainage basin. The drainage facility costs include both major systems, ie., channel realignments or erosion protection, and minor systems, i.e., local storm sewer and inlets. Since the exact type and cost of a minor system is directly tied to a specific type of development, it is difficult to accurately predict the cost for these systems. In addition, since reimbursements are based on the final construction costs of these systems, in some instances more money may be spent on these minor systems than necessary, thereby sacrificing the stability of the fund for major system improvements.

Drainage fees within the Jimmy Camp Creek Drainage Basin have been computed using only the major systems costs. A major system is defined as one which will convey over 500 cfs based on a 100-year storm frequency. The location and size of those systems can be found in the Recommendations Section of this report or on the Drainage Improvements Map, Exhibit 18, located in the back of this report.

As previously described, the channel alternatives chosen within the Jimmy Camp Creek Basin were based upon existing channel configurations and possible flood hazard potential. The improvement schemes vary from the use of natural channels to heavy riprap or soil cement lining. Due to these extremes, construction costs vary from reach to reach. Regional detention facilities have been proposed for the upper reaches of Jimmy Camp Creek and its tributaries, thereby permitting the construction of less expensive facilities in the lower portion of the basin. The dentention facilities also reduce the flooding potential in the lower basin from developed runoff generated in the upper basin. The cost of the land used in constructing these facilities has been included in the basin fee. However, since most of the land utilized for these facilities is already located within the 100-year floodplain area, only $5,000.00 per acre has been allowed for the cost of the land. This same price was used to determine land reimbursement cost for the buffer zone adjacent to the channels left in their natural state.

Bridge replacement costs were computed only for those existing crossings which were determined to be hydraulically inadequate. (See Table No. 5). These replacement costs have been included in the overall Basin Fee since their reconstruction was necessary due to drainage constraints. Construction costs for future bridges have not been included since their exact quantity, size and locations cannot be accurately predicted. In addition, their construction is not required based on any hydrologic improvement. It is recommended that the cost of any future bridges be included in the cost of the roadway construction. The amount of land within the Jimmy Camp Creek Basin subject to drainage fees was calculated using current City/County policy which dictates that only existing platted lands and existing Regional Parks can be deducted from the gross basin acreage. No deductions were made for lands within FEMA floodplains or any other seemingly unbuildable areas (i.e., the Corral Bluffs). In addition, no lands within the City of Fountain were included since the City of Fountain does not presently participate in the existing City/County drainage fee system. Drainage fee adjustments would be required if the City of Fountain became a participant in the fee system in the future.

The following is a breakdown of areas and costs within the basin:

TABLE NO. 13

Basin Fees

Area		
Total Basin	42,755	Ac
Total Platted Land	6,985	Ac
Total Unplatted Land	35,770	Ac
Improvement Costs		
Total Basin	$81,362,400	
Fees		
Total Basin ($/ACRE)	$2,275	

CONCLUSIONS AND RECOMMENDATIONS

RECOMMENDATIONS

This section outlines the type and location of proposed improvements to the drainage system in the Jimmy Camp Creek Basin. Although specific cross section or profile improvements are not shown in this report, they were developed in some sections to determine the estimated costs for the improvements. Bridge - related recommendations are covered in their own specific section. The costs listed in this section cover the construction costs of the items mentioned but do not include engineering or contingency costs.

The Recommendations Section divides each channel reach into specific improvement sections. Some of the sections occur between easily identifiable land marks while other sections refer to specific channel stations. These channel stations are shown on the Drainage Improvements Map, Exhibit 18, and were derived from the existing channel centerline stations listed in the HEC-2 computer output obtained from FEMA for the Jimmy Camp Creek Basin.

Reach 1 - Jimmy Camp Creek

Fountain Creek to Old Pueblo Road

It is recommended that the abandoned concrete arch bridge just upstream of Fountain Creek be removed to improve the outlet capacity of Jimmy Camp Creek into Fountain Creek. The existing channel upstream of the bridge is well vegetated and within the Fountain Creek floodplain. Since a natural buffer zone exists, no additional protection is recommended in this area. The cost for bridge removal is estimated at $75,000.

Old Pueblo Road to the D & RGW Railroad Bridge

The majority of the existing channel in this section should be realigned to improve the approach to the Old Pueblo Road Bridge and reduce potential fooding caused by the poor flow characterstics of the existing channel. The new 2610 ft. long, 250 ft. wide channel should be protected with Type 4 protection. The new channel should begin at the Old Pueblo Road bridge and connect back into the existing channel approximately 400 ft. south of the D&RGW Railroad Bridge. The existing channel along Old Pueblo Road should be filled. This would still permit local drainage systems to utilize the old alignment. The estimated cost for this improvement is $985,000.

D & RGW Railroad Bridge to Iowa Avenue

This section is presently in a predominately stable vegetated condition. Only one area of side slope failure was noted. It is recommended that approximately 500 lf of Type 5 protection be added to stabilize this steep slope area approximately 500 ft. north of the railroad structure. No further protection is recommended within this area. The cost for work in this section is $145,000.

Iowa Avenue to Link Road

The mild channel bed slope of 0.005 ft./ft. and broad 300 ft to 1000 ft floodplain in this section of the reach have aided the growth of vegetation in and along the channel. Due to the extent of vegetation within the channel in the vicinity of the Link Road bridge, it is recommended that the channel bottom and side slopes should be cleared of trees and brush. No protection is recommended within this section of the channel. Approximately $60,000 is estimated for this area.

Reach 2 - Jimmy Camp Creek

Link Road to the end of the Corps of Engineers Study (Sta 225+52)

The channel in the area of the Link Road Bridge must be realigned due to the meanders and oxbows in the existing channel. A new 200 ft. wide channel with Type 4 protection should be constructed for a distance of 1,700 ft. upstream from the bridge. The realignment and new channel section will result in an increase of the channel slope and will also increase the velocity. In addition to the realignment work, it is recommended that the channel bottom and sides be cleared of brush and trees within the main floodway of the channel. The cost of these improvements is estimated at $605,000.

Beginning of SCS Study (Sta 225+52) to Existing Peaceful Valley Road

This section of the reach is one of the most sinuous sections of Jimmy Camp Creek. Both realignment and deepening of the channel is recommended. The lowering of the channel bottom is needed to permit the construction of a bridge at Peaceful Valley Road and to reduce the extremely wide floodplain in the vicinity of Peaceful Valley Road. Realignment of the channel is recommended to improve the flow characteristics of the channel and to eliminate the existing meanders and sharp bends.

The improvement work is to include the changing of the bed slope from 0.0070 ft./ft. to 0.0056 ft./ft. and to lower the channel at Peaceful Valley Road by 10 ft. The realignment of the channel should utilize bends with a minimum radius of 700 ft. In this manner, a meandering channel can still be permitted, since it is the most stable type of channel which exists in nature. The new 200 ft. wide channel would extend for 8,350 ft. and require Type 3 protection. The total cost would be $2,685,000.

Reach 3 - Jimmy Camp Creek

Existing Peaceful Valley Road to the Marksheffel Tributary

Improvements in this reach center around lowering the existing channel to permit a bridge crossing at Peaceful Valley Road and to lower the projected 100 - year water surface elevation. This will protect the existing Peaceful Valley Estates Subdivision. Minor alignment corrections are also recommended with a minimum radius of 700 ft. bends. In addition to these channel improvements, this reach contains the proposed juncture of East Tributary. The recommended work would reduce the channel length from 5,300 ft. to 4,900 ft. and change the bed slope from 0.0061 ft./ft. to 0.0077 ft./ft. Type 3 protection would be required within the reach, with costs estimated at $2,485,000.

Marksheffel Tributary to Bradley Road

This reach contains a bed slope of 0.0075 ft./ft. and a very broad floodplain. Due to the lower velocities through this area, it is recomended that Type 2 protection be added to the westerly bank for a length of 2,200 ft. Also, a minor alignment correction is required at the juncture of the Marksheffel Tributary. Much of the eastern bank area is proposed for park land so only minor side slope regrading would be necessary. The cost for this area is $160,000.

Bradley Road to Sta 559+00

The channel within this section of Jimmy Camp Creek varies in width from 100 ft. to 700 ft. The existing 100 ft. channel should be widened to a minimum of 200 ft. This would decrease stream velocities from 18 fps to 14 fps. To accomplish the widening, it will be necessary to excavate into the steep 30 ft. high easterly embankment. This is due to constraints imposed by the residential development which is currently being platted on the westerly bank. A 600 ft. length of Type 5 protection is recommended for this excavated area with Type 4 protection continuing to the Bradley Road bridge. The opposite bank should be protected with Type 4 protection for a length of 2,200 ft. An estimated cost of $600,000 is anticipated in this section.

Sta 559+00 to Confluence of Corral Tributary

Required improvements to this area are minimal except for the construction of 800 ft. of Type 5 protection and an estimated 20,000 cy of fill to eliminate an existing 20 ft. high wall along the westerly bank. The banks upstream and downstream of this protection area would only require some regrading of the side slopes to a 3:1 minimum with reseeding. The easterly bank does not require protection, but a 100 ft. buffer zone should be provided from the edge of the floodway. Estimated cost for this area is $150,000.

Reach 4 - Jimmy Camp Creek

Confluence with Corral Tributary to Drennan Road

Since this reach does not contain flows from other major tributaries, the proposed channel width is 100 ft. The improvements in this area are limited to some widening and 900 ft. of realignment. Type 3 protection is required in this section. The bed slope is presently 0.01 ft./ft. with no apparent signs of further degradation. The improvements for this reach are estimated at $620,000

Drennan Road to Sta 626+76

The existing 60 ft. to 70 ft. wide channel in this section should be widened to 100 ft. Two drop structures are recommended to be placed in the improved section to reduce velocities into the bridge. With the slower velocities and 3:1 side slopes, only Type 2 protection is needed. The wider section will also reduce the floodplain limits at the Drennan Road Bridge. Cost for this work is $175,000.

Sta 626+76 to Sta 663+66

This section of channel needs only minor widening and realignment to attain a 100 ft. wide section. The expected 12.2 fps velocities will require Type 3 protection to stabilize the side slopes against erosion. The proposed improvements in this 3,690 ft. section will cost $615,000.

Sta 663+66 to Detention Facility #JCC1

This reach is characterized by a wide, low-flowing channel. Some of the existing side slopes need to be regraded to a 3:1 minimum slope and reseeded. The channel currently has a bed slope of 0.01 ft./ft. and a wide floodplain. This is an area which is recommended to remain natural. A minimum 100 ft. buffer zone from the edge of the floodway is recommended to account for any possible stream migration. The construction costs for this area are estimated at $35,000.

Detention Facility #JCC1

This is the southernmost detention basin on Jimmy Camp Creek. It is proposed to be constructed upstream of a proposed roadway and will encompass over 25 acres and detain up to 175 ac. ft. of water, with a flow reduction of 6,010 cfs to 5,540 cfs. The on-channel basin should be provided with a 50 ft. wide low-flow channel having a bed slope of 0.005 ft./ft. and a 50 ft. x 8 ft. box culvert outlet. The interior of the basin should be seeded and could be turned into a multi-use facility. The earthwork required to construct this basin is estimated at 300,000 cy. Also a series of three 4-foot drops will be required to lower the stream into the basin. Total construction cost for the basin is estimated at $670,000.

Detention Facility #JCC1 to Sta 785+96

Jimmy Camp Creek in this area is a minimum of 100 ft. wide and is characterized by a series of very wide meanders through the floodplain which vary from 300 to 400 ft. in width. Due to its low-flow depth and wide floodplain it is recommended that this section of channel be left in its natural state. Some minor regrading and reseeding of the banks is recommended but no other protection is required. A minimum buffer zone of 100 ft. should be established beyond the floodway to provide a safety zone. The estimated cost in this section is $30,000.

Sta 785+96 to State Highway 94 (Detention Facility #JCC2)

Parts of this reach are more dynamic than the previous section. Three existing bends require 3,000 ft. of Type 4 protection on the outside to protect the existing channel from erosion. The remainder of the section is recommended to be natural. A minimal amount of bank regrading is necessary in addition to reseeding of all other unprotected side slopes. The improvement cost for this section is $285,000.

Reach 5 - Jimmy Camp Creek

Detention Facility #JCC2

This 90 ac. ft., 18.0 acre detention facility is designed to function as an off-channel facility, which will reduce the rate of flow from 5,740 cfs to 5,280 cfs. A 50 ft. wide low-flow channel is recommended along the eastern side of the basin and the channel lowered by using three drop structures. It is to be further constricted by a two stage in-channel soil cement weir. The low-flow stage of the weir should have a bottom width of 25 ft. with the second stage weir having a width of 150 ft. The second stage weir would not function until the channel depth exceeds 6 ft. As the channel flow depth exceeds 2 ft., the water would back up into the excavated 15 acre basin. The in-channel soil-cement weir would permit the existing State Highway 94 bridge to remain intact. The estimated cost for this basin is $475,000.

Detention Facility #JCC2 to Detention Facility #JCC3

This 1,000 ft. reach between the detention facilities is recommended to be left in its natural state except for some minor bank regrading. Also, all side slopes should be reseeded to prevent erosion. A minimum 100 ft. buffer zone is recommended beyond the floodway. The total cost of this section is $10,000.

Detention Facility #JCC3

Approximately 250,000 cy of excavation will be required to construct this 150 ac. ft., 15.0 acre, on-channel detention facility. It is designed in conjunction with a proposed roadway with a 36 ft. x 8 ft. box culvert outlet. This facility will reduce the flow from 6,700 cfs to 4,740 cfs. A 50 ft. wide, 3 ft. deep low-flow channel should be provided in the bottom of the basin so the facility could be utilized when it is dry. It will require a series of 3 drop structures to lower the existing channel into the basin. The total cost for this facility is estimated at $560,000.

Detention Facility #JCC3 to the Regional Park Boundary

This 5,800 ft. reach extends slightly beyond the limits of the 1975 SCS study. In this area, the soil composition changes from the erodible sands to the more resistant clays and claystones. Concurrently, the channel floodplain narrows as the channel bed slope increases. The channel bottom is still approximately 100 ft. wide but the velocities exceed 14 fps. It is recommended that the side slopes be regraded to a minimum of 3:1 where necessary. The side slopes should then be protected using Type 4 protection. The estimated cost for this work is $1,260,000.

Proposed Regional Park

The flows within the proposed park boundaries increase from 3,100 cfs to 6,700 cfs as side tributaries join the main channel. Although erosion may occur within this 13,400 ft. reach, it is recommended that it be left in its natural state. A buffer zone 100 ft. from the edge of the floodway should be provided although lateral movement within this area is not expected to be significant. No cost is estimated for this area.

Regional Park Boundary to Sta 1109+00

This reach extends for 2,400 ft. beyond the proposed park with an average bed slope of 0.018 ft./ft. Existing velocities exceed 14 fps and the probability of bed degradation exists. It is, therefore, recommended that 4 drop structures be constructed within the 50 ft. wide channel to lower velocities and stabilize the bed. Type 3 protection should then be provided on the side slopes. Total cost for these improvements is $450,000.

Sta 1109+00 to Sta 1130+00

Flows in this upper reach are approximately 1,850 cfs. Widening and straightening of the existing channel is recommended. A minimum 25 ft. wide channel should be constructed and protected using Type 3 protection along the 2,100 ft. reach. Total cost is $335,000

Sta 1130+00 to Sta 1165+00

This section of the channel should be straightened to eliminate sharp bends. Although flows are only 900 cfs, the velocities are approximately 10.5 fps, and therefore, Type 3 protection is recommended for the 20 ft. wide channel. These improvements will cost approximately $450,000.

Reach 6 - Corral Tributary

Confluence with Jimmy Camp Creek to Drennan Road

This portion of Corral Tributary should be left in as natural a condition as possible. The 100-year flows were determined to be 10,000 cfs and side slope failure is evident in the high-walled banks. It is recommended to place 500 lf of Type 5 protection to stabilize the existing steep banks and regrade the remaining side slopes at 3:1.

At the Drennan Road bridge, additional protection (such as riprap) should be provided above the existing concrete abutments and extended downstream 100 ft. past the structure. Total cost for the improvements is estimated at $160,000.

Drennan Road to Sta 68+60 (Proposed Confluence of Franceville Tributary)

As previously mentioned, flows have been diverted from Franceville Tributary and have run adjacent to Drennan Road. To protect the highway, and in conjunction with other improvements for Franceville Tributary, it will be necessary to fill the erosion channel alongside Drennan Road. Fill quantity was estimated at 4,000 cy.

Improvements within the channel itself include placing Type 4 protection from the Drennan Road bridge upstream for 550 lf and widening the channel to a minimum of 100 ft. Some realignment will also be required to correct the severe curvature by constructing a channel with a minimum radius of 400 ft. After realignment, three 4-foot grade control structures will be required to keep the bed slope equal to the existing slope due to the shortened channel length. Type 5 bank protection should be placed in the widened section. Total cost for the improvements is estimated at $820,000.

Proposed Confluence of Franceville Tributary to Proposed Confluence of Strip Mine Tributary, (Sta 124+00)

It is recommended to widen this portion of the channel to a minimum of 75 ft. This will reduce the velocity from 15.3 fps to 13.0 fps and lower the depth of flow from 7 ft. to 6 ft. Earthwork is estimated at 100,000 cy. The proposed side slope protection scheme includes soil cement (Type 5) at a 1:1 slope placed 7 1/2 ft. up from the bottom and then grading the remaining slope at 3:1 until it intersects with the natural slope. The cost of improvements in this section totals $1,510,000.

Sta 124+00 to Detention Facility #COR1 (Sta 130+50)

For this short reach, it is recommended to improve the channel bottom profile to a slope of .006 ft./ft. as well as some minor realignment. The channel should be widened to 50 ft. and the side slopes regraded to 3:1. Place a revegetation mat on the graded side slopes to prohibit erosion. Total cost for improvements is estimated at $60,000.

Corral Detention Facility #COR1

The construction of this 170 ac. ft., 18.9 acre facility will require the excavation of approximately 250,000 cy of material and will reduce the flow rate from 4,820 cfs to 3,400 cfs. The site was chosen to utilize an existing broad floodplain area and the proposed crossing of an arterial roadway. A 25 ft. x 8 ft. box culvert outlet will be required to drain the facility and it should be designed with a 25 ft. wide x 3 ft. deep low-flow channel. Two drop structures will be needed at the inlet to the facility. The estimated cost is $525,000.

Detention Facility #COR1 to Sta 187+50

This channel reach is currently comprised of a series of bends and meanders which should be realigned. It is recommended that the realigned 75-ft. wide section use a series of curves having a minimum radius of 500 ft. Since the realignment will shorten the channel from 3,750 ft. to 2,650 ft., it is also recommended that two drop structures be installed to control the bed slope and flow velocities. The new channel velocity is estimated at 9.4 fps; hence, the channel should be adequately protected by using Type 2 protection. The cost of these improvements is $290,000.

Sta 187+50 to Detention Facility #COR2

Work in this section of the channel is limited to regrading steep bank areas to a minimum 3:1 slope and adding Type 3 protection, due to the 11.1 fps flow velocity. Only one area of alignment correction is recommended. The total cost for this 6,300 ft. reach of channel is $1,035,000.

Detention Facility #COR2

This 100 ac. ft., 19.1 acre facility is proposed in a wide section of floodplain and will reduce the 100-year flow rate from 5,300 cfs to 4,600 cfs. The earthwork required to provide adequate storage volume is 260,000 cy. The facility should be provided with a 50 ft. wide x 3 ft. deep low-flow channel and a 35 ft. x 6 ft. box culvert outlet through a 10 ft. high earth embankment. A 50 ft. lined weir will also be needed to provide adequate outlet capacity. Three drop structures will need to be installed at the inlet to lower the natural stream to the level of the facility. The cost for this is estimated at $620,000.

Detention Facility #COR2 to State Highway 94

The existing channel section in this reach has a minimum width of 100 ft., with some portions up to 150 ft. wide. It is recommended that this section be left natural with only side slope regrading and revegetation work required. A 100 ft. buffer zone from the edge of the floodway should be provided instead of bank protection. The cost for this area is $20,000.

Reach 7 - Corral Tributary

Detention Facility #COR3

This is essentially an existing 12.0 acre facility formed by the ponding of the channel at the 36 ft. x 6 ft. box culvert which crosses State Highway 94. Some excavation, estimated at 30,000 cy, should be performed to provide 85.0 ac. ft. of storage volume, which will reduce the flow rate from 5,800 cfs to 3,930 cfs. The estimated cost to upgrade this facility is $60,000.

Detention Facility #COR3 to STA 346+56

The existing 1,800 ft. section of channel needs to be realigned with four drop structures installed to lower the slope and velocity. The 50 ft. wide improved channel should be protected with Type 2 protection for the proposed 1,400 ft. length. Including the 10,000 cy of estimated earthwork, the total cost of this improvement is $220,000.

Sta 346+56 to Sta 394+36

Of the total 4,780 ft. of existing channel, the lower 1,500 ft. and the upper 2,100 ft. must be realigned. The estimated earthwork for this work is 31,000 cy. Due to the shorter length of the new 50 ft. channel, which is 3,600ft., three drop structures will be required to lower the slope and velocity. Type 3 protection is recommended and the cost for this section is estimated at $560,000.

Sta 394+36 to Sta 427+36

Some minor alignment corrections and widening should be performed in this reach to provide a minimum 30 ft. wide channel. The earthwork for this improvement is estimated at 20,000 cy. The side slopes should also be protected using Type 3 protection for the entire 3,300 ft. length. The cost for this improvement is estimated at $395,000.

Reach 8 - Strip Mine Tributary

Existing Confluence with Corral Tributary to Proposed Diversion Channel, (Sta 35+00)

In this area, Strip Mine Tributary runs parallel to Corral Tributary, beginning a short distance from the confluence upstream for approximately 3,000 ft. In lieu of developing two parallel systems, it was determined to be more economical to divert Strip Mine flows directly to Corral Tributary. Therefore, it is recommended to abandon the reach from the existing confluence with Corral Tributary upstream to Sta 35+00 and to reclaim the land. A fill quantity of 70,000 cy will be required at a cost of $105,000.

Proposed Juncture with Corral Tributary to Sta 35+00

In conjunction with the above recommendation, a new 100 ft. wide, 1,200 ft. long channel should be constructed. Additionally, three 4-foot drop structures will be required to reduce the bed slope from .017 ft./ft. to .008 ft./ft. To inhibit erosion, the side slopes should be regraded to 3:1 and a Revegetation Mat (Type 2) employed. Total cost for improvements in this section is estimated to be $190,000.

Sta 35+00 to Existing Side Channel, (Sta 77+00)

Historically, large flows have breached Strip Mine Tributary and formed a side overflow channel. It is recommended to construct an embankment across the side channel to contain all flows within Strip Mine Tributary itself.

Beginning at Sta 35+00 a transition section should be constructed in the upstream direction to increase the channel width from 100 ft. to 150 ft., where the proposed alignment begins. From the end of the transition upstream to Sta 77+00, widen the channel to 150 ft. to match the existing channel width which is approximately 150 ft. Provide Type 2 protection for the entire reach. Earthwork is estimated at 40,000 cy and the cost of improvements totals $250,000.

Sta 77+00 to Strip Mine Detention Facility #SM1

This section of the stream is about 150 ft. wide with a bed slope of 0.01 ft./ft. and flow depths of less than 3 ft. It is recommended that this part of the channel be left in its natural state. Some bank regrading will be needed along with approximately 700 ft. of channel widening. It is also recommended that a minimum 100 ft. buffer zone be provided between the edge of the floodway and any proposed development. Estimated cost is $75,000.

Detention Facility #SM1

This facility is located to take advantage of an existing abandoned surface mining area. Two existing pits can be expanded and connected to serve as a 90 ac. ft., 13.5 acre facility. A 150 ft. wide diversion structure will be required to divert the flow from Strip Mine Tributary into the facility once the main channel flow limit has been exceeded. This flow would then enter the facility and be released at a much slower rate through a 50 ft. wide, riprap lined weir back into the Strip Mine Tributary. This will reduce the flow rate from 5,000 cfs to 3,250 cfs. The cost for this facility is $320,000.

Detention Facility #SM1 to Detention Facility #SM2

This wide section of channel is recommended to be left natural. Flow depths are less than 2 ft. with a velocity less than 8 fps. Some regrading of the side slopes to a minimum of 3:1 is recommended along with reseeding all banks. Also recommended is 300 ft. of channel realignment and a 100 ft. buffer zone from the edge of the floodway. In addition to the main channel work, an existing tributary should be connected to the main channel at Sta180+00. This 400 ft. diversion channel would eliminate the need for 3,000 ft. of parallel channels. The cost for the main channel work is estimated at $85,000.

Detention Facility #SM2

This 60 ac. ft., 19.0 acre, on-channel detention facility is recommended to be constructed at the confluence of two forks of Strip Mine Tributary. One fork drains the area north of State Highway 94 and contributes 2,000 cfs to the flow, while the other fork drains the area east of Franceville Road and contributes about 1,400 cfs to the flow. This facility will require the construction of a 10 ft. high, 500 ft. long embankment across the channel. A 30 ft. x 5 ft. box culvert outlet with a 50 ft. wide lined weir spillway would meter the rate of flow out of the basin to 2,500 cfs compared with 3,400 cfs unchecked flow. A total of five drop structures will be needed on both forks to lower the streams into the facility. Also, approximately 240,000 cy of earth will need to be moved to provide the necessary storage. The estimated cost of this facility is $625,000.

Detention Facility #SM2 to 600 ft. North of SR 94

The channel in this area is about 75 ft. wide with shallow channel banks. The depth of flow is estimated at 2.5 ft. with a velocity of 10.6 fps. It is recommended that some side slopes be regraded to a minimum of 3:1 and Type 3 protection be provided. The cost of this work is $155,000.

Sta 240+50 to Sta 275+50

In this section, a minimum 40 ft. wide channel should be provided with Type 3 protection on the side slopes. The 1,300 cfs will produce flow depths less than 3 ft. with velocities of 10.6 fps. The cost for this 3,500 ft. reach is $405,000.

Reach 9 - Franceville Tributary

Existing Confluence with Jimmy Camp Creek to Sta 38+30

The work in this section of the tributary should be limited to regrading the side slopes to a 3:1 minimum and reseeding the area. A 100 ft. buffer zone beyond the channel banks should provide an adequate safety area for the 2.75 ft. depth of flow expected. The estimated cost for improvements in this area is $40,000.

Sta 38+30 to Sta 63+30

This section of the tributary is very flat and has no defined channel. It is recommended that a 6 ft. wide concrete lined channel be used in this area. The estimated cost for the new channel is $210,000.

Sta 63+30 to Sta 130+50

This section encompasses two areas, both of which produce less than 500 cfs. The area from Sta 130+50 to Drennan Road will no longer receive flows from Franceville Tributary due to the proposed diversion channel north of this area, so only local flows will collect at Drennan Road. These flows should continue in a small ditch, along Drennan Road, westerly to Corral Tributary, except for what will cross Drennan Road through the two existing culverts. The flows south of Drennan Road to Sta 63+30 will be less than 500 cfs. The costs for handling minor flows have been included in the minor systems costs and are not included in the Basin Fee.

New Confluence with Corral Tributary to Sta 130+50

As mentioned previously in this report, the proposed confluence is advantageous for a number of reasons; first, the existing problems associated with the Drennan Road crossing of the Franceville Tributary; and secondly, the severe erosion which is currently occurring adjacent to the northeast abutment of the Corral Tributary crossing of Drennan Road. Finally, the additional flow from the Franceville Tributary at the proposed confluence point does not significantly effect the overall cost of channel improvements within the Corral Tributary downstream of this point.

The actual improvements necessary to reroute the Franceville Tributary include approximately 120,000 cy of earthwork and six drop structures to keep velocities in the proposed 75 ft. wide channel near 8 fps. The 4,750 ft. long channel will require Type 2 protection. The estimated cost for this improvement is $630,000.

Sta 130+50 to the Franceville Tributary Detention Facility #FRI

This reach of Franceville Tributary contains the only defined channel in the tributary. However, it still needs to be widened to 75 ft. and deepened in some areas. Earthwork was estimated at 90,000 cy for the 4,400 ft. channel. Due to the 0.01 ft./ft. bed slope, velocities of 10.5 fps can be expected. Therefore, Type 3 protection is recommended for the entire channel. Total cost is estimated at $710,000.

Franceville Tributary Detention Facility #FR1

This 100 ac. ft. detention facility is designed to take advantage of the natural terrain in the area as well as to keep the facility within the existing floodplain. Approximately 100,000 cy of earth would have to be removed from this 20 acre site to provide the storage volume required to reduce the flow rate from 4,980 cfs to 2,800 cfs. Also, a 10 ft. high, 600 ft. long embankment will have to be constructed. A 30 ft. x 5 ft. box culvert principal outlet with a 50 ft. lined weir emergency spillway is recommended to meter the flows from the facility. Low flows should be contained in a 25 ft. wide x 2 ft. deep low-flow channel. The cost for this facility is $250,000.

Detention Facility #FR1 to Sta 256+80

The existing channel into the detention facility location is a wide, grassed swale, and a totally new channel will need to be constructed. The new 50 ft. wide channel will require about 90,000 cy of earthwork and Type 3 protection due to 11.6 fps velocity expected. The estimated cost for this 6,670 ft. length of channel is $1,000,000.

Sta 256+80 to Franceville Road

This section begins at the proposed confluence point of one of the many hillside tributaries which cross Franceville Road. From this point the channel extends in a northeasterly direction until it crosses Franceville Road. The existing channel is wide and shallow with numerous bends. It is recommended that the proposed channel be a minimum of 25 ft. wide and eliminate the more severe bends. Due to the steepness of this reach (3%), Type 3 protection is recommended for the 12 fps velocity expected. The estimated cost for this section is $250,000.

Reach 10 - East Tributary

Existing Confluence with Jimmy Camp Creek to Retention Facility #EA1 (Sta 21+10)

It is recommended to utilize and improve the existing East Tributary as a secondary channel (see "New Confluence with Jimmy Camp Creek to Retention Facility #EA1"on the next page) to handle any outflow from the retention pond. A maximum flow of 400 cfs is anticipated in this channel and the bottom width should be a minimum of 10 ft. The existing crossing at Peaceful Valley Road consists of a 48" corrugated metal pipe which should be removed and replaced with a 12 ft. x 5 ft. box culvert under the highway fill. The cost to improve the secondary channel was estimated at $15,000. (See Table No. 6 for box culvert costs).

Retention Facility #EA1

Retention facility #EA1 utilizes an existing 13.0 acre pond and a diversion structure which provides a limit to the peak flow contributed by East Tributary into Jimmy Camp Creek. The design is such that flows greater than 2,500 cfs would be diverted into an existing 100 ac. ft. retention facility which will reduce the flow rate from 950 to 400 cfs. Water surface elevation will be controlled by a 36" reinforced concrete pipe principal outlet and a 20 ft. wide emergency spillway that would flow into the secondary channel. The cost to improve and construct the retention facility was estimated to be $45,000.

New Confluence with Jimmy Camp Creek to Retention Facility #EA1 (Sta 46+62)

It is recommended to construct a new 75 ft. wide channel to direct flows from East Tributary into Jimmy Camp Creek upstream of Peaceful Valley Road. Historically, peak flows from both Jimmy Camp Creek and East Tributary crossed Peaceful Valley Road separately. The proposed channel scheme will require only one bridge to be built over Jimmy Camp Creek. Earthwork to construct the 800 ft. long channel is estimated at 55,000 cy and Type 2 bank protection is recommended for the entire length. Total cost of improvements is estimated to be $145,000.

Sta 46+62 to Detention Facility #EA2 (Sta 179+32)

For the greater portion of the downstream section of East Tributary, the existing channel is in poor condition in terms of carrying capacity for the 100 - year storm. It will be necessary to widen the channel to 75 ft. and deepen it to a minimum of 7 1/2 ft. Type 2 side slope protection should be placed along the entire section. Total cost for improvements in this 2 1/2 mile reach is estimated at $1,400,000.

Detention Facility #EA2

It was determined that an 18.4 acre detention facility located on the upstream side of a proposed roadway would provide the required 110 ac. ft. capacity necessary to reduce 100-year developed flows from 4,860 cfs to 3,400 cfs. The required outflow structure is a 36 ft. x 8 ft. box culvert and three 4-foot drop structures will be required to lower the stream bed into the detention facility. Cost for the entire facility is estimated to be $520,000.

Sta 186+32 to Detention Facility #EA3

This portion of East Tributary has no clearly defined channel to carry the major flows. It is recommended that a 75 ft. wide channel be constructed to replace the existing grassed swale. The new channel will need to be deepened by constructing a .0085 ft./ft. bed slope. This mild bed slope will permit velocities near 8 fps, therefore, only Type 2 protection will be required. The cost for this channel improvement is $450,000.

Detention Facility #EA3

This 18.4 acre facility will take advantage of the proposed Bradley Road alignment as part of the embankment needed for the facility. The earthwork estimated for this 120 ac. ft. facility is 200,000 cy. A 20 ft. x 6 ft. box culvert outlet will be required to reduce the flow rate from 3,600 cfs to 1,850 cfs. And a 25 ft. wide x 2 ft. deep low-flow channel should be provided through the facility. Two drop structures will be needed at the inlet due to the elevation differences between the bottom of the facility and the flowline of the inlet channel. The total cost for this facility is $435,000.

Detention Facility #EA3 to Drennan Road

This length of channel will require approximately 23,000 cy of excavation to deepen and widen the channel to 75 ft. Also, it is recommended that 1,800 ft. of the channel below Drennan Road be realigned. Since the velocities are approaching 11 fps, Type 3 protection should be provided on the 3:1 side slopes. The cost for these improvements is estimated at $660,000.

Drennan Road to Meridian Road

This reach will require approximately 600 ft. of realignment of the existing channel, reducing the stream length from 2,450 ft. to 2,000 ft. Two drop structures will be required to prevent an increase in the bed slope. The realignment and widening of the channel to 75 ft. will require about 30,000 cy of earthwork. Type 2 protection should be provided for this section, bringing the estimated cost for these improvements to $200,000.

Meridian Road to Sta 370+74

This portion of the stream will require some widening and deepening of the existing channel to provide a minimum 75 ft. wide section. It is also recommended that four drop structures be installed to flatten the bed slope from .0160 ft./ft. to .0120 ft./ft. which will lower the velocity to below 10 fps. Type 3 protection is recommended for the 3:1 side slopes. The total cost of this section, including 45,000 cy of earthwork, is $640,000.

Sta 370+74 to Franceville Road

The existing channel in this section needs to be widened to a minimum of 50 ft. wide with 500 ft. of realignment required in the extremely sharp bends. Earthwork is estimated at 20,000 cy for this section. Since the velocities are above 10 fps, Type 3 protection should be provided. The estimated cost for these improvements is $545,000.

Franceville Road to Sta 448+64

The existing 50 ft. wide channel requires only minimal widening throughout this 2,100 ft. section, and the estimated earthwork is 10,000 cy. Type 3 protection should be provided on the 3:1 side slopes. The estimated cost is $245,000 for these improvements.

Marksheffel Tributary

Marksheffel Road Crossing to Drennan Road

The channels and detention facility in this area have been designed and/or constructed. Therefore, no additional recommendations are being presented within this area of the Colorado Centre Metropolitan District.

Drennan Road to Detention Facility #MRK2

The existing channel in this area is a broad grassed swale. It is recommended that a 6 ft. wide concrete channel be constructed to carry the flows to Drennan Road. The estimated cost is $35,000.

Detention Facility #MRK2

It is recommended that a 35 ac. ft. detention facility be constructed in this area to reduce the flow rate from 1,200 cfs to 860 cfs. This will match the capacity of the downstream facilities constructed within Colorado Centre. Earthwork for this 6.5 acre facility is estimated at 60,000 cy. A 10 ft. high embankment with a 10 ft. x 4 ft. box culvert outlet and a 25 ft. lined weir should be provided. The estimated cost for this facility is $150,000.

Detention Facility #MRK2 to City Limits

It is recommended that a 6 ft. wide concrete lined channel be constructed along the existing swale path to accommodate flows from the existing airport property. The estimated cost is $255,000.

Fontaine Tributary

Existing Confluence with Jimmy Camp Creek to the Proposed Marksheffel Road Crossing

A new 50 ft. wide channel is recommended since upsizing the existing channel and providing three roadway crossings along the original flow route would be much more costly. The Marksheffel crossing will occur 1,400 ft. east of Link Road. Earthwork for the 800 ft. of channel is estimated at 8,000 cy, and Type 2 protection should be provided since the velocities will be controlled by the 0.004 ft./ft. bed slope. Estimated cost is $75,000.

Marksheffel Road Crossing to the Existing Channel

A new 50 ft. wide channel with a 0.0040 ft./ft. bed slope should be constructed parallel to and 400 ft. west of existing Marksheffel Road. Approximately 2,300 ft. of channel will have to be constructed to reach the existing channel. The earthwork is estimated at 50,000 cy. Type 2 protection is recommended for the banks. The estimated cost is $260,000.

The Existing Channel Tie-In to the Juncture with the Side Channel from the West

This section of the existing channel is a broad grassed swale. A new 2,500 ft. channel will require Type 2 protection since the new channel section would confine the flows to a 50 ft. width and increase velocities. The cost of this improvement including 35,000 cy of earthwork is $250,000. The 2,400 ft. long, 40 ft. wide side channel cost is estimated at $180,000.

Existing Side Channel to 5,500 ft. Upstream

The existing 30 ft. wide channel should be widened to 50 ft. The earthwork for the new 5,200 ft. channel is 25,000 cy. Type 2 protection should be provided on the 3:1 side slopes. The cost of this reach is $380,000.

Previous Location to Fontaine Road

The existing 30 ft. wide channel should be widened to 40 ft. Earthwork for this 3,100 ft. of channel is estimated at 6,000 cy. Type 2 protection should be provided on the 3:1 side slopes. The cost of this improvement is $175,000.

Detention Facility #FON1

A 90 ac. ft., 20.2 acre detention facility is recommended at Fontaine Road. It will require 150,000 cy of earthwork to provide enough volume. Also, a new 20 ft. x 8 ft. box culvert outlet would have to be constructed across Fontaine to reduce the flow rate from 3,700 cfs to 1,650 cfs. The estimated cost for this facility is $250,000. (See Table No. 6 for the box culvert costs).

PRIORITIES

The recommendations listed in this report address several problems, some of which are existing while others will only be manifested with the increase in development. It is the intent of this section to prioritize the major improvements to correct these problem areas. In order to achieve this, this section addresses the existing needs separately from the future needs.

Existing needs are those improvements which are necessary to address problems which exist prior to further development in the basin. The following improvements should be undertaken as soon as funds are available:

A. Lower Jimmy Camp Creek at Peaceful Valley Road and construct the new juncture with East Tributary to prevent flooding to existing homes and the Peaceful Valley Roadway.

B. Realign Jimmy Camp Creek from the D&RGW railroady bridge to Old Pueblo Road to prevent flooding along Old Pueblo Road.

C. Remove trees, brush and accumulated sediment from the vicinity of the Link Road bridge.

Future needs are those improvements which are made necessary by development in the basin. The following facilities schedule is recommended:

DETENTION FACILITIES

The lowermost detention facility located along any major tributary should be constructed as soon as 20% of the land which is tributary to that stream is platted.

These include the following facilities:

JCC1	**EA1**	**MRK1**	**FON1**
COR1	**FR1**	**SM1**	

The following detention facilities should be constructed as soon as 60% of the land which is tributary to that stream is platted:

JCC2

COR2 (Construct COR3 if development occurs north of SR 94 first)

SM2

EA2

The remainder of the detention facilities should be constructed as soon as 80% of the land which is tributary to that stream is platted. These include:

JCC3

EA3

COR3

Some adjustment to the construction timing of particular basins may be necessary, depending on the location of development. Also some staging of the detention facilities is possible depending on where and to what extent development occurs.

CHANNEL IMPROVEMENTS

Channel improvements within the basin, other than those already noted, are based upon the timing of development along the channel. Although areas of poor alignment, flooding and severe erosion exist, the approach of development will necessitate channel improvements. Since most of the existing land is utilized as range land, it is not affected by flooding or channel movement

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GLOSSARY OF TERMS

Aggradation. The accumulation of stream bed material due to sedimentation.

Antecedent Soil Moisture. This study assumes that precipitation for the five days prior to the design storm was more than 1.4 inches and less than 2.1 inches.

Assessment. The charge against any particular parcel of land within the boundaries of an irrigation, water, sewer, drainage, or other district created for the purpose of constructing improvements, or a share of the total cost of such improvement, usually based upon the proportionate benefits received by such parcel as a result of the improvement. A special assessment is direct tax levy assessed against property to pay for improvements which ordinarily are a direct benefit to the property itself.

Canal. An artificial open channel or watercourse constructed for one or more of the following purposes: (1) transporting water, and (2) connecting two or more bodies of water.

Catchment. See Watershed.

Channel. A natural or artificial watercourse of perceptible extent which periodically or continuously contains moving water, or which forms a connecting link between two bodies of water. It has a definite bed and banks which serve to confine the water.

Channel Reach. That portion of channel under consideration (longitudinal).

Channel Stability. Channel stability in the strictest sense is a condition in which the shape and alignment of a specific reach of a particular stream are fixed. However, this condition does not exist in nature. For the purposes of this plan, channel stability is defined as the condition in which the overall flow and sediment carrying characteristics are not altered significantly from those presently existing, or a condition in which an existing channel does not aggrade or degrade rapidly, or one in which the channel flow remains within its designated right-of-way and one which constant maintenance is not required to retain flow capacity through one flood season.

Channel Storage. The volume of water stored in a channel. Generally considered in the attenuation of the peak of a flood hydrograph moving downstream.

Coefficient of Roughness. A factor, in the Kutter, Manning, Bazin, or other formula for computing the average velocity of flow of water in a watercourse or conduit, which represents the effect of roughness of the confining material of the watercourse or conduit upon the energy losses in the flowing water.

Computer Model. The process whereby physical processes are mathematically simulated using data drawn from a real situation, whether it be the hydrologic response of a watershed or the reaction of a building to an earthquake.

Critical Depth. The particular depth of flow in an open channel with a given discharge at which the specific energy is at a minimum; i.e., a minimum specific energy. The given discharge may flow at an alternate depth above or below critical in the given channel but the specific energy of the flow at either alternate depth will be greater than for the flow at critical depth.

Critical Flow. Flow at critical depth.

Culvert. A closed conduit for the passage of surface drainage water under or over a roadway, railroad, canal or other impediment.

Dam. A barrier constructed across a watercourse for the purpose of (1) creating a reservoir, (2) diverting water therefrom into a conduit or channel.

Degradation. The loss of stream bed material due to erosion.

Design Storm. A storm of specific duration, volume, intensity and frequency derived for the purposes of designing facilities or evaluating existing conditions and determining flood hazard areas.

Detention. Temporary storage of a flood flow. Detention storage is used to reduce peak discharges while leaving the runoff volumes intact.

Dimensionless Hydrograph. A unit-hydrograph for which the discharge is expressed by a ratio of the discharge to peak discharge and the time by the ratio of time to peak time.

Discharge. In its simplest concept discharge means outflow; therefore, the use of this term is not restricted as to course or location, and it can be applied to describe the flow of water from a pipe or from a drainage basin. If the discharge occurs in some course or channel, it is correct to speak of the discharge of a canal or of a river. It is also correct to speak of the discharge of a canal or stream into a lake, a stream, or an ocean. The discharge of drainage basins is distinguished as follows:

Yield. Total water runout, includes runoff plus underflow.

Runoff. That part of water yield that appears in a stream.

Streamflow. The actual flow in streams, whether or not subject to regulation or underflow.

Each of these terms can be reported in total volumes (such as acre-feet) or time rates (such as cubic feet per second or acre-feet per year).

Drainage Basin. See Watershed.

Drainage Improvement. Drainage improvement consists of structural and non-structrual alternatives. Structural alternatives include detention ponds, dikes, storm sewers and channel improvement; non-structural alternatives include land use planning, flood insurance and mitigation.

Drainage Report. A drainage report is a document prepared by a registered professional engineer for the purpose of describing the existing drainage conditions, predicting the effects of development or other land use changes and proposing solutions to alleviate any adverse effects of development on the drainage environment.

Drainage Way. A route or course along which water moves or may move to drain an area.

Erosion. Wear or scouring of a surface caused by wind or water.

Evapotranspiration. The rate at which precipitation evaporates in an area.

Excess Precipitation. That part of the total precipitation that contributes directly to surface runoff.

Flood. Any relatively high flow that overtops the natural or artificial banks in any reach of a stream or that ponds to a depth sufficient to cause damages to property or losses to the general public.

Flood Damages. Flood damages are any and all losses incurred due to flowing or ponding water. For the purposes of this study, all property even partially inundated by the 5 or 100-year floods is deemed damaged and streets which flood above curb depth are also regarded as flood damaged.

Flood Hazard Area. Flood hazard areas are any areas in which flood damages occur or may occur due to development.

Floodplain. That area above and alongside a river, floodway, or channel stream which is subject to inundation by out-of-bank flow.

Flood Routing. The process by which a flood wave (hydrograph) is transmitted downstream and its shape influenced by the channel and flood plain through which it travels. In general, the less efficiently the stream system conveys the flows, the larger the impact on the flood wave and vice versa.

Flood Storage Area. Flood storage area is that portion of the regulatory area that may serve as a temporary storage area for flood waters from the 100-year flood and that lies landward of the floodway.

Floodway. Floodway is that portion of the regulatory area required for the reasonable passage or conveyance of the design flood. This is the area of significant depths and velocities and due consideration should be given to effects of fill, loss of cross - sectional flow area, and resulting increased water surface elevations.

Free Surface Flow. The type of flow in either open channels or closed conduits which has a free water surface and whose driving force is gravity.

Freeboard. The vertical distance between the normal maximum level of the surface of the liquid in a conduit, reservoir, tank, basin, canal, etc., and the top of the confining structure, which is provided so that waves and other movements of the liquid will not overtop such confining structures.

Frequency. An expression, usually in percent, of how often a hydrologic event of given size, intensity, duration or magnitude should on an average be equaled or exceeded in any one year, i.e., the 1% chance event has 1 chance in 100 of being equaled or exceeded in any year.

Gabion. A wire basket containing stones, connected to others to provide protection against erosion.

Gradient. Ratio of the fall of the grade line to its length.

Headcutting. The process by which aggradation reduces the natural stream bed slope by lowering the channel elevation as it moves upstream.

Hydraulics. A branch of science that deals with practical applications of the mechanics of water movement.

Hydraulic Grade Line. In full, closed - conduit flow, the hydraulic grade line is the vertical distance to the top of the pipe measured from some datum, plus the pressure component which is calculated by taking the pressure in pounds per square foot and dividing by the specific weight of water in pounds per cubic foot. In open channel or free surface flow, the hydraulic grade line is the water surface because there is no pressure component.

Hydrograph. A plot of the passage of a flood wave past a point, plotted with the discharge rate on the vertical axis and time on the horizontal axis.

Hydrologic Soil Group. For runoff determination, soils are grouped into four categories (A,B,C and D) according to their runoff potentials, with Group A having the lowest runoff potential and Group D the highest. This method was derived by the U. S. D. A. Soil Conservation Service. Soils information is available through the El Paso County office.

Infiltration. (1) The entering of water through the interstices or pores of a soil or other porous medium. (2) The absorption of liquid water by the soil, either as it falls as preciptation, or from a stream flowing over the surface. See Surface Infiltration.

Invert. The floor, bottom or lowest portion of the internal cross section of a conduit. Used particularly with reference to aqueducts, sewers, tunnels, and drains.

Inverted Siphon. Refers to conduit flowing freely up and downstream but which is pressurized in a depressed section to carry water underneath an obstacle.

Lining. Impervious material such as concrete, clay or asphalt, placed on the sides and bottom of a ditch, channel, and reservoir to prevent or reduce seepage of water through the sides and bottom and/or to prevent erosion.

Major Drainage System. That storm drainage system which carries the runoff from a storm having a frequency of occurrence of once in 100 years. The major system will function whether or not is has been planned and designed, and whether or not improvements are situated wisely in respect to it.

The major system usually includes many features such as streets, gulches, and major drainage channels. Storm sewer systems may reduce the flow in many parts of the major system by storing and transporting water. The good planning and designing of a major system should eliminate major damage and loss of life from storms having a one percent chance of occurring in any given year.

Normal Depth. The depth at which water will flow if allowed to flow in a long, straight channel with constant slope, shape, roughness and discharge.

N-Hour Rainfall. The total amount of rainfall within a period of N hours.

N-Year Flood. The flood which will be equaled or exceeded, on an average of, once in every period of N years, i.e., the 100-year flood designates a magnitude of flood event, which over the long term will be equaled or exceeded once in 100 years. This does not preclude two events in one year.

Offstream Storage. The temporary storage of storm runoff water away from the main channel flow.

On-Site Ponding. A storm drainage facility whereby a portion or all of the excess runoff from a site is stored by ponding and either released at a low rate or allowed to infiltrate and/or evaporate.

Overland Flow. In general, flow not contained within a well - defined channel or water course.

Peak Rate of Runoff. The maximum rate of runoff during a given runoff event.

Pervious. Applied to a material through which water passes relatively freely.

Porosity. (1) An index of the void characteristics of a soil or stratum as pertaining to percolation; degree of perviousness. (2) The ratio, usually expressed as a percentage of (a) the volume of the interstices in a given quantity of material to (b) the total volume of material.

Precipitation. Any moisture that falls from the atmosphere, including snow, sleet, rain and hail.

Rainfall Distribution. The areal and/or time distribution of a rainfall event.

Rainfall Intensity Curve. A curve which expresses the relation between rate of rainfall and duration. Each curve is generally for a period of years during which time the intensities shown will not, on the average, be exceeded more than once.

Reach. Any length of river or channel. Usually used to refer to sections which are uniform with respect to discharge, depth, area or slope, or sections between gaging stations.

Recurrence Interval. The average interval of time within which the magnitude of the storm, or flood, will be equaled or exceeded. See Frequency.

Retention Storage. Storage facilities designed to permanently store runoff. The objective is to reduce peak runoff rates and volumes at downstream locations.

Riprap. Rough stone of various sizes placed compactly or irregularly to prevent scour by water or debris.

Routing, Hydraulic. (1) The derivation of an outflow hydrograph of a channel or stream from known values of upstream inflow. (2) The process of determining progressively the timing and shape of a flood wave at successive points along a stream or channel.

Runoff. That part of precipitation carried off from the area upon which it falls. Also, the rate of surface discharge of the above.

Runoff Curve Number. A dimensionless number indicating the runoff potential from a particular soil cover complex. Derived by the U.S.D.A Soil Conservation Service in "NEH-4 Hydrology."

Scour. The erosive action of running water in streams or channels in excavating and carrying away material from the bed and banks.

Sediment Load. The total amount of sediment including bed load, wash load, and suspended load carried by a stream.

Soil Cover Complex. The combination of soil type, as defined by the Soil Conservation Service, and land use or cover which directly effects the rainfall/runoff response of every parcel of land.

Spillway. A low level passage serving a dam or reservoir through which surplus water may be discharged; usually an open ditch around the end of a dam.

Storm Drainage Facility. Any structure, levee, channel, storm sewer, pond, pump station, or dam which has the function of passing, containing, directing or storing storm runoff.

Storm Runoff. The water running off from the surface of a drainage area during and immediately following a period of precipitation.

Stream. A body of flowing water. The term is usually applied to a body of water flowing in a natural surface channel, but is also applied to a body of water flowing in a well-defined, open or closed conduit or a jet of water issuing from any opening, such as a nozzle, a fissure in a rock, etc.

a. Continuous. A stream which habitually flows or contains water throughout its entire course, or between any two points on its course.

b. Ephemeral. (1) One that flows only in direct response to precipitation. Such a stream receives no water from springs, and no long-continued supply from melting snow or other surface source. Its channel is at all times above the water table. (2) The term may be arbitrarily restricted to streams or stretches of streams that do not flow continuously during periods of as much as one month.

c. Intermittent. A stream which flows during protracted periods, but not continually, when it receives water from springs or surface runoff.

d. Perennial. A stream which flows continuously at all seasons of a year and during dry as well as wet years. Such streams are usually fed by ground water, and their water surface generally stands at a lower level than that of the water table in the locality.

Stream Flow. A term used to designate the water which is flowing in a stream channel, canal, ditch, etc.

Surface Infiltration. That rainfall which percolates into the ground surface and which therefore does not contribute directly to the storm runoff flow.

Switchback Alignment. A series of meanders or natural curves in a stream.

Time of Concentration. The time required for rainfall as runoff to travel from the most remote location in the basin to the point of outfall measured from the time rainfall starts.

Time to Peak. Measured from the time rainfall starts, the time to the peak of the hydrograph.

Thalweg. The line of maximum depth in a channel or the normal flow path in a wide channel.

Tributary Basin. An area tributary to a specific point under study.

Unit Hydrograph. A unit hydrograph is defined as the hydrograph of one inch of direct runoff from the tributary area resulting from a unit storm. A unit storm is a rainfall of such duration that the period of surface runoff is not appreciably less for any rain of shorter duration. The unit hydrograph thus represents the integrated effects of factors such as tributary area, shape, stream pattern, channel capacities, and stream and land slopes.

Velocity. A time rate of change of position.

a. Erosive. That velocity of water in a stream, channel, canal, ditch, etc., which, when exceeded, will cause erosion of banks or bed.

b. Mean. The average velocity of a stream flowing in a channel or conduit at a given cross section or in a given reach. It is equal to the discharge divided by the cross-sectional area of the section, or the average cross- sectional area of the reach. Also called Average Velocity.

c. Permissible. (1) The highest velocity at which water may be carried through a structure, canal, or conduit without excessive damage. (2) The highest velocity throughout a substantial length of a conduit that will not scour.

Watercourse. Any streambed, channel, riverbed, or other flow path with defined bed and banks.

Watershed. The area which contributes runoff to some specific point (also basin, drainage area, catchment).

5-Year Flood. The 5-year flood has a 20% chance of being equaled or exceeded in any year.

Hydraulic Terms

ac. ft. - An acre foot is equal to 43,560 cubic feet or 325,828.8 gallons ofwater.

b - Bottom width of the channel.

cfs - Flow rate in cubic feet per second.

cy - Cubic yards.

D - Depth, usually referring to the depth of flow in a channel.

fps - Feet per second.

lf - Linear feet.

Q - Amount of flow usually expressed in cubic feet per second (cfs). Also, see runoff.

So - Stream gradient or slope

V - Velocity of speed at which the flow travels either overland or through a channel.

Fr - Froude Number - A flow parameter, which is a measure of the extent to which gravitational action affects the flow. A Froude number greater than 1 indicates supercritical flow and a value less than 1 subcritical flow. The simplest form of the Froude number is given by the equation:

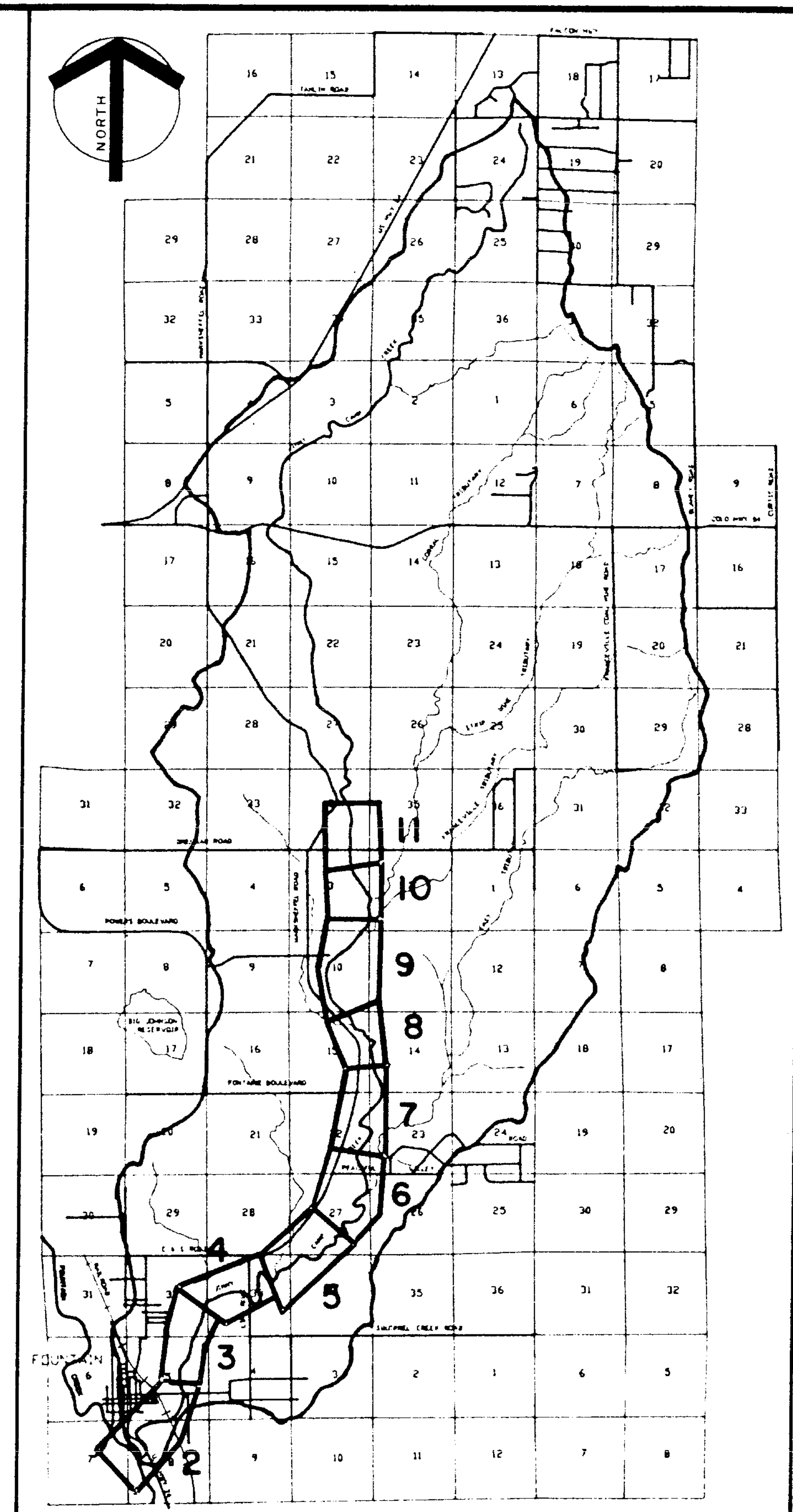
$$F_r = \frac{V}{gD}$$

where V is velocity, **g** the acceleration due to gravity (32.2 ft./sec./sec.), and **D** the depth.

INDEX TO SHEETS

SHEET NO.	DESCRIPTION
1	INDEX SHEET
2–11	FLOOD HAZARD MAPS
12–17	WATER SURFACE PROFILE MAPS
18–19	WATER SURFACE ELEVATIONS

NOTE·
CORPS OF ENGINEERS AERIAL PHOTOGRAPHY WAS USED FOR BASE MAPS ON SHEETS 2-4. U.S. DEPARTMENT OF AGRICULTURE SOILS CONSERVATION SERVICE AERIAL PHOTOGRAPHY WAS USED FOR BASE MAPS ON SHEETS 5-11.



AREA MAP
N.T.S

LEGEND

FLOOD PLAIN LIMITS

SCS 100 YEAR FLOOD

PROPOSED 100 YEAR FLOOD

GROUND ELEVATION IN FEET MEAN SEA LEVEL DATUM — 5800

CONTOUR, Index 4.0'

CONTOUR, Interpolated 2.0'

CROSS SECTION — J100 J100

CROSS SECTION CONTINUED — F050 F050

INTERMITTENT STREAM

AERIAL PHOTOGRAPHY AND TOPOGRAPHY ARE FOR EXISTING CONDITIONS AS OF MAY 1973. FLOOD HAZARD AREAS REFLECT DEVELOPED AND DETENTION CONDITIONS.

FLOOD AREA OUTLINES WERE DETERMINED BY MATCHING WATER SURFACE ELEVATIONS WITH TOPOGRAPHY.

TOPOGRAPHIC DETAIL WAS COMPILED BY PHOTOGRAMMETRIC METHODS TO MEET NATIONAL MAP ACCURACY STANDARDS. THE PHOTOGRAPHIC IMAGE CONTAINS DISPLACEMENTS DUE TO RELIEF AND IT DOES NOT MATCH THE TOPOGRAPHIC DETAIL IN ALL AREAS.

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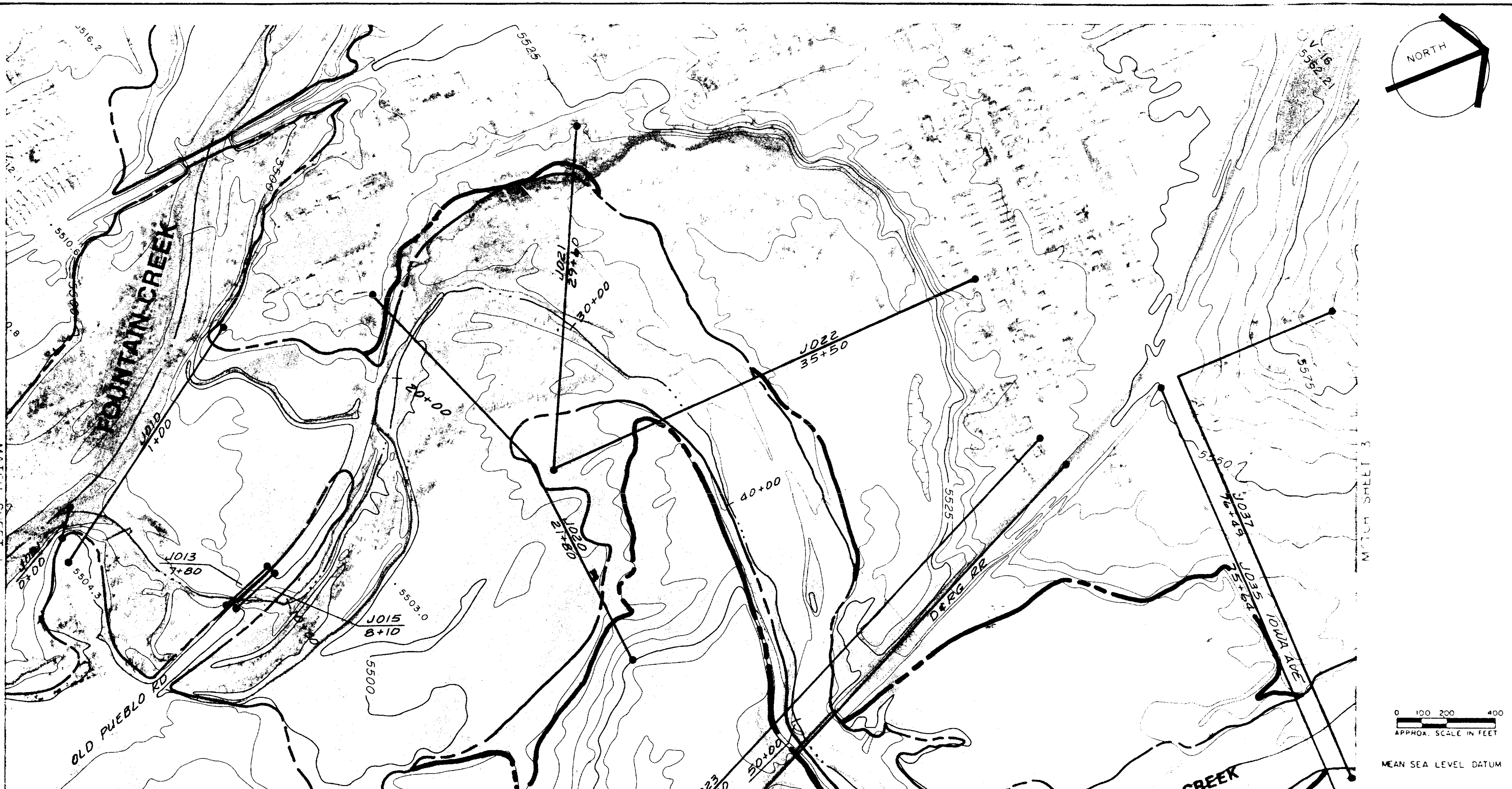

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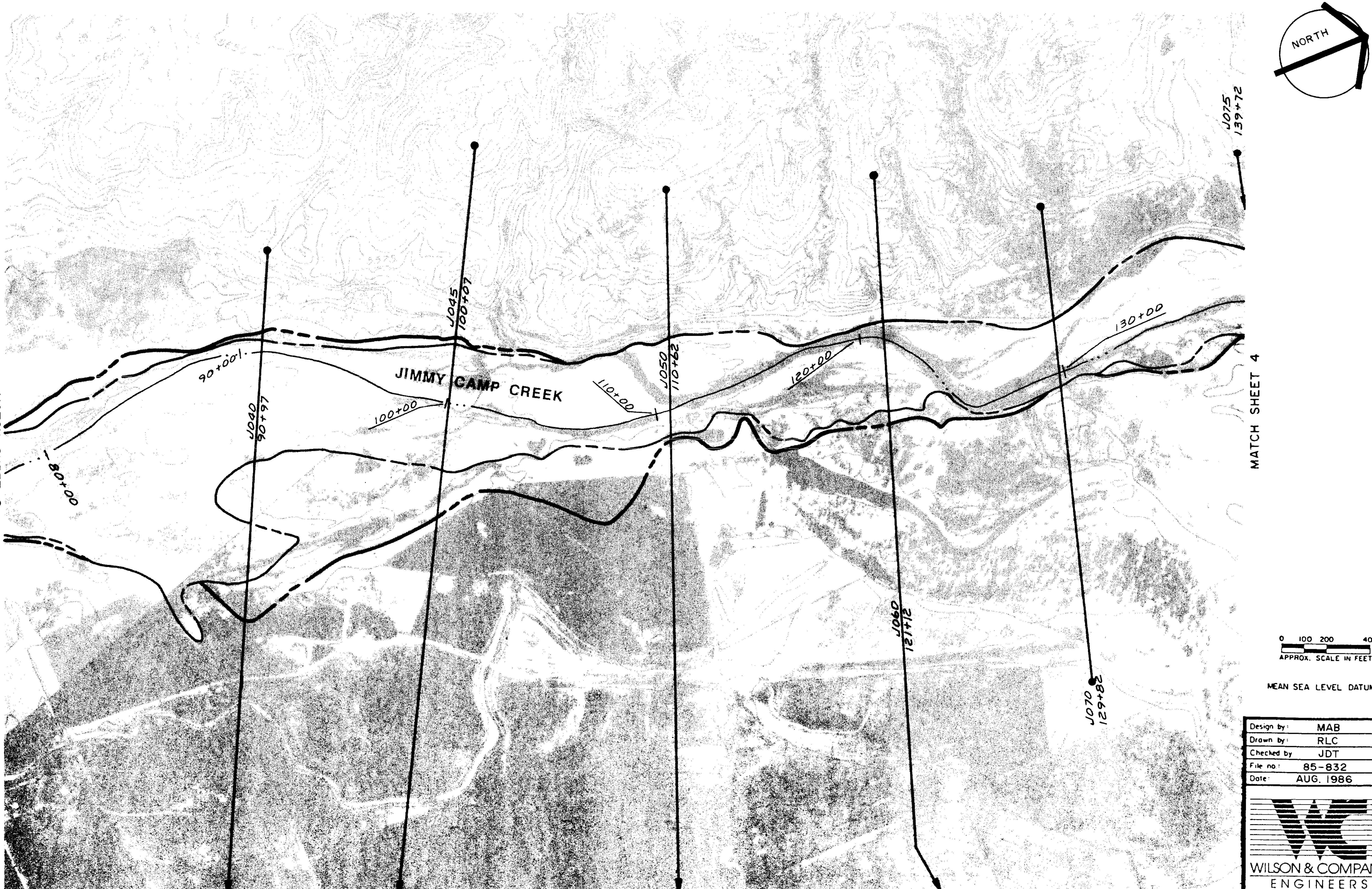
Sheet 2 of 19



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Sheet 3 of 19

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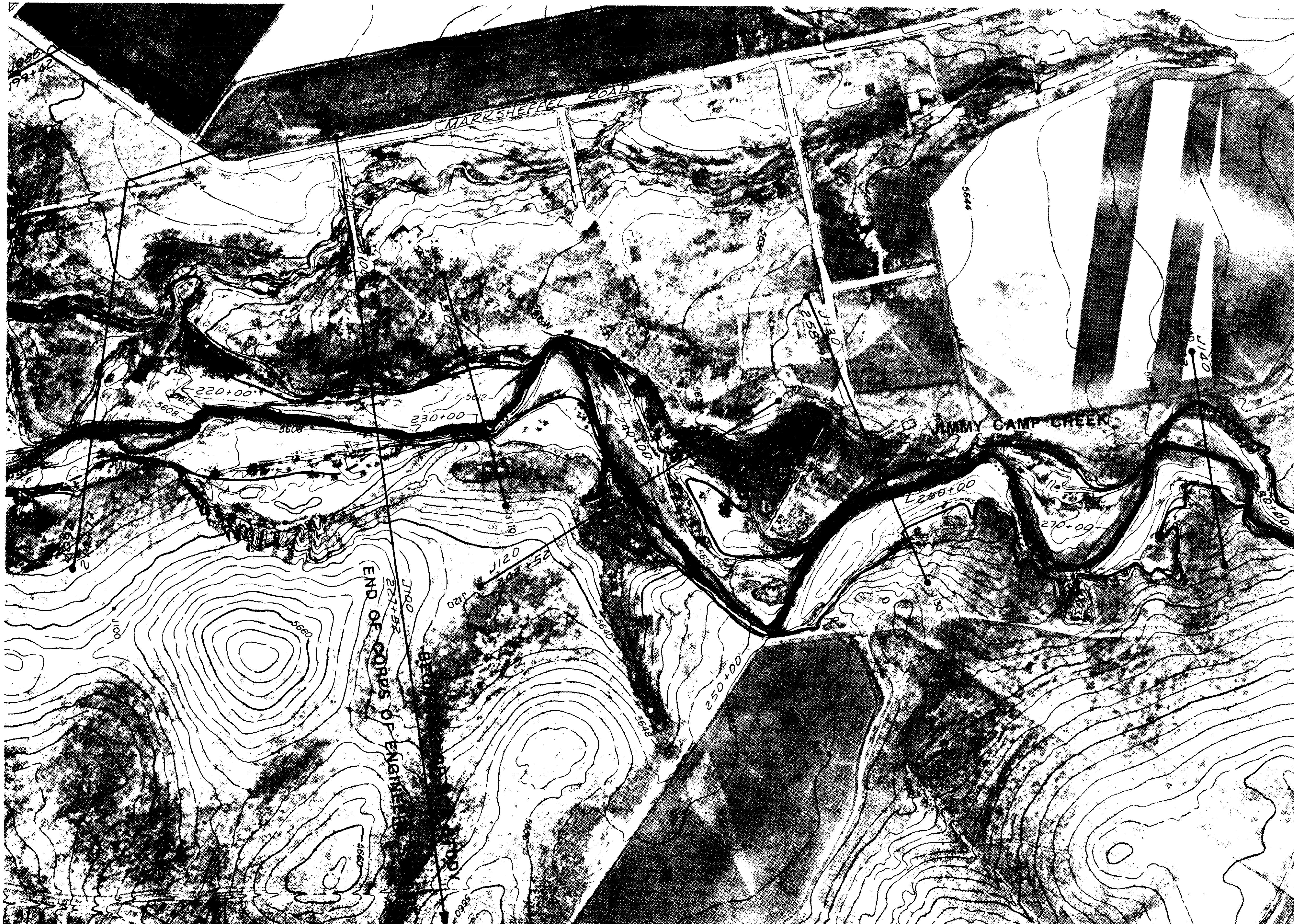
MATCH SHEET 4



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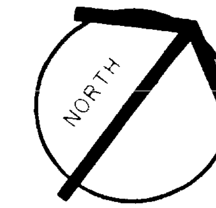

0 100 200 400

APPROX. SCALE IN FEET

MEAN SEA LEVEL DATUM

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0 100 200 400
APPROX. SCALE IN FEET

MEAN SEA LEVEL DATUM

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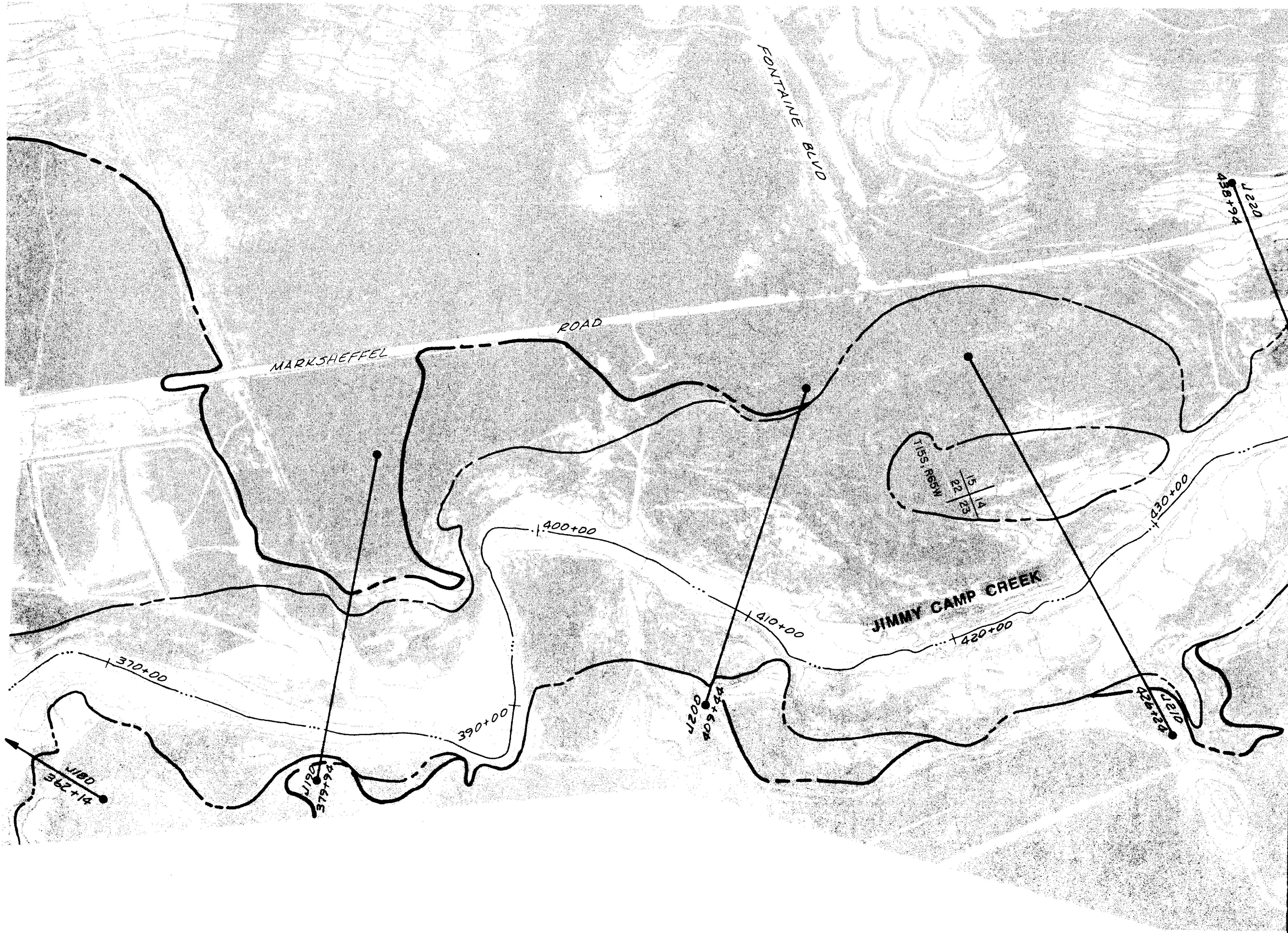

NORTH

0 100 200 400
APPROX. SCALE IN FEET

MEAN SEA LEVEL DATUM

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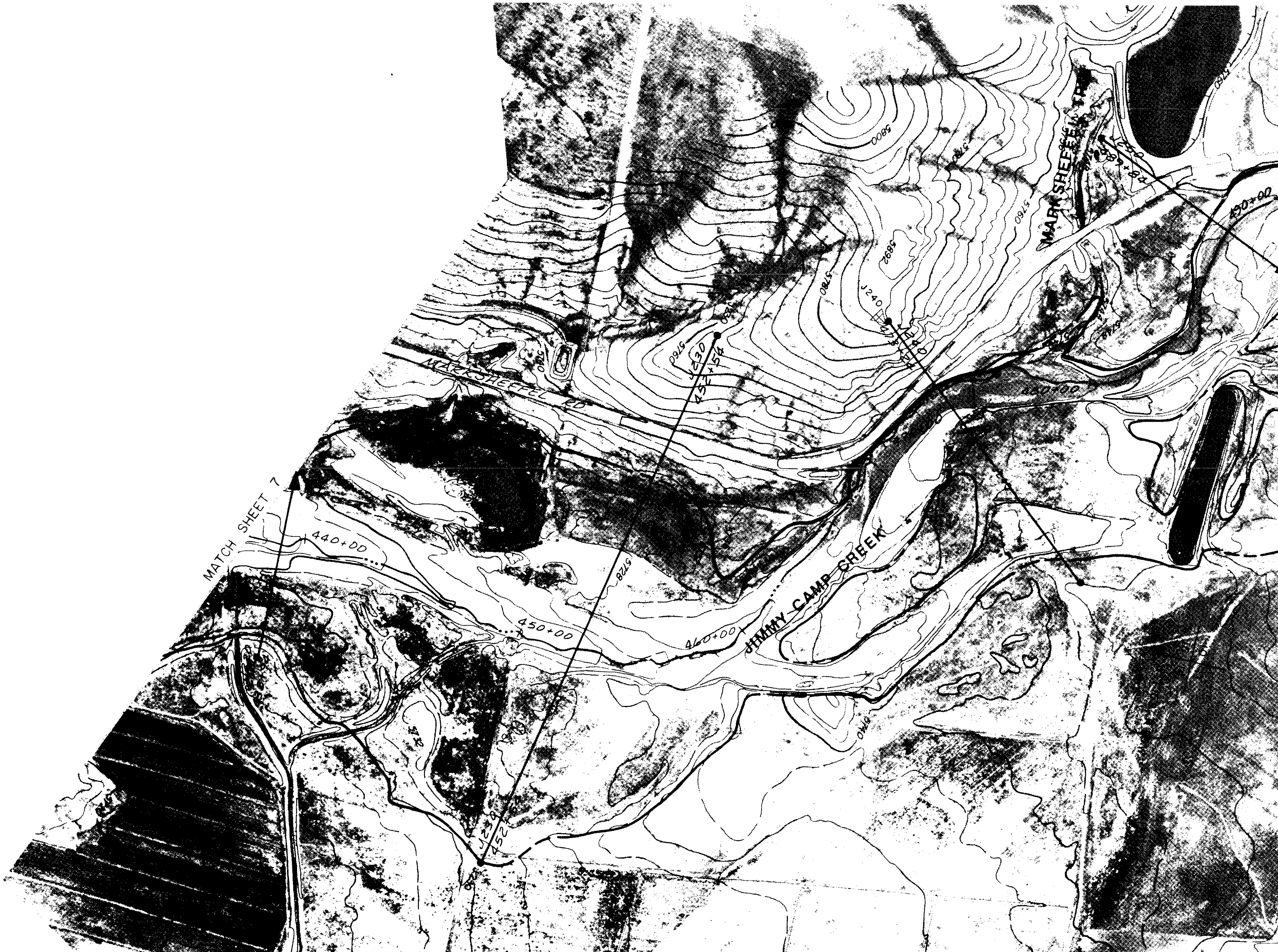

0 100 200 400
APPROX. SCALE IN FEET

MEAN SEA LEVEL DATUM

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Date:	AUG. 1986

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Sheet 8 of 19


NORTH
OLD MARYSHEFFEY ROAD ALIGNMENT
CAMP CREEK
MATCH SHEET 10
MATCH SHEET 8
500+00
510+00
540+00
5752
5764
5768
5784
5792
5880
0 100 200 400
APPROX. SCALE IN FEET
MEAN SEA LEVEL DATUM
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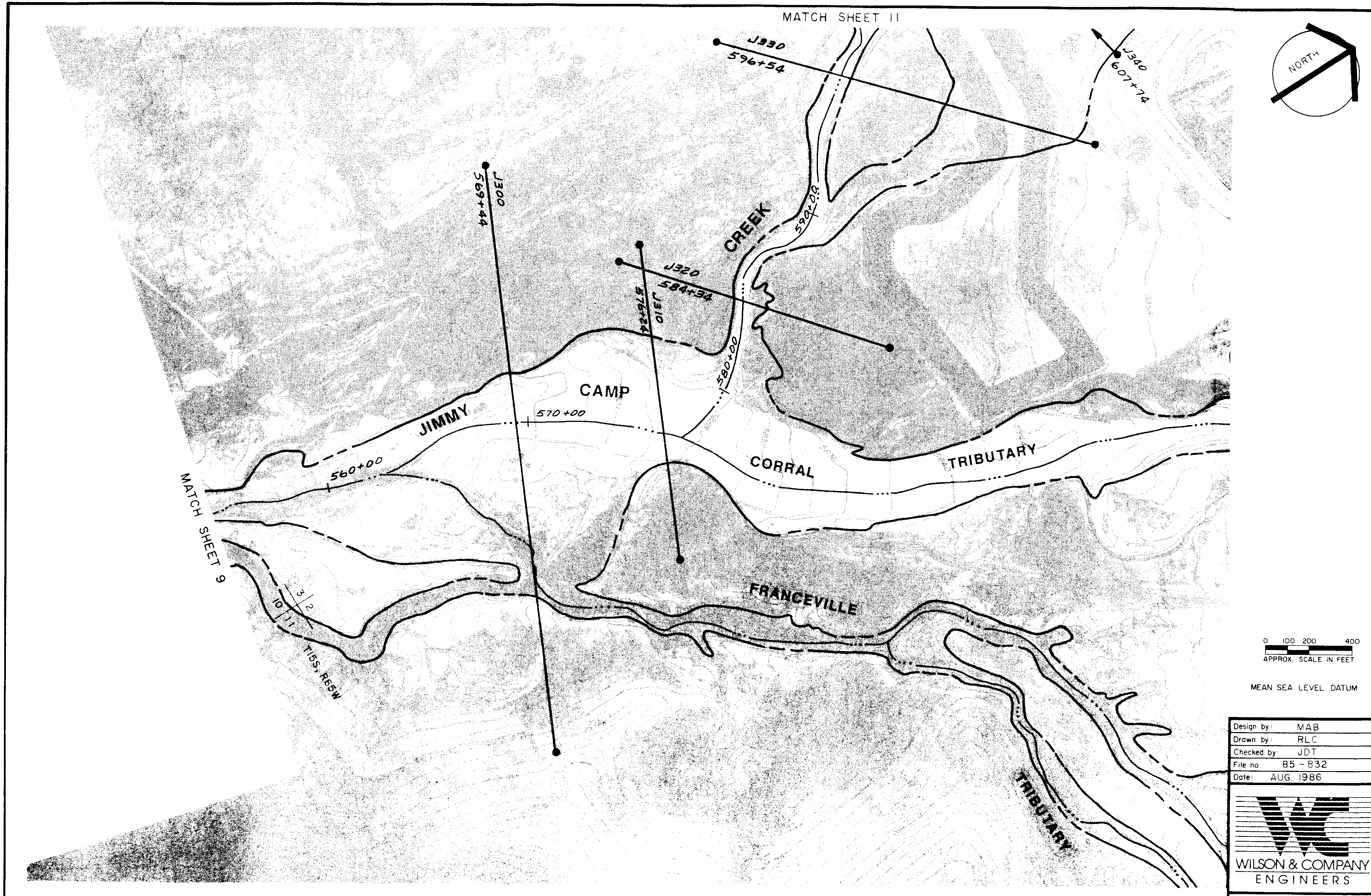

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Sheet 10 of 19

0 100 200 400
APPROX. SCALE IN FEET

MEAN SEA LEVEL DATUM

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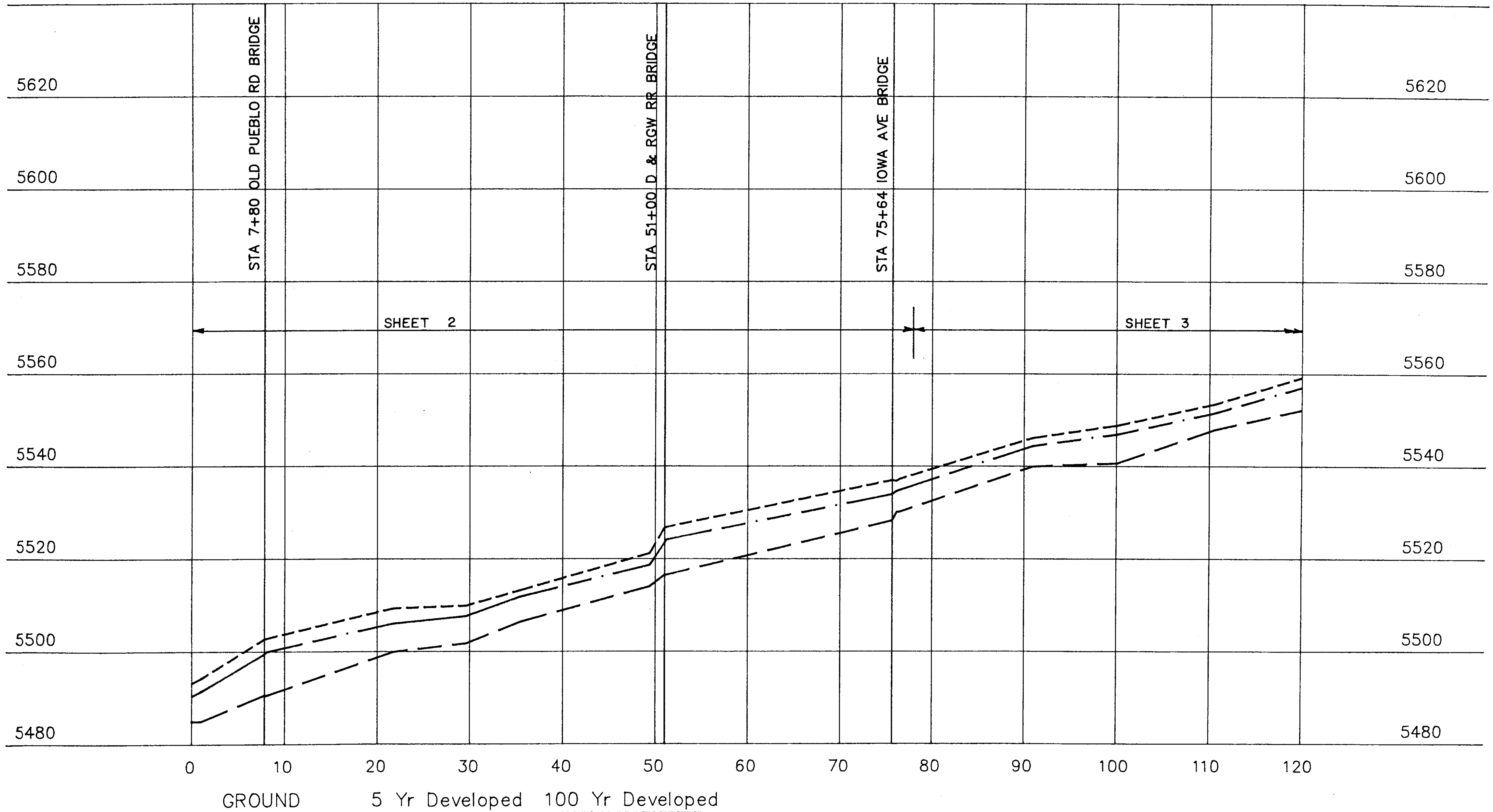
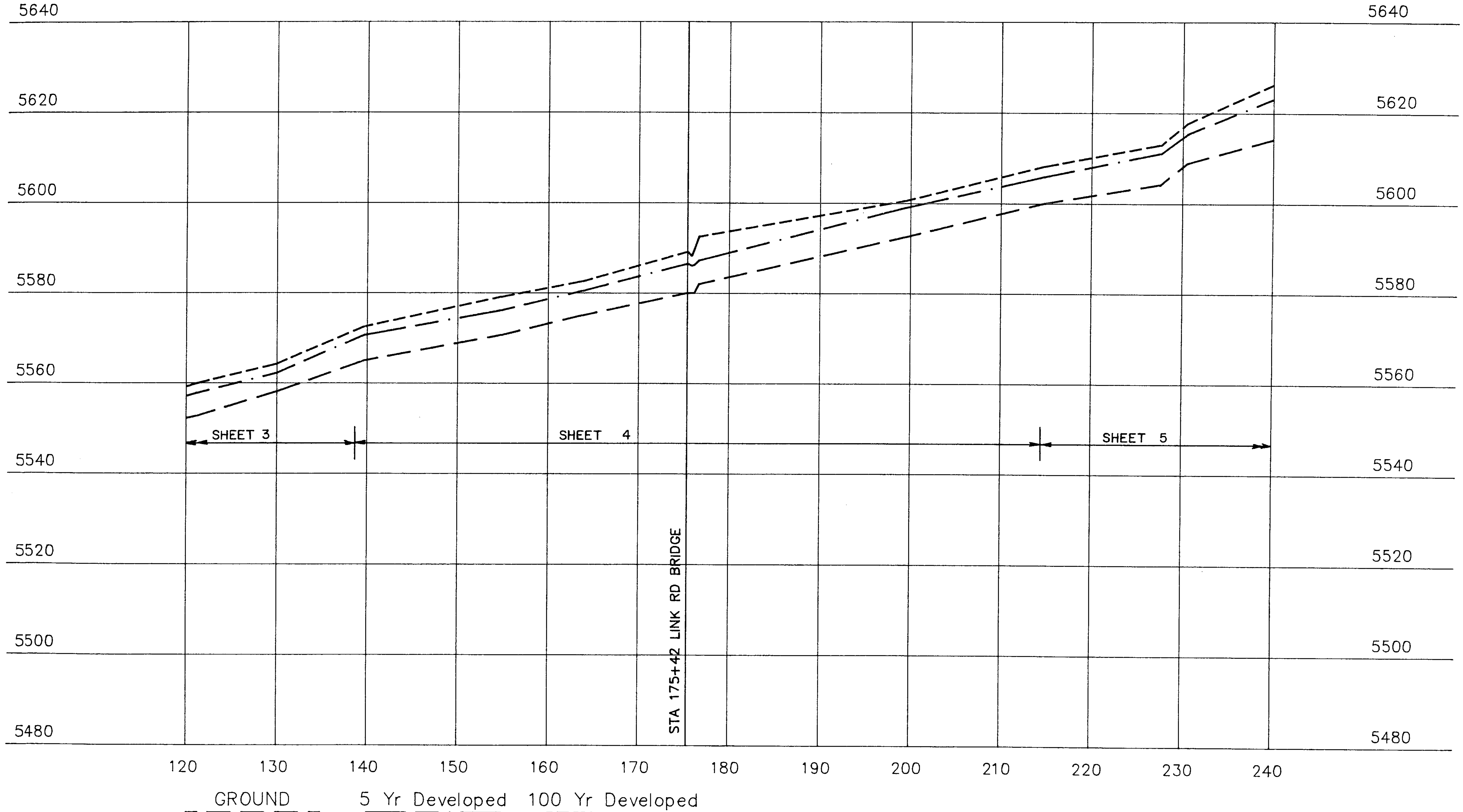


STA 7+80 OLD PUEBLO RD BRIDGE
STA 51+00 D & RGW RR BRIDGE
STA 75+64 IOWA AVE BRIDGE
SHEET 2
SHEET 3
5620
5600
5580
5560
5540
5520
5500
5480
0
10
20
30
40
50
60
70
80
90
100
110
120
GROUND
5 Yr Developed
100 Yr Developed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5620
5600
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5560
5540
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SHEET 3
SHEET 4
SHEET 5
STA 175+42 LINK RD BRIDGE
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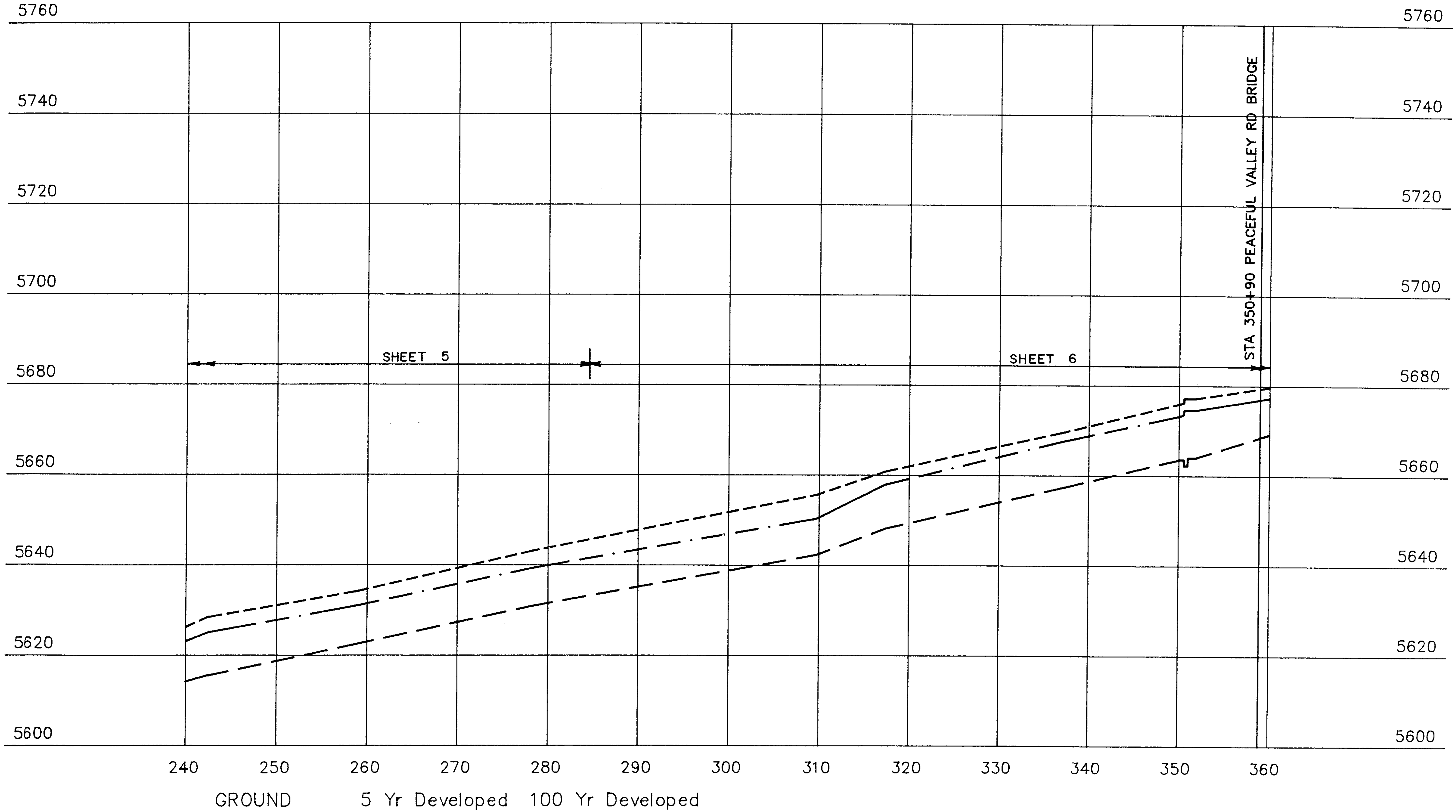
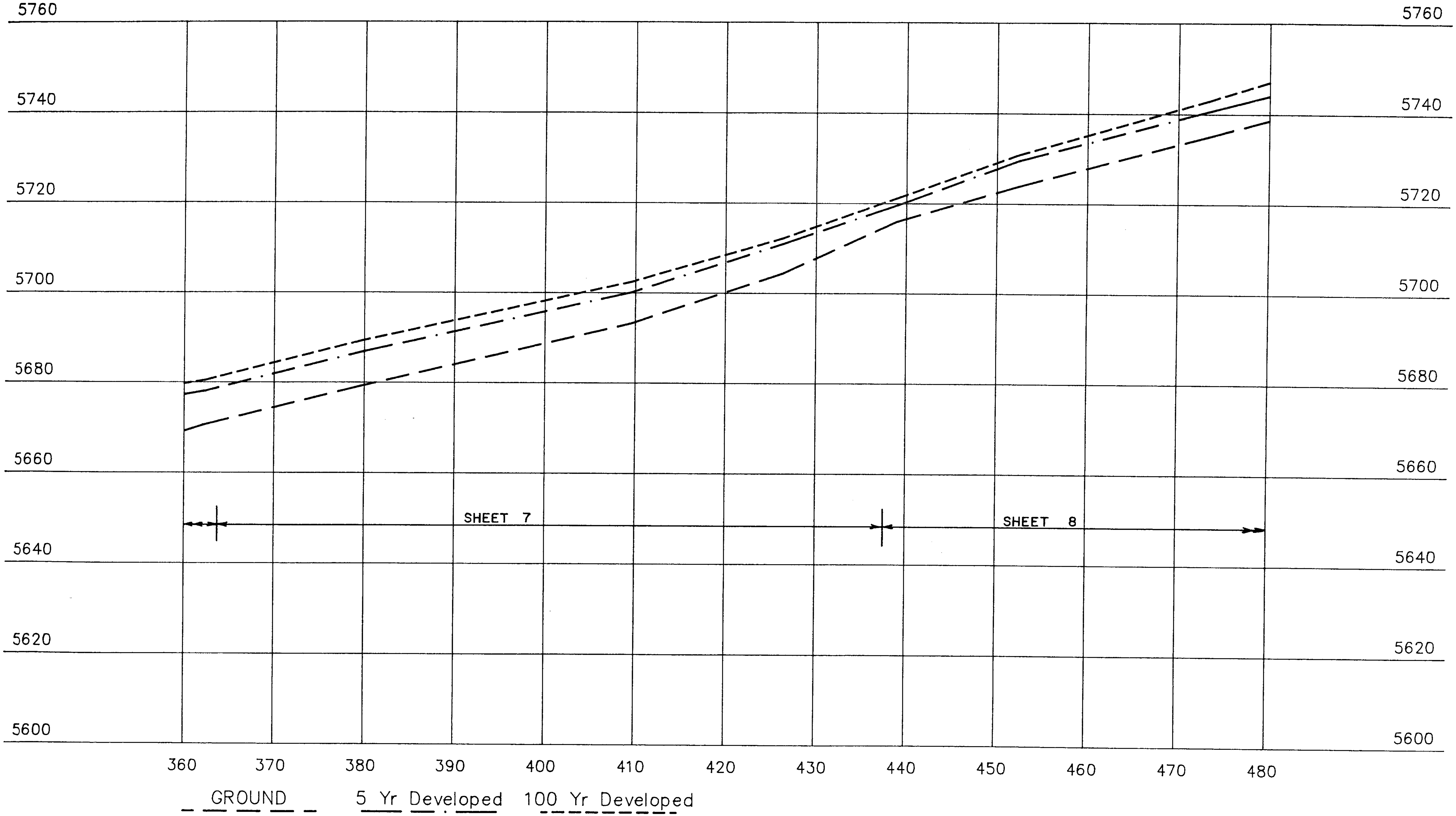
240
GROUND
5 Yr Developed
100 Yr Developed



5760
5740
5720
5700
5680
5660
5640
5620
5600
SHEET 5
SHEET 6
STA 350+90 PEACEFUL VALLEY RD BRIDGE
240
250
260
270
280
290
300
310
320
330
340
350
360
GROUND
5 Yr Developed
100 Yr Developed


5760
5740
5720
5700
5680
5660
5640
5620
5600
SHEET 7
SHEET 8
360
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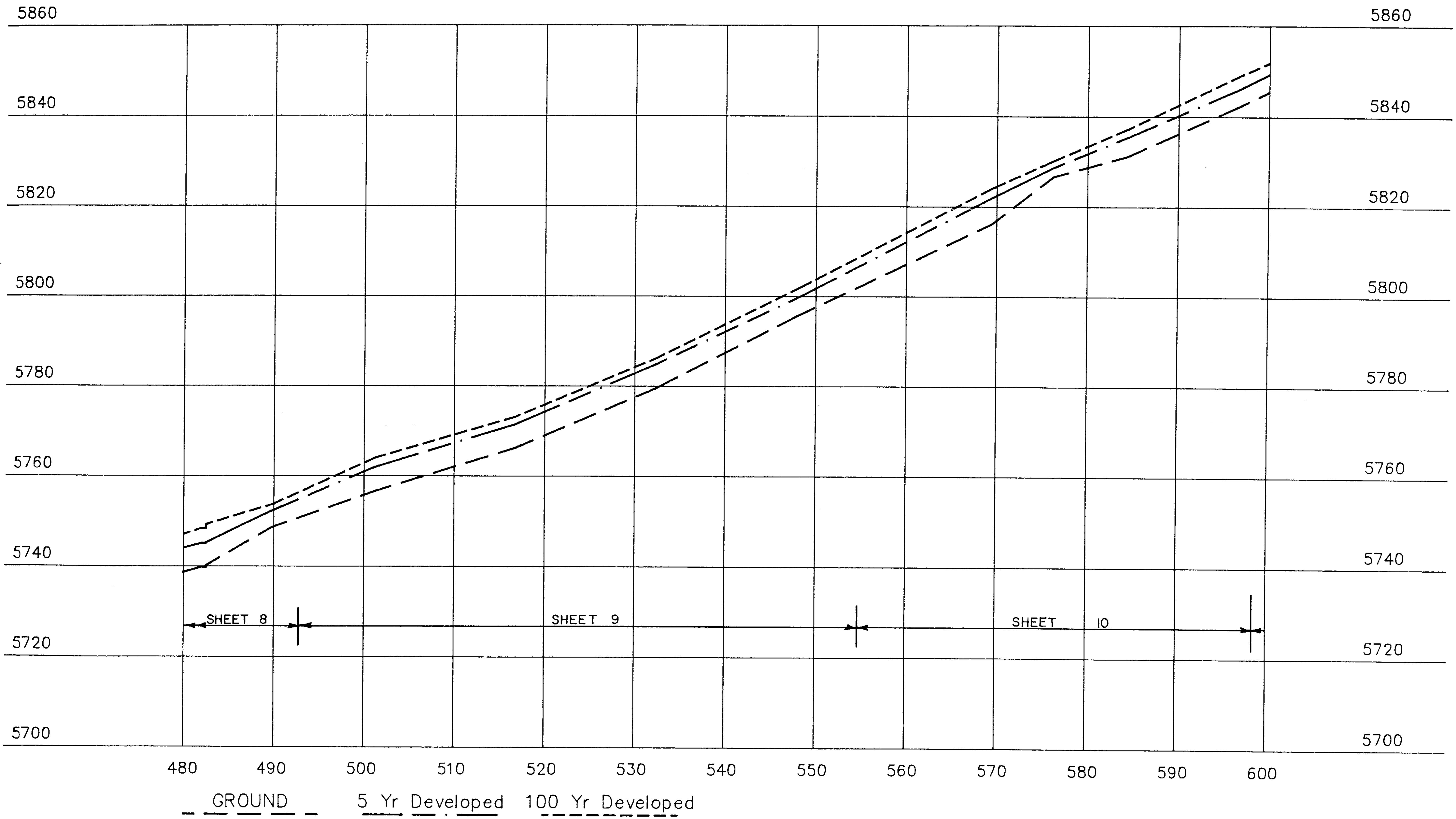
380
390
400
410
420
430
440
450
460
470
480
GROUND
5 Yr Developed
100 Yr Developed



5860
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5800
5780
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5720
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490
500
510
520
530
540
550
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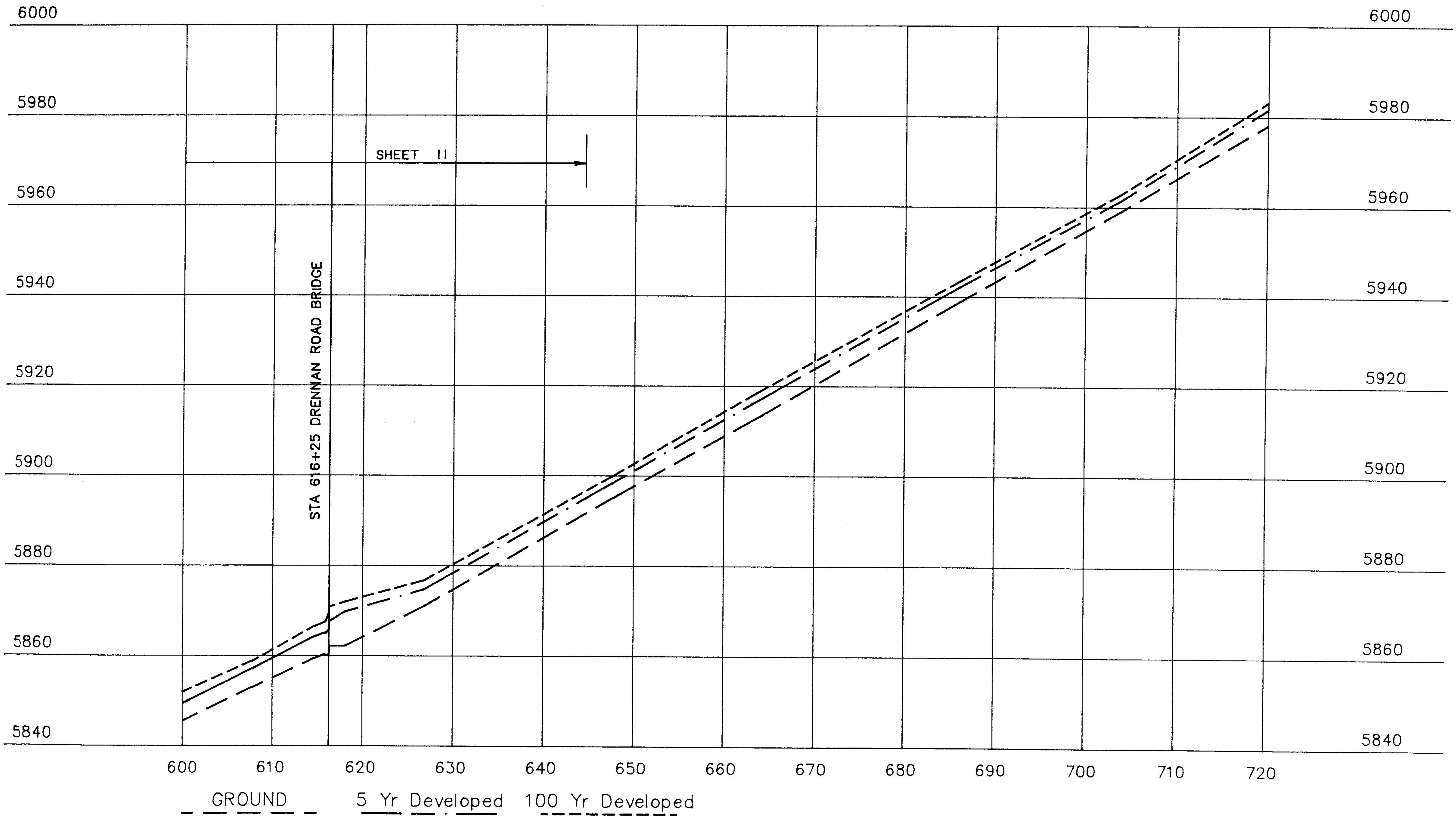
570
580
590
600
SHEET 8
SHEET 9
SHEET 10
GROUND
5 Yr Developed
100 Yr Developed



6000
5980
5960
5940
5920
5900
5880
5860
5840
SHEET 11
STA 616+25 DRENNAN ROAD BRIDGE
600
610
620
630
640
650
660
670
680
690
700
710
720
GROUND
5 Yr Developed
100 Yr Developed

COMPARISON OF EXISTING 100-YEAR FLOWS AND WATER SURFACE ELEVATIONS

- SCS Vs WCEA -

SCS X-Sect.	Station	HEC-2 X-Sect.	SCS 100-Year Elev.	SCS 100-Year Flow	WCEA 100-Year Elev.	WCEA 100-Year Flow
Jimmy Camp Creek Tributary						
J110	230+52	88	5616.5	14,500	5613.0	21,800
J120	242+52	92	5626.7	14,500	5628.6	21,800
J130	258+92	96	5632.5	14,500	5634.3	21,800
J140	278+32	100	5641.2	14,300	5643.4	21,400
J150	309+72	104	5652.4	14,300	5656.0	21,400
J160	317+32	108	5659.7	14,300	5661.1	21,400
J170	337+12	112	5668.4	14,200	5669.8	21,400
J173	350+12	116	5674.8	12,900	5676.0	18,100
J175	350+93	120	5675.6	12,900	5677.0	18,100
J177	351+84	124	5675.7	12,900	5677.0	18,400
J180	362+14	128	5678.9	12,900	5680.1	18,400
J190	379+94	132	5687.7	12,900	5689.0	18,400
J200	409+44	136	5701.4	12,900	5702.2	18,400
J210	426+24	140	5711.3	12,900	5712.1	18,700
J220	438+94	144	5720.5	12,600	5721.4	18,700
J230	452+54	148	5730.2	12,600	5730.9	18,700
J240	473+24	152	5741.7	12,600	5743.2	18,700
J250	489+84	156	5753.9	11,800	5754.1	17,800
J260	501+24	160	5762.4	11,800	5764.4	17,800
J270	516+64	164	5772.8	11,800	5773.5	17,800
J280	532+24	168	5785.1	11,800	5786.4	17,800
J290	548+24	172	5803.1	11,800	5802.5	17,800
J300	569+44	176	5823.3	11,400	5824.4	15,900
J310	576+24	180	5830.2	10,700	5831.0	15,900
J320	584+34	184	5839.0	7,400	5839.8	6,800
J330	596+54	188	5849.0	7,100	5848.5	6,800
J340	607+74	192	5859.6	7,100	5859.8	6,800
J343	614+54	196	5867.0	7,100	5866.8	6,800
J345	616+25	200	5873.5	7,100	5868.3	6,800
J347	618+06	204	5873.6	7,100	5873.2	6,800
J350	626+76	208	5877.4	7,100	5877.2	6,800
J360	647+56	212	5900.4	7,100	5900.3	6,800
J370	663+66	216	5919.2	6,900	5919.3	7,100
J380	686+16	220	5944.0	6,900	5944.1	7,100
J390	703+76	224	5962.9	6,600	5963.1	7,200
J400	722+36	228	5986.4	6,400	5986.6	7,200
J410	743+56	232	6008.9	6,400	6009.2	7,200
J420	758+46	236	6024.7	6,400	6024.9	7,200
J430	777+86	240	6047.4	6,200	6047.7	7,200
J440	797+96	244	6070.6	6,200	6071.0	7,200
J450	817+76	248	6094.4	5,800	6094.8	6,800
J460	838+26	252	6120.6	5,800	6120.9	6,800
J470	848+06	256	6133.5	5,800	6133.8	6,800
J473	860+86	260	6148.6	5,500	6148.9	6,800
J476	863+67	264	6152.6	5,500	6151.3	6,800

COMPARISON OF EXISTING 100-YEAR FLOWS AND WATER SURFACE ELEVATIONS

- SCS Vs WCEA -

SCS X-Sect.	Station	HEC-2 X-Sect.	SCS 100-Year Elev.	SCS 100-Year Flow	WCEA 100-Year Elev.	WCEA 100-Year Flow
J477	866+68	268	6156.2	5,500	6154.6	6,300
J480	870+68	272	6161.6	5,500	6161.9	6,300
J490	886+08	276	6181.7	5,500	6182.0	6,300
J500	901+98	280	6202.2	5,200	6202.6	6,300
J510	912+68	284	6218.3	5,200	6218.8	6,300
J520	925+68	288	6234.5	5,200	6235.0	6,300
East Tributary						
J170	0+00	112	5668.4	5,500	5670.5	21,600
E003	15+40	290	5671.7	5,500	5675.1	4,400
E005	16+61	292	5673.4	5,500	5675.2	4,400
E007	18+22	294	5673.7	5,500	5675.3	4,400
E010	21+12	296	5681.3	5,500	5681.1	4,400
E020	45+12	300	5686.6	5,500	5686.0	4,400
E030	58+52	304	5689.5	5,500	5688.6	4,400
E040	80+12	308	5700.0	5,500	5699.7	4,400
E050	100+72	312	5709.1	5,200	5708.9	4,900
E060	119+92	316	5716.3	5,200	5716.1	4,900
E070	137+12	320	5727.4	4,750	5727.2	4,400
E080	160+52	324	5740.6	4,750	5740.4	4,400
E090	179+32	328	5760.2	4,400	5760.1	4,200
E095	193+12	333	5772.0	3,650	5772.2	4,200
E120	206+12	340	5789.9	3,650	5785.8	4,200
E135	236+92	345	5808.0	3,650	5809.3	4,200
E138	254+22	349	5828.4	3,650	5828.2	4,200
E150	266+82	352	5843.2	3,300	5843.5	2,400
E160	286+52	356	5866.6	2,700	5866.3	2,400
E163	305+92	360	5882.7	2,700	5882.7	2,400
E165	308+53	364	5884.7	2,700	5883.9	1,500
E167	309+54	368	5886.0	2,700	5884.8	1,500
E170	323+34	372	5898.4	2,700	5898.0	1,500
E175	334+14	380	5910.4	2,400	5910.1	1,700
E180	344+94	388	5921.6	2,400	5921.3	1,700
E190	365+14	392	5954.3	2,000	5953.8	1,400
E200	386+14	396	5985.3	2,000	5984.9	1,400
E210	411+24	400	6025.3	1,350	6025.3	1,300
E220	423+44	404	6059.0	1,350	6058.9	1,300
E230	432+64	408	6080.9	1,350	6080.9	1,300

COMPARISON OF EXISTING 100-YEAR FLOWS AND WATER SURFACE ELEVATIONS

- SCS Vs WCEA -

SCS X-Sect.	Station	HEC-2 X-Sect.	SCS 100-Year Elev.	SCS 100-Year Flow	WCEA 100-Year Elev.	WCEA 100-Year Flow
Corral Tributary						
J310	0+00	180	5830.1	7,300	5830.3	9,600
C010	7+00	512	5839.4	7,300	5840.3	9,600
C020	20+50	516	5852.1	7,300	5852.7	9,600
C030	30+50	520	5858.1	7,300	5859.2	9,600
C033	36+10	524	5863.3	7,300	5864.3	9,600
C035	36+79	528	5866.0	7,300	5867.6	9,600
C037	38+90	532	5867.8	7,300	5869.0	9,600
C040	52+60	536	5889.9	7,300	5891.3	9,600
C050	68+60	540	5903.0	7,300	5904.3	9,600
C060	83+10	544	5912.0	7,000	5913.8	9,600
C070	100+20	548	5925.5	7,000	5927.4	9,400
C080	120+04	552	5945.4	5,000	5946.1	5,900
C090	130+44	556	5955.4	5,000	5956.0	5,900
C100	158+44	560	5976.1	5,000	5976.4	5,900
C110	187+44	564	5995.3	4,600	5995.7	4,900
C120	205+44	568	6007.8	4,600	6007.9	4,900
C130	222+54	572	6023.7	4,400	6024.1	4,900
C140	244+44	576	6043.7	4,100	6045.2	4,800
C150	266+24	580	6063.4	4,100	6063.2	4,800
C160	286+64	584	6081.9	3,900	6082.6	4,800
C170	298+94	588	6093.4	3,900	6093.3	4,500
C180	311+54	592	6106.7	3,500	6110.8	4,500
C183	313+74	596	6110.0	3,500	6115.0	4,900
C185	314+65	600	6112.9	3,500	6116.1	4,900
C187	315+56	604	6113.0	3,500	6116.1	4,900
C190	319+36	608	6115.6	3,200	6116.3	4,900
C200	330+66	612	6132.0	2,800	6134.1	4,900
C210	346+56	616	6154.1	2,800	6154.3	3,000
C220	369+56	620	6174.7	2,400	6174.9	3,000
C230	380+16	624	6187.9	2,200	6187.5	1,900
C240	394+36	628	6203.3	2,050	6203.2	1,900
Strip Mine Tributary						
C070	0+00	548	5925.5	4,500	5927.0	9,400
M010	24+00	632	5956.0	4,500	5955.8	4,000
M030	77+00	640	6000.9	4,300	6000.8	4,000
M050	109+60	648	6035.5	4,300	6035.5	4,400
M055	123+60	652	6052.0	4,200	6052.1	4,400
M060	139+60	656	6068.5	4,200	6068.6	4,400
M070	161+50	660	6097.6	3,600	6097.4	3,800
M080	181+70	664	6123.1	3,600	6123.2	3,000
M090	201+60	668	6147.5	3,600	6148.0	3,000
M100	212+80	672	6164.6	3,200	6164.7	2,800
M103	233+50	676	6197.5	2,500	6197.6	2,800
M105	234+51	680	6198.3	2,500	6200.4	2,800

COMPARISON OF EXISTING 100-YEAR FLOWS AND WATER SURFACE ELEVATIONS

- SCS Vs WCEA -

SCS X-Sect.	Station	HEC-2 X-Sect.	SCS 100-Year Elev.	SCS 100-Year Flow	WCEA 100-Year Elev.	WCEA 100-Year Flow
Franceville Tributary						
F010	8+00	416	5823.5	3,500	5819.0	2,500
F020	23+30	420	5838.7	3,500	5837.7	2,500
F030	38+30	424	5860.8	2,800	5860.3	2,500
F040	53+10	428	5879.6	3,300	5879.4	2,500
F055	82+90	440	5897.6	3,100	5897.4	2,500
F060	91+90	448	5906.7	3,100	5906.4	2,500
F070	113+50	452	5932.1	3,100	5931.8	2,500
F080	130+50	456	5947.2	2,900	5947.0	2,700
F085	137+50	462	5954.7	2,900	5954.6	2,700
F090	155+50	466	5976.0	2,800	5975.9	2,700
F095	168+90	468	5988.8	2,800	5988.8	2,700
F100	178+60	476	6001.1	2,800	6000.9	2,400
F115	203+10	481	6008.9	1,700	6009.0	2,400
F120	214+10	484	6022.4	1,700	6022.6	2,400
F130	222+40	488	6032.7	1,700	6032.9	2,400
F145	237+80	493	6068.5	1,030	6068.9	2,400
F160	256+80	500	6118.6	900	6119.9	2,400
F170	269+30	504	6158.0	900	6159.4	2,400
F173	283+90	506	6211.3	740	6212.3	2,400