

PAP-853

DESIGN SUMMARY

Skookum Creek Fish Hatchery Intake Structure Modifications

March 2000

by

Joseph P. Kubitschek
Rodney J. Wittler
Frederick Tan

WATER RESOURCES
RESEARCH LABORATORY
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DESIGN SUMMARY

Skookum Creek Fish Hatchery Intake Structure Modifications

Lummi Indian Nation
Salmon Enhancement Program
Bellingham, Washington

Prepared by
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Rodney J. Wittler
Frederick Tan

DATE	PEER REVIEWER(S)	CODE
	Signature	
	Printed Name	
	Signature	
	Printed Name	
Author Initials	<i>JK</i>	PEER REVIEW NOT REQUIRED

United States Department of the Interior
Bureau of Reclamation
Technical Service Center
Denver, Colorado



March 2000

Introduction

In 1998 the U.S. Bureau of Reclamation (Reclamation), Pacific Northwest Regional Office completed an Engineering Appraisal Report to assist the Lummi Indian Nation with the evaluation of problems at the Skookum Creek Fish Hatchery water supply intake structure. The scope of work included data gathering, field inspection, hydraulic and hydraulic design studies, cost analysis, evaluation of design alternatives for gradient stabilization, diversion structure modifications, fish passage considerations, and pipeline protection (Reclamation, PN Region, 1998). The information has subsequently been reviewed and a final concept has been developed and designed by Reclamation's Technical Service Center in Denver, CO. This report documents the final design concept, including design considerations and design details.

Skookum Creek Fish Hatchery is located on the South Fork of the Nooksack River just downstream from the confluence with Skookum Creek, the primary tributary of the South Fork, Nooksack River. The hatchery was constructed in 1969. A critical component of the hatchery water supply is the diversion structure located on Skookum Creek approximately 1,500 ft upstream from the confluence. Skookum Creek is a high-gradient natural channel with discharges of record ranging from 17 – 3,050 ft³/s. Over the past 30 years Skookum Creek has experienced considerable degradation that has lowered the effective water surface elevations at the diversion structure and limited the diversion capacity. Furthermore, the concrete-encased pipeline that conveys the diversion flow to the hatchery has become exposed. Temporary solutions have been implemented at the diversion structure to provide sufficient head for the required diversion flow rates (6-12 ft³/s). However, permanent solutions are required to reduce annual maintenance efforts, ensure adequate deliveries to the hatchery, provide adequate protection for the conveyance pipeline, and implement enhanced fish passage near the diversion structure. For further information on the existing facilities see the Engineering Appraisal Report, Skookum Creek Fish Hatchery Water Supply Intake Modifications, U.S. Bureau of Reclamation, PN Region, February 1998.

Design Requirements

The design requirements for this project include the following components:

- **Adjustable Diversion Structure** consisting of a stoplog structure to provide adequate head for diversion discharges of 6-12 ft³/s over the full range of Skookum Creek hydraulic conditions. Anticipated need is during low flow periods of August-October. During the remainder of the year the structure may be removed.
- **Gradient Stabilization Structures** consisting of two rock-ramp structures located to modify the energy grade line and eliminate further degradation along Skookum Creek.
- **Fish Passage Structure** consisting of a vertical-slot fish ladder to enhance fish passage at the diversion structure allowing fishery access to habitat upstream of the diversion structure.
- **Right-Bank Rock Structure** consisting of riprap protection downstream of the diversion structure for the concrete-encased diversion pipeline. Large Woody-Debris (LWD) will be used to further roughen the channel and provide habitat diversity.

Design Description

Analysis

An HEC-RAS model of the Skookum Creek reach in question was developed to investigate alternatives and estimate performance of the channel modifications. A summary of the results is included as appendix A. Comparison of depth-averaged channel velocities (Figure 1) at various

stations along the reach indicate a significant reduction in velocity along the diversion structure. This reduction in velocity is due to the upstream rock-ramp modification that lowers the channel slope to 7.5% at that location. Although velocities, at some locations, are higher than the target velocity of 4.0 ft/s, low velocity zones will exist due to boundary effects and the size of the specified material that will be used for construction of the gradient stabilization structures (i.e. rock ramps). In any case, the modified channel velocities were not significantly increased over the existing channel velocities except at the upstream sections. This result is likely an artifact of the HEC-RAS model.

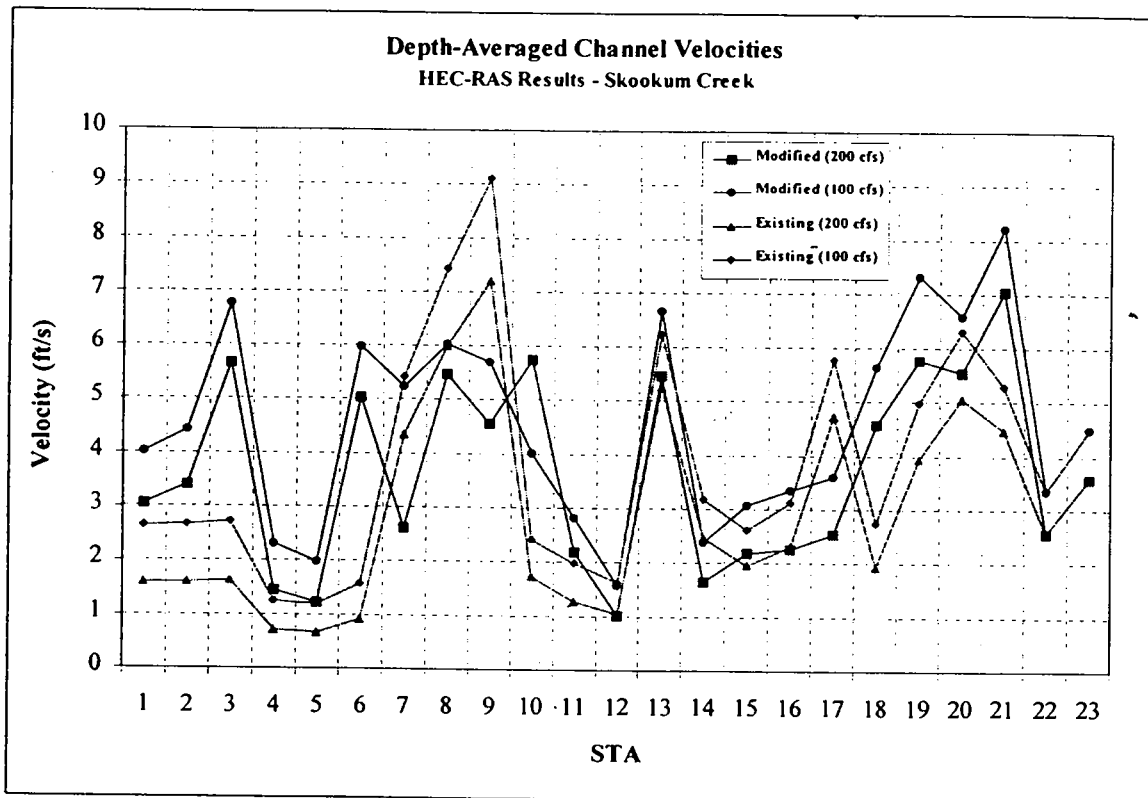


Figure 1. HEC-RAS Channel Velocity Results. Station designations are from upstream to downstream and correspond with HEC-RAS river stations 64-22.

Adjustable Diversion (Stop-log) Structure

The diversion structure consists of a concrete sill and stoplog structure. It is intended to provide sufficient flexibility to meet hatchery flow requirements over wide ranging stage-discharge conditions while at the same time considering fish passage objectives along Skookum Creek. The overall height of the structure is 3.5 ft. The structure spans Skookum Creek and is oriented upstream from the intake to the left bank of Skookum Creek (see dwg OA-57-2, General Plan). The top elevation of the concrete sill was set at EL 398.50 ft. This was done to minimize upstream sediment deposition and reduce damage potential during high flow events (i.e. low profile) as well as sediment entrainment into the diversion structure. Square structural tubing is set in the concrete sill on 6-ft centers to accept 5x16 wide-flange posts that will comprise the stoplog structure guides. These guides are intended to be removable to prevent damage during high flow events since the diversion structure will be required only during low flow periods (i.e. August-October). The stoplogs consist of 4x4 wood beams that will span the 6-ft distance between guideposts. These stoplogs can also be installed or removed, as needed, to meet diversion and fish passage requirements (see dwgs OA-57-10&11).

* SECOND LOW FLOW PERIOD -- JAN. - FEB.
STOPLOGS DEPLOYED DURING

Gradient Stabilization Structures

Two rock-ramp structures have been designed to provide gradient stabilization along the critical reach of Skookum Creek, namely from the diversion structure downstream along the concrete-encased pipeline (see dwg OA-57-2, General Plan). The upstream most structure is the largest of the two structures and is intended to stabilize the existing debris field located just downstream of the diversion structure intakes. Furthermore, this structure as designed, reduces the gradient of the existing channel, along that reach to a slope of 7.5%, thereby improving fish passage potential during low-flow periods. The downstream structure is required to provide adequate backwater for stability at the toe of the upstream rock structure and sufficient flow depth for the fish ladder entrance as well as reduce the effective energy gradient along this reach of the channel consequently reducing channel velocities. Both rock-ramp structures consist of large riprap material sized and placed to maintain stability under high channel discharge conditions (see dwgs OA-57-4).

Right-Bank Revetment Structure

The final component of the project includes protection of the concrete-encased pipeline and the construction of a permanent access road to the diversion structure. A revetment type structure is intended for such protection and was designed (i.e. riprap sizing) for the maximum flow conditions expected (i.e. Skookum Creek discharges up to 3,050 ft³/s). The embankment angle of repose was set at 1.75:1 and the access roadway elevation set such that it will remain high and dry for Skookum Creek discharges up to 3,000 ft³/s (see dwgs OA-57-5&6). LWD will be incorporated into the design to provide additional channel roughness and habitat diversity. This type of structure was selected over a barb-type structure since the high-gradient characteristics of Skookum Creek makes the application of barbs questionable from a stability standpoint.

Supervision of Rock Material Structures Construction

The Contracting Officer Technical Representative (COTR) shall assist in the supervision of the construction of all rock material structures, including the gradient stabilization and revetment structures. Assistance will be in the form of advising the contractor on the selection, and placement of rock, and construction of the gradient stabilization structure in particular. Attention will be placed on fish passage features especially on the downstream gradient stabilization structure.

Fish Passage Structure

The fish passage structure consists of a conventional vertical-slot fish ladder (see dwgs OA-57-7, 8&9). The ladder is intended to provide fish passage during low flow periods when passage conditions, over the rock drop structure (primarily flow depth) are less than optimum. Based on a two-dimensional HEC-RAS model, depth barriers may occur along the upstream rock-ramp structure during Skookum Creek discharges below approximately 50 ft³/s. The results of the HEC-RAS Analysis are included as Appendix A. Below this condition the fish ladder would be operated to ensure adequate passage. Above this condition, the ladder may be operated or shutdown, as passage potential over the rock-ramp structure is expected to be adequate. It is important to note that due to the large material size used to construct the rock-ramp structures, intermediate pools will likely exist such that passage during low flow conditions may be better than indicated by the HEC-RAS results. Additional flexibility has been incorporated into the ladder design consisting of removable baffles. The temporary baffles may be removed seasonally for maintenance. Furthermore, the fish ladder may double as a sluiceway following removal of the baffles should sluicing of the diversion structure be required. Finally, this configuration also allows for back-flushing the fish screens to reduce maintenance requirements associated with manual cleaning. In this case, water may be intermittently drawn through the upstream intake

and passed backward through the fish screens and down the sluiceway. Although such operation will not likely solve all of the cleaning problems associated with the fish screens since the flow distribution through the screens will not likely be uniform, it is expected to reduce the manual cleaning effort.

Operational Plan

The stoplog structure was designed for the maximum flexibility to maintain adequate head for the required diversion flow rates during a wide range of Skookum Creek discharges. Stoplogs may be installed and removed seasonally, before and after the annual low flow periods for Skookum Creek (i.e. August-September). During this time stoplogs may be installed or removed as needed to meet diversion head and fish passage requirements. Furthermore, stoplogs at specific locations may be removed at any time to provide a slot for fish passage should the upstream rock-ramp structure provide adequate passage. No fail-safe mechanisms have been incorporated into the design. Should an unexpected high flow event be encountered, the stoplog structure may remain in place until it can be accessed for removal.

During this low-flow period, the fish ladder may be operated to provide adequate fish passage. The ladder was sized to operate over a discharge range from 10-30 ft³/s. This requires a minimum Skookum Creek discharge of 25 ft³/s to provide sufficient flow to the hatchery (i.e. up to 15 ft³/s) while maintaining adequate operational flows to the fish ladder. Below this condition, hatchery flows may be reduced to provide adequate ladder flow. During higher flow periods (above 50 ft³/s) sufficient discharge will be available along the rock-ramp structure to provide adequate fish passage. However, the fish ladder may remain operational, as desired, to enhance passage.

Finally, the fish ladder, as designed may be used as a sluiceway for the diversion structure. The temporary baffles may be removed at any time to create a sluiceway. Furthermore, flow may be re-routed along the upstream side of the screen structure and passed through the screens and down the sluiceway to provide back-flush cleaning of the screens as needed.

The primary advantages of this design include:

- Operational flexibility in maintaining required diversion heads at the intake structure for a wide range of Skookum Creek discharges.
- Operational flexibility in operating the fish ladder to provide enhanced fish passage during low flow periods and a sluiceway during maintenance periods.
- Operational flexibility in back-flushing the diversion screens to reduce manual cleaning requirements.
- Gradient stabilization to permanently ensure adequate hydraulic conditions required for diversions to the Skookum Creek Fish Hatchery and fish passage to habitat above the Skookum Creek Diversion Structure.
- Concrete-encased pipeline protection.

**Skookum Creek Fish Hatchery Water Supply Intake Modification with
Channel and Fish Passage Improvement**

Salmon Enhancement Program

Lummi Indian Reservation

Lummi, Washington

Attachment A

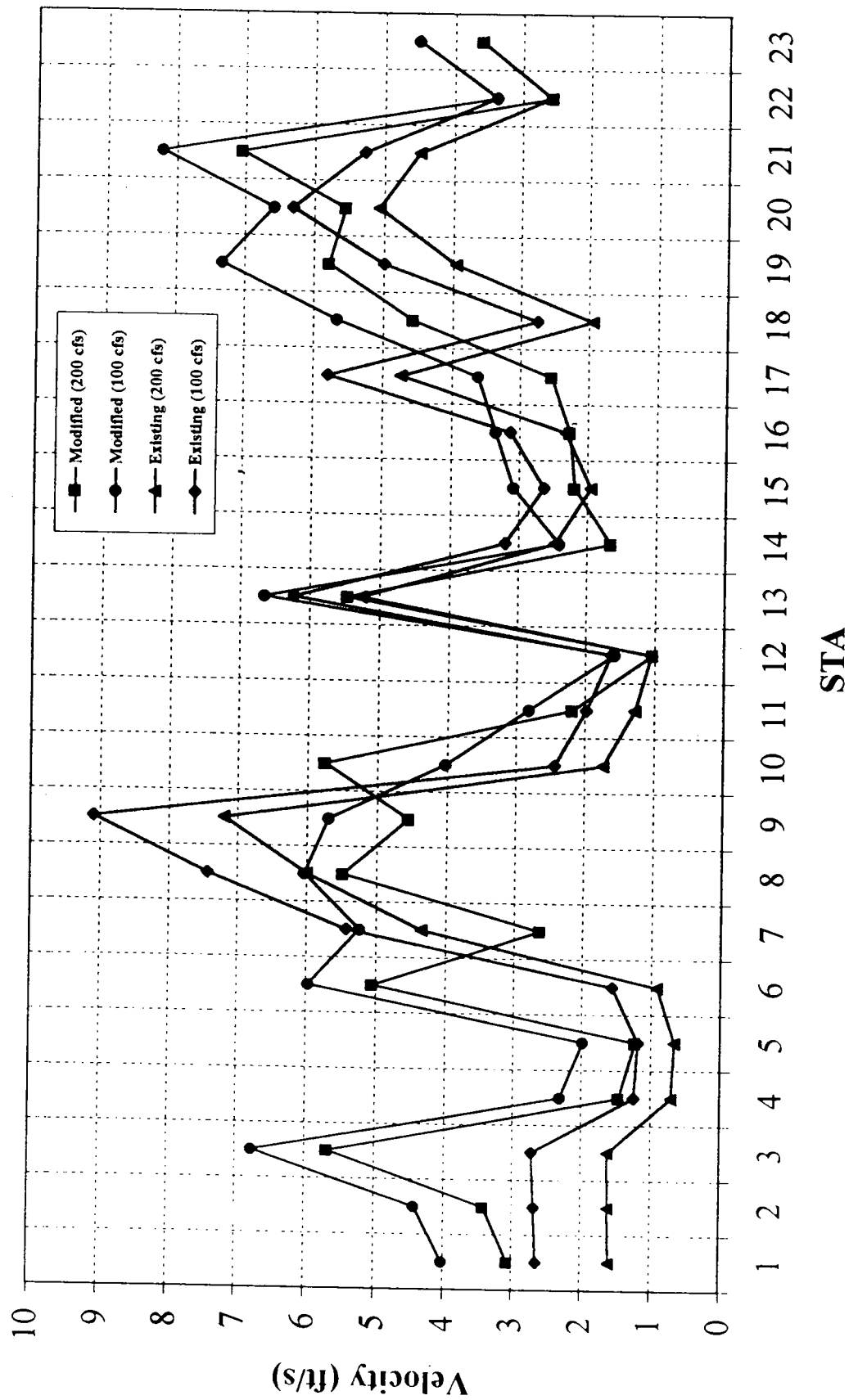
(March 2000)

Hydraulics Analysis

HEC-RAS Data and Results

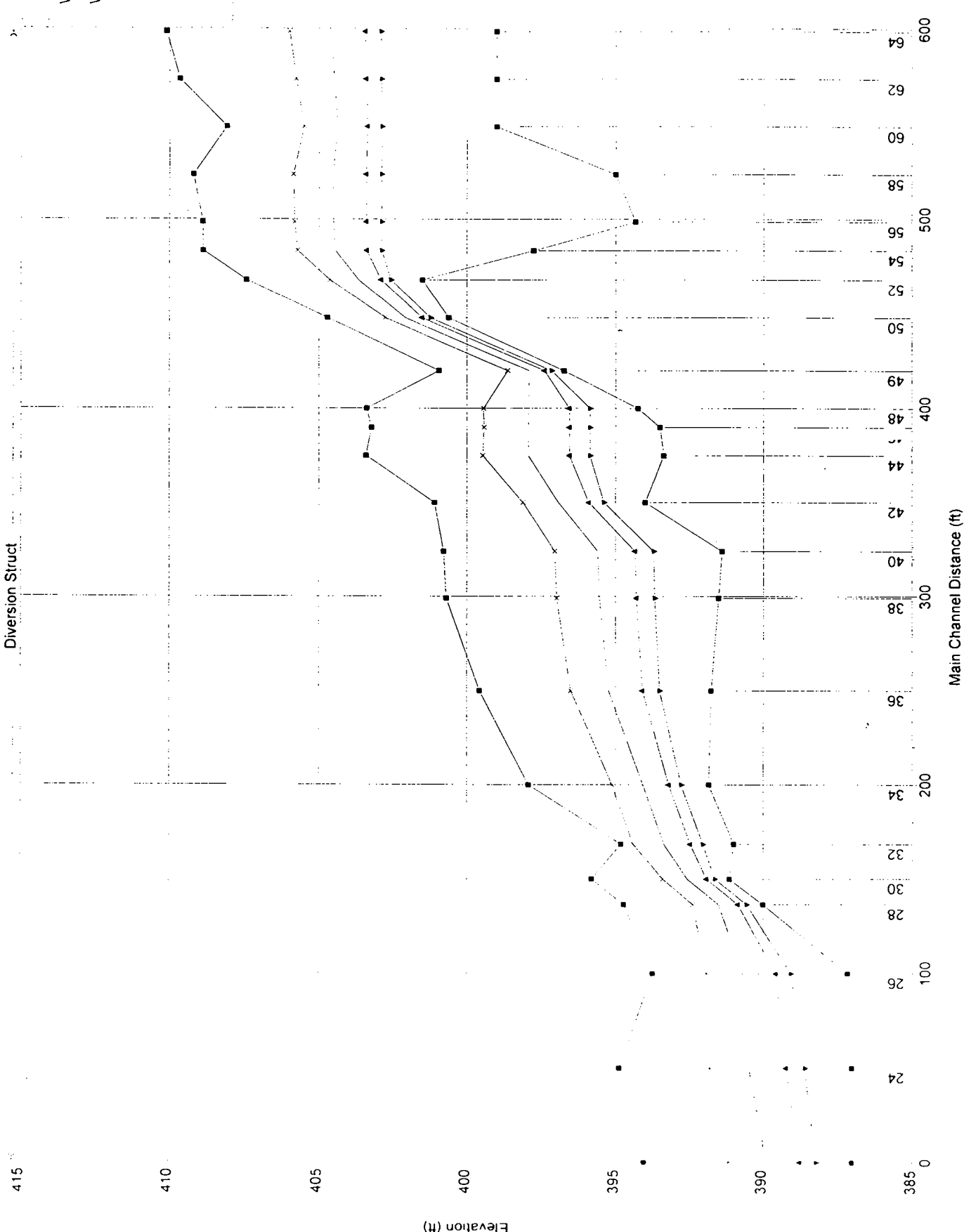
Depth-Averaged Channel Velocities

HEC-RAS Results - Skookum Creek



Skookum Cr. Plan 03 - Existing Channel 03/23/2000
 Geom: Skookum Creek Existing Flow: Skookum Creek

Division Struct.



- Legend
- WS 3000 cfs
 - WS 1000 cfs
 - WS 500 cfs
 - WS 200 cfs
 - WS 100 cfs
 - Ground

415

410

405

400

395

390

385

64

62

60

58

56

54

52

50

49

48

47

46

44

42

40

38

36

34

32

30

28

26

24

600

500

400

300

200

100

0

Main Channel Distance (ft)

Elevation (ft)

HEC-RAS Plan: Skookum River: Skookum Creek Reach: Diversion Struct

Reach	River Sta	Q Total (cfs)	Min ChElev (ft)	WS Elev (ft)	Crit WS Elev (ft)	Elev (ft)	Elev (ft)	Elev (ft)	Elev (ft)	Elev (ft)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Diversion Struct	64	500.00	399.00	404.60	402.68	404.95	0.003244	4.73	105.64	27.00	0.42		
Diversion Struct	64	200.00	399.00	403.45	401.48	403.55	0.001384	2.64	75.62	25.05	0.27		
Diversion Struct	64	100.00	399.00	402.91	400.86	402.95	0.000611	1.60	62.49	24.17	0.18		
Diversion Struct	64	1000.00	399.00	405.99	404.12	406.73	0.005254	6.91	144.72	29.35	0.55		
Diversion Struct	64	3000.00	399.00	410.11	408.05	411.88	0.007496	10.68	280.99	36.90	0.68		
Diversion Struct	62	500.00	399.00	404.49	402.68	404.86	0.003512	4.86	102.79	26.82	0.44		
Diversion Struct	62	200.00	399.00	403.41	401.48	403.52	0.001437	2.68	74.66	24.98	0.27		
Diversion Struct	62	100.00	399.00	402.90	400.86	402.94	0.000622	1.61	62.11	24.15	0.18		
Diversion Struct	62	1000.00	399.00	405.77	404.12	406.58	0.005966	7.22	138.41	28.98	0.58		
Diversion Struct	62	3000.00	399.00	409.65	408.06	411.65	0.008851	11.35	264.42	36.05	0.74		
Diversion Struct	60	500.00	399.00	404.38	402.68	404.77	0.003844	5.02	99.64	26.62	0.46		
Diversion Struct	60	200.00	399.00	403.37	401.48	403.48	0.001495	2.72	73.66	24.91	0.28		
Diversion Struct	60	100.00	399.00	402.88	400.86	402.92	0.000634	1.62	61.72	24.13	0.18		
Diversion Struct	60	1000.00	399.00	405.50	404.12	406.41	0.007053	7.66	130.53	28.52	0.63		
Diversion Struct	60	3000.00	399.00	408.07	408.07	411.25	0.016723	14.30	209.81	33.12	1.00		
Diversion Struct	58	500.00	395.00	404.53	400.20	404.62	0.000608	2.45	203.98	39.34	0.19		
Diversion Struct	58	200.00	395.00	403.41	398.42	403.43	0.000199	1.24	160.68	38.23	0.11		
Diversion Struct	58	100.00	395.00	402.89	397.43	402.90	0.000074	0.71	141.11	37.66	0.06		
Diversion Struct	58	1000.00	395.00	405.86	401.83	406.10	0.001218	3.89	257.06	40.16	0.27		
Diversion Struct	58	3000.00	395.00	409.18	404.99	410.08	0.003163	7.61	393.99	42.32	0.44		
Diversion Struct	56	500.00	394.33	404.51	399.72	404.61	0.000556	2.43	205.40	33.98	0.17		
Diversion Struct	56	200.00	394.33	403.41	397.82	403.43	0.000162	1.19	167.91	33.67	0.09		
Diversion Struct	56	100.00	394.33	402.89	396.87	402.90	0.000056	0.66	150.74	33.24	0.05		
Diversion Struct	56	1000.00	394.33	405.82	401.28	406.07	0.001248	4.00	249.95	34.40	0.26		
Diversion Struct	56	3000.00	394.33	408.88	404.66	409.98	0.004049	8.40	357.08	35.76	0.47		
Diversion Struct	54	500.00	397.78	404.45	401.71	404.59	0.001216	2.95	169.41	39.61	0.25		
Diversion Struct	54	200.00	397.78	403.38	400.79	403.42	0.000468	1.57	127.51	38.66	0.15		
Diversion Struct	54	100.00	397.78	402.88	400.30	402.90	0.000195	0.92	108.30	38.20	0.10		
Diversion Struct	54	1000.00	397.78	405.71	402.81	406.04	0.002168	4.55	219.84	40.27	0.34		
Diversion Struct	54	3000.00	397.78	408.87	405.82	409.90	0.003853	8.19	369.98	48.77	0.49		
Diversion Struct	52	500.00	401.50	403.67	403.67	404.49	0.021292	7.24	69.04	43.07	1.01		
Diversion Struct	52	200.00	401.50	402.91	402.91	403.37	0.025515	5.43	36.80	41.28	1.01		
Diversion Struct	52	100.00	401.50	402.57	402.57	402.86	0.029536	4.35	22.97	40.50	1.02		
Diversion Struct	52	1000.00	401.50	404.63	404.63	405.88	0.018926	8.97	111.48	45.12	1.01		
Diversion Struct	52	3000.00	401.50	407.42	407.42	409.68	0.013551	12.17	251.54	55.45	0.94		

HFC-RAS Plan: Skookum River: Skookum Creek Reach: Diversion Struct (Continued)

Reach	River Sta	Q Total (cfs)	Min Chl El (ft)	W/S Elev (ft)	Chl W/S (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Diversion Struct	50	500.00	400.60	402.09	402.52	403.56	0.064707	9.75	51.28	45.30	1.62
Diversion Struct	50	200.00	400.60	401.51	401.77	402.37	0.069898	7.43	26.90	38.23	1.56
Diversion Struct	50	100.00	400.60	401.23	401.39	401.78	0.074265	6.00	16.66	34.34	1.52
Diversion Struct	50	1000.00	400.60	402.76	403.43	405.03	0.057535	12.09	82.79	47.90	1.61
Diversion Struct	50	3000.00	400.60	404.72	405.92	408.89	0.045971	16.48	185.02	56.44	1.55
Diversion Struct	49	500.00	396.75	397.92	398.62	400.35	0.164718	12.52	39.93	35.63	2.08
Diversion Struct	49	200.00	396.75	397.40	397.78	398.69	0.180415	9.10	21.98	34.55	2.01
Diversion Struct	49	100.00	396.75	397.17	397.41	397.97	0.201616	7.20	13.89	34.05	1.99
Diversion Struct	49	1000.00	396.75	398.63	399.70	402.22	0.132632	15.19	65.85	36.49	1.99
Diversion Struct	49	3000.00	396.75	400.93	402.68	406.86	0.087101	19.54	153.55	39.30	1.74
Diversion Struct	48	500.00	394.25	397.94	396.08	398.16	0.003513	3.79	131.85	36.08	0.35
Diversion Struct	48	200.00	394.25	396.57	395.24	396.66	0.002493	2.43	82.38	35.81	0.28
Diversion Struct	48	100.00	394.25	395.87	394.88	395.92	0.001967	1.73	57.64	35.68	0.24
Diversion Struct	48	1000.00	394.25	399.43	397.15	399.88	0.004820	5.36	186.65	37.20	0.42
Diversion Struct	48	3000.00	394.25	403.39	400.28	404.63	0.007335	8.94	335.54	38.03	0.53
Diversion Struct	46	500.00	393.50	397.94	395.43	398.12	0.002335	3.40	147.08	33.51	0.29
Diversion Struct	46	200.00	393.50	396.57	394.55	396.63	0.001198	1.98	101.19	33.26	0.20
Diversion Struct	46	100.00	393.50	395.87	394.16	395.90	0.000679	1.28	78.16	33.13	0.15
Diversion Struct	46	1000.00	393.50	399.42	396.55	399.82	0.003836	5.08	196.84	33.73	0.37
Diversion Struct	46	3000.00	393.50	403.22	399.83	404.54	0.007796	9.22	325.51	33.98	0.52
Diversion Struct	44	500.00	393.38	397.95	395.12	398.08	0.001578	2.84	176.18	38.99	0.24
Diversion Struct	44	200.00	393.38	396.57	394.32	396.61	0.000784	1.63	122.39	38.69	0.16
Diversion Struct	44	100.00	393.38	395.87	393.97	395.89	0.000428	1.05	95.56	38.54	0.12
Diversion Struct	44	1000.00	393.38	399.46	396.14	399.74	0.002523	4.26	235.23	39.40	0.31
Diversion Struct	44	3000.00	393.38	403.41	399.11	404.33	0.004664	7.69	393.12	40.48	0.43
Diversion Struct	42	500.00	394.00	396.94	396.94	397.92	0.029857	7.93	63.04	32.88	1.01
Diversion Struct	42	200.00	394.00	395.91	395.91	396.51	0.031938	6.23	32.09	27.27	1.01
Diversion Struct	42	100.00	394.00	395.40	395.40	395.83	0.033599	5.26	19.03	22.58	1.01
Diversion Struct	42	1000.00	394.00	398.13	398.13	399.51	0.028336	9.44	105.97	38.59	1.00
Diversion Struct	42	3000.00	394.00	401.08	401.08	403.94	0.025686	13.56	221.35	39.44	1.01
Diversion Struct	40	500.00	391.40	395.61	394.47	395.88	0.004118	4.22	118.47	45.80	0.46
Diversion Struct	40	200.00	391.40	394.34	393.47	394.50	0.004226	3.19	62.76	38.80	0.44
Diversion Struct	40	100.00	391.40	393.72	392.94	393.81	0.003481	2.46	40.64	32.20	0.39
Diversion Struct	40	1000.00	391.40	397.06	395.45	397.52	0.004004	5.40	185.21	45.82	0.47
Diversion Struct	40	3000.00	391.40	400.77	398.13	401.88	0.004891	8.44	355.27	45.87	0.53

HEC-RAS Plan: Skookum River: Skookum Creek Reach: Diversion Struct (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch E (ft)	WS Elev (ft)	Crit W.S (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chn (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Ch
Diversion Struct	38	500.00	391.52	395.55	394.08	395.78	0.002835	3.90	128.34	43.14	0.40
Diversion Struct	38	200.00	391.52	394.29	393.27	394.40	0.002290	2.63	75.95	40.37	0.34
Diversion Struct	38	100.00	391.52	393.67	392.90	393.73	0.001980	1.95	51.31	39.07	0.30
Diversion Struct	38	1000.00	391.52	397.00	395.10	397.42	0.003271	5.21	191.96	44.67	0.44
Diversion Struct	38	3000.00	391.52	400.69	397.89	401.75	0.004308	8.29	361.86	47.29	0.53
Diversion Struct	36	500.00	391.77	395.23	394.12	395.58	0.007056	4.71	106.23	37.60	0.49
Diversion Struct	36	200.00	391.77	394.09	393.27	394.24	0.005613	3.13	63.86	36.30	0.42
Diversion Struct	36	100.00	391.77	393.51	392.88	393.59	0.004930	2.32	43.11	35.45	0.37
Diversion Struct	36	1000.00	391.77	396.52	395.21	397.16	0.008708	6.43	155.56	38.98	0.57
Diversion Struct	36	3000.00	391.77	399.58	398.26	401.36	0.013569	10.73	279.72	42.24	0.73
Diversion Struct	34	500.00	391.85	394.07	394.07	394.94	0.031942	7.50	66.68	38.63	1.01
Diversion Struct	34	200.00	391.85	393.19	393.19	393.71	0.038606	5.78	34.63	33.97	1.01
Diversion Struct	34	100.00	391.85	392.78	392.78	393.12	0.044609	4.74	21.12	30.60	1.00
Diversion Struct	34	1000.00	391.85	395.11	395.11	396.43	0.028339	9.21	108.63	41.83	1.01
Diversion Struct	34	3000.00	391.85	397.94	397.94	400.43	0.023946	12.65	237.20	47.77	1.00
Diversion Struct	32	500.00	391.00	393.36	392.47	393.64	0.010585	4.26	117.28	50.45	0.49
Diversion Struct	32	200.00	391.00	392.47	391.80	392.59	0.007922	2.75	72.78	49.95	0.40
Diversion Struct	32	100.00	391.00	392.04	391.50	392.10	0.006147	1.94	51.45	49.71	0.34
Diversion Struct	32	1000.00	391.00	394.40	393.32	394.94	0.012905	5.87	170.41	51.25	0.57
Diversion Struct	32	3000.00	391.00	394.81	395.84	398.62	0.080824	15.68	191.37	51.72	1.44
Diversion Struct	30	500.00	391.15	392.56	392.56	393.27	0.050217	6.76	73.94	52.68	1.01
Diversion Struct	30	200.00	391.15	391.92	391.92	392.30	0.059803	4.99	40.09	52.37	1.00
Diversion Struct	30	100.00	391.15	391.64	391.64	391.88	0.068052	3.95	25.33	52.23	1.00
Diversion Struct	30	1000.00	391.15	393.40	393.40	394.51	0.044364	8.47	118.00	53.40	1.00
Diversion Struct	30	3000.00	391.15	395.81	395.81	397.91	0.037682	11.62	258.23	62.33	1.01
Diversion Struct	28	500.00	390.00	391.52	391.73	392.58	0.048379	8.26	60.51	44.54	1.25
Diversion Struct	28	200.00	390.00	390.85	390.99	391.47	0.061373	6.31	31.70	41.55	1.27
Diversion Struct	28	100.00	390.00	390.55	390.64	390.95	0.068892	5.07	19.71	38.82	1.25
Diversion Struct	28	1000.00	390.00	392.38	392.68	393.90	0.040417	9.89	101.06	49.62	1.22
Diversion Struct	28	3000.00	390.00	394.72	395.16	397.40	0.030117	13.15	228.22	58.65	1.17
Diversion Struct	26	500.00	387.15	390.69	390.37	391.33	0.012066	6.41	78.05	38.34	0.79
Diversion Struct	26	200.00	387.15	389.56	389.42	389.99	0.016852	5.28	37.89	32.31	0.86
Diversion Struct	26	100.00	387.15	389.05	388.99	389.37	0.021375	4.49	22.29	29.14	0.90
Diversion Struct	26	1000.00	387.15	391.91	391.45	392.87	0.011050	7.86	127.17	42.45	0.80
Diversion Struct	26	3000.00	387.15	393.75	394.40	396.66	0.022949	13.69	219.10	61.46	1.28

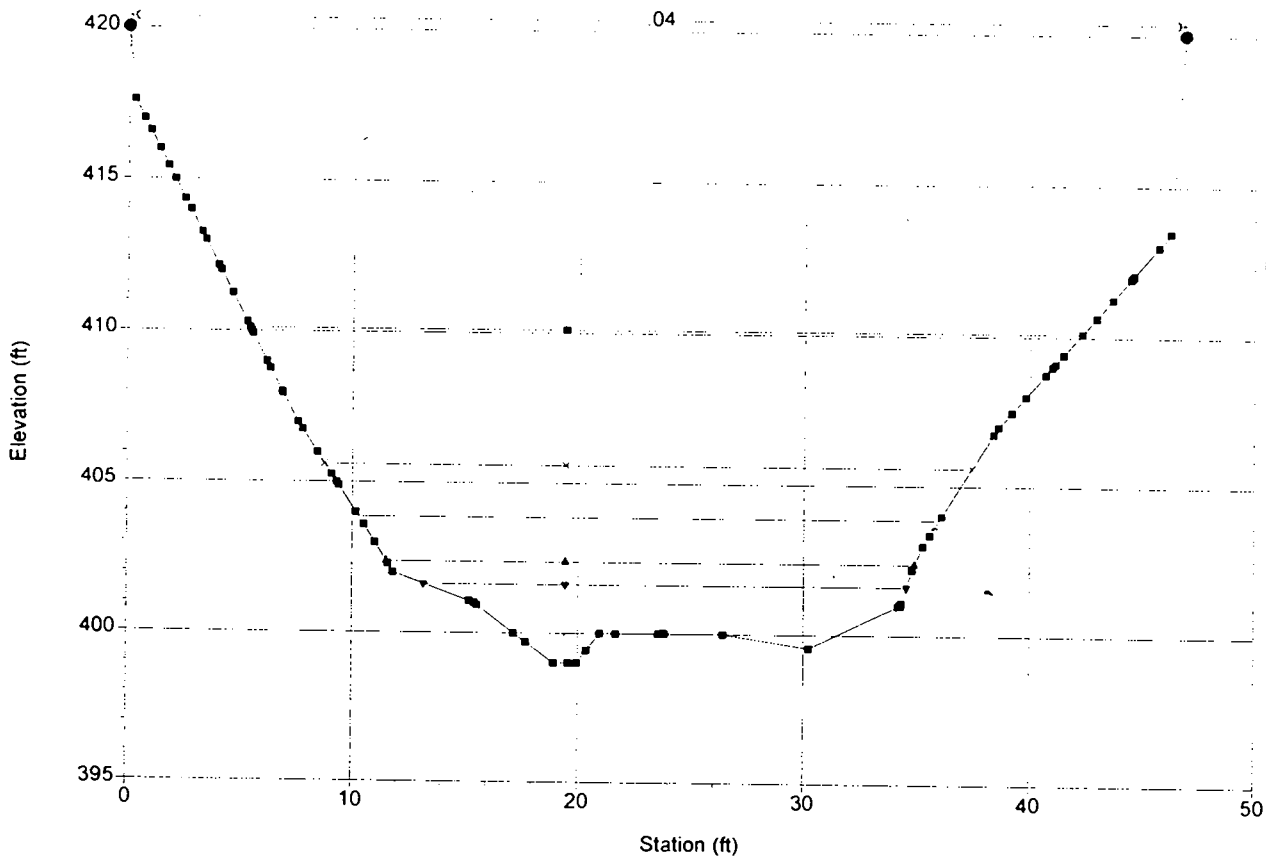
HEC-RAS Plan: Skookum River: Skookum Creek Reach: Diversion Struct (Continued)

Reach	River Sta	O Total (cfs)	Min Ch E1 (ft)	W/S Elev (ft)	Crit W/S (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Ctnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Ch1
Diversion Struct	24	500.00	387.00	390.47	389.36	390.80	0.005313	4.56	109.54	45.64	0.52
Diversion Struct	24	200.00	387.00	389.21	388.38	389.38	0.004298	3.37	59.28	34.42	0.45
Diversion Struct	24	100.00	387.00	388.58	387.92	388.68	0.003688	2.57	38.84	30.40	0.40
Diversion Struct	24	1000.00	387.00	391.81	390.53	392.32	0.005565	5.75	173.87	51.63	0.55
Diversion Struct	24	3000.00	387.00	394.86	393.22	396.02	0.006299	8.65	346.95	57.98	0.62
Diversion Struct	22	500.00	387.00	389.87	389.36	390.43	0.010000	5.99	83.42	38.26	0.72
Diversion Struct	22	200.00	387.00	388.75	388.38	389.07	0.010007	4.51	44.32	31.53	0.67
Diversion Struct	22	100.00	387.00	388.20	387.92	388.40	0.010002	3.60	27.81	28.09	0.64
Diversion Struct	22	1000.00	387.00	391.16	390.54	391.94	0.010007	7.05	141.83	48.25	0.72
Diversion Struct	22	3000.00	387.00	394.03	393.23	395.60	0.010009	10.03	299.02	57.88	0.78

Skookum Cr. Plan 03 - Existing Channel 03/23/2000

Geom: Skookum Creek Existing Flow: Skookum Creek

River = Skookum Creek Reach = Diversion Struct RS = 64



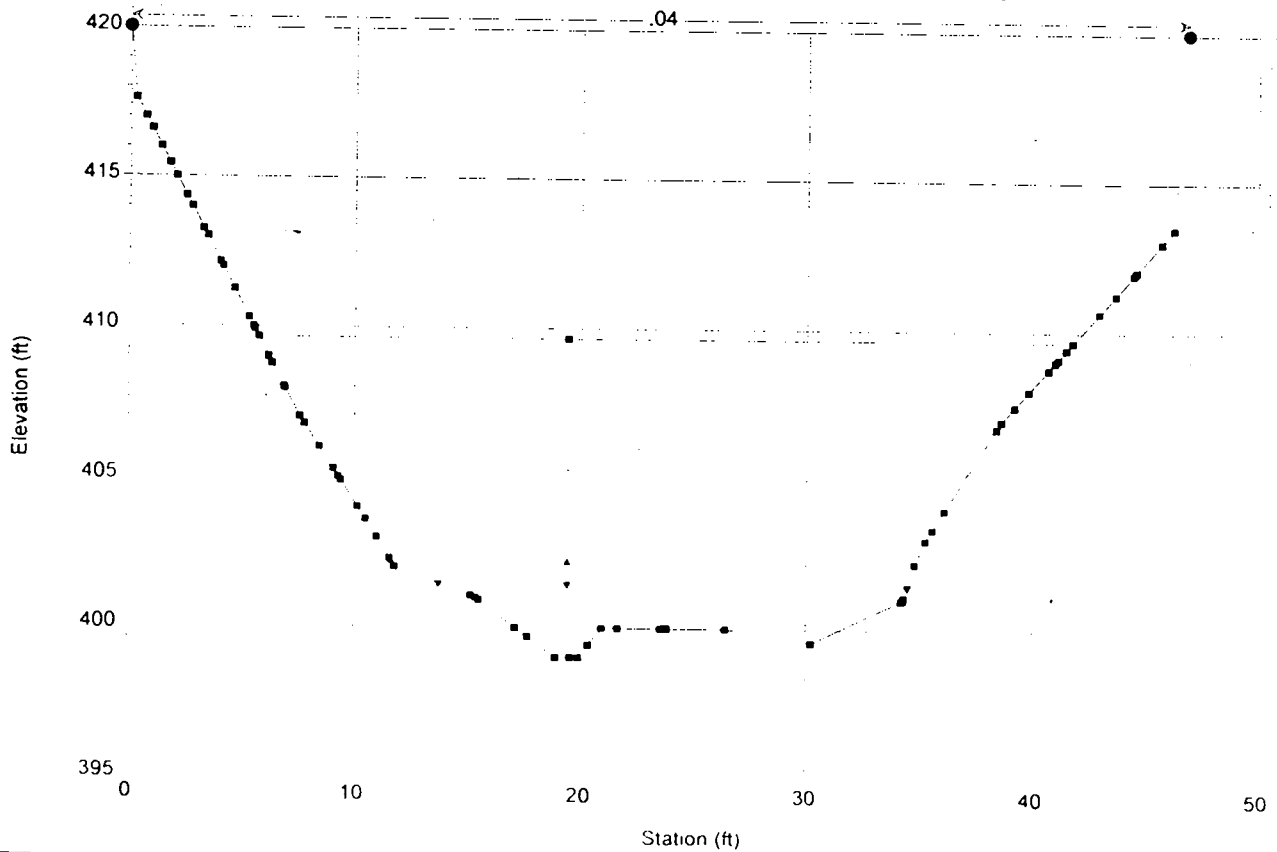
Legend

- WS 3000 cfs
- WS 1000 cfs
- ▲ WS 500 cfs
- ▼ WS 200 cfs
- ▼ WS 100 cfs
- Ground
- Bank Sta

Skookum Cr. Plan 03 - Existing Channel 03/23/2000

Geom: Skookum Creek Existing Flow: Skookum Creek

River = Skookum Creek Reach = Diversion Struct RS = 62



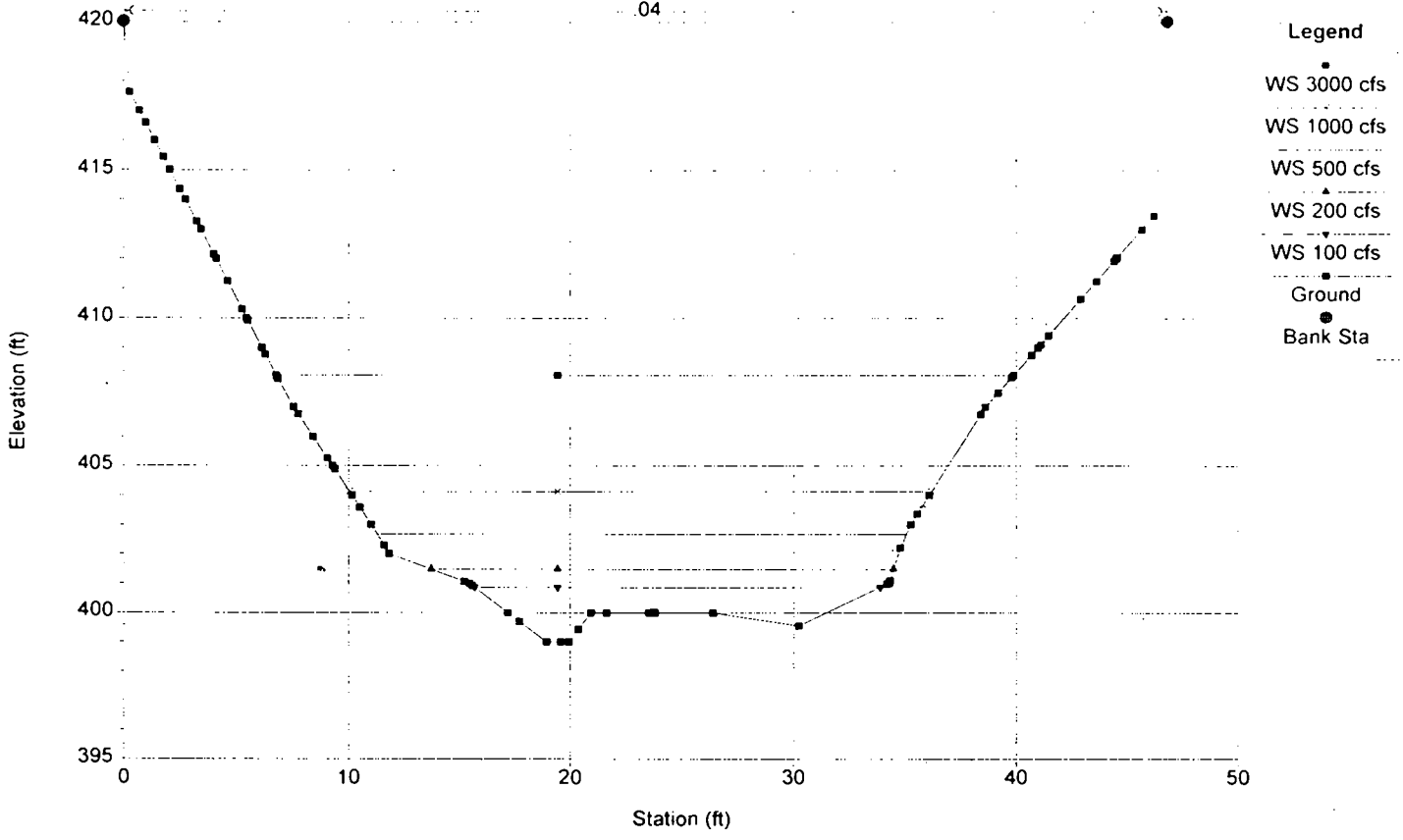
Legend

- WS 3000 cfs
- WS 1000 cfs
- ▲ WS 500 cfs
- ▼ WS 200 cfs
- ▼ WS 100 cfs
- Ground
- Bank Sta

Skookum Cr. Plan 03 - Existing Channel 03/23/2000

Geom: Skookum Creek Existing Flow: Skookum Creek

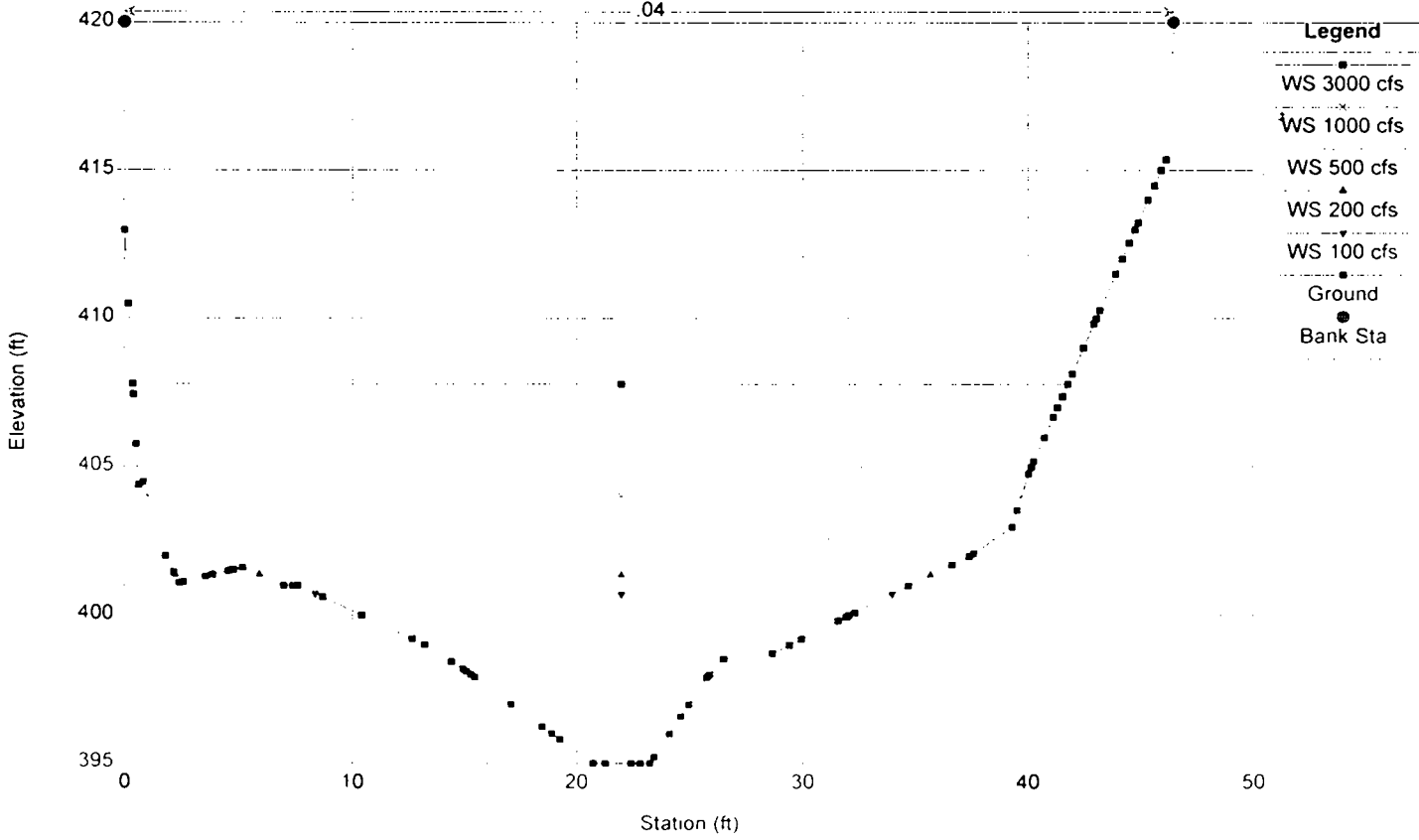
River = Skookum Creek Reach = Diversion Struct STA 0+50 RS = 60



Skookum Cr. Plan 03 - Existing Channel 03/23/2000

Geom: Skookum Creek Existing Flow: Skookum Creek

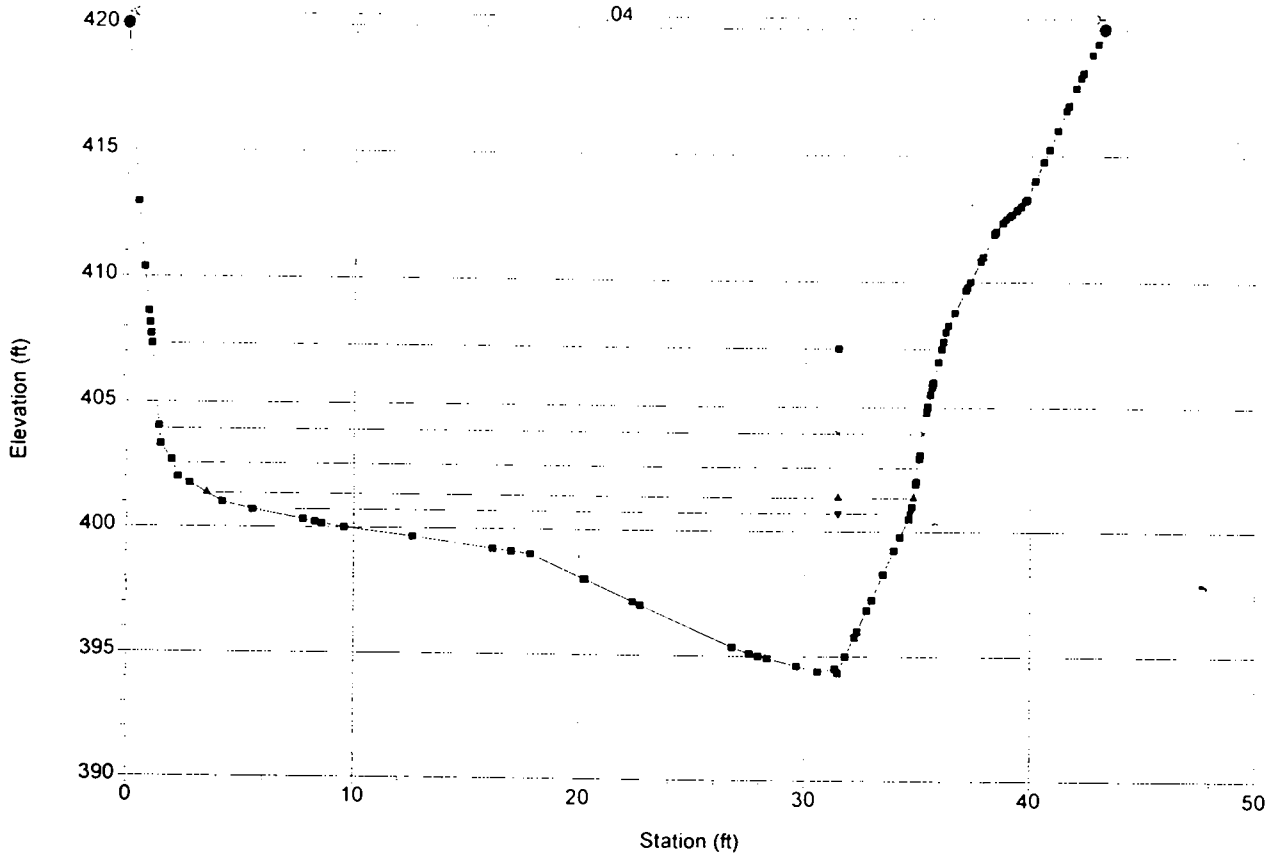
River = Skookum Creek Reach = Diversion Struct STA 0+75 RS = 58



Skookum Cr. Plan 03 - Existing Channel 03/23/2000

Geom: Skookum Creek Existing Flow: Skookum Creek

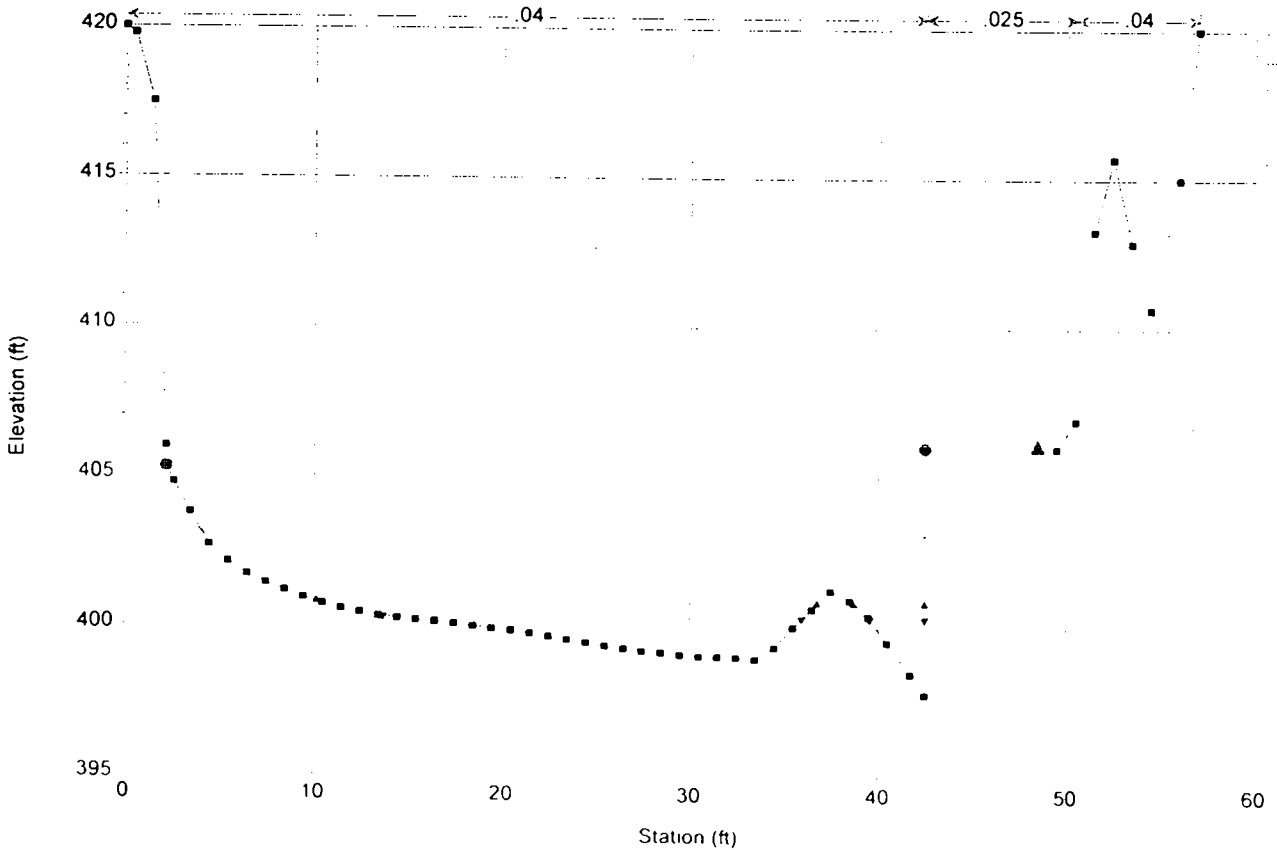
River = Skookum Creek Reach = Diversion Struct SECT B-B, STA 1+00 RS = 56



Skookum Cr. Plan 03 - Existing Channel 03/23/2000

Geom: Skookum Creek Existing Flow: Skookum Creek

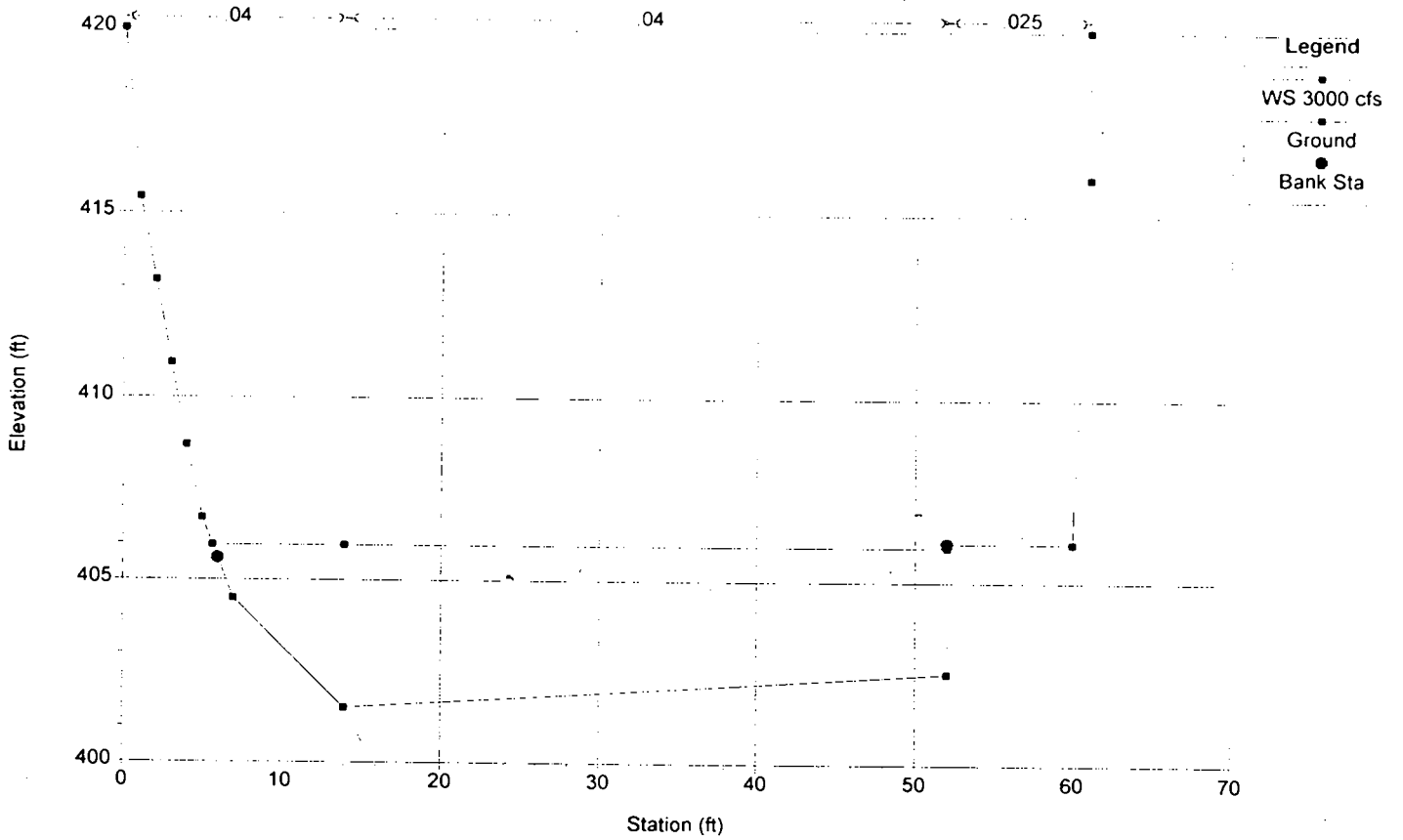
River = Skookum Creek Reach = Diversion Struct SECT C-C, STA 1+15 RS = 54



Skookum Cr. Plan 03 - Existing Channel 03/23/2000

Geom: Skookum Creek Existing Flow: Skookum Creek

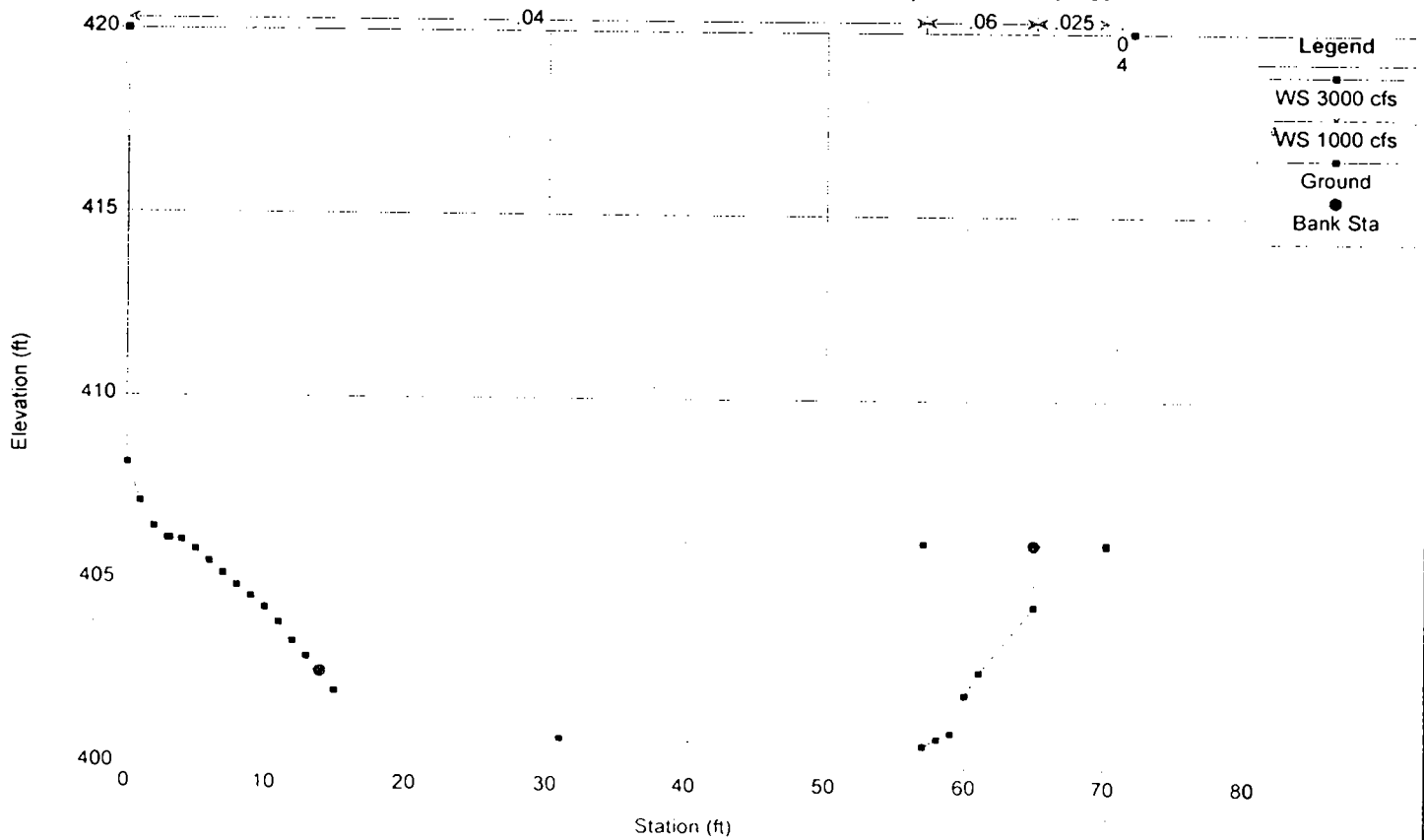
River = Skookum Creek Reach = Diversion Struct SECT D-D, STA 1+30 RS = 52



Skookum Cr. Plan 03 - Existing Channel 03/23/2000

Geom: Skookum Creek Existing Flow: Skookum Creek

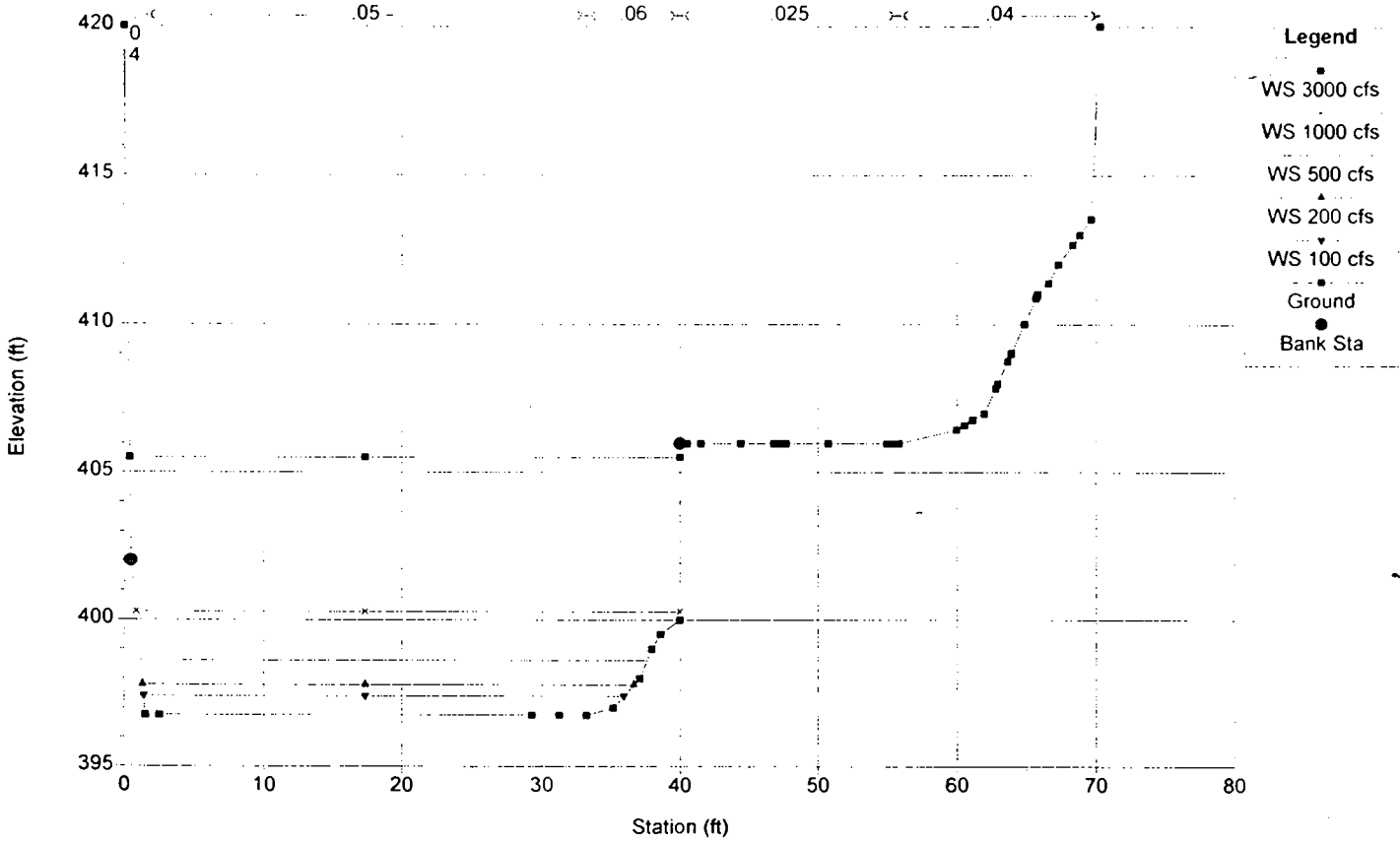
River = Skookum Creek Reach = Diversion Struct SECT E-E, STA 1+50 RS = 50



Skookum Cr. Plan 03 - Existing Channel 03/23/2000

Geom: Skookum Creek Existing Flow: Skookum Creek

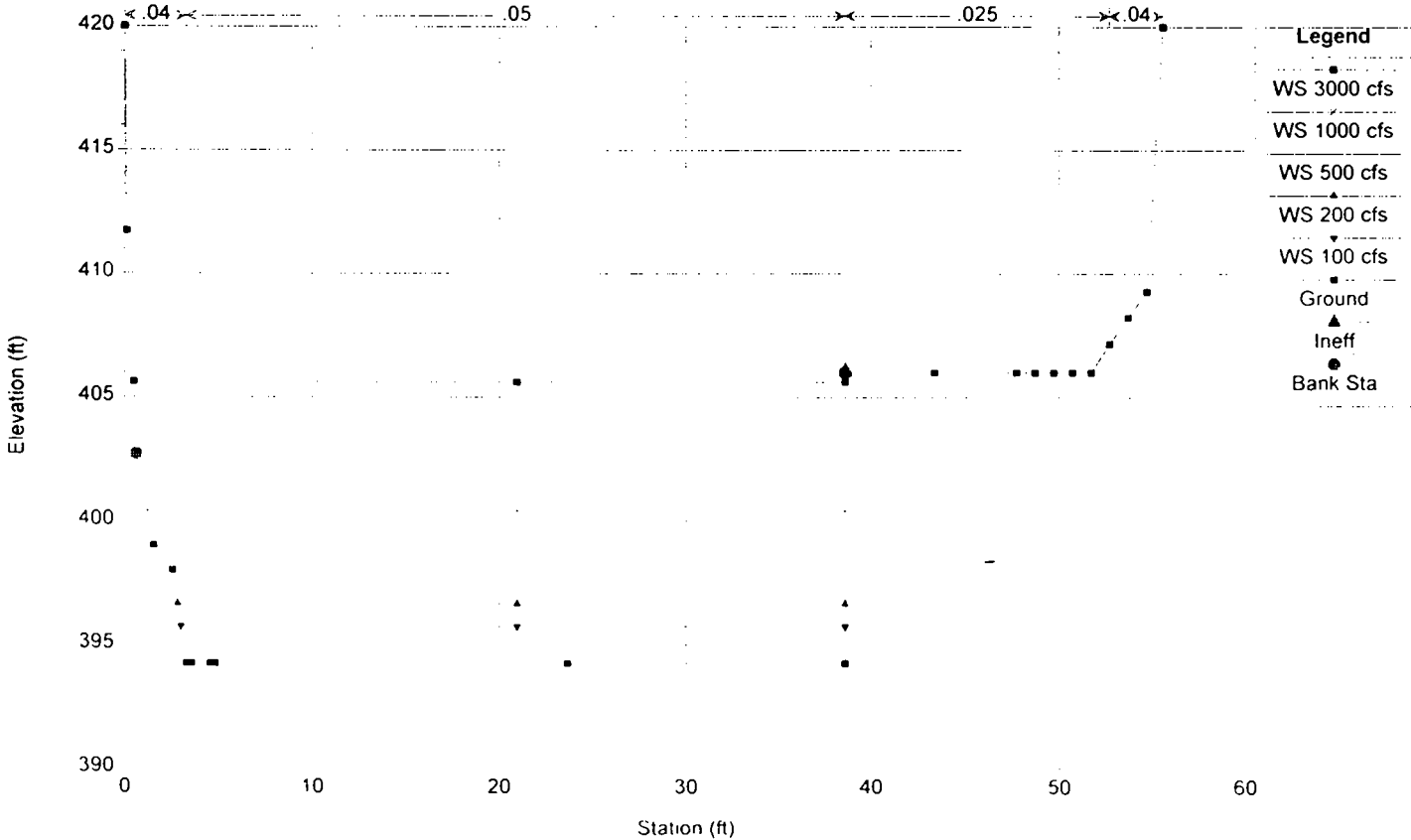
River = Skookum Creek Reach = Diversion Struct STA 1+80 (Crest of upper ramp) RS = 49



Skookum Cr. Plan 03 - Existing Channel 03/23/2000

Geom: Skookum Creek Existing Flow: Skookum Creek

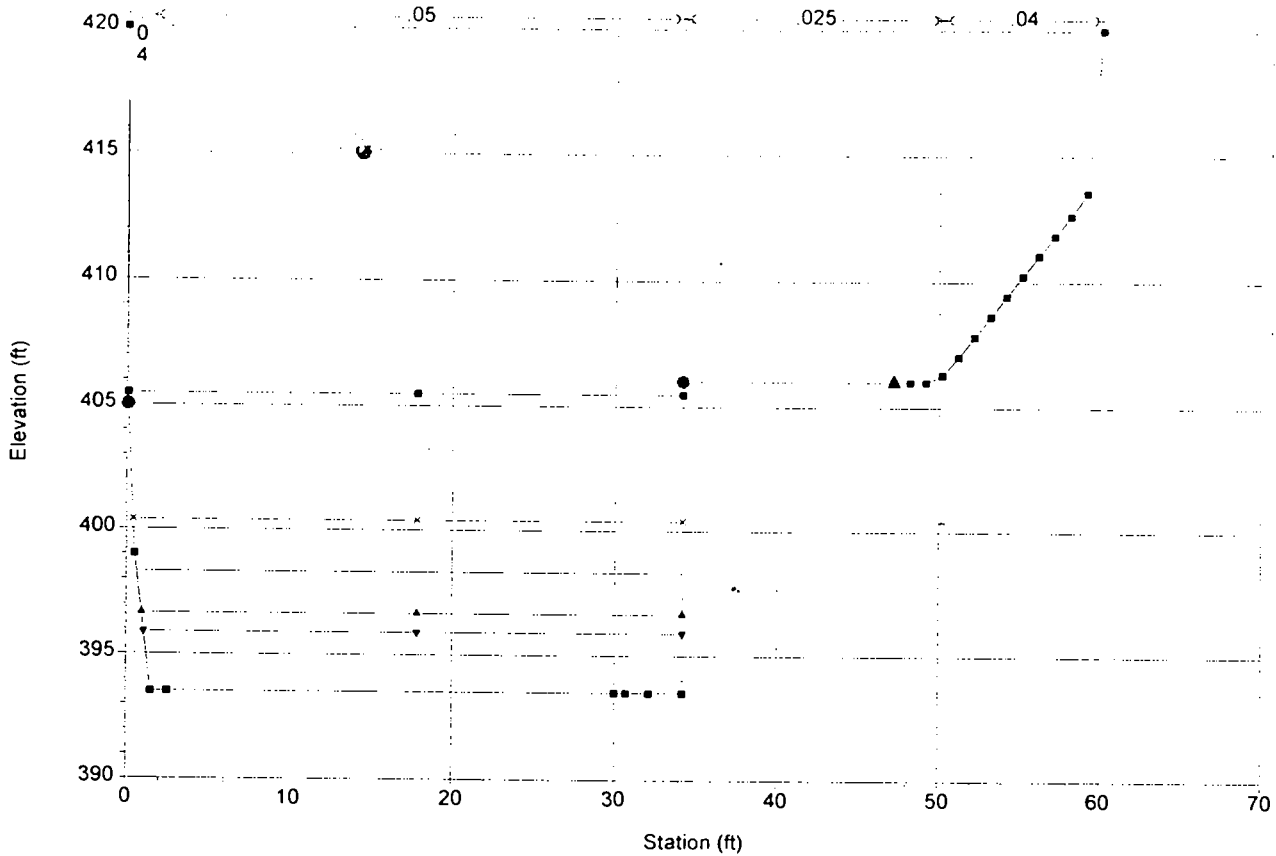
River = Skookum Creek Reach = Diversion Struct SECT-F-F, STA 2+00 (Midway upper ramp) RS = 48



Skookum Cr. Plan 03 - Existing Channel 03/23/2000

Geom: Skookum Creek Existing Flow: Skookum Creek

River = Skookum Creek Reach = Diversion Struct SECT G-G, STA 2+10 RS = 46

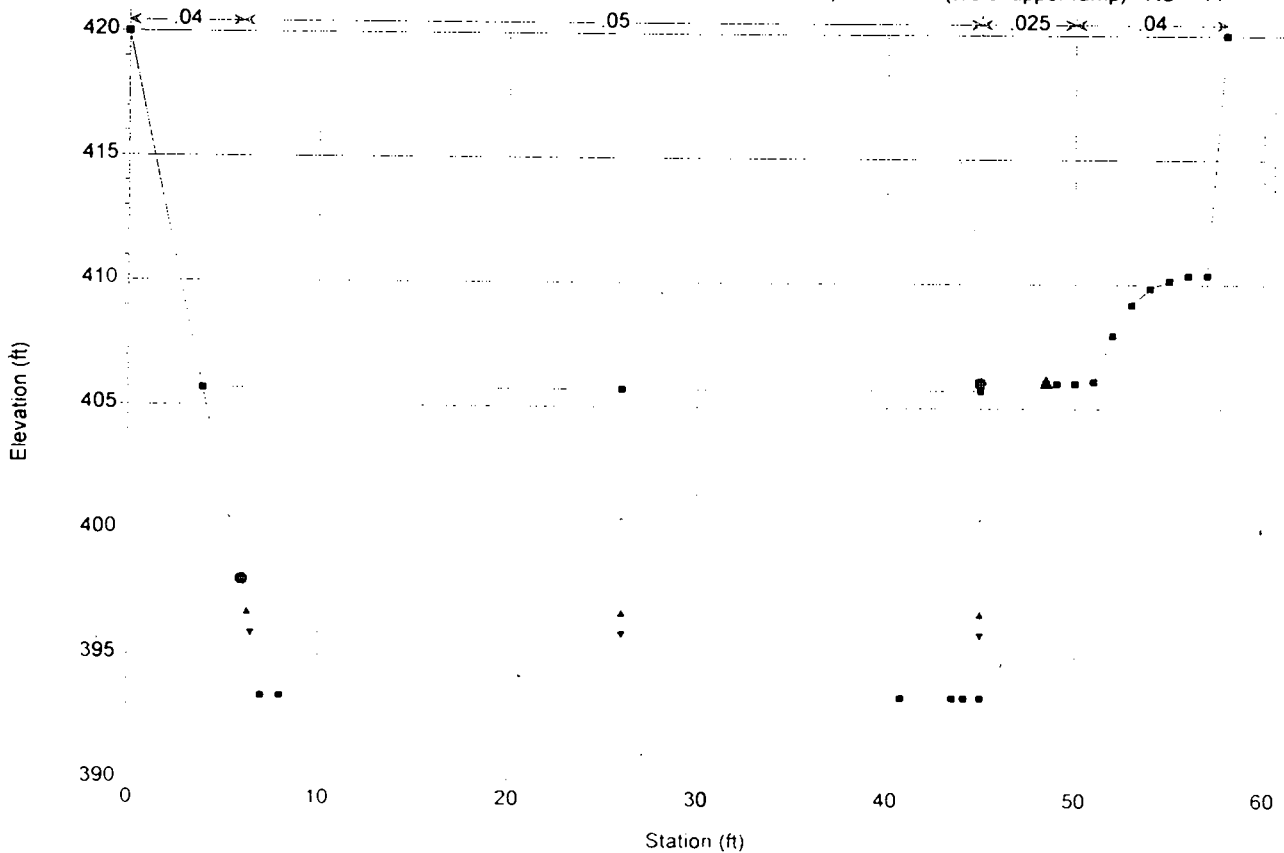


- Legend**
- WS 3000 cfs
 - ▲ WS 1000 cfs
 - ▼ WS 500 cfs
 - ▲ WS 200 cfs
 - ▼ WS 100 cfs
 - Ground
 - ▲ Ineff
 - Bank Sta

Skookum Cr. Plan 03 - Existing Channel 03/23/2000

Geom: Skookum Creek Existing Flow: Skookum Creek

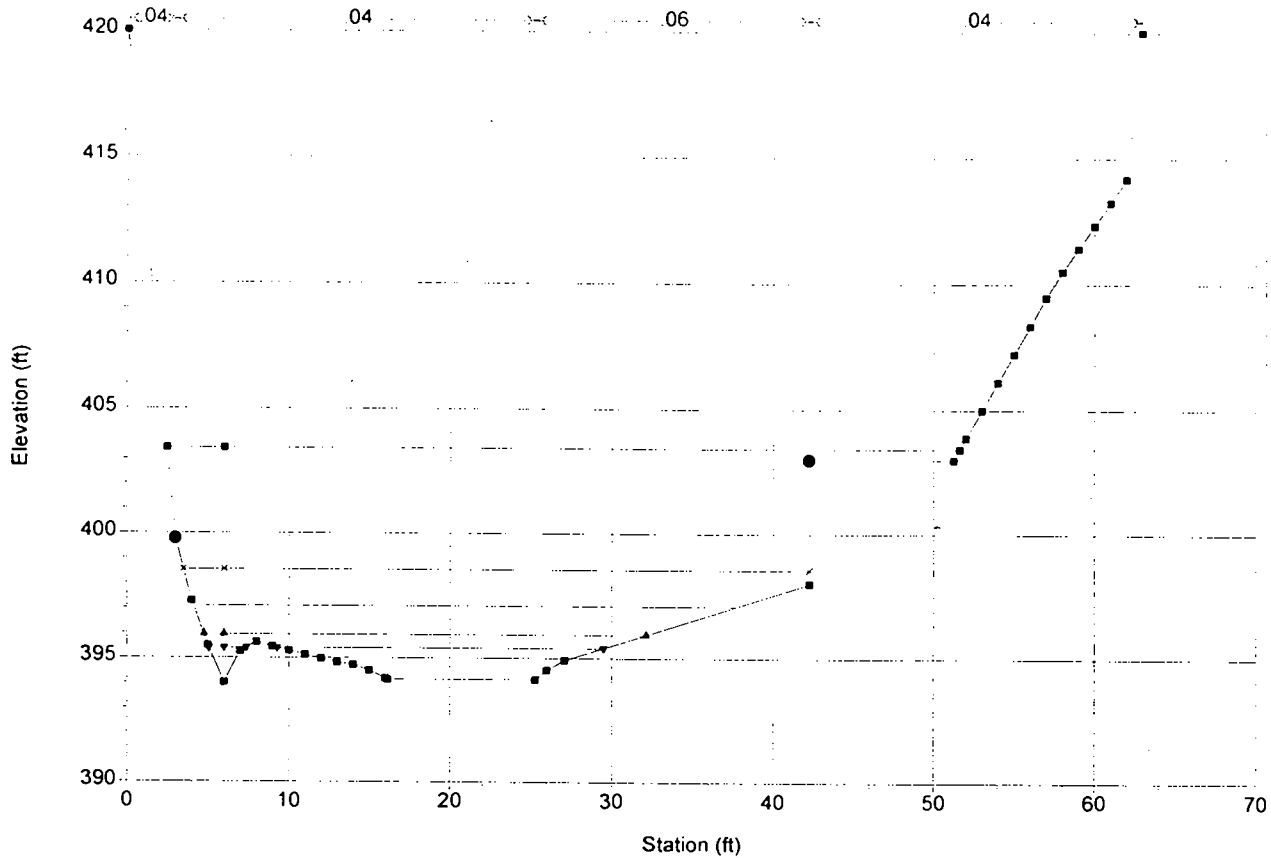
River = Skookum Creek Reach = Diversion Struct SECT H-H, STA 2+25 (toe of upper ramp) RS = 44



- Legend**
- WS 3000 cfs
 - ▲ WS 1000 cfs
 - ▼ WS 500 cfs
 - ▲ WS 200 cfs
 - ▼ WS 100 cfs
 - Ground
 - ▲ Ineff
 - Bank Sta

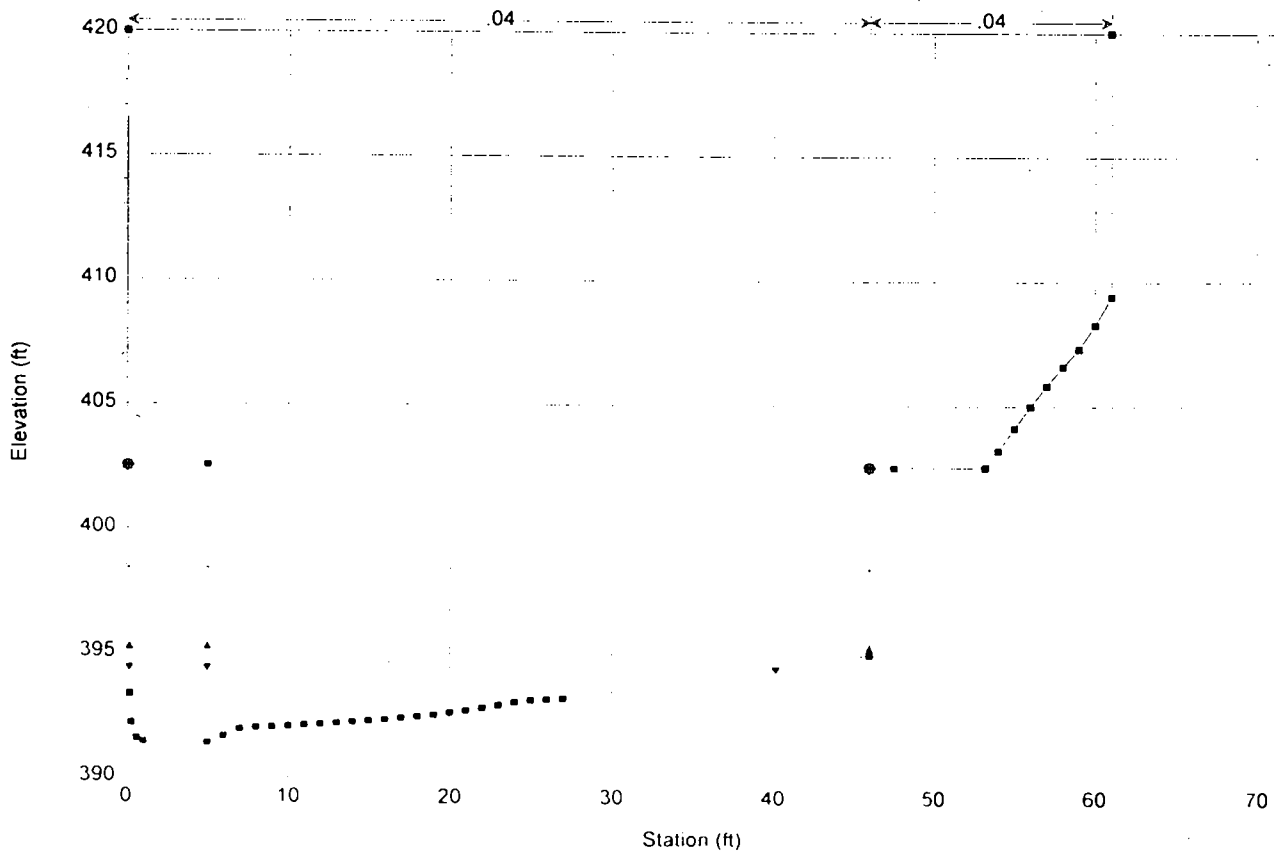
Skookum Cr. Plan 03 - Existing Channel 03/23/2000

Geom: Skookum Creek Existing Flow: Skookum Creek
 River = Skookum Creek Reach = Diversion Struct SECT J-J, STA 2+50 RS = 42



Skookum Cr. Plan 03 - Existing Channel 03/23/2000

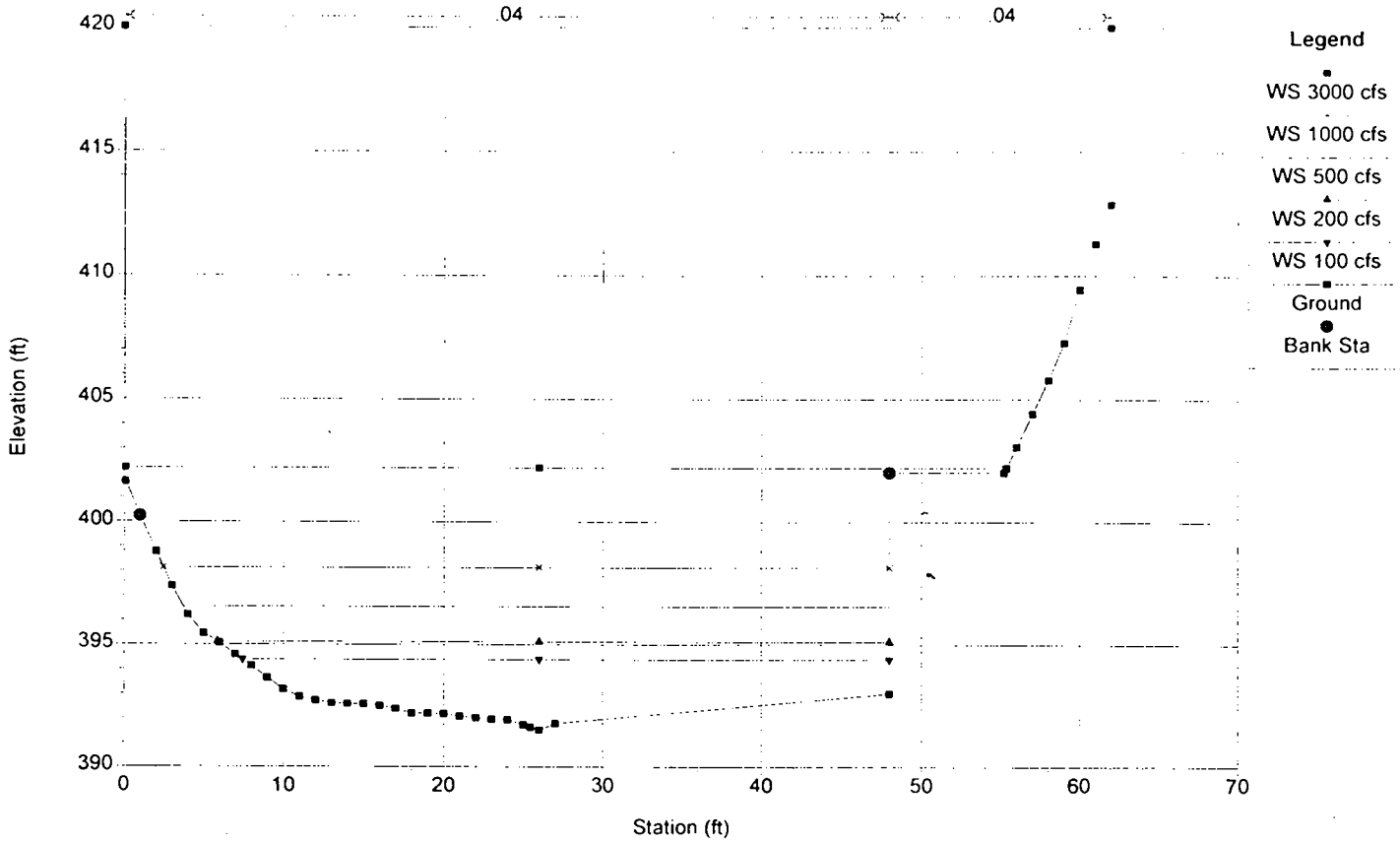
Geom: Skookum Creek Existing Flow: Skookum Creek
 River = Skookum Creek Reach = Diversion Struct SECT K-K, STA 2+75 RS = 40



Skookum Cr. Plan 03 - Existing Channel 03/23/2000

Geom: Skookum Creek Existing Flow: Skookum Creek

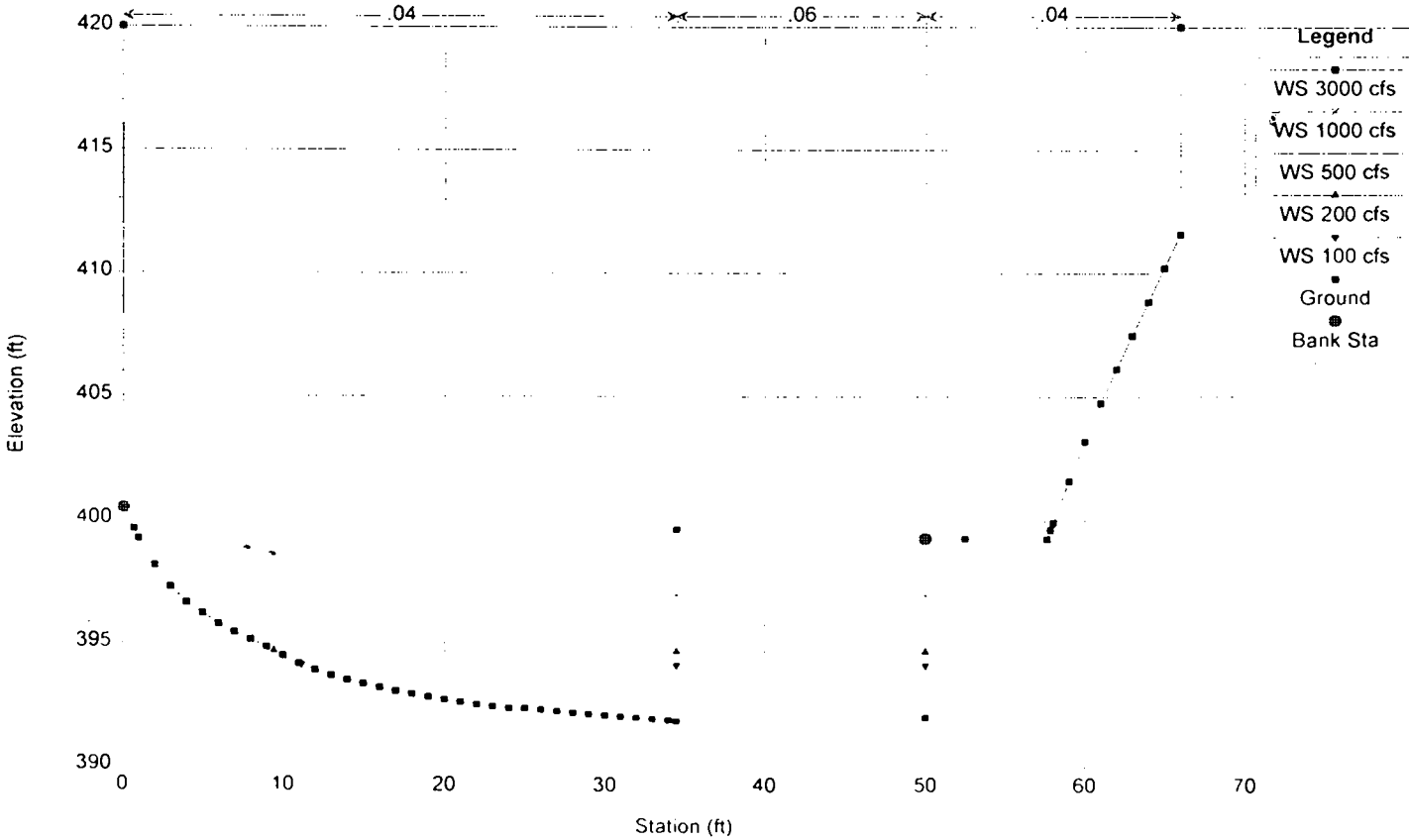
River = Skookum Creek Reach = Diversion Struct SECT L-L, STA 3+00 RS = 38



Skookum Cr. Plan 03 - Existing Channel 03/23/2000

Geom: Skookum Creek Existing Flow: Skookum Creek

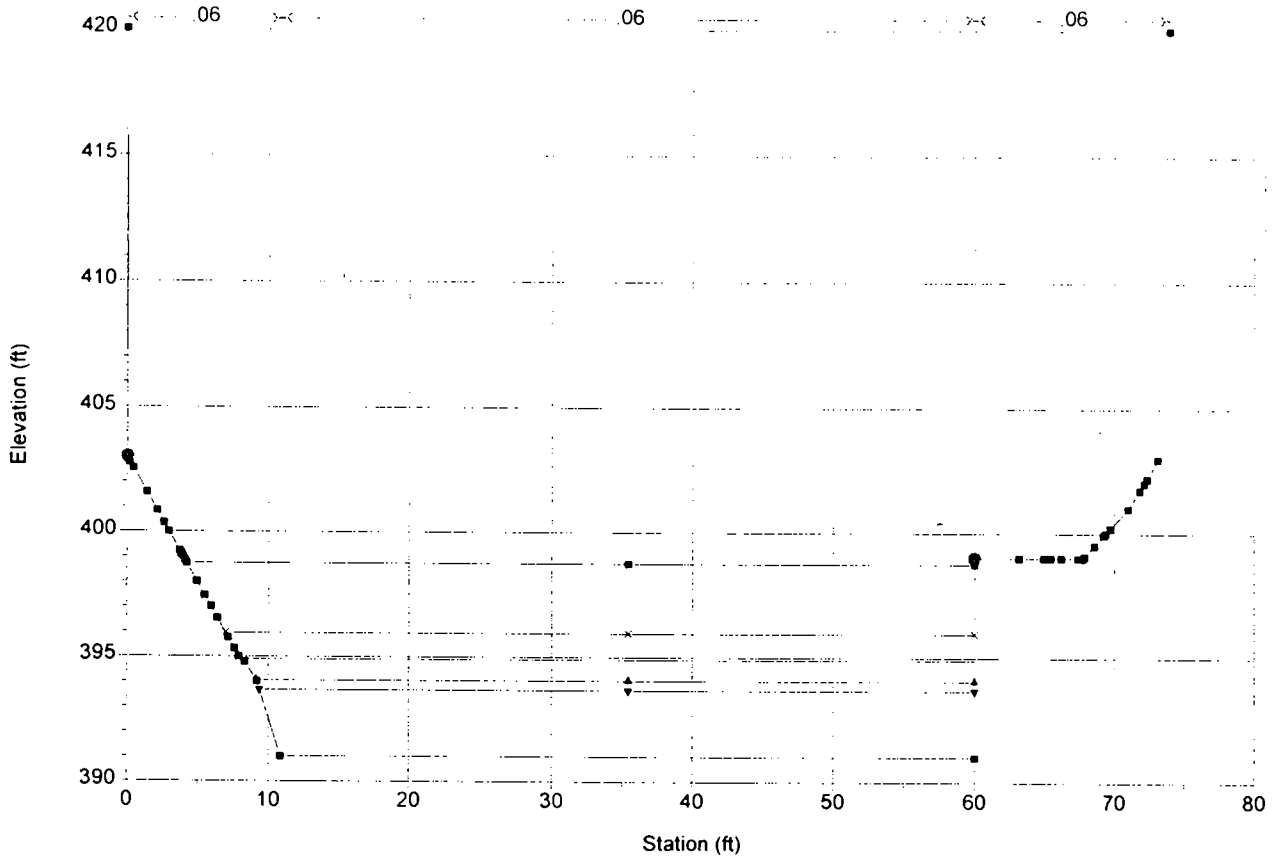
River = Skookum Creek Reach = Diversion Struct SECT N-N, STA 4+00 RS = 34



Skookum Cr. Plan 03 - Existing Channel 03/23/2000

Geom: Skookum Creek Existing Flow: Skookum Creek

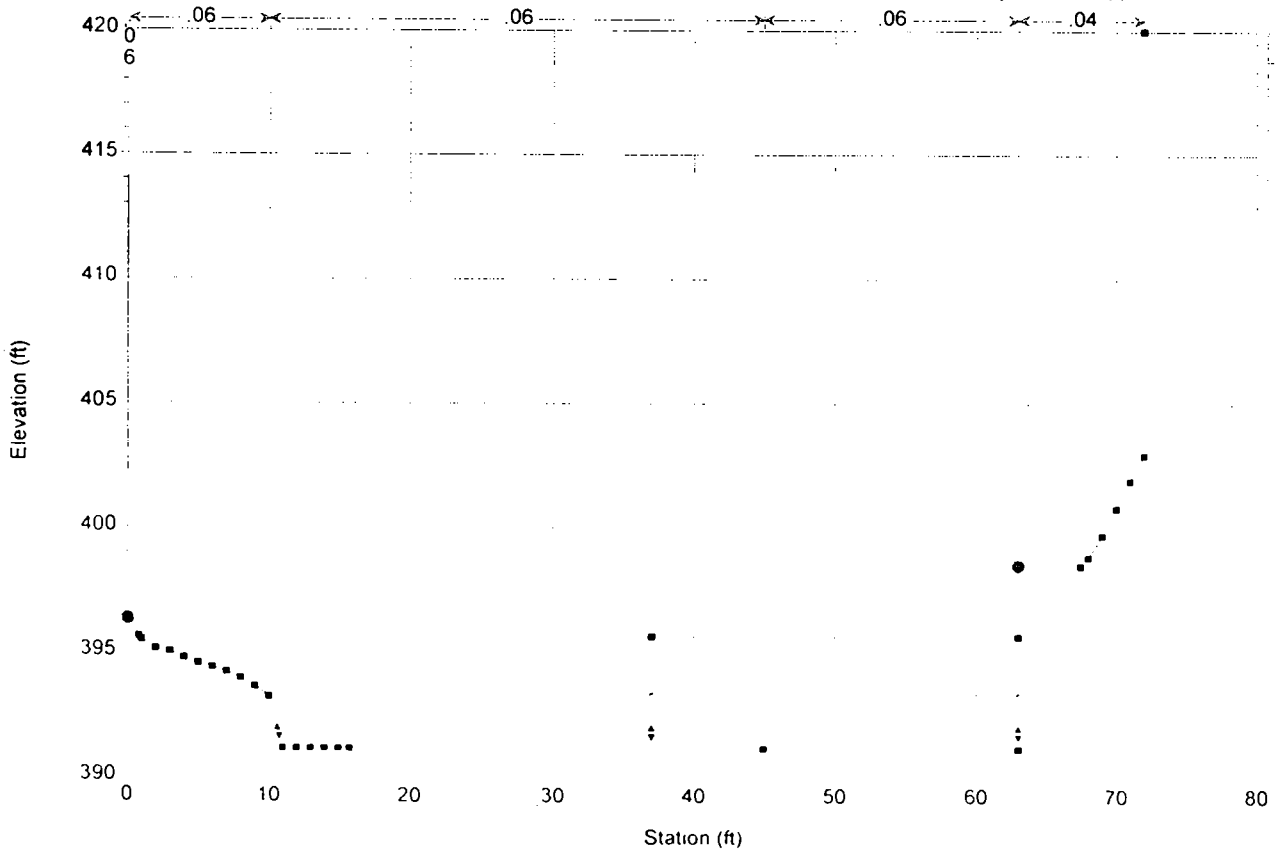
River = Skookum Creek Reach = Diversion Struct STA 4+31.6 (Crest of lower ramp) RS = 32



Skookum Cr. Plan 03 - Existing Channel 03/23/2000

Geom: Skookum Creek Existing Flow: Skookum Creek

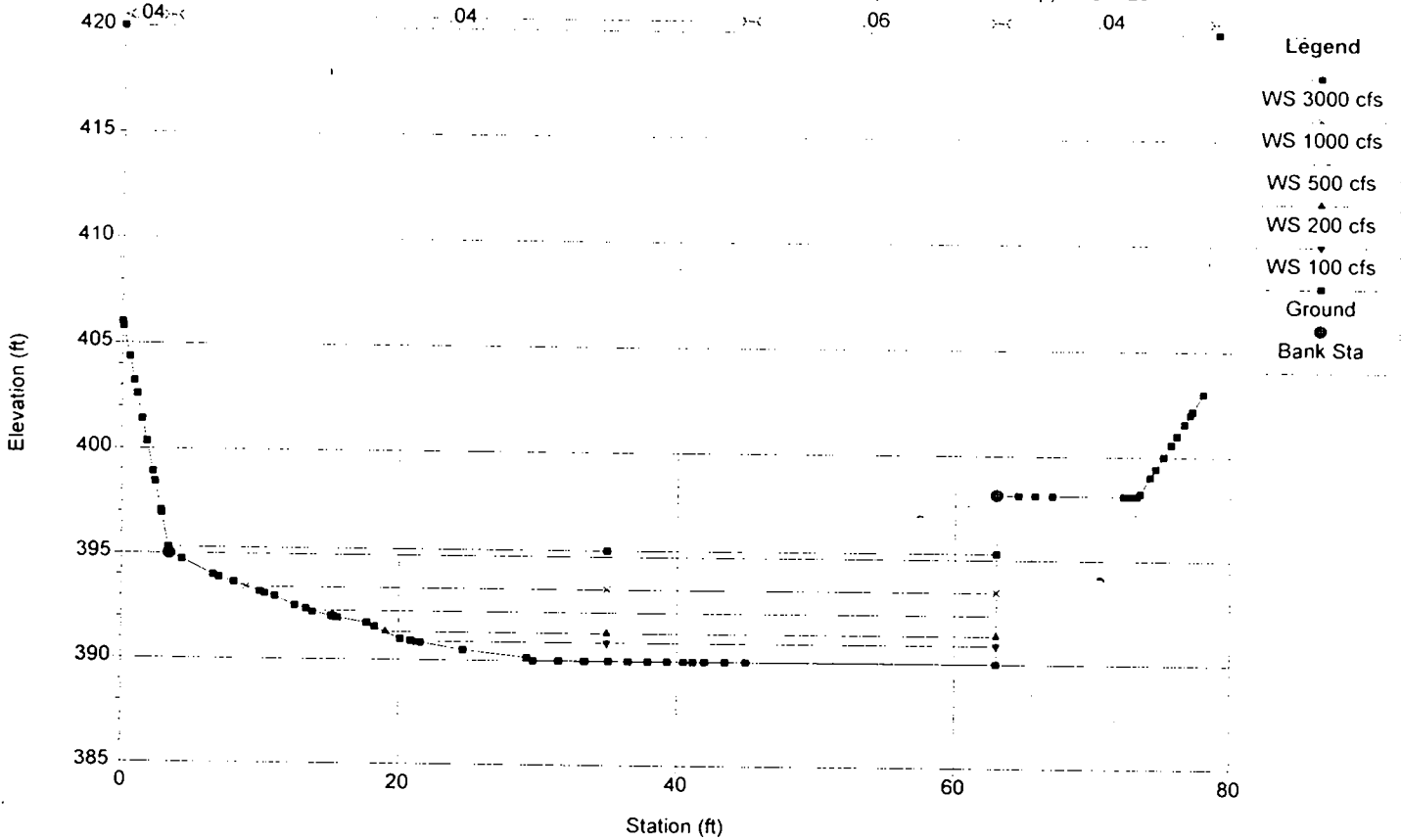
River = Skookum Creek Reach = Diversion Struct SECT P-P, STA 4+50 (Midway lower ramp) RS = 30



Skookum Cr. Plan 03 - Existing Channel 03/23/2000

Geom: Skookum Creek Existing Flow: Skookum Creek

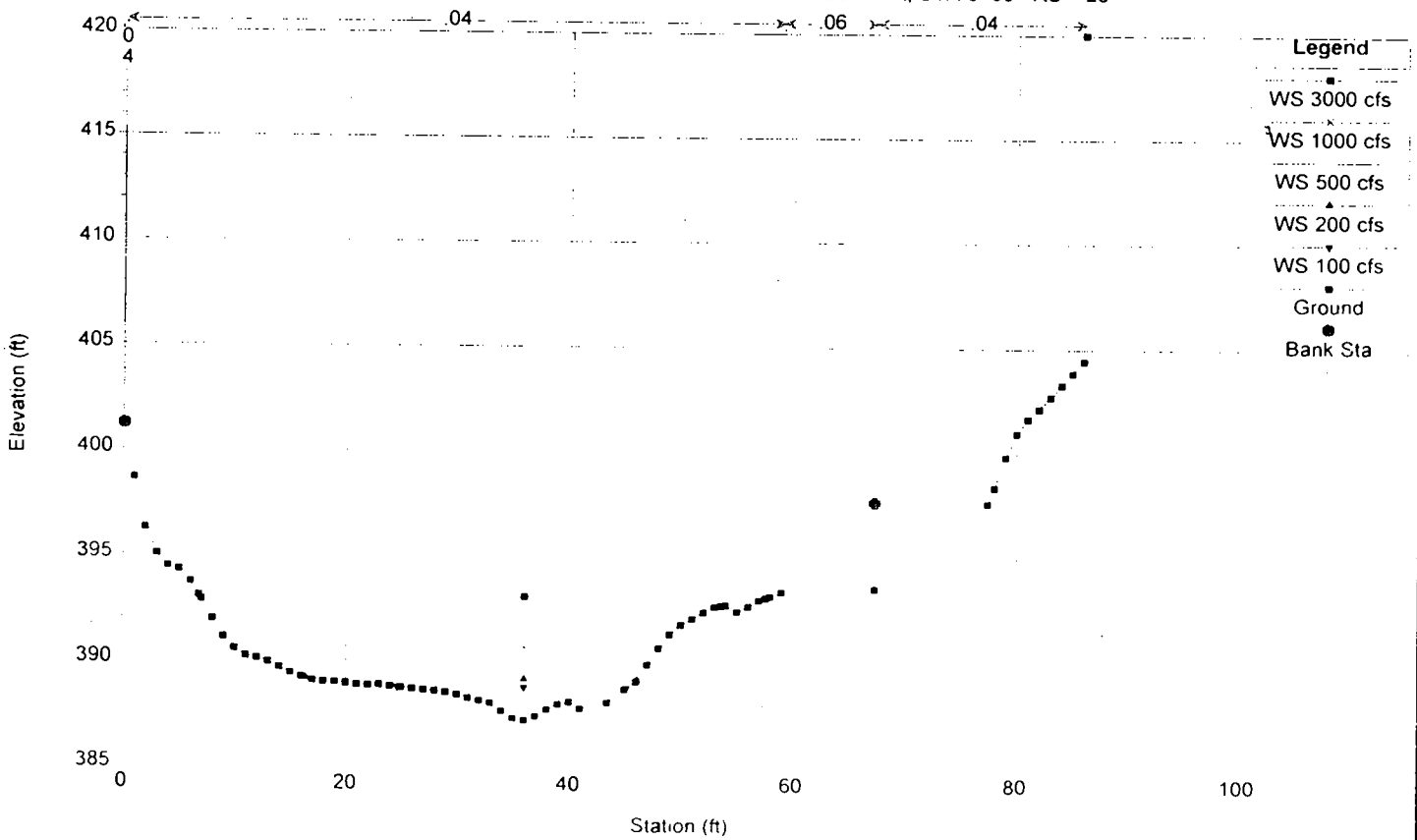
River = Skookum Creek Reach = Diversion Struct STA 4+63.5 (Toe of lower ramp) RS = 28



Skookum Cr. Plan 03 - Existing Channel 03/23/2000

Geom: Skookum Creek Existing Flow: Skookum Creek

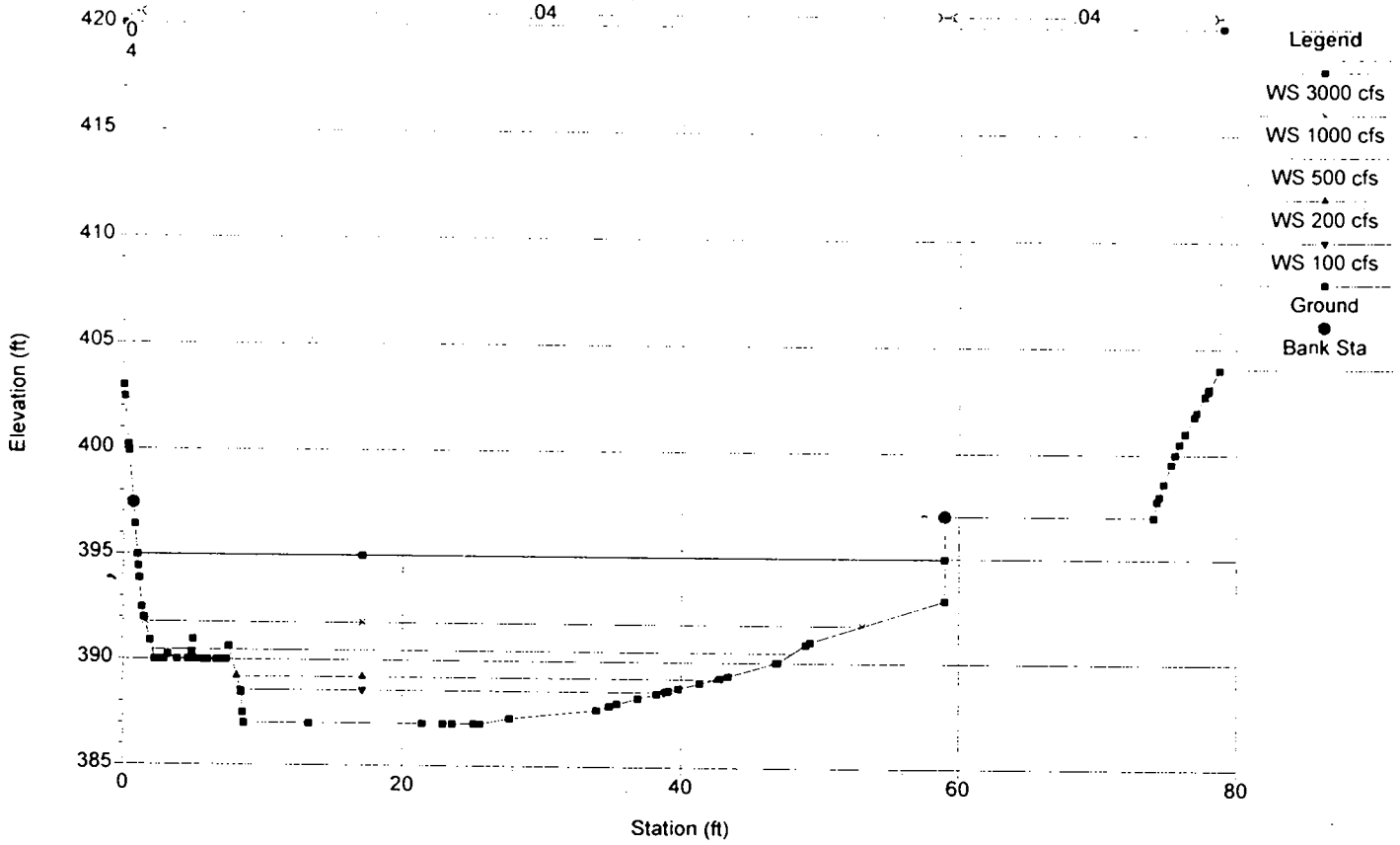
River = Skookum Creek Reach = Diversion Struct SECT R-R, STA 5+00 RS = 26



Skookum Cr. Plan 03 - Existing Channel 03/23/2000

Geom: Skookum Creek Existing Flow: Skookum Creek

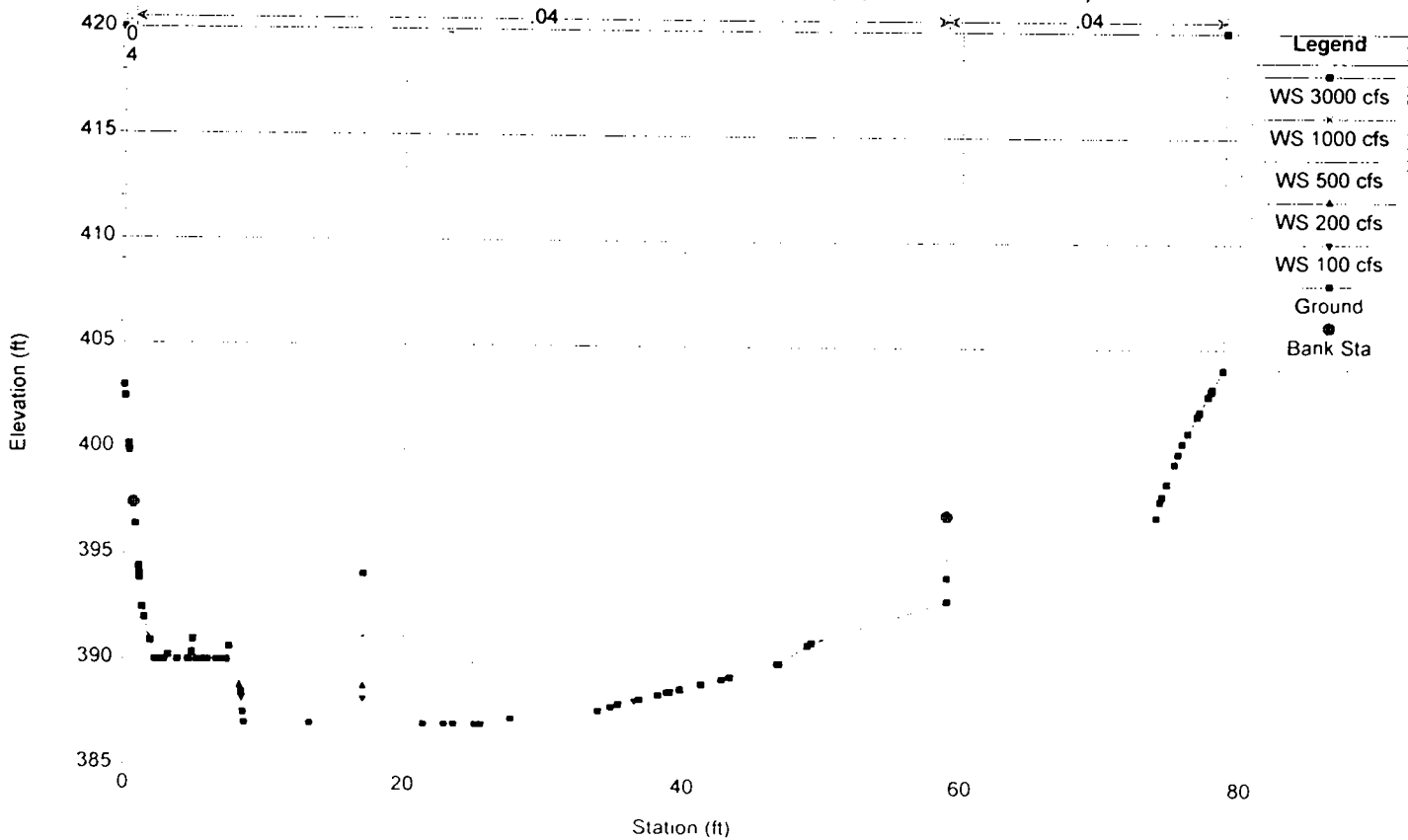
River = Skookum Creek Reach = Diversion Struct STA 5+50 RS = 24



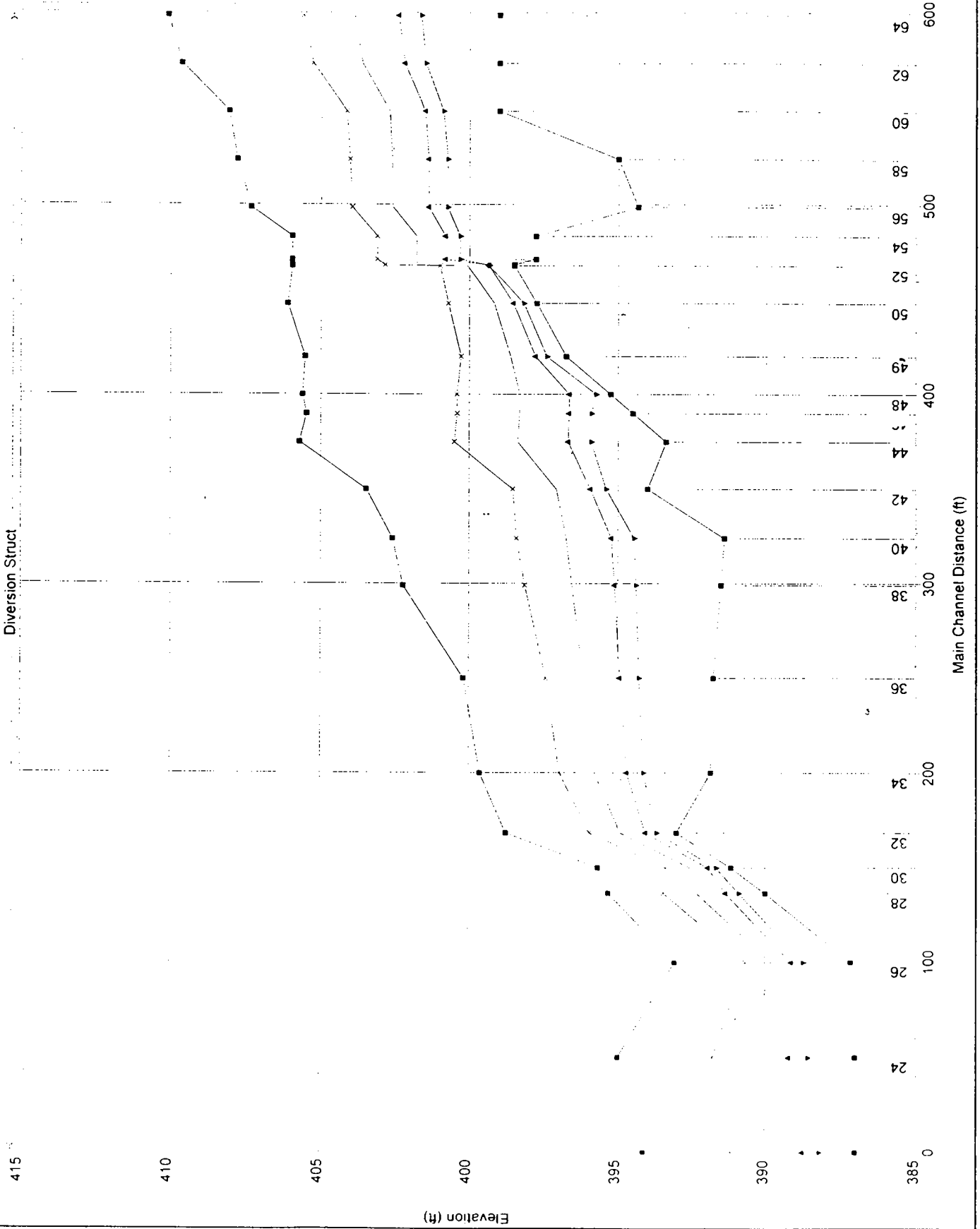
Skookum Cr. Plan 03 - Existing Channel 03/23/2000

Geom: Skookum Creek Existing Flow: Skookum Creek

River = Skookum Creek Reach = Diversion Struct STA 6+00 (Duplicate of River STA. 24) RS = 22



Skookum Cr. Plan 04 - Revised Design 03/23/2000
 Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek



- Legend
- WS 3000 cfs
 - ▲ WS 1000 cfs
 - ▼ WS 500 cfs
 - △ WS 200 cfs
 - ▽ WS 100 cfs
 - Ground

HEC-RAS Plan: Skookum River, Skookum Creek Reach: Diversion Structure

Reach	River Sta	Q Total (cfs)	Min Chl El (ft)	W/S Elev (ft)	Crit W/S (ft)	E G Elev (ft)	E G Slope (ft/ft)	Vel Cntl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Diversion Struct	64	500.00	399.00	403.86	402.68	404.38	0.005869	5.80	86.23	25.75	0.56
Diversion Struct	64	200.00	399.00	402.38	401.48	402.63	0.004876	4.02	49.81	23.42	0.49
Diversion Struct	64	100.00	399.00	401.62	400.86	401.77	0.004281	3.06	32.68	21.41	0.44
Diversion Struct	64	1000.00	399.00	405.61	404.12	406.48	0.006567	7.47	133.84	28.71	0.61
Diversion Struct	64	3000.00	399.00	410.11	408.05	411.88	0.007496	10.68	281.00	36.90	0.68
Diversion Struct	62	500.00	399.00	403.59	402.68	404.21	0.007507	6.30	79.32	25.30	0.63
Diversion Struct	62	200.00	399.00	402.18	401.48	402.48	0.006600	4.43	45.14	23.15	0.56
Diversion Struct	62	100.00	399.00	401.46	400.86	401.64	0.005942	3.42	29.20	20.74	0.51
Diversion Struct	62	1000.00	399.00	405.27	404.12	406.28	0.008129	8.05	124.22	28.14	0.68
Diversion Struct	62	3000.00	399.00	409.65	408.06	411.65	0.008850	11.35	264.43	36.05	0.74
Diversion Struct	60	500.00	399.00	402.68	402.68	403.88	0.020285	8.79	56.91	23.85	1.00
Diversion Struct	60	200.00	399.00	401.48	401.48	402.19	0.022938	6.77	29.56	20.81	1.00
Diversion Struct	60	100.00	399.00	400.86	400.86	401.37	0.026602	5.68	17.61	18.26	1.02
Diversion Struct	60	1000.00	399.00	404.12	404.12	405.92	0.018799	10.75	93.01	26.20	1.01
Diversion Struct	60	3000.00	399.00	408.07	408.07	411.25	0.016729	14.30	209.78	33.11	1.00
Diversion Struct	58	500.00	395.00	402.59	400.20	402.82	0.002368	3.85	129.73	36.97	0.36
Diversion Struct	58	200.00	395.00	401.36	398.42	401.45	0.001157	2.31	86.62	31.44	0.25
Diversion Struct	58	100.00	395.00	400.73	397.43	400.76	0.000484	1.46	68.66	25.65	0.16
Diversion Struct	58	1000.00	395.00	404.01	401.83	404.47	0.003306	5.44	183.70	38.71	0.44
Diversion Struct	58	3000.00	395.00	407.79	405.01	409.03	0.005019	8.94	335.64	41.42	0.55
Diversion Struct	56	500.00	394.33	402.56	399.72	402.76	0.001762	3.58	139.72	32.99	0.31
Diversion Struct	56	200.00	394.33	401.36	397.82	401.42	0.000750	1.99	100.71	31.29	0.20
Diversion Struct	56	100.00	394.33	400.72	396.87	400.74	0.000344	1.23	81.42	29.19	0.13
Diversion Struct	56	1000.00	394.33	403.94	401.28	404.39	0.002997	5.38	185.77	33.82	0.40
Diversion Struct	56	3000.00	394.33	407.33	404.68	408.86	0.006474	9.92	302.49	34.95	0.59
Diversion Struct	54	500.00	397.78	401.76	401.73	402.64	0.022400	7.53	66.38	36.15	0.98
Diversion Struct	54	200.00	397.78	400.79	400.79	401.35	0.027387	5.97	33.51	30.36	1.00
Diversion Struct	54	100.00	397.78	400.30	400.30	400.70	0.030737	5.05	19.80	25.13	1.00
Diversion Struct	54	1000.00	397.78	403.08	402.82	404.24	0.015774	8.63	115.87	38.38	0.88
Diversion Struct	54	3000.00	397.78	405.96	405.82	408.61	0.016926	13.05	229.88	40.28	0.96
Diversion Struct	5275	Inline Weir									
Diversion Struct	52	500.00	398.50	400.06	400.06	400.84	0.021997	7.10	70.42	45.22	1.00
Diversion Struct	52	200.00	398.50	399.35	399.35	399.77	0.025998	5.24	38.19	45.12	1.00
Diversion Struct	52	100.00	398.50	399.35	399.35	399.45	0.006499	2.62	38.19	45.12	0.50
Diversion Struct	52	1000.00	398.50	400.97	400.97	402.22	0.019850	8.95	111.74	45.35	1.00

HEC-RAS Plan: Skookum River, Skookum Creek Reach: Diversion Structure (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	WS Elev (ft)	Crit WS (ft)	E/G Elev (ft)	E/G Slope (ft/ft)	Vel Chn (ft/s)	Flow Area (sq ft)	Top Width (ft)	FOUde #	Chl
Diversion Struct	52	3000.00	398.50	405.96	403.64	407.17	0.005564	8.84	339.55	46.33		0.57
Diversion Struct	50	500.00	397.75	399.17	399.38	400.24	0.035482	8.33	60.02	42.81		1.24
Diversion Struct	50	200.00	397.75	398.53	398.63	399.10	0.038980	6.04	33.12	42.45		1.20
Diversion Struct	50	100.00	397.75	398.18	398.31	398.65	0.069012	5.48	18.24	42.25		1.47
Diversion Struct	50	1000.00	397.75	400.70	400.33	401.67	0.014482	7.92	126.34	45.31		0.84
Diversion Struct	50	3000.00	397.75	406.11	403.08	406.96	0.004105	7.44	413.32	67.03		0.47
Diversion Struct	49	500.00	396.75	398.62	398.62	399.53	0.033844	7.64	65.42	36.48		1.01
Diversion Struct	49	200.00	396.75	397.78	397.78	398.28	0.039576	5.69	35.16	35.35		1.01
Diversion Struct	49	100.00	396.75	397.41	397.41	397.73	0.044985	4.55	22.00	34.55		1.00
Diversion Struct	49	1000.00	396.75	400.27	399.70	401.22	0.017229	7.84	127.63	39.17		0.76
Diversion Struct	49	3000.00	396.75	405.52	402.68	406.77	0.007776	8.96	335.09	39.60		0.54
Diversion Struct	48	500.00	395.25	398.31	397.08	398.64	0.006306	4.56	109.60	36.40		0.46
Diversion Struct	48	200.00	395.25	396.65	396.24	396.90	0.012788	4.03	49.63	35.73		0.60
Diversion Struct	48	100.00	395.25	395.74	395.88	396.25	0.099541	5.75	17.39	35.49		1.45
Diversion Struct	48	1000.00	395.25	400.41	398.15	400.85	0.004769	5.34	187.23	37.43		0.42
Diversion Struct	48	3000.00	395.25	405.61	401.25	406.56	0.004731	7.81	384.50	38.16		0.43
Diversion Struct	46	500.00	394.50	398.32	396.43	398.56	0.003722	3.95	126.53	33.55		0.36
Diversion Struct	46	200.00	394.50	396.65	395.55	396.78	0.003703	2.82	70.93	33.18		0.34
Diversion Struct	46	100.00	394.50	395.90	395.16	395.97	0.003777	2.18	45.84	33.01		0.33
Diversion Struct	46	1000.00	394.50	400.39	397.56	400.79	0.003862	5.09	196.38	33.79		0.37
Diversion Struct	46	3000.00	394.50	405.47	400.82	406.50	0.005397	8.13	368.78	34.10		0.44
Diversion Struct	44	500.00	393.38	398.38	395.12	398.48	0.001183	2.59	192.87	39.10		0.21
Diversion Struct	44	200.00	393.38	396.68	394.32	396.72	0.000702	1.58	126.75	38.71		0.15
Diversion Struct	44	100.00	393.38	395.90	393.97	395.92	0.000411	1.03	96.79	38.55		0.11
Diversion Struct	44	1000.00	393.38	400.49	396.14	400.69	0.001531	3.63	276.00	39.68		0.24
Diversion Struct	44	3000.00	393.38	405.71	399.11	406.31	0.002463	6.24	486.79	41.10		0.31
Diversion Struct	42	500.00	394.00	397.08	397.08	398.31	0.026602	8.92	56.05	22.99		1.01
Diversion Struct	42	200.00	394.00	395.93	395.93	396.62	0.029136	6.66	30.05	22.34		1.01
Diversion Struct	42	100.00	394.00	395.39	395.39	395.86	0.031623	5.46	18.30	20.09		1.01
Diversion Struct	42	1000.00	394.00	398.54	398.54	400.45	0.025866	11.09	90.16	23.61		1.00
Diversion Struct	42	3000.00	394.00	403.44	403.44	406.01	0.014306	13.21	239.89	49.17		0.79
Diversion Struct	40	500.00	391.40	396.74	394.45	396.96	0.002478	3.80	131.63	33.04		0.34
Diversion Struct	40	200.00	391.40	395.22	393.44	395.31	0.001443	2.40	83.43	30.44		0.26
Diversion Struct	40	100.00	391.40	394.45	392.94	394.49	0.000927	1.66	60.40	29.11		0.20
Diversion Struct	40	1000.00	391.40	398.42	395.73	398.85	0.003644	5.28	189.44	35.91		0.41

HEC-RAS Plan: Skookum River: Skookum Creek Reach: Diversion Struct (Continued)

Diversion Struct	River Sta	Q Total (cfs)	Min Ch El (ft)	W/S Elev (ft)	Crit W/S (ft)	E G Elev (ft)	E G Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #	Chl
Diversion Struct	40	3000.00	391.40	402.55	399.20	403.68	0.006225	8.51	353.18	53.13		0.52
Diversion Struct	38	500.00	391.52	396.54	394.89	396.87	0.004503	4.62	108.17	32.26		0.44
Diversion Struct	38	200.00	391.52	395.11	393.72	395.26	0.003025	3.08	64.90	27.68		0.35
Diversion Struct	38	100.00	391.52	394.38	393.16	394.46	0.002024	2.18	45.80	24.87		0.28
Diversion Struct	38	1000.00	391.52	398.14	396.26	398.72	0.005759	6.14	162.81	36.21		0.51
Diversion Struct	38	3000.00	391.52	402.20	399.73	403.49	0.007267	9.12	331.49	55.26		0.59
Diversion Struct	36	500.00	391.77	396.15	394.83	396.60	0.006438	5.41	92.37	28.33		0.53
Diversion Struct	36	200.00	391.77	394.92	393.60	395.10	0.003440	3.35	59.79	24.89		0.38
Diversion Struct	36	100.00	391.77	394.28	393.03	394.36	0.002004	2.26	44.34	23.03		0.29
Diversion Struct	36	1000.00	391.77	397.43	396.28	398.33	0.009965	7.63	131.00	31.94		0.66
Diversion Struct	36	3000.00	391.77	400.18	399.98	402.83	0.020024	13.08	229.40	39.59		0.96
Diversion Struct	34	500.00	391.85	395.77	394.90	396.24	0.008216	5.50	90.87	35.39		0.61
Diversion Struct	34	200.00	391.85	394.68	393.83	394.88	0.005336	3.62	55.25	30.06		0.47
Diversion Struct	34	100.00	391.85	394.13	393.30	394.23	0.003571	2.54	39.29	27.38		0.37
Diversion Struct	34	1000.00	391.85	396.96	396.15	397.80	0.010569	7.36	135.85	40.05		0.70
Diversion Struct	34	3000.00	391.85	399.62	399.29	401.79	0.016018	11.84	256.34	57.11		0.90
Diversion Struct	32	500.00	393.00	394.89	394.89	395.76	0.045829	7.47	66.97	39.11		1.01
Diversion Struct	32	200.00	393.00	394.05	394.05	394.55	0.054347	5.66	35.32	35.88		1.01
Diversion Struct	32	100.00	393.00	393.67	393.67	393.99	0.062703	4.57	21.88	34.27		1.01
Diversion Struct	32	1000.00	393.00	395.94	395.94	397.22	0.040522	9.10	109.87	42.97		1.00
Diversion Struct	32	3000.00	393.00	398.75	398.75	401.08	0.034429	12.24	245.01	53.06		1.00
Diversion Struct	30	500.00	391.15	392.54	392.99	394.14	0.119416	10.15	49.28	36.91		1.55
Diversion Struct	30	200.00	391.15	391.93	392.16	392.77	0.128597	7.33	27.27	35.63		1.48
Diversion Struct	30	100.00	391.15	391.65	391.79	392.17	0.141797	5.78	17.31	35.03		1.45
Diversion Struct	30	1000.00	391.15	393.35	394.07	395.78	0.103993	12.50	79.97	38.87		1.54
Diversion Struct	30	3000.00	391.15	395.65	396.85	399.79	0.085904	16.33	183.72	51.50		1.52
Diversion Struct	28	500.00	390.00	392.32	392.42	393.32	0.027749	8.04	62.20	36.56		1.09
Diversion Struct	28	200.00	390.00	391.33	391.42	392.01	0.033606	6.58	30.41	28.91		1.13
Diversion Struct	28	100.00	390.00	390.88	390.97	391.36	0.040039	5.55	18.00	25.82		1.17
Diversion Struct	28	1000.00	390.00	393.43	393.53	394.79	0.024109	9.35	106.91	43.66		1.05
Diversion Struct	28	3000.00	390.00	395.30	396.21	398.85	0.038106	15.12	198.40	53.43		1.38
Diversion Struct	26	500.00	387.15	389.79	390.37	391.67	0.060710	11.02	45.39	33.48		1.67
Diversion Struct	26	200.00	387.15	389.12	389.42	390.17	0.065266	8.21	24.35	29.66		1.60
Diversion Struct	26	100.00	387.15	388.73	388.99	389.50	0.060886	7.05	14.18	20.52		1.50
Diversion Struct	26	1000.00	387.15	390.65	391.45	393.29	0.050953	13.04	76.69	38.22		1.62

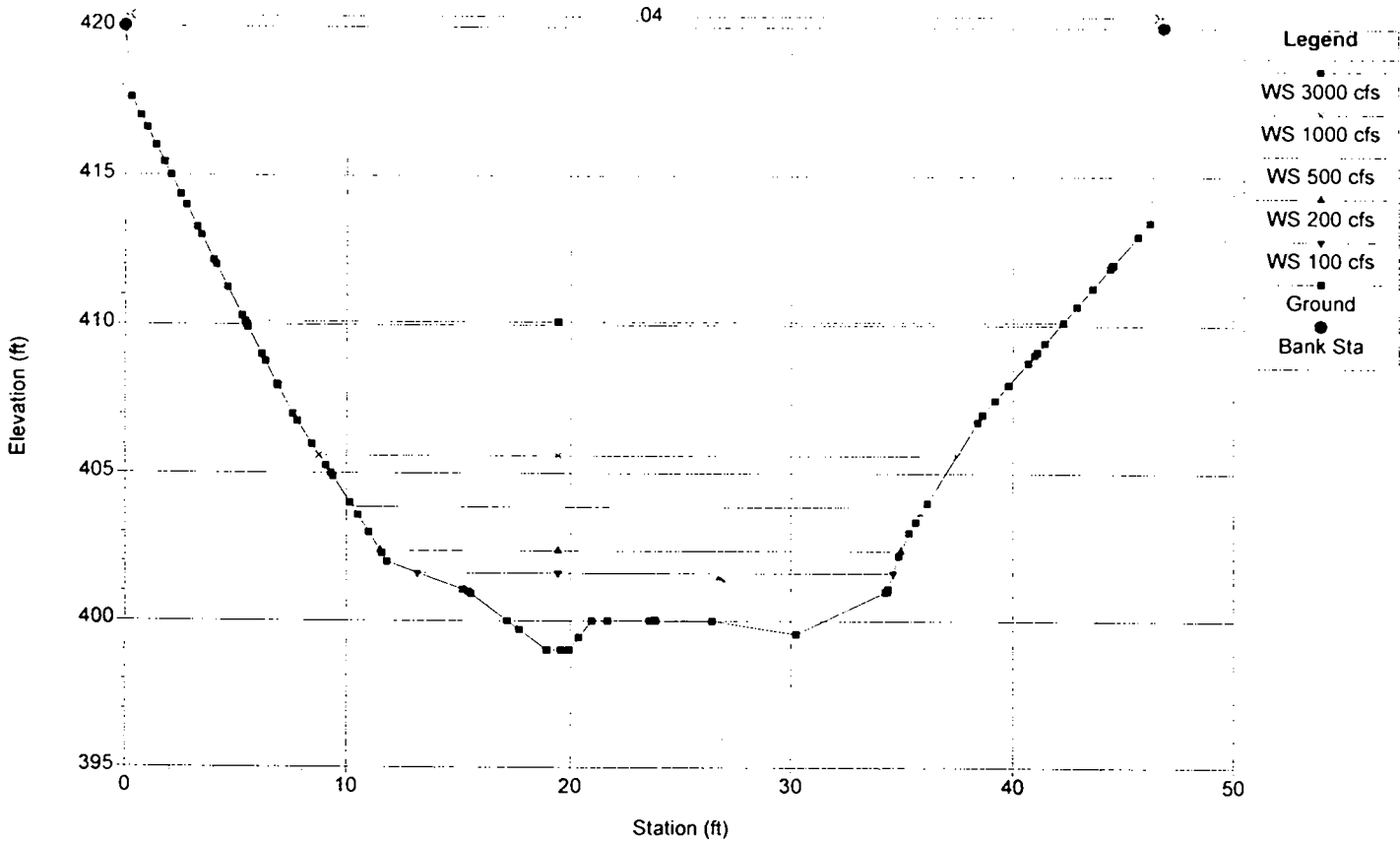
HEC-RAS Plan: Skookum River: Skookum Creek Reach: Diversion Struct (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W/S (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #	Chi
Diversion Struct	26	3000.00	387.15	393.06	394.37	397.35	0.039677	16.63	180.40	50.80		1.56
Diversion Struct	24	500.00	387.00	390.47	389.36	390.80	0.005313	4.56	109.54	45.64		0.52
Diversion Struct	24	200.00	387.00	389.21	388.38	389.38	0.004298	3.37	59.28	34.42		0.45
Diversion Struct	24	100.00	387.00	388.58	387.92	388.68	0.003688	2.57	38.84	30.40		0.40
Diversion Struct	24	1000.00	387.00	391.78	390.53	392.31	0.005453	5.83	171.38	48.51		0.55
Diversion Struct	24	3000.00	387.00	394.97	393.20	396.22	0.006450	8.98	334.05	53.47		0.63
Diversion Struct	22	500.00	387.00	389.87	389.36	390.43	0.010000	5.99	83.42	38.26		0.72
Diversion Struct	22	200.00	387.00	388.75	388.38	389.07	0.010007	4.51	44.32	31.53		0.67
Diversion Struct	22	100.00	387.00	388.20	387.92	388.40	0.010002	3.60	27.81	28.09		0.64
Diversion Struct	22	1000.00	387.00	391.15	390.54	391.93	0.010011	7.08	141.19	47.62		0.72
Diversion Struct	22	3000.00	387.00	394.11	393.20	395.79	0.010001	10.39	288.74	52.30		0.78

Skookum Cr. Plan 04 - Revised Design 03/23/2000

Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek

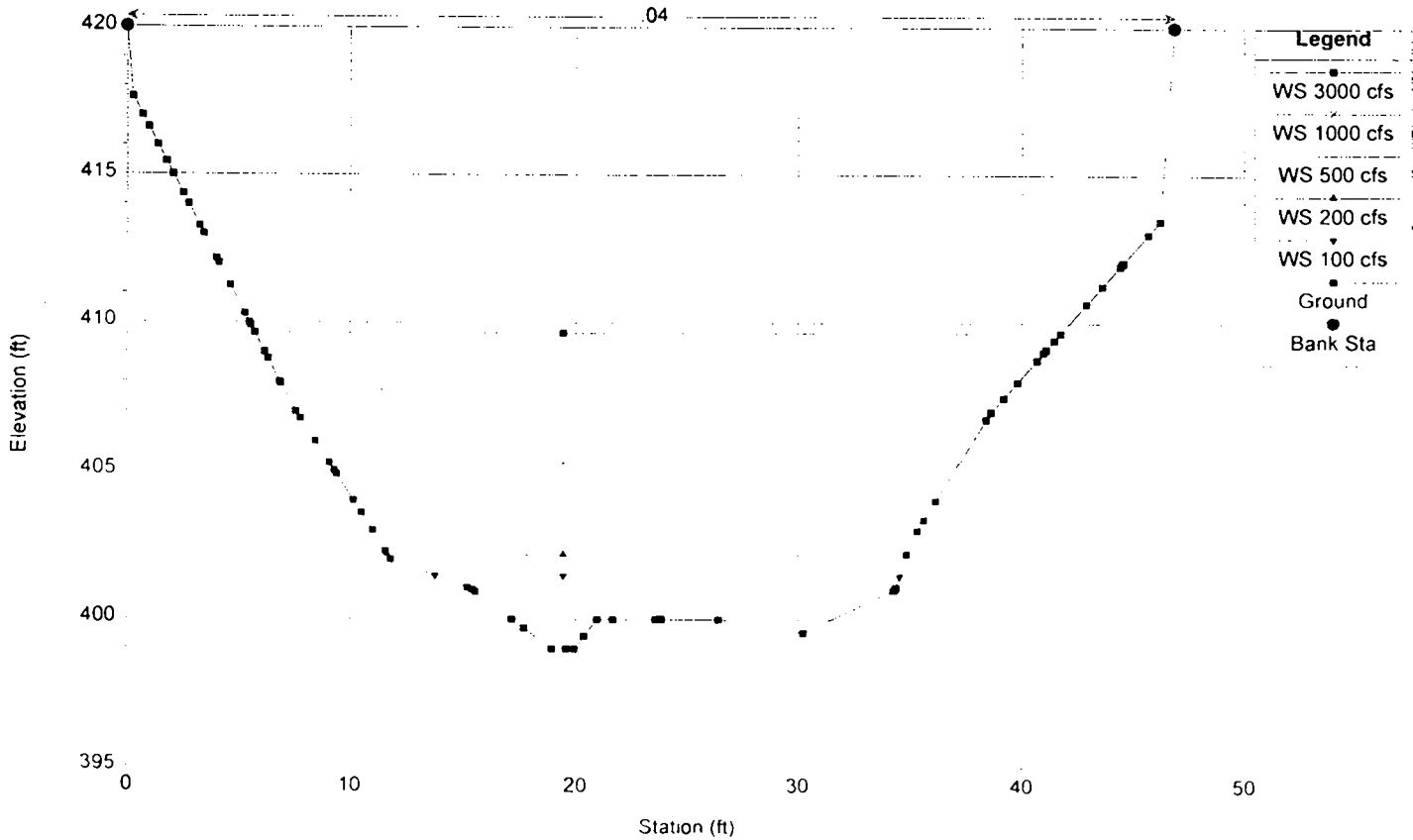
River = Skookum Creek Reach = Diversion Struct RS = 64



Skookum Cr. Plan 04 - Revised Design 03/23/2000

Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek

River = Skookum Creek Reach = Diversion Struct RS = 62

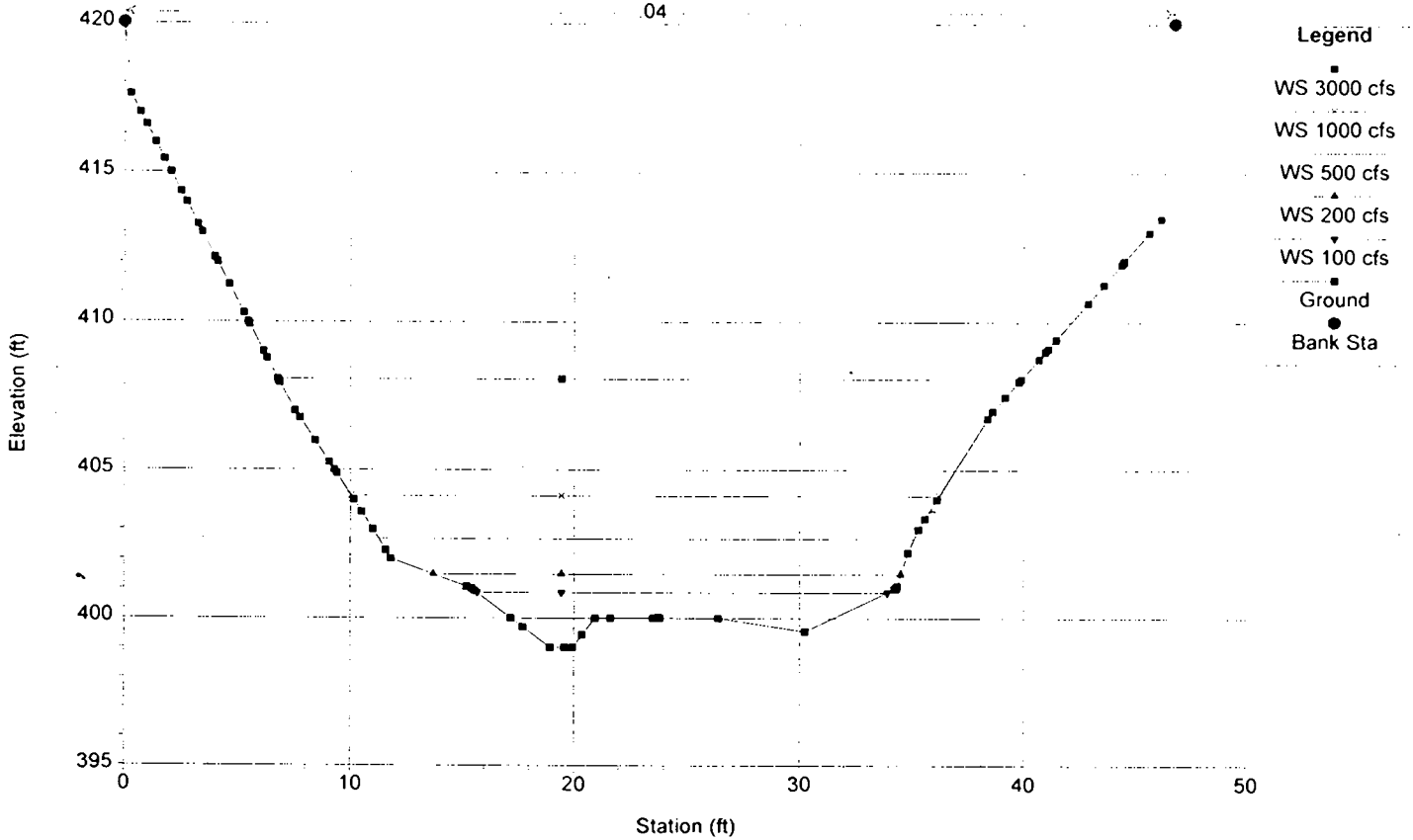


Skookum Cr. Plan 04 - Revised Design 03/23/2000

Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek

River = Skookum Creek Reach = Diversion Struct STA 0+50 RS = 60

.04



Legend

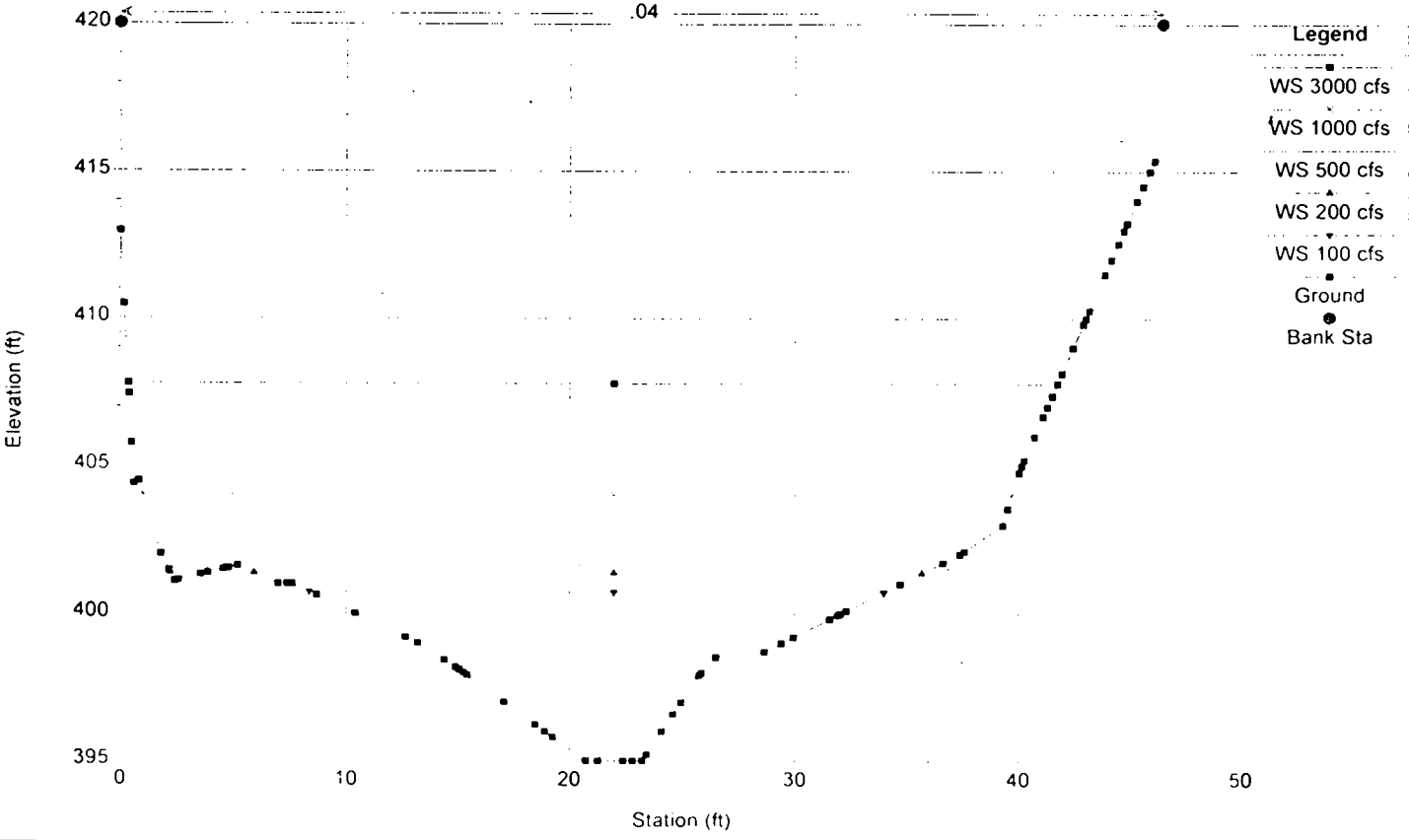
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- WS 1000 cfs
- WS 500 cfs
- WS 200 cfs
- WS 100 cfs
- Ground
- Bank Sta

Skookum Cr. Plan 04 - Revised Design 03/23/2000

Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek

River = Skookum Creek Reach = Diversion Struct STA 0+75 RS = 58

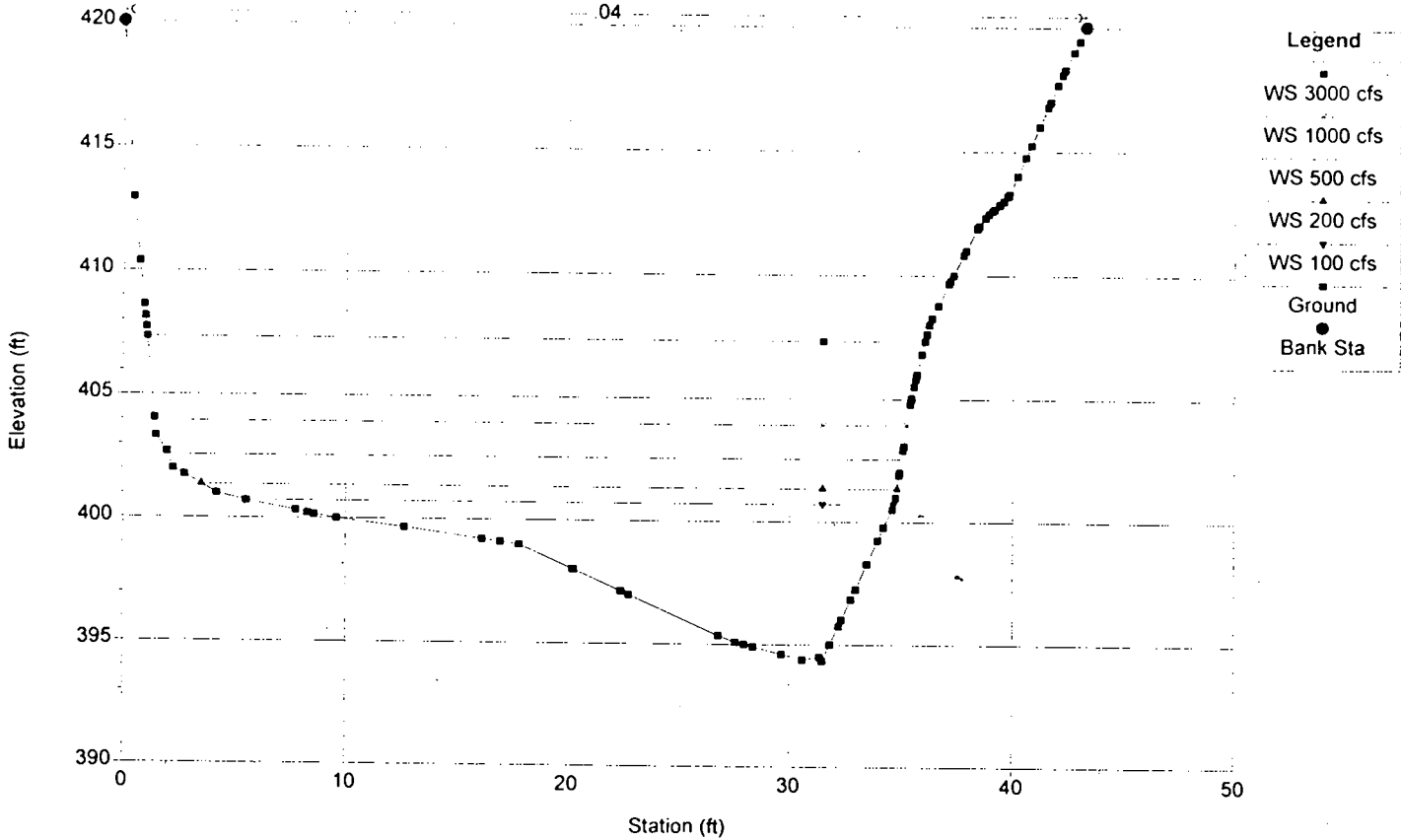
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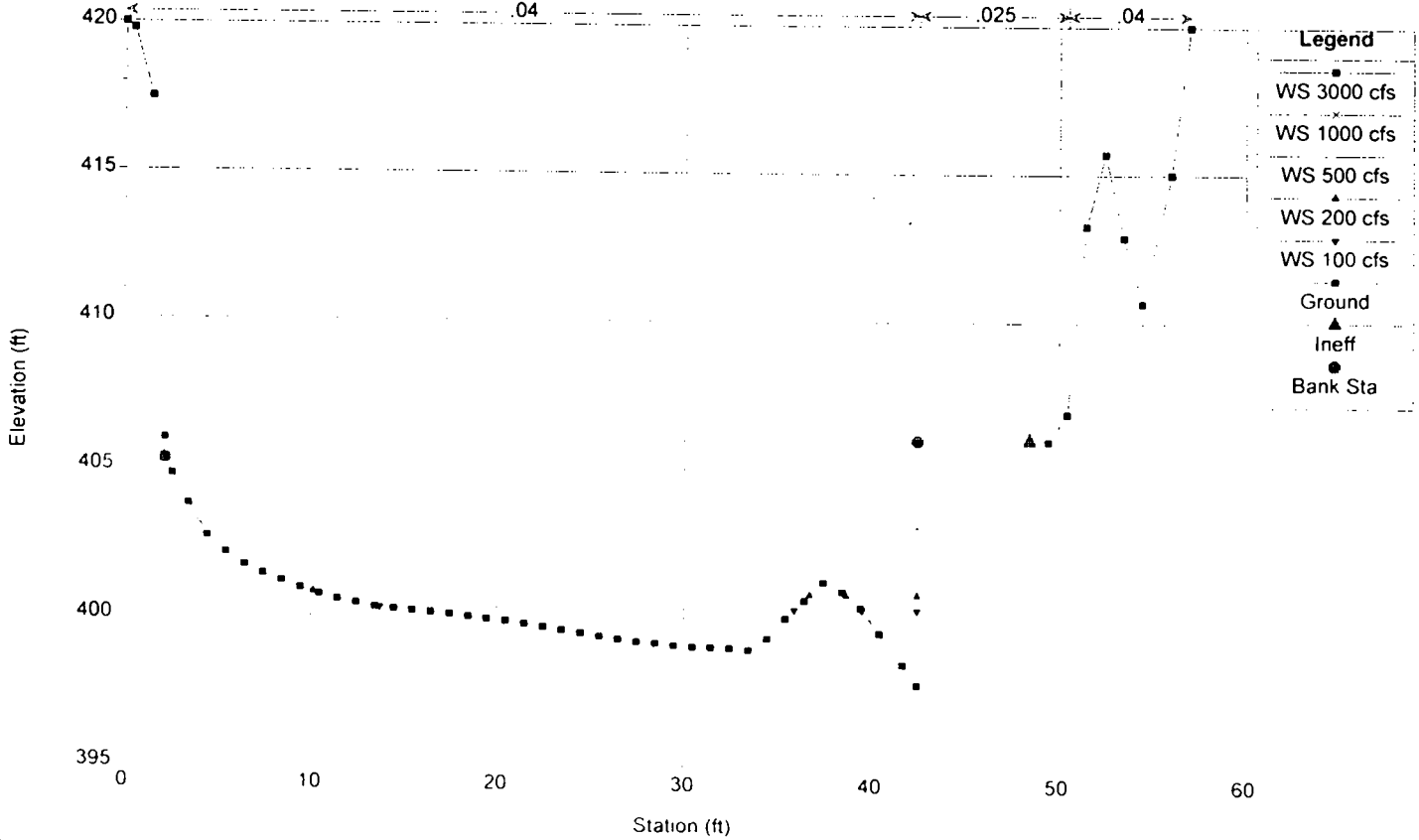
Legend

- WS 3000 cfs
- WS 1000 cfs
- WS 500 cfs
- WS 200 cfs
- WS 100 cfs
- Ground
- Bank Sta

Skookum Cr. Plan 04 - Revised Design 03/23/2000
 Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek
 River = Skookum Creek Reach = Diversion Struct SECT B-B, STA 1+00 RS = 56



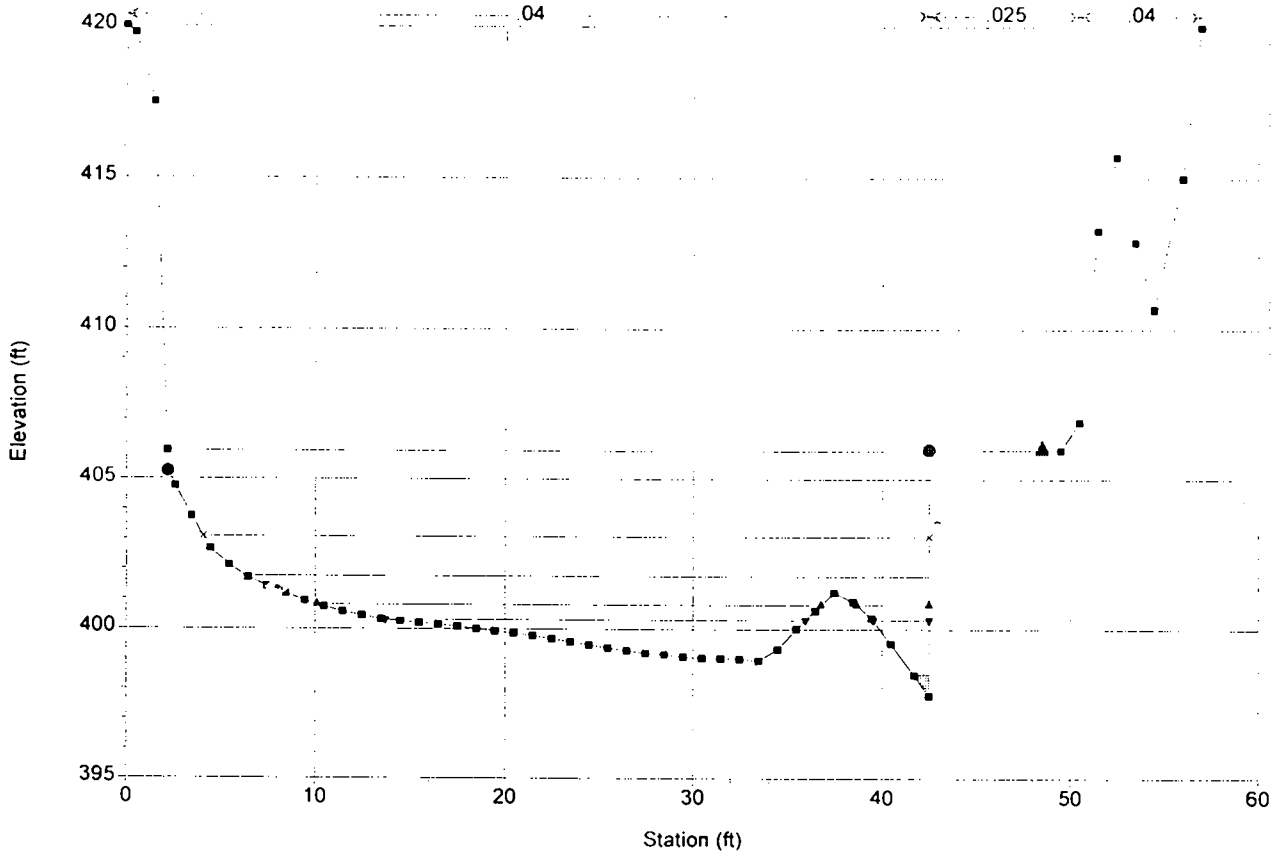
Skookum Cr. Plan 04 - Revised Design 03/23/2000
 Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek
 River = Skookum Creek Reach = Diversion Struct SECT C-C, STA 1+15 RS = 54



Skookum Cr. Plan 04 - Revised Design 03/23/2000

Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek

River = Skookum Creek Reach = Diversion Struct RS = 52.75

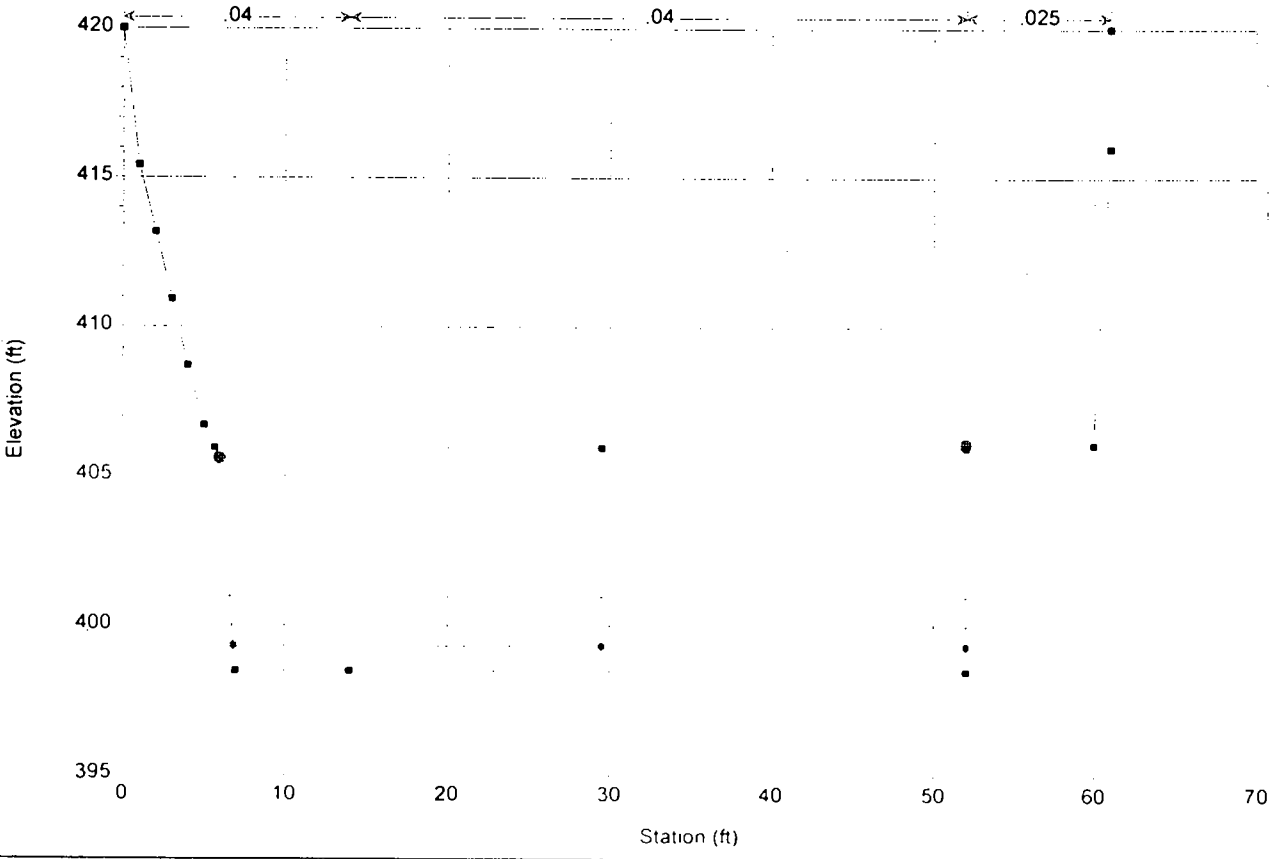


- Legend**
- WS 3000 cfs
 - WS 1000 cfs
 - ▲ WS 500 cfs
 - ▼ WS 200 cfs
 - ◄ WS 100 cfs
 - Ground
 - ▲ Ineff
 - Bank Sta

Skookum Cr. Plan 04 - Revised Design 03/23/2000

Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek

River = Skookum Creek Reach = Diversion Struct SECT D-D, STA 1+30 RS = 52

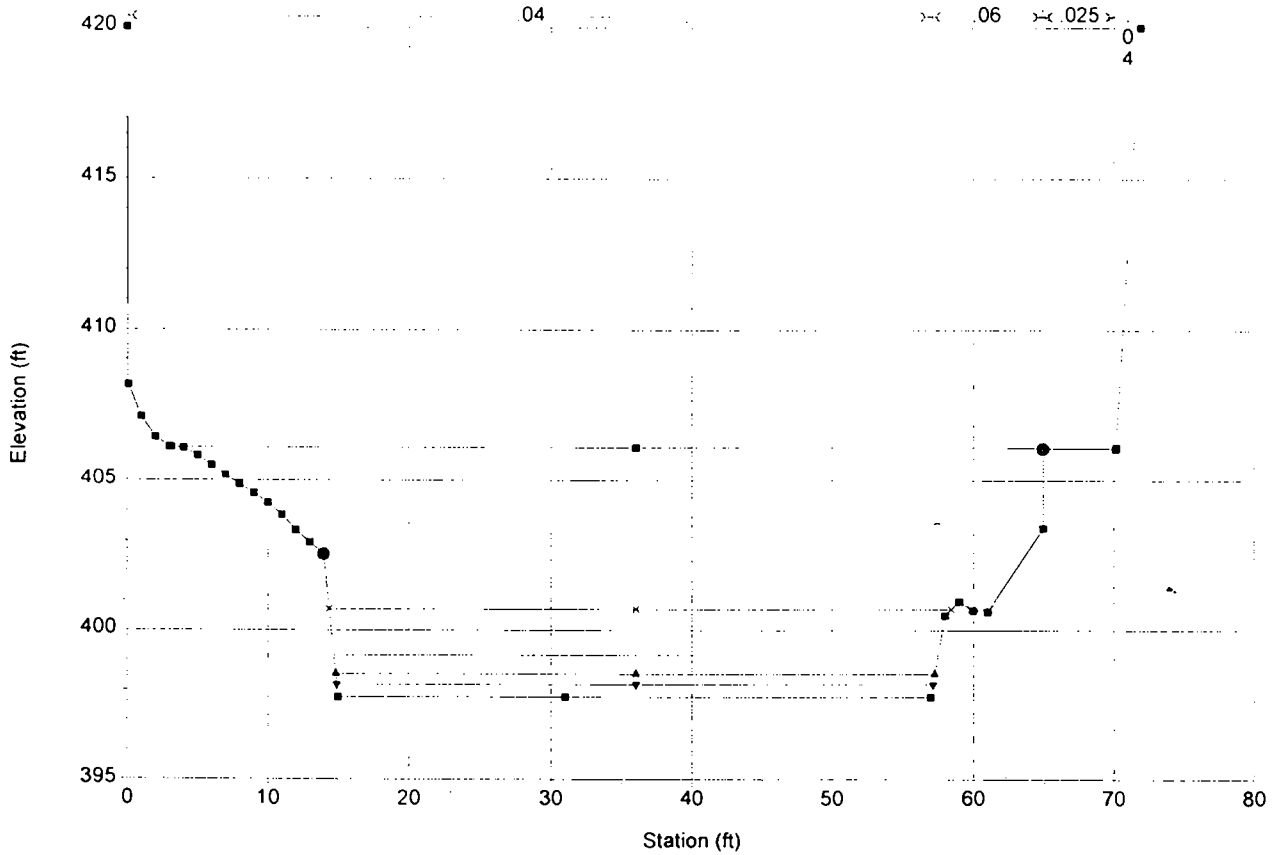


- Legend**
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 - WS 1000 cfs
 - ▲ WS 500 cfs
 - ▼ WS 200 cfs
 - ◄ WS 100 cfs
 - Ground
 - Bank Sta

Skookum Cr. Plan 04 - Revised Design 03/23/2000

Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek

River = Skookum Creek Reach = Diversion Struct SECT E-E, STA 1+50 RS = 50

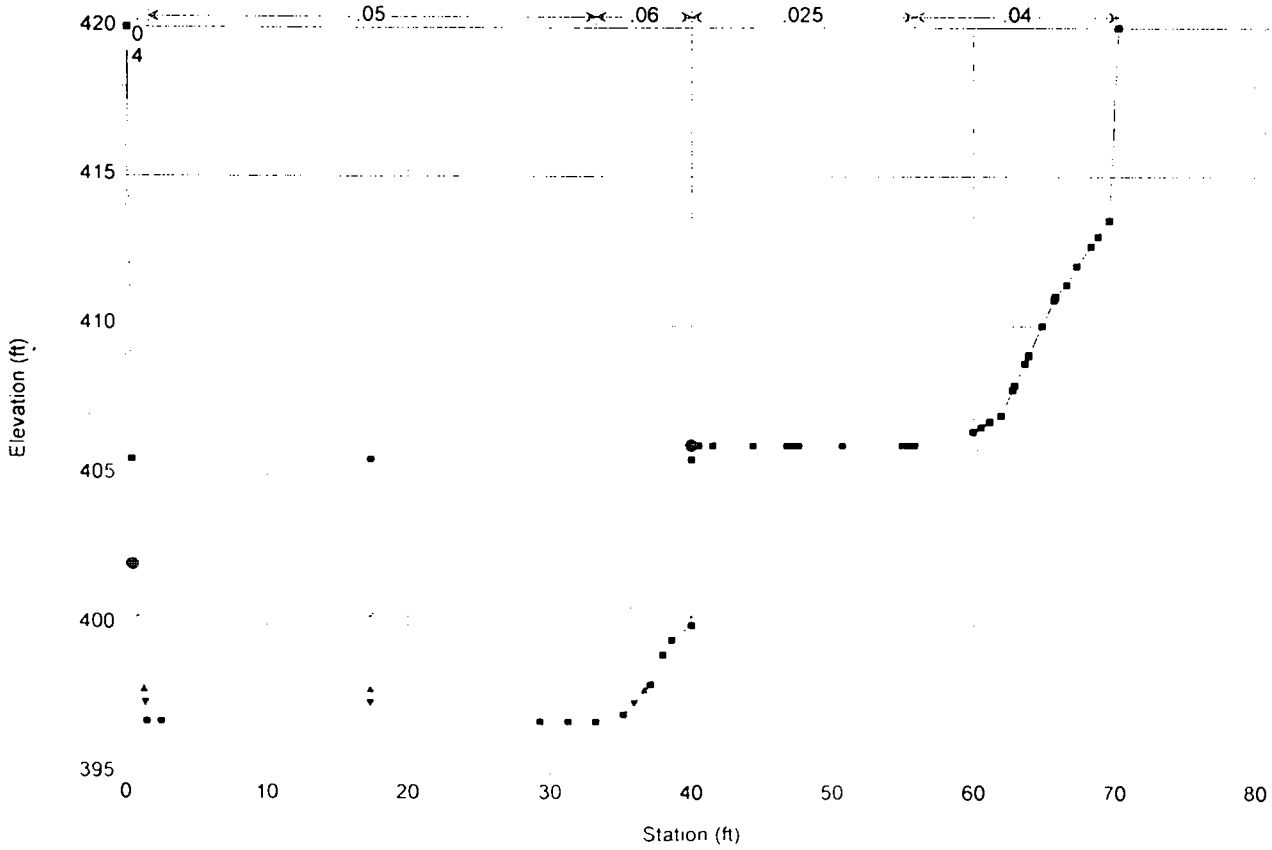


- Legend**
- WS 3000 cfs
 - WS 1000 cfs
 - △ WS 500 cfs
 - ▽ WS 200 cfs
 - ◇ WS 100 cfs
 - Ground
 - Bank Sta

Skookum Cr. Plan 04 - Revised Design 03/23/2000

Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek

River = Skookum Creek Reach = Diversion Struct STA 1+80 (Crest of upper ramp) RS = 49

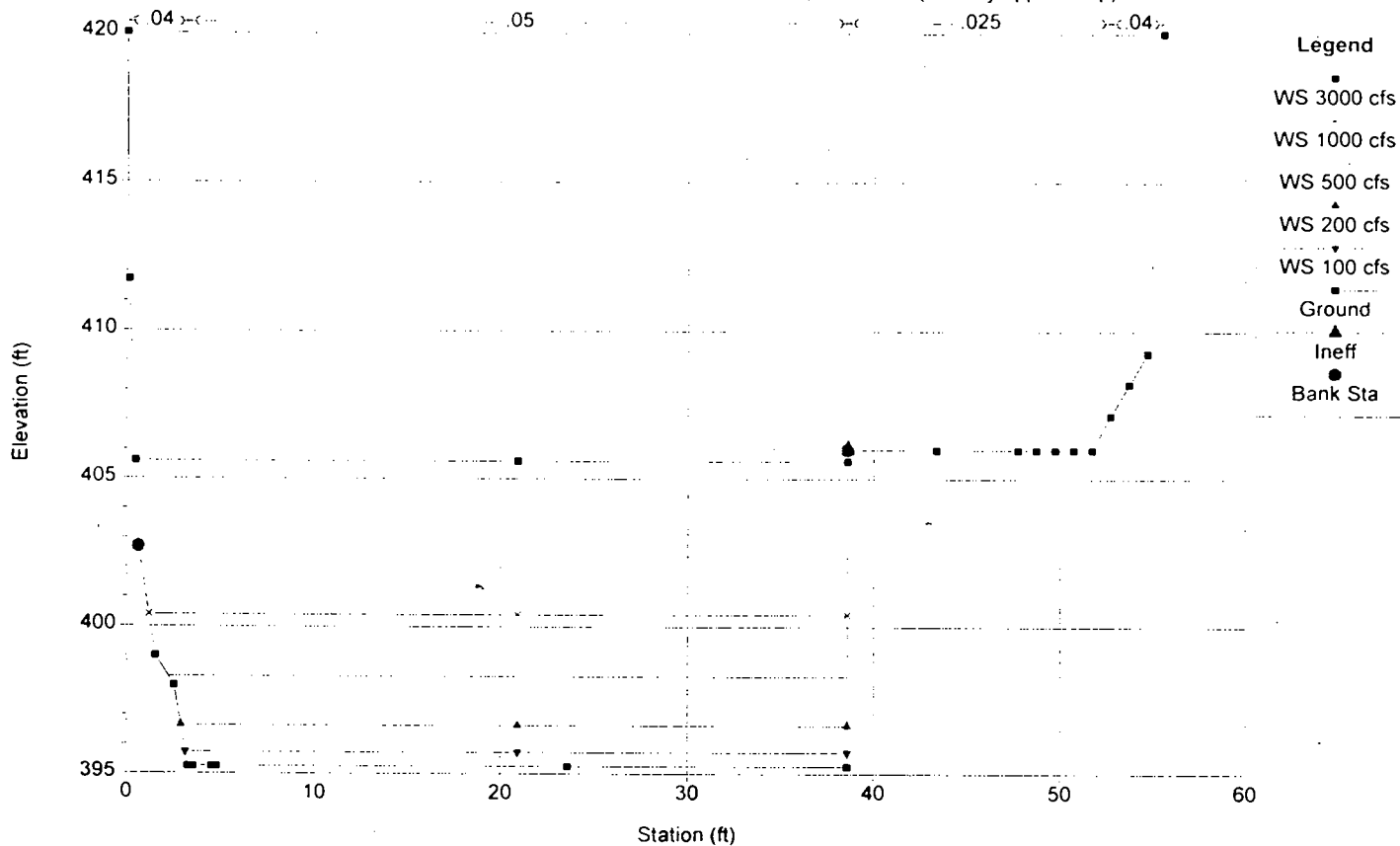


- Legend**
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 - WS 1000 cfs
 - △ WS 500 cfs
 - ▽ WS 200 cfs
 - ◇ WS 100 cfs
 - Ground
 - Bank Sta

Skookum Cr. Plan 04 - Revised Design 03/23/2000

Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek

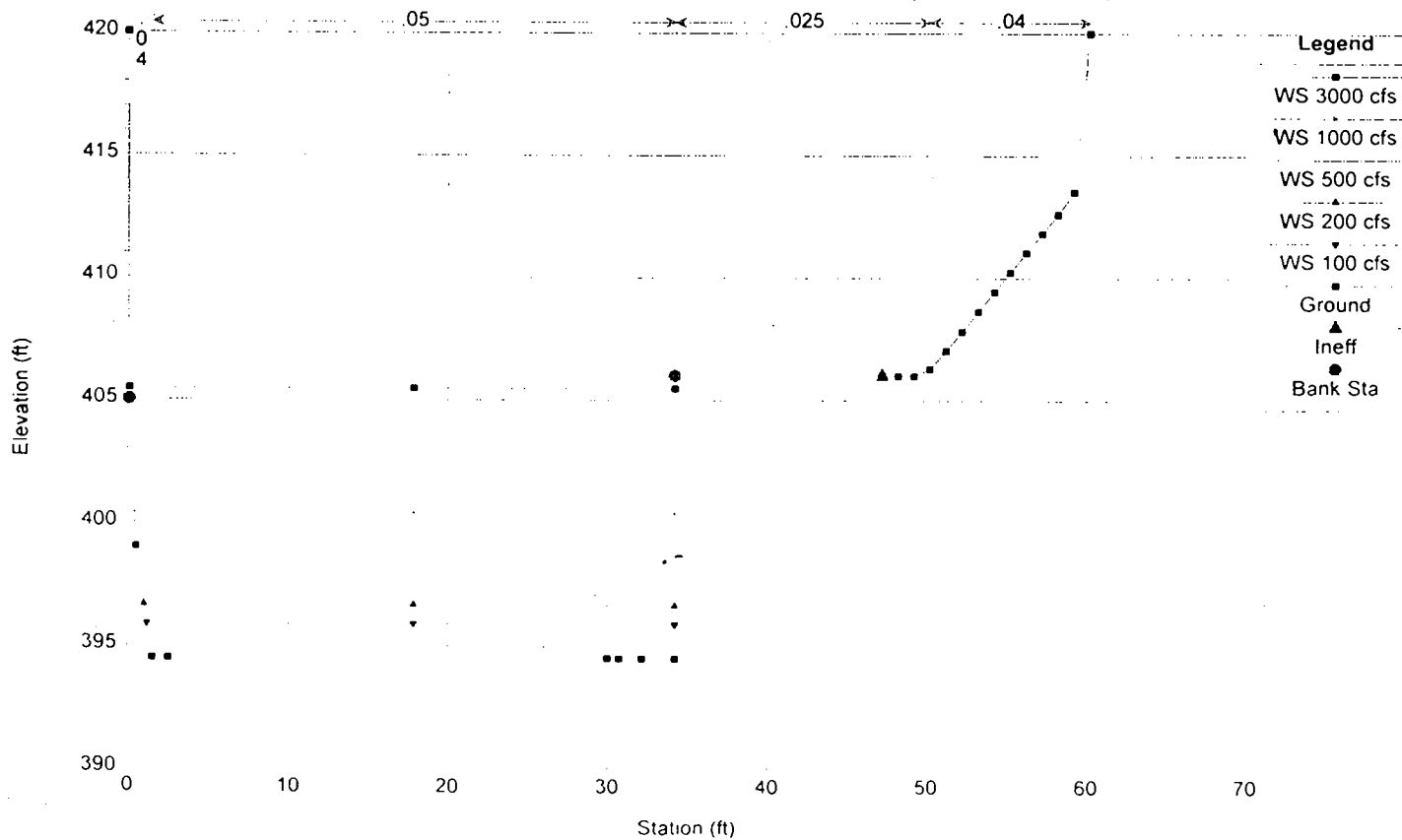
River = Skookum Creek Reach = Diversion Struct SECT F-F, STA 2+00 (Midway upper ramp) RS = 48



Skookum Cr. Plan 04 - Revised Design 03/23/2000

Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek

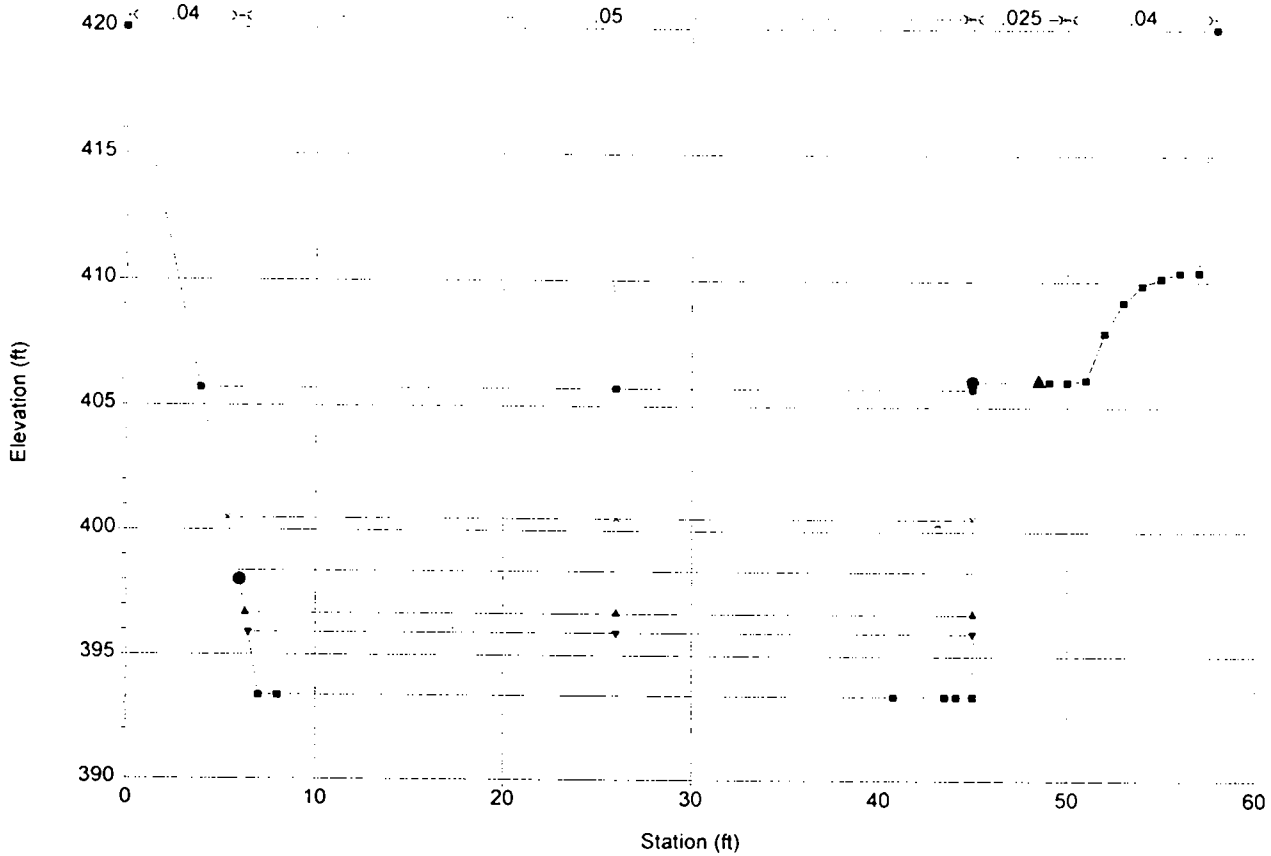
River = Skookum Creek Reach = Diversion Struct SECT G-G, STA 2+10 RS = 46



Skookum Cr. Plan 04 - Revised Design 03/23/2000

Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek

River = Skookum Creek Reach = Diversion Struct SECT H-H, STA 2+25 (toe of upper ramp) RS = 44

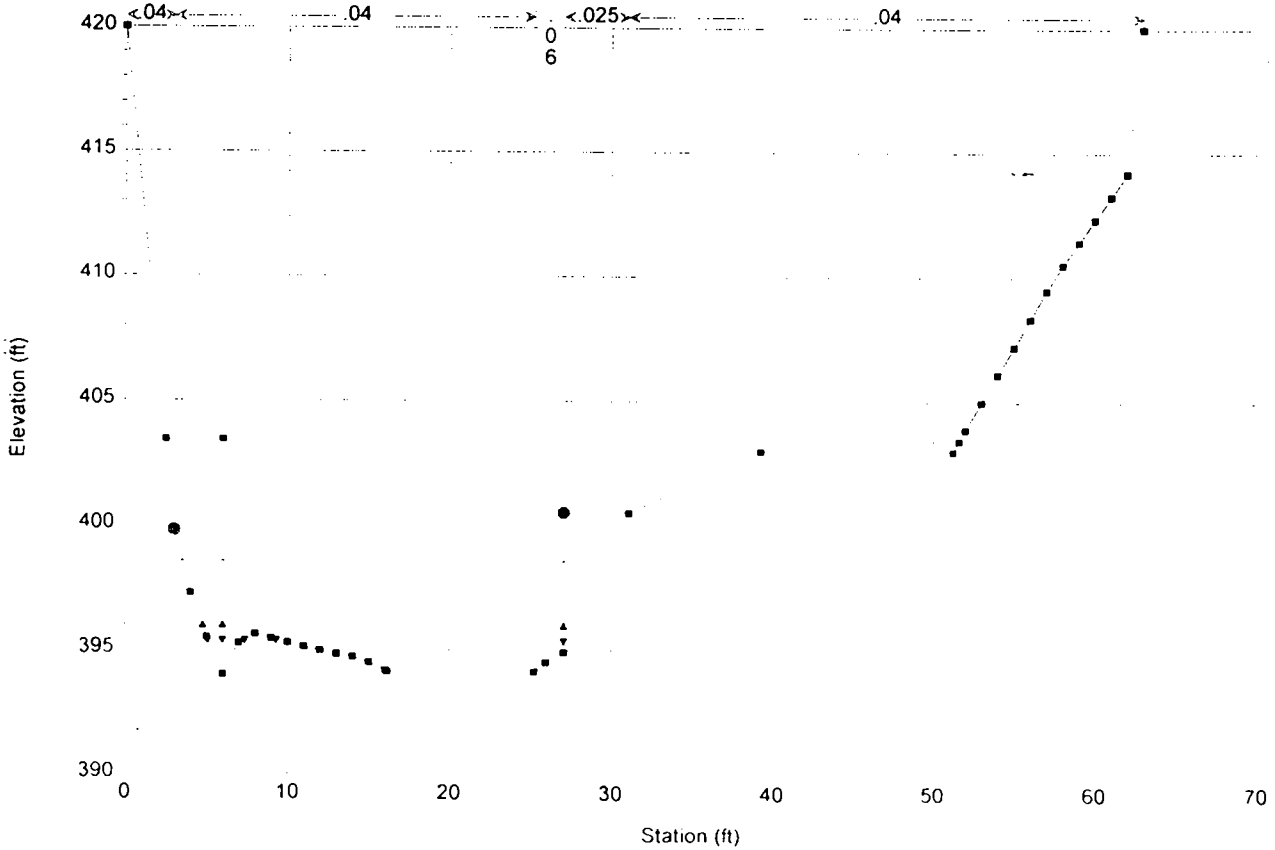


- Légend**
- WS 3000 cfs
 - WS 1000 cfs
 - WS 500 cfs
 - ▲ WS 200 cfs
 - ▼ WS 100 cfs
 - Ground
 - ▲ Ineff
 - Bank Sta

Skookum Cr. Plan 04 - Revised Design 03/23/2000

Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek

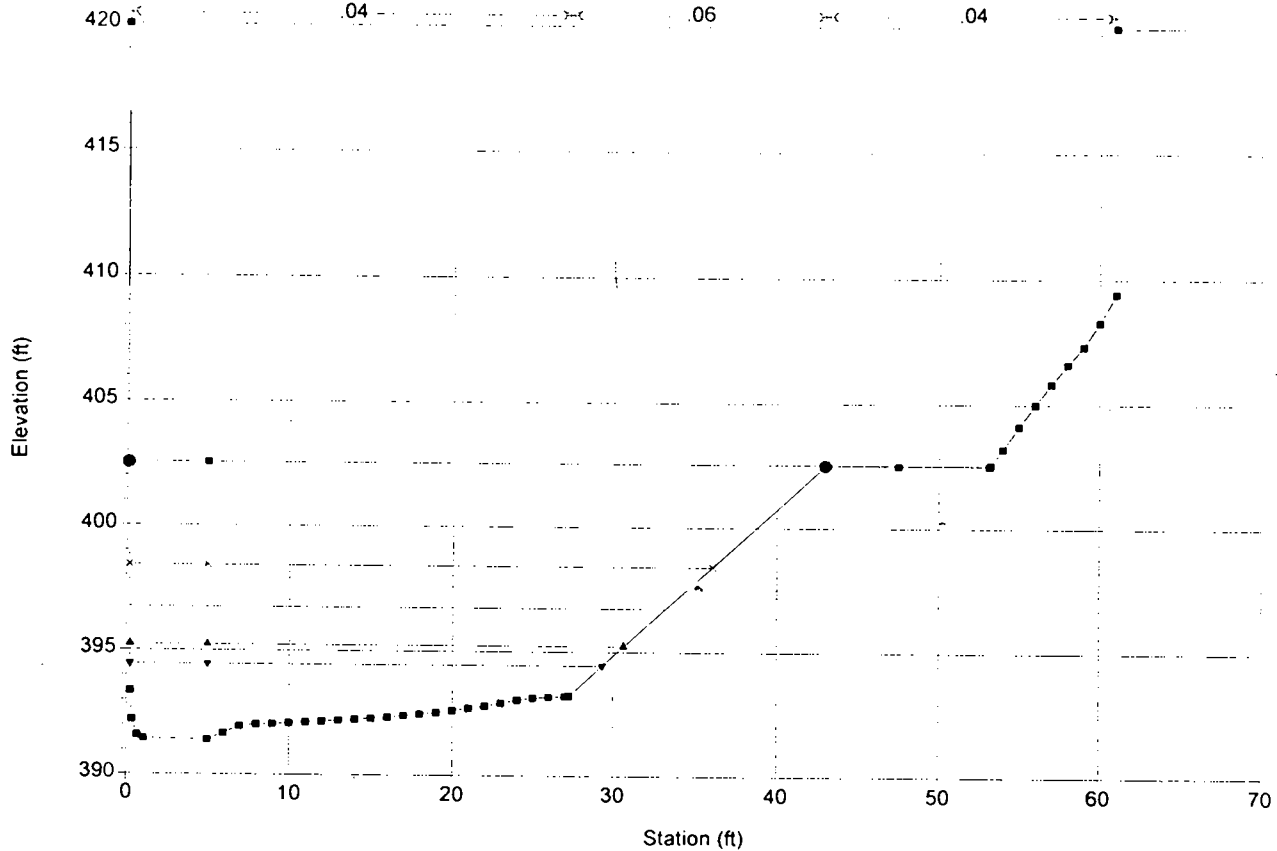
River = Skookum Creek Reach = Diversion Struct SECT J-J, STA 2+50 RS = 42



- Legend**
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 - WS 1000 cfs
 - WS 500 cfs
 - ▲ WS 200 cfs
 - ▼ WS 100 cfs
 - Ground
 - Bank Sta

Skookum Cr. Plan 04 - Revised Design 03/23/2000

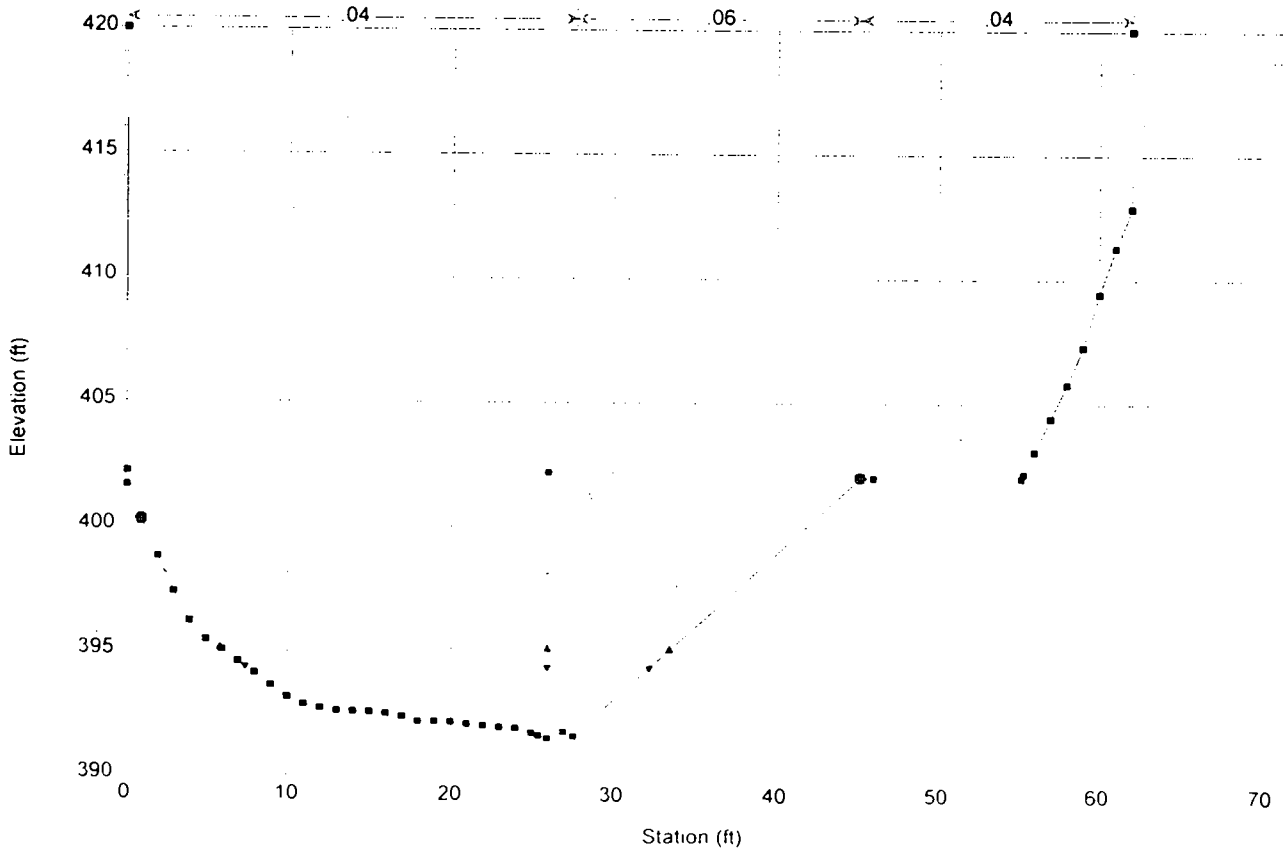
Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek
 River = Skookum Creek Reach = Diversion Struct SECT K-K, STA 2+75 RS = 40



- Legend**
- WS 3000 cfs
 - ▲ WS 1000 cfs
 - ▼ WS 500 cfs
 - ◆ WS 200 cfs
 - WS 100 cfs
 - Ground
 - Bank Sta

Skookum Cr. Plan 04 - Revised Design 03/23/2000

Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek
 River = Skookum Creek Reach = Diversion Struct SECT L-L, STA 3+00 RS = 38

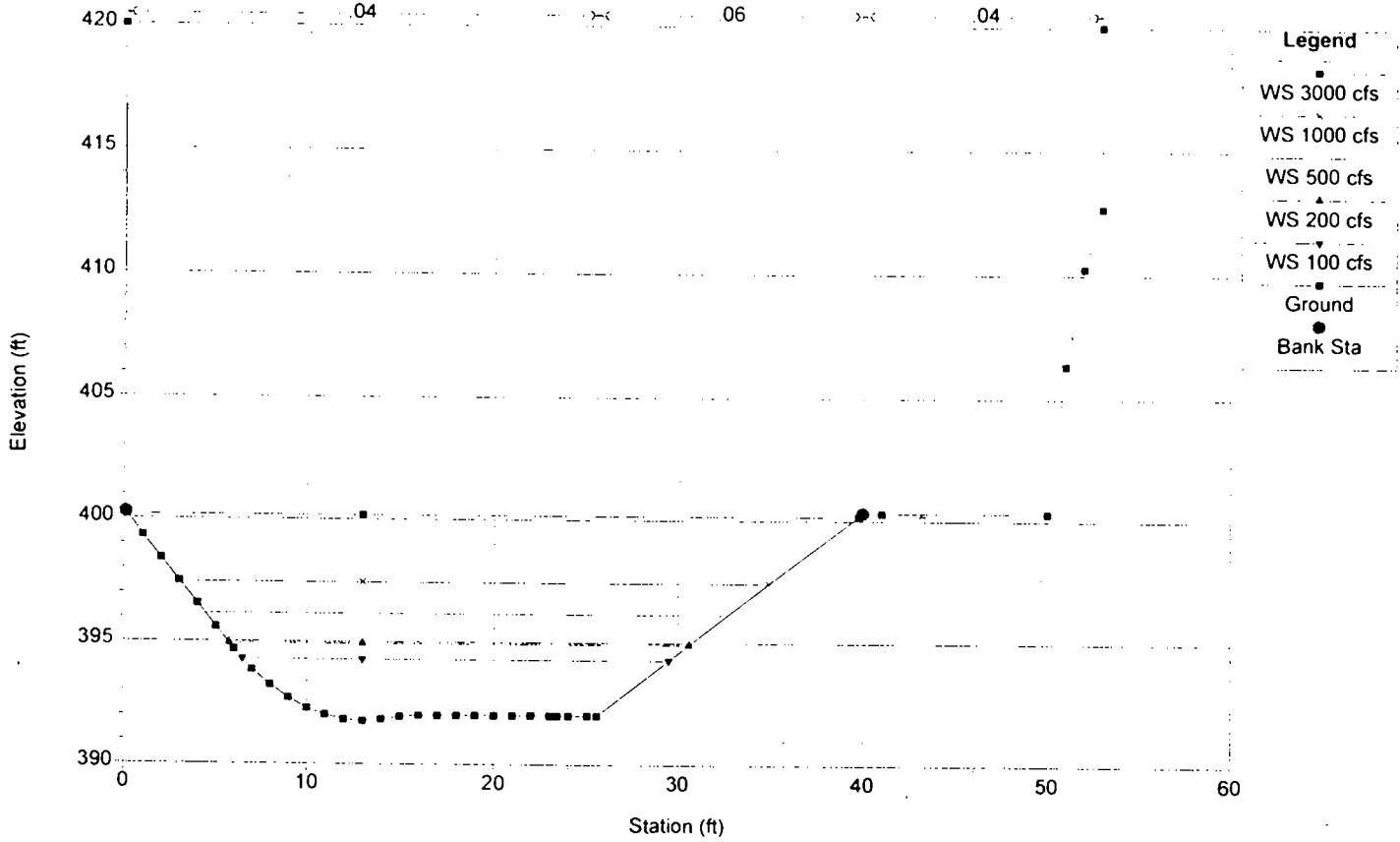


- Legend**
- WS 3000 cfs
 - ▲ WS 1000 cfs
 - ▼ WS 500 cfs
 - ◆ WS 200 cfs
 - WS 100 cfs
 - Ground
 - Bank Sta

Skookum Cr. Plan 04 - Revised Design 03/23/2000

Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek

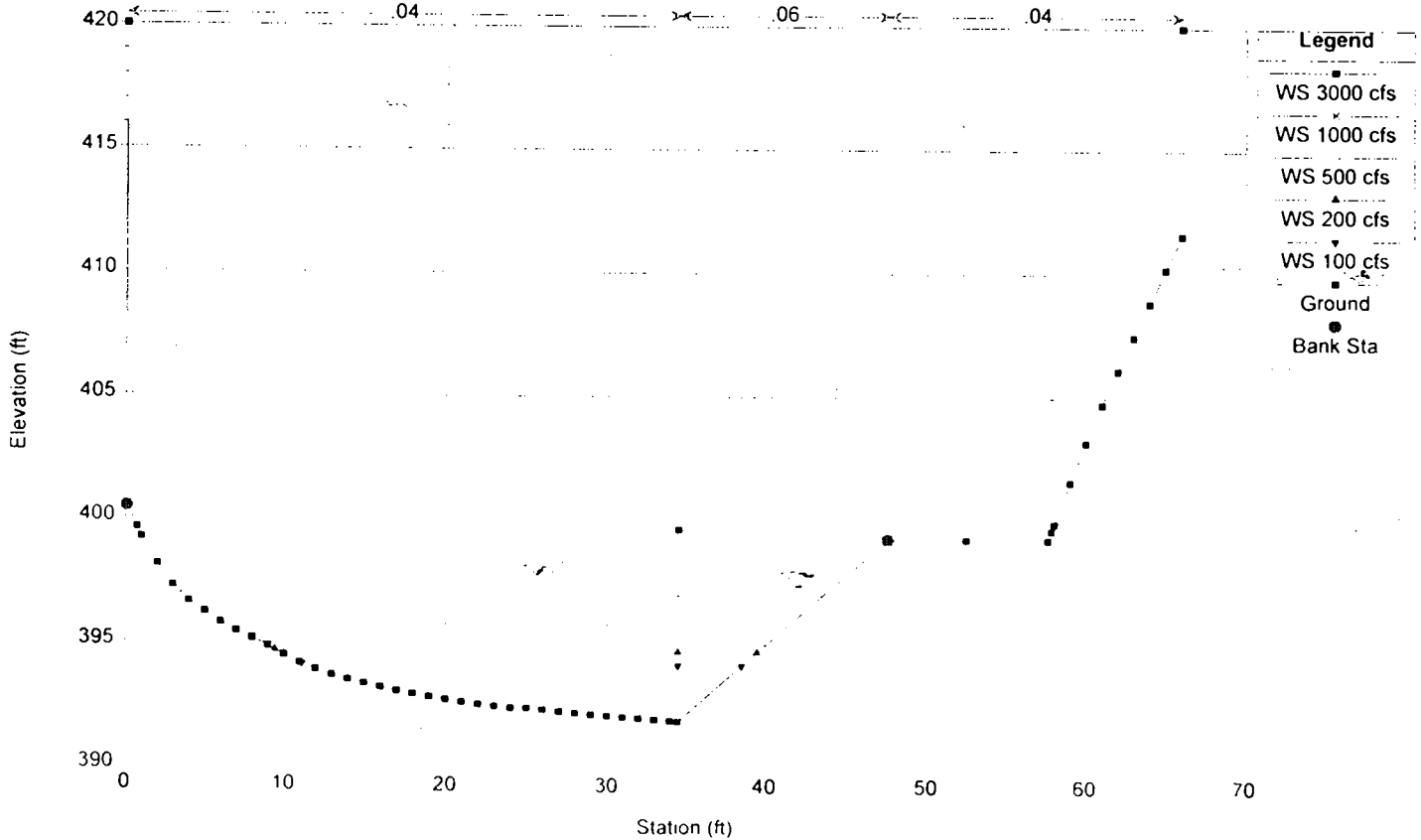
River = Skookum Creek Reach = Diversion Struct SECT M-M, STA 3+50 RS = 36



Skookum Cr. Plan 04 - Revised Design 03/23/2000

Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek

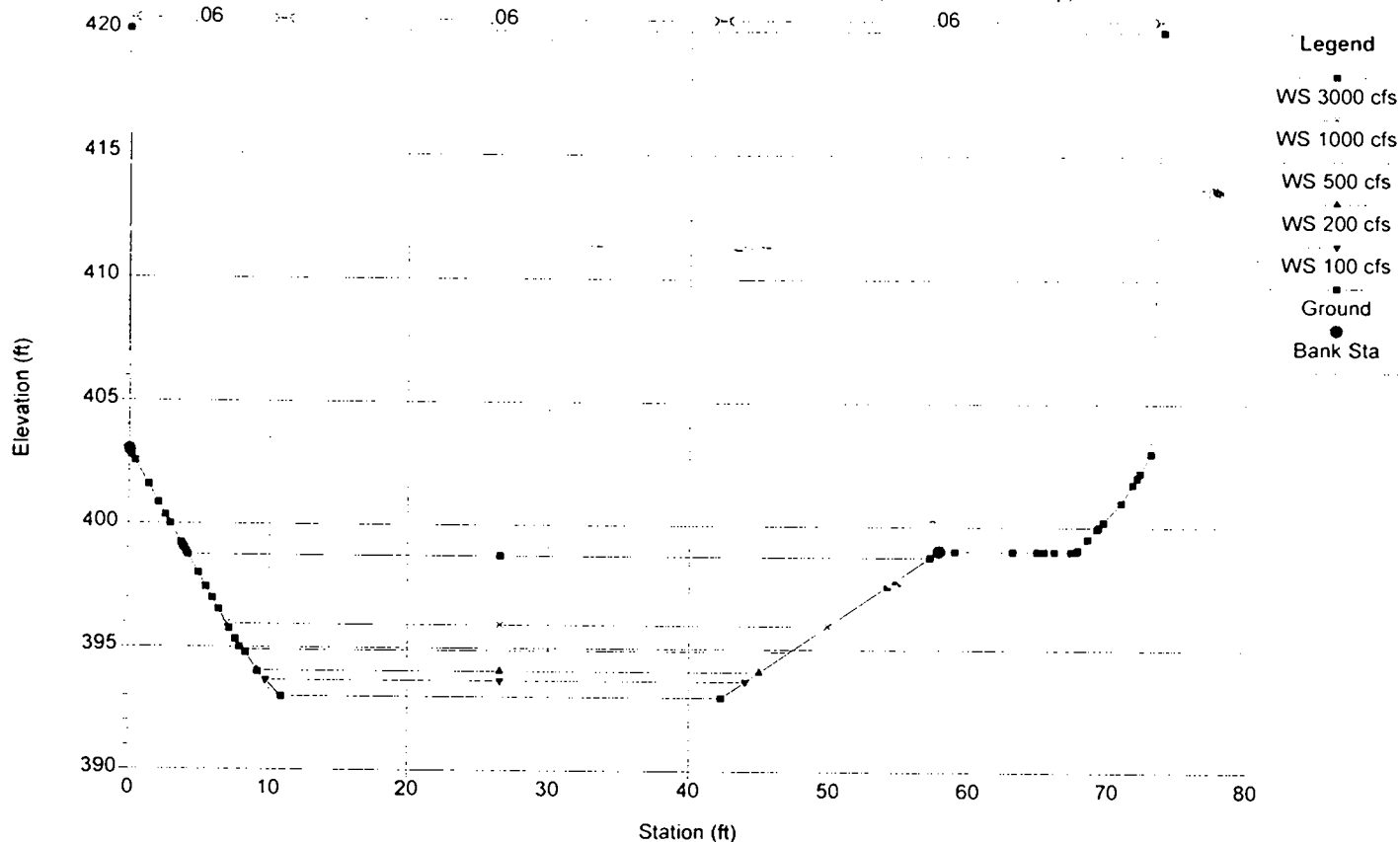
River = Skookum Creek Reach = Diversion Struct SECT N-N, STA 4+00 RS = 34



Skookum Cr. Plan 04 - Revised Design 03/23/2000

Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek

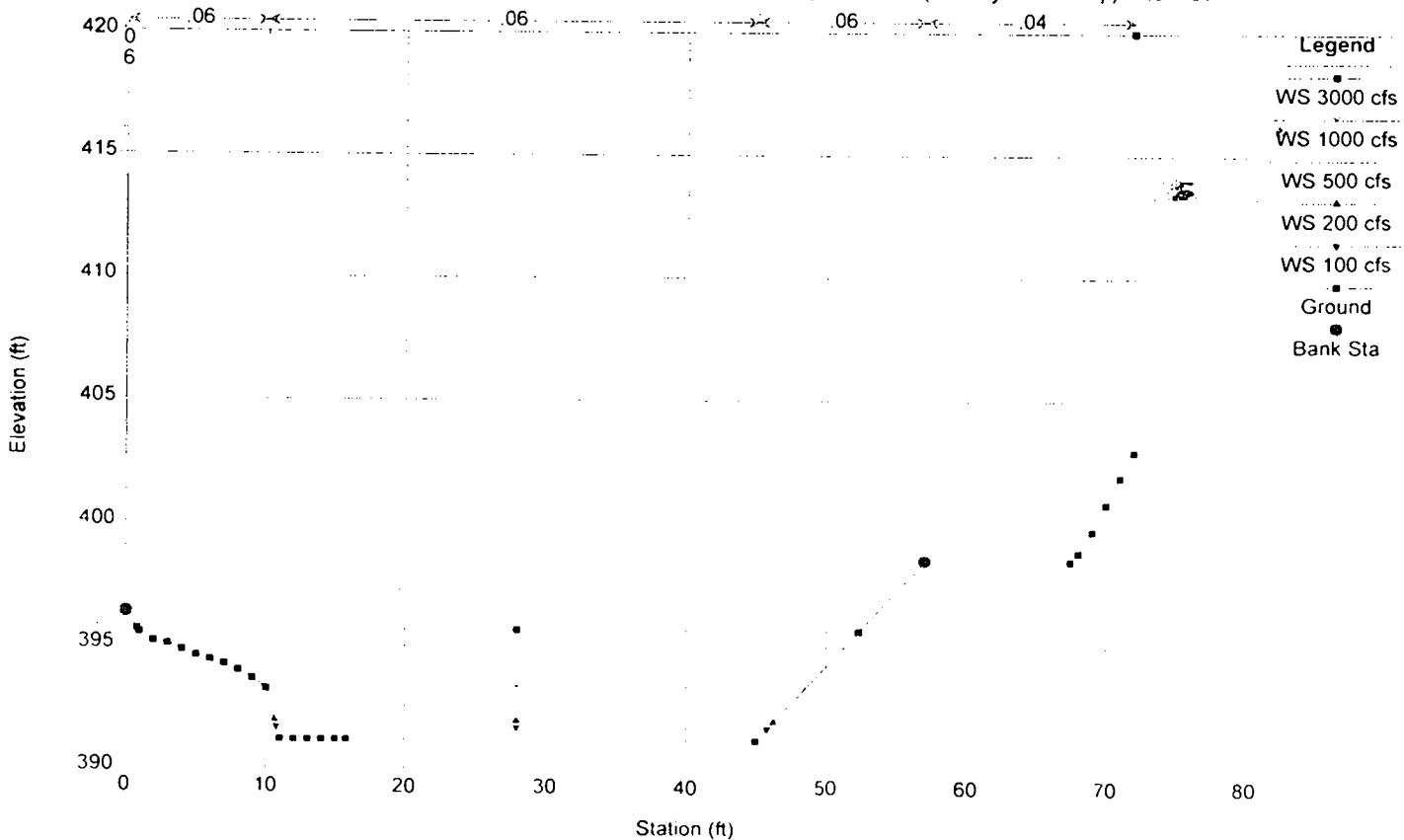
River = Skookum Creek Reach = Diversion Struct STA 4+31.6 (Crest of lower ramp) RS = 32



Skookum Cr. Plan 04 - Revised Design 03/23/2000

Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek

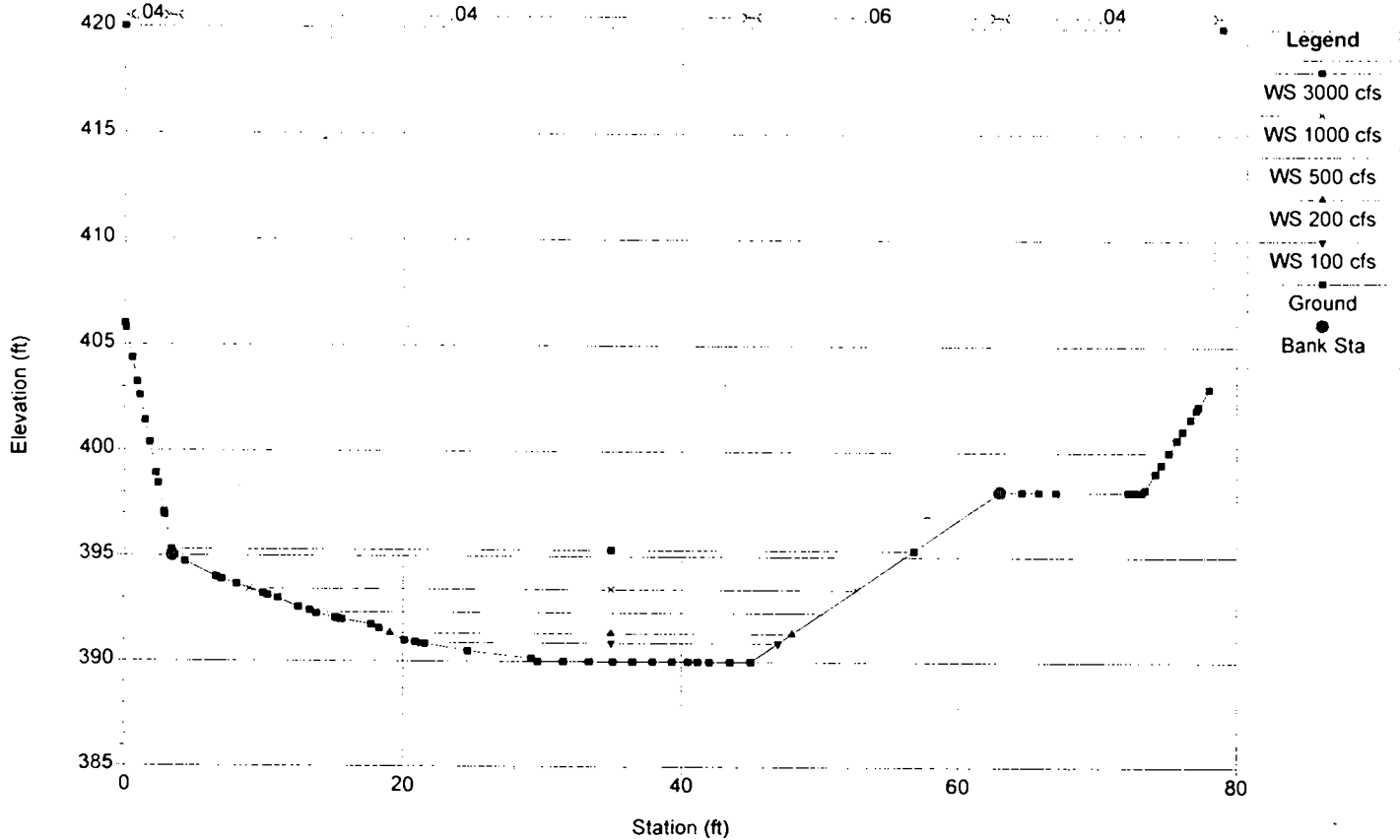
River = Skookum Creek Reach = Diversion Struct SECT P-P, STA 4+50 (Midway lower ramp) RS = 30



Skookum Cr. Plan 04 - Revised Design 03/23/2000

Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek

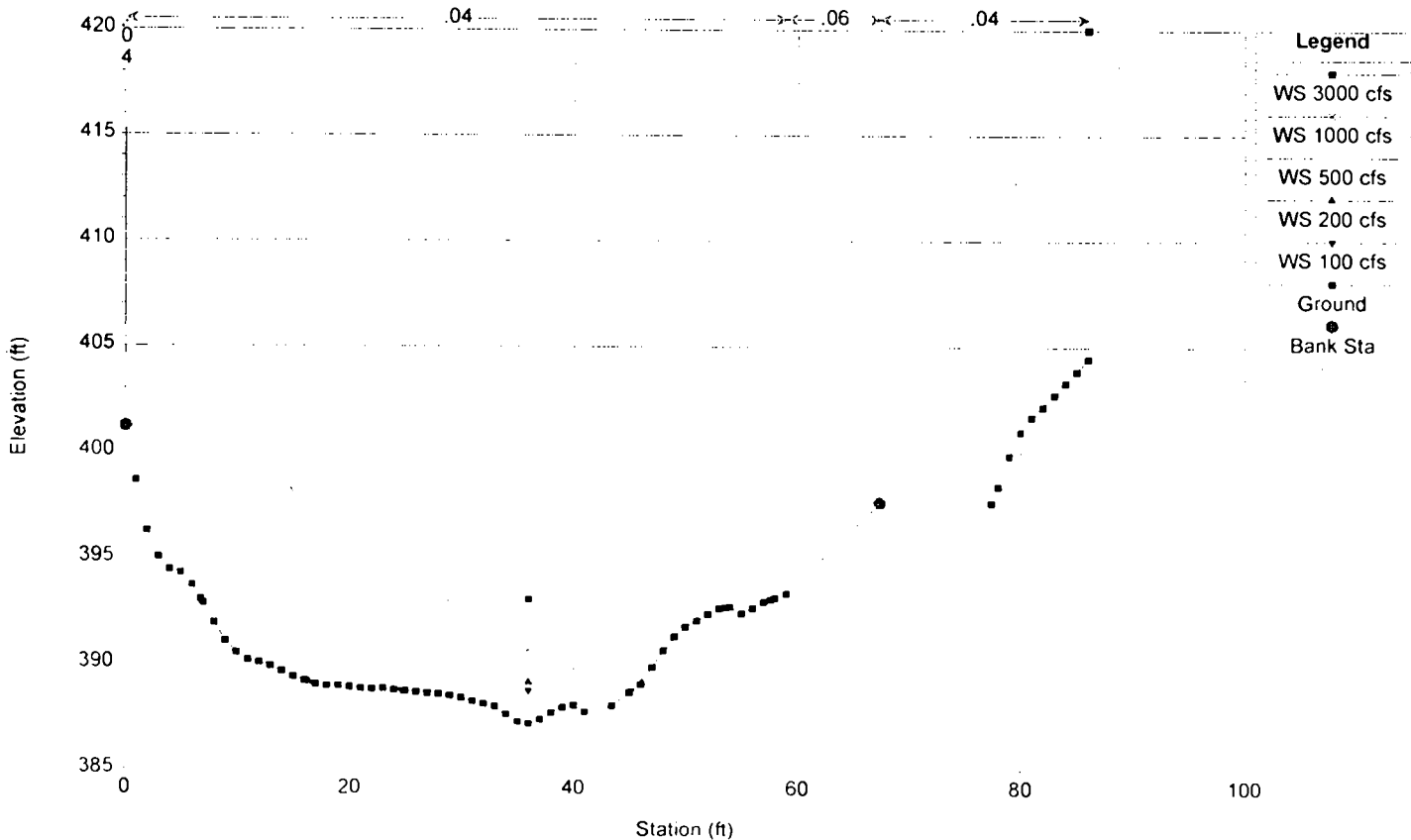
River = Skookum Creek Reach = Diversion Struct STA 4+63.5 (Toe of lower ramp) RS = 28



Skookum Cr. Plan 04 - Revised Design 03/23/2000

Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek

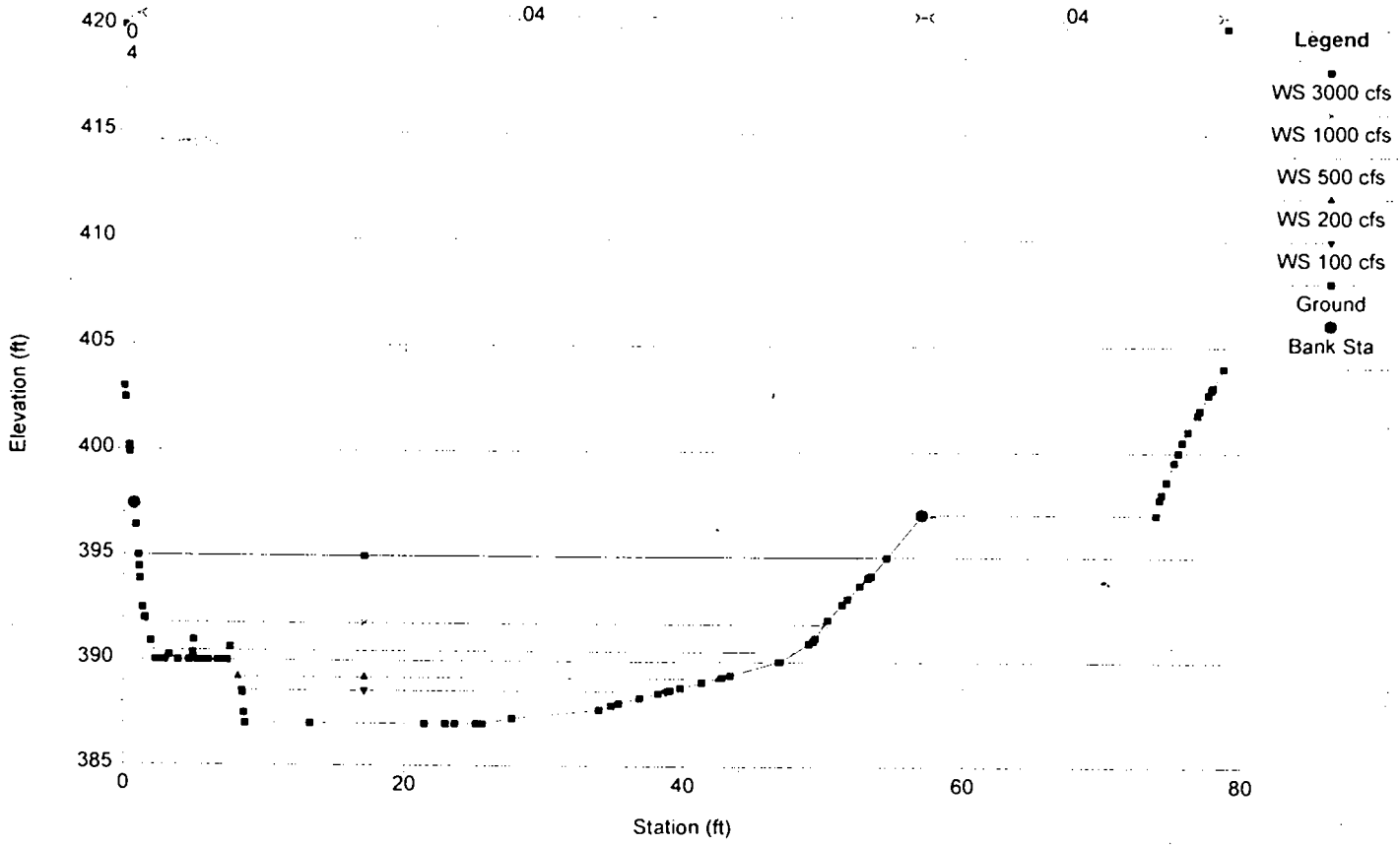
River = Skookum Creek Reach = Diversion Struct SECT R-R, STA 5+00 RS = 26



Skookum Cr. Plan 04 - Revised Design 03/23/2000

Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek

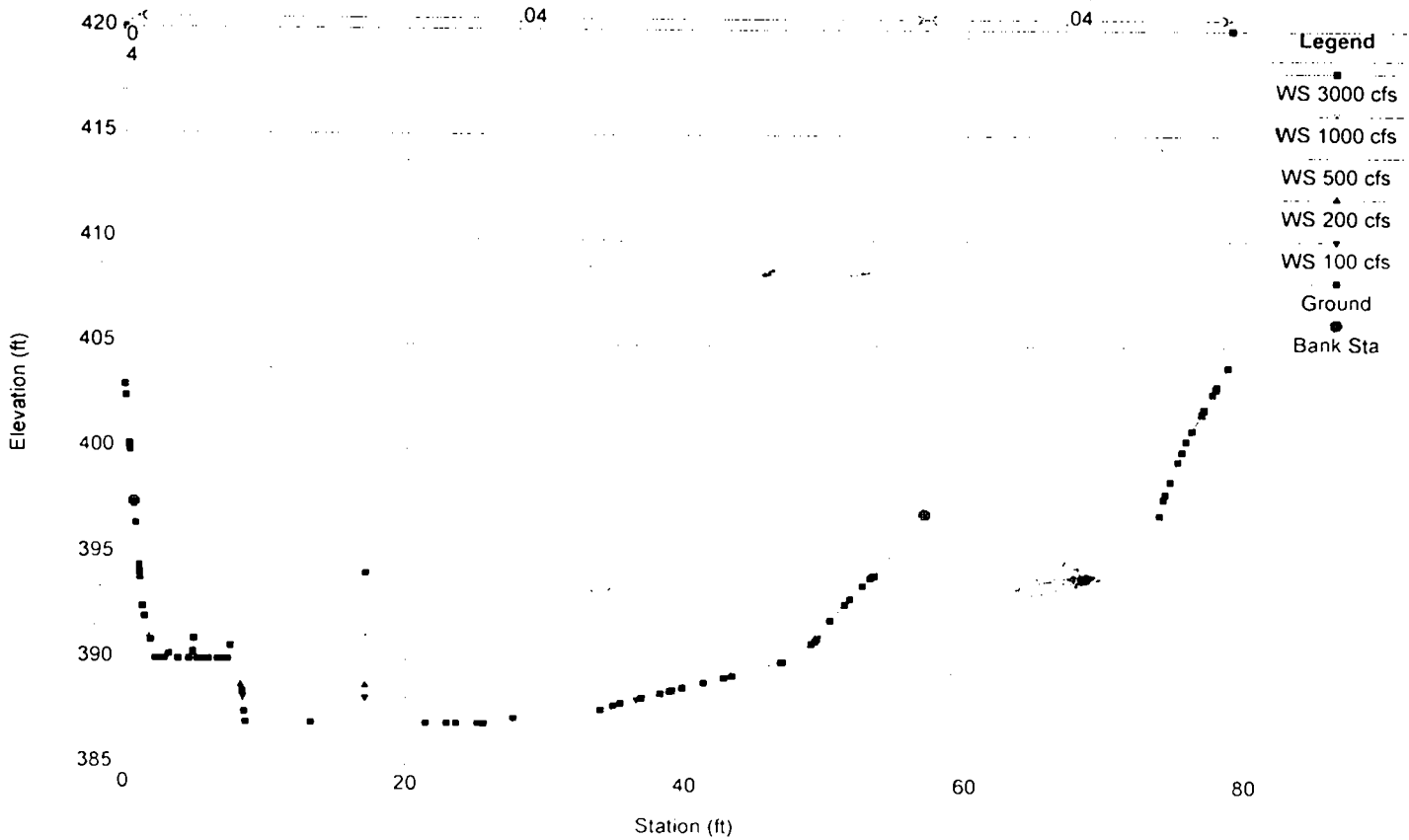
River = Skookum Creek Reach = Diversion Struct STA 5+50 RS = 24



Skookum Cr. Plan 04 - Revised Design 03/23/2000

Geom: Skookum Creek Mod & Excavated Flow: Skookum Creek

River = Skookum Creek Reach = Diversion Struct STA 6+00 (Duplicate of River STA. 24) RS = 22



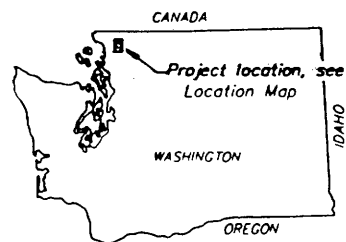
**Skookum Creek Fish Hatchery Water Supply Intake Modification with
Channel and Fish Passage Improvement**

**Salmon Enhancement Program
Lummi Indian Reservation
Lummi, Washington**

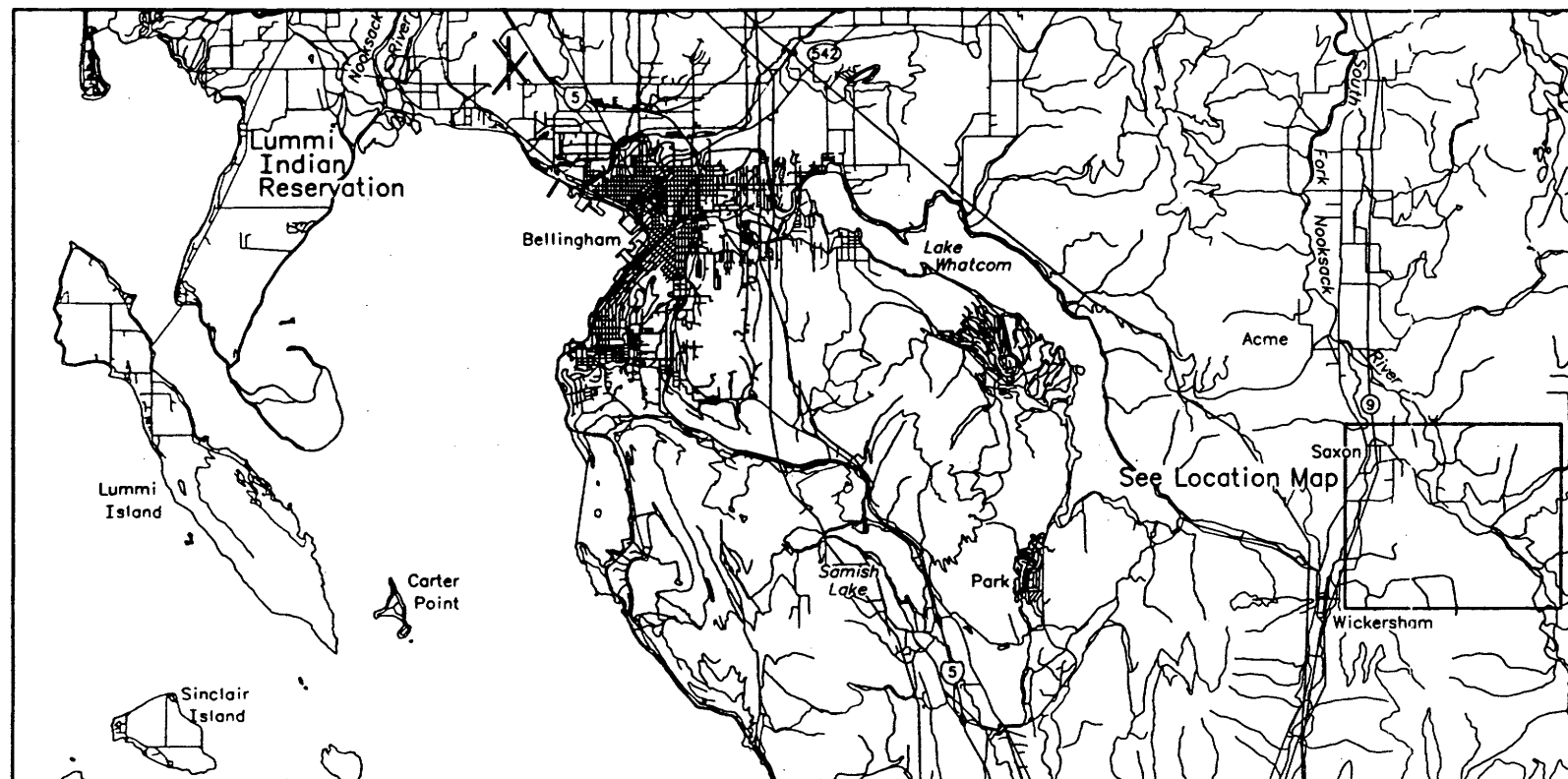
Attachment B

Drawings

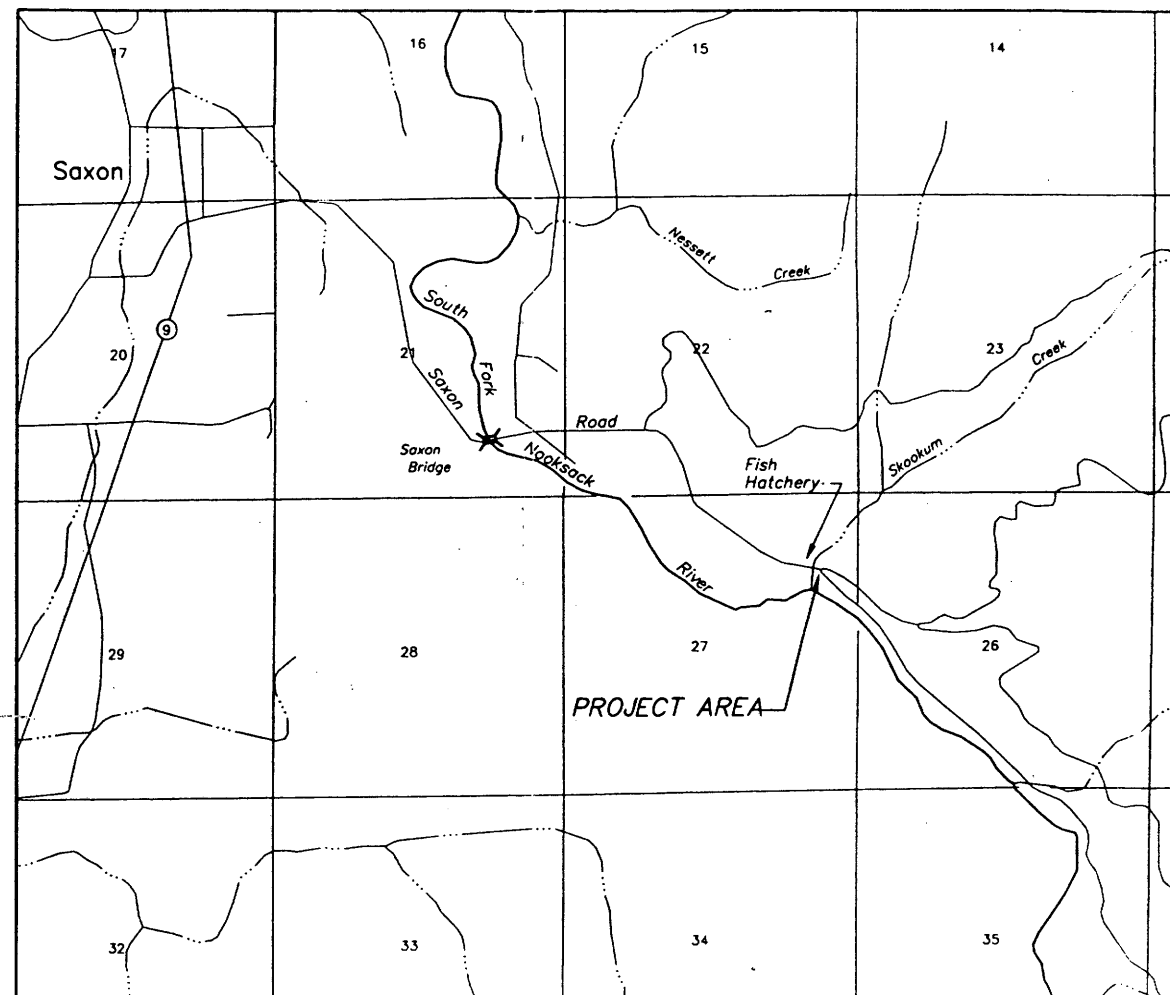
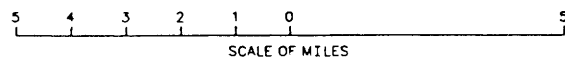
March 2000



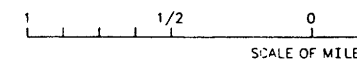
KEY MAP



VICINITY MAP



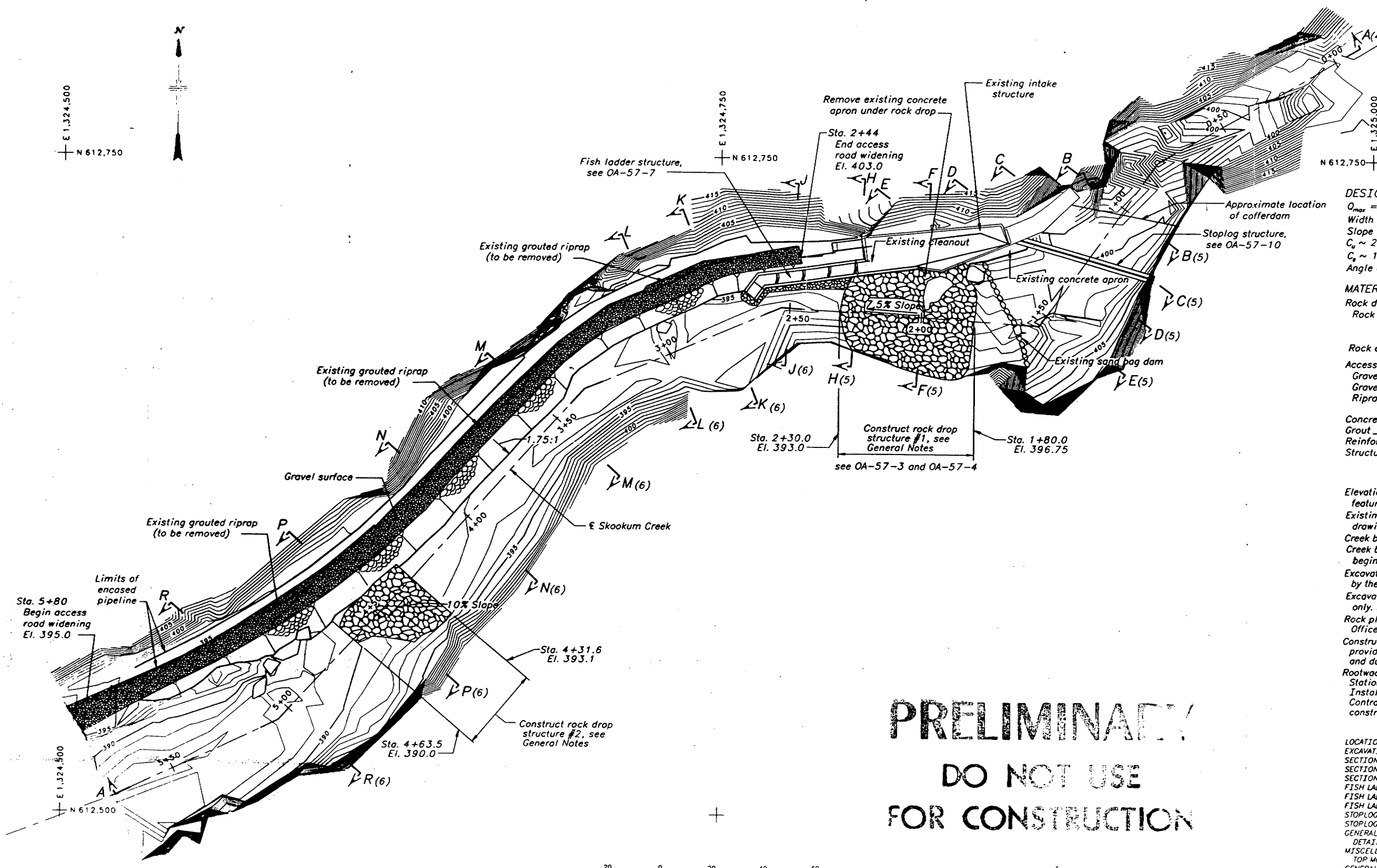
LOCATION MAP



PRELIMINARY

DO NOT USE FOR CONSTRUCTION

ALWAYS THINK SAFETY		
UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION NATIVE AMERICAN ASSISTANCE PROGRAM SALMON ENHANCEMENT PROGRAM LUMMI INDIAN RESERVATION SKOOKUM CREEK FISH HATCHERY LOCATION MAP		
DESIGNED F. TAN	CHECKED M. CAMPBELL	
DRAWN J. WHITFIELD	TECH. APPR.	
APPROVED _____		
CAD SYSTEM AUTOCAD R14.01 DRAWN: COC/MSJ	CAD FILENAME 0A571.DWG DATE: MARCH 30, 1999	DATE AND TIME PLOTTED JANUARY 18, 2000, 10:34 0A-57-1



NOTES

DESIGN CRITERIA:
 $Q_{max} = 3,050$ cfs (Maximum recorded - Nov. 27, 1949)
 Width = 33 feet (at toe of gradient restoration structure)
 Slope = 10% (0.1 rad)
 $C_u \sim 2.15$
 $C_s \sim 1.0$
 Angle of repose ~ 40 degrees (0.7 rad)

MATERIALS:
 Rock drop (Gradient restoration) structure:
 Rock size D100 < 6.0 feet
 D50 > 3.5 feet
 D10 > 0.5 feet
 Rock density = 140 lbs/cu. ft. minimum

Access road embankment:
 Gravel surfacing - Clean roadway base material
 Gravel fill - Aggregate base surfacing
 Riprap protection - Rock size D50 > 3.0 feet

Concrete at 28 days _____ f'c = 4,000 psi
 Grout _____ f'c = 4,000 psi
 Reinforcement _____ fy = 60,000 psi
 Structural Steel _____ fy = 36,000 psi (ASTM A36)

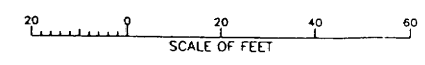
GENERAL NOTES

Elevations and dimensions of existing channel and apparent features may vary from those shown.
 Existing site conditions may vary from those shown on this drawing.
 Creek bed may be gravel, cobble, boulder or sound rock.
 Creek bed and banks are to be cleared of all debris prior to beginning construction.
 Excavation of the creek bed and bank shall be as directed by the Contracting Officer's Representative.
 Excavate unembedded and surfacial material (less than D50) only. Do not remove any competent material during construction.
 Rock placement shall be as directed by the Contracting Officer's Technical Representative.
 Construct rock drops with tech. supervision and specifications provided by Contracting Officer's tech. representative prior to and during construction.
 Rootwads required at Sections L-L, M-M, N-N, R-R and at Station 5+50. See drawing OA-57-7 for typical installation. Install rootwads with tech. supervision provided by Contracting Officer's tech. representative prior to and during construction.

REFERENCE DRAWINGS

LOCATION MAP	OA-57-1
EXCAVATION PLAN	OA-57-3
SECTIONS, SHEET 1 OF 3	OA-57-4
SECTIONS, SHEET 2 OF 3	OS-57-5
SECTIONS, SHEET 3 OF 3	OA-57-6
FISH LADDER STRUCTURE, SHEET 1 OF 2	OA-57-7
FISH LADDER STRUCTURE, SHEET 2 OF 2	OA-57-8
FISH LADDER BATTLE	OS-57-9
STOPLOG STRUCTURE, SHEET 1 OF 2	OA-57-10
STOPLOG STRUCTURE, SHEET 2 OF 2	OA-57-11
GENERAL NOTES AND MINIMUM REQUIREMENTS FOR DETAILING REINFORCEMENT	40-D-6263
MISCELLANEOUS METALWORK	40-D-6592
TOP MOUNTED PIPE GUARDRAILS	40-D-7012
GENERAL CONCRETE OUTLINE NOTES	40-D-7012

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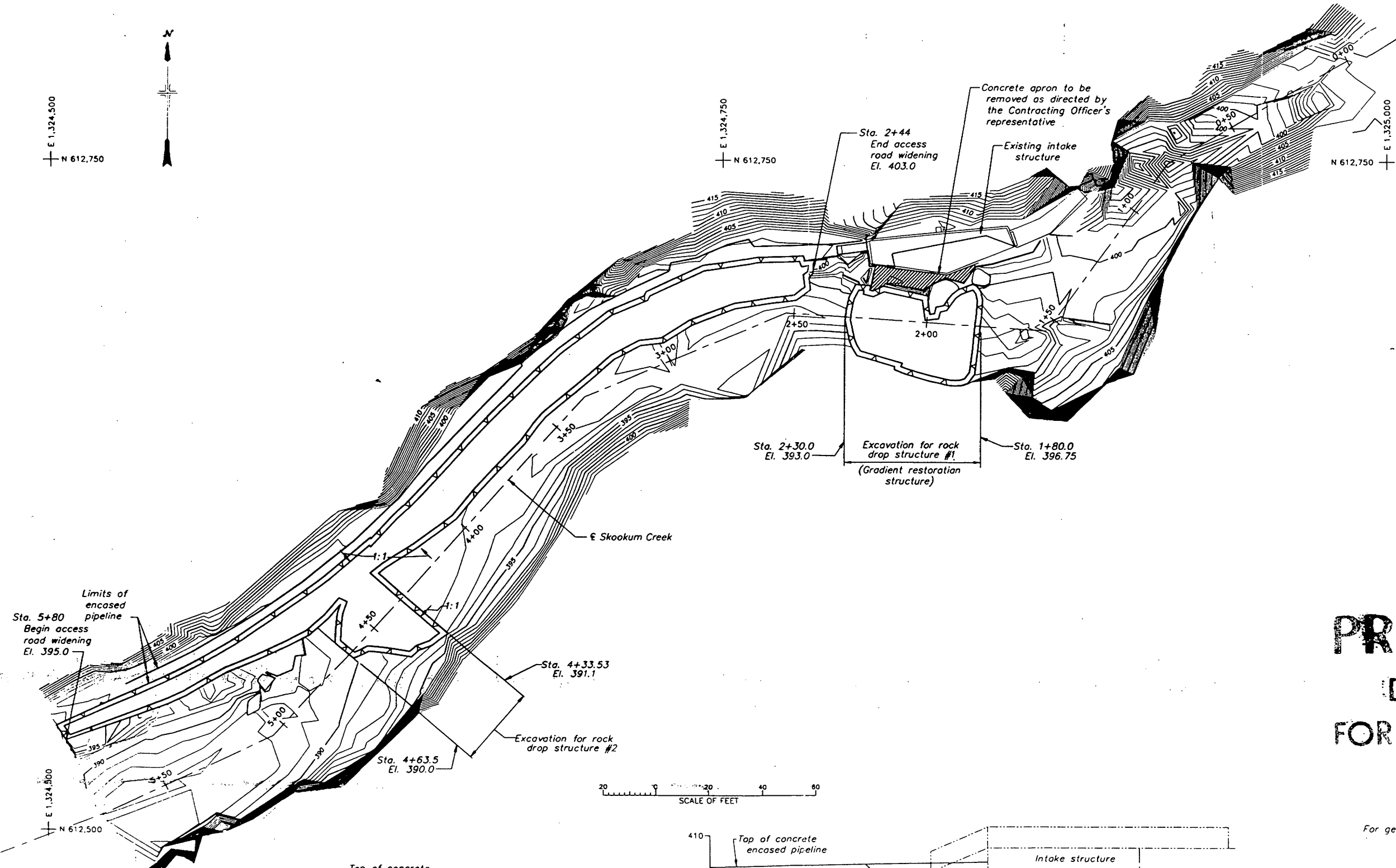
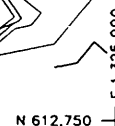
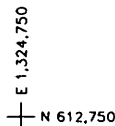
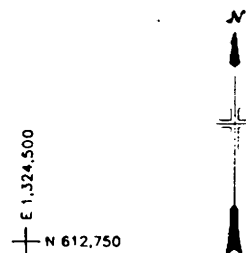
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 SALMON ENHANCEMENT PROGRAM
 LUMMI INDIAN RESERVATION - WASHINGTON

SKOOKUM CREEK FISH HATCHERY
GENERAL PLAN

DESIGNED BY J. WITTLER CHECKED BY F. TAN
 DRAWN BY D.C. RICHMAN TECH. APPROV.
 APPROVED _____

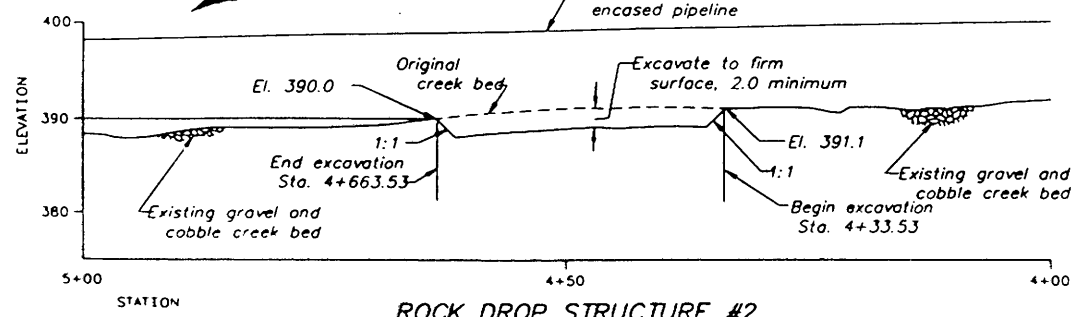
DATE AND TITLE REVISED
 MARCH 24, 2000 13.13
 MARCH 23, 1988 OA-57-2



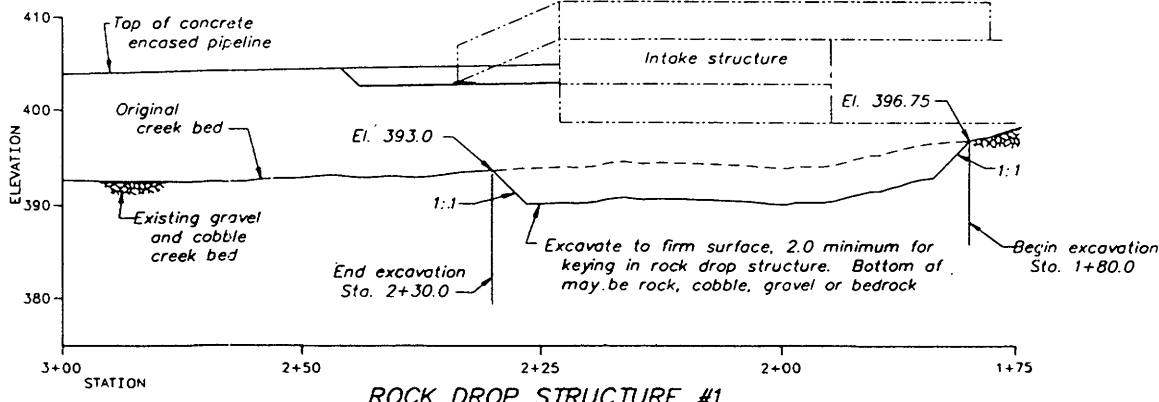
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NOTE

For general notes, see drawing OA-57-2.



ROCK DROP STRUCTURE #2 PROFILE



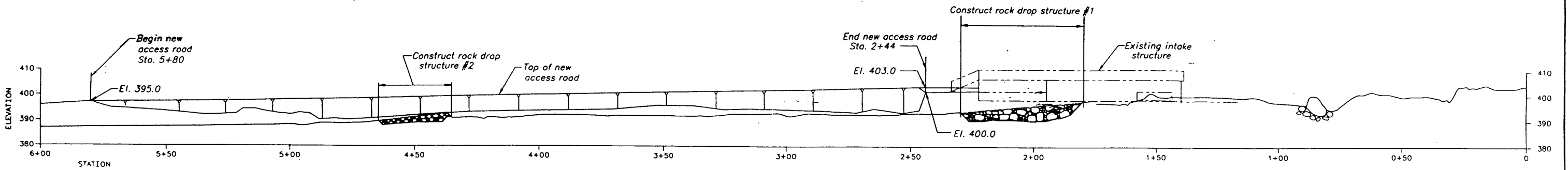
ROCK DROP STRUCTURE #1 PROFILE

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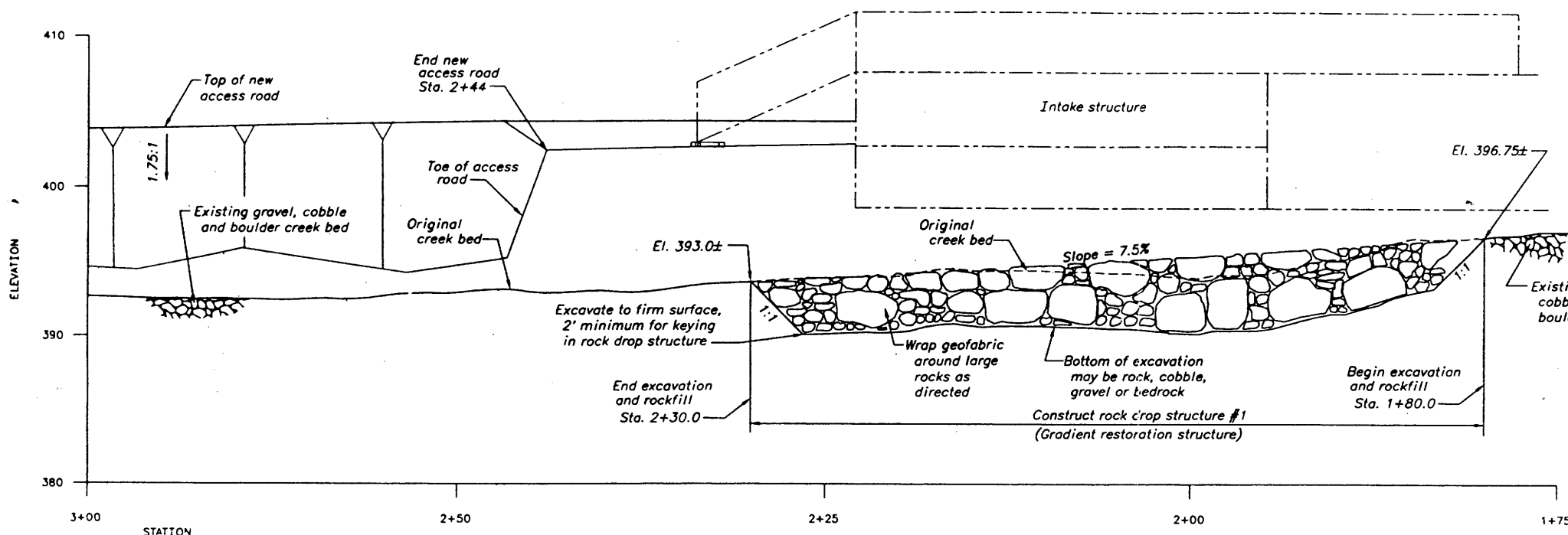
UNITED STATES
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 LUMMI INDIAN RESERVATION - WASHINGTON
SKOOKUM CREEK FISH HATCHERY
EXCAVATION PLAN AND SECTIONS

DESIGNED BY J. MITTLER CHECKED BY J. TAN / J. KUB'SCHE
 DRAWN BY D.F. BINGHAM TECH APPR.
 APPROVED _____

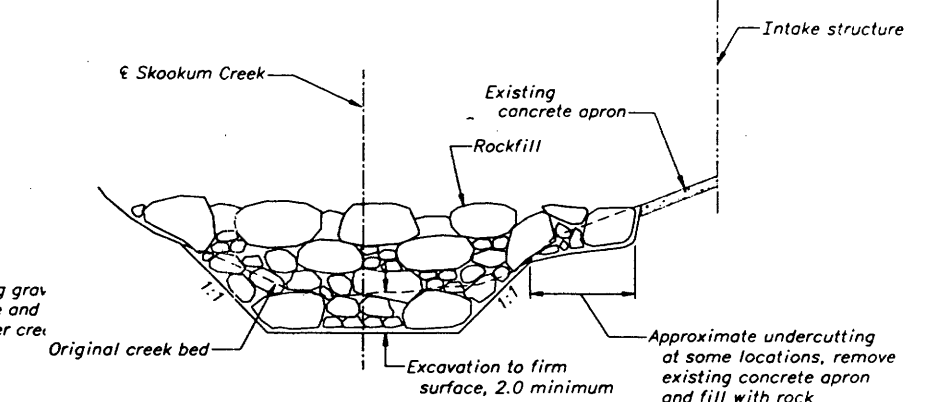
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 DENVER, COLORADO 80202-3199 3/25/09 0A-57-3



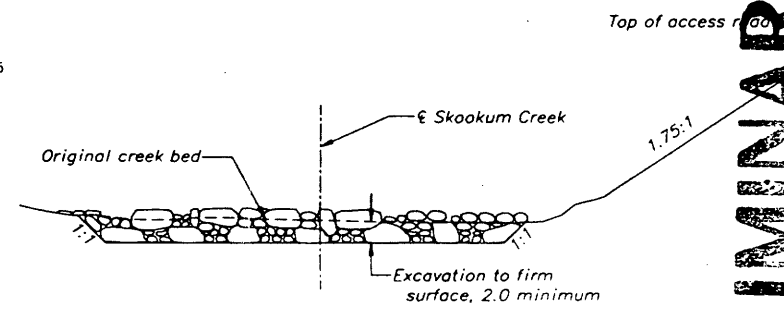
SECTION A-A



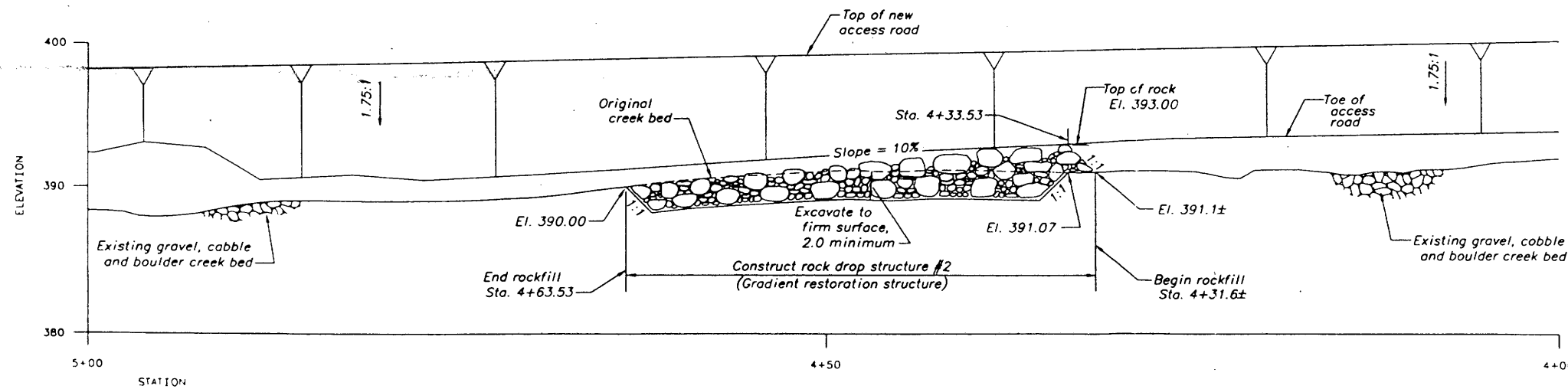
ROCK DROP STRUCTURE #1 PROFILE



TYPICAL SECTION ROCK DROP STRUCTURE #1



TYPICAL SECTION ROCK DROP STRUCTURE #2

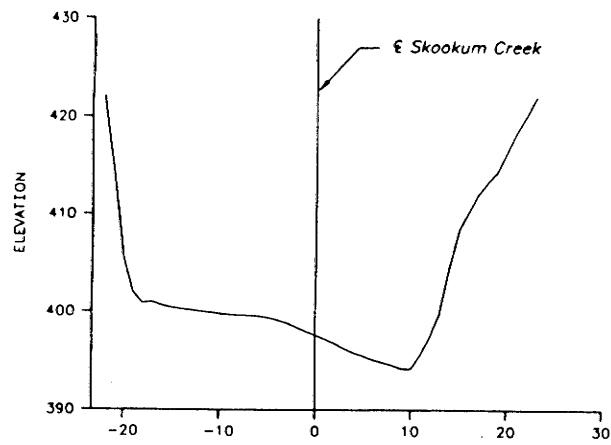


ROCK DROP STRUCTURE #2 PROFILE

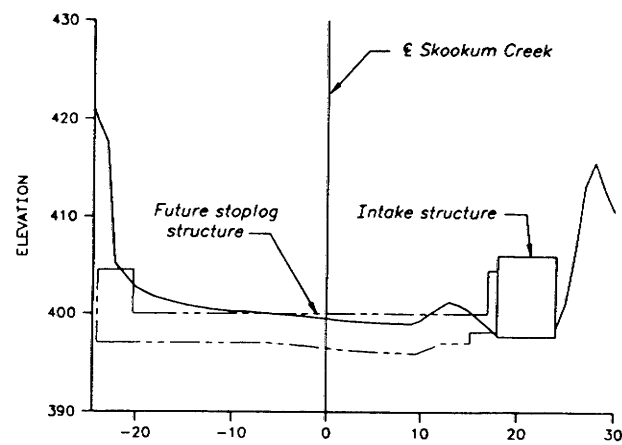
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NOTE
For general notes, see drawing OA-57-5

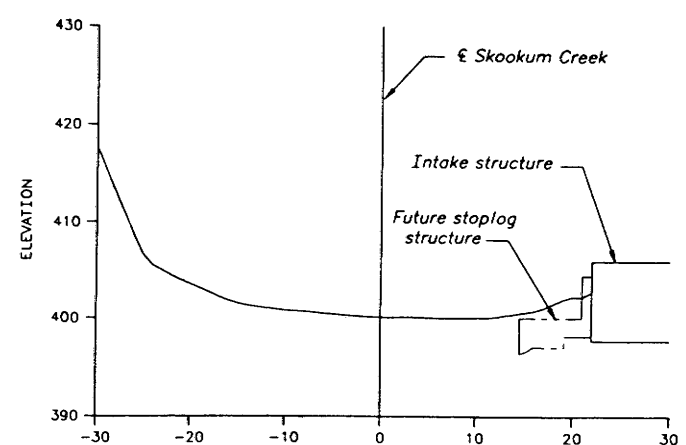
ALWAYS THINK SAFETY		
UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION NATIVE AMERICAN ASSISTANCE PROGRAM SALMON ENHANCEMENT PROGRAM LUMMI INDIAN RESERVATION - WASHINGTON SKOOKUM CREEK FISH HATCHERY ROCK DROP STRUCTURES #1 AND #2 AND SECTION A-A		
DESIGNED <i>P. J. WITTLER</i>	CHECKED <i>F. TAYLOR</i>	DATE <i>10/28/93</i>
DRAWN <i>C. S. WALSH/J. WHITEFIELD</i>	TECH. APPR.	
APPROVED _____		
CAD SYSTEM AutoCAD R14.01 DATE: 02/24/94	CAD FILE NAME QA-5748.DWG SHEET 1 OF 3	DATE AND TIME PLOTTED MARCH 24, 2000 10:29 0A-57-4



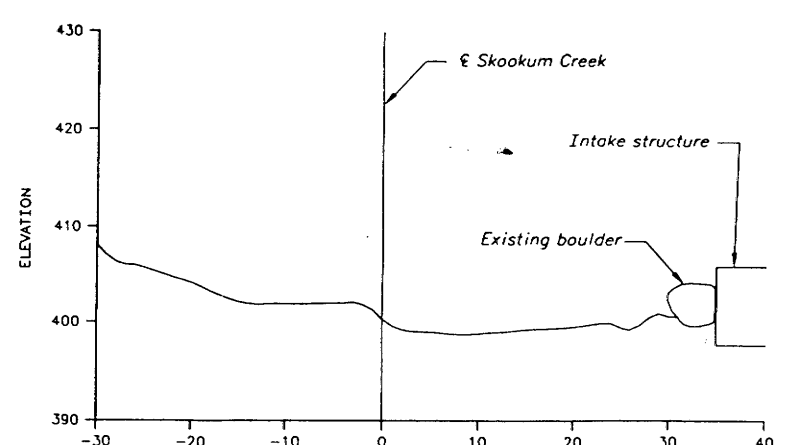
SECTION B-B
(STA. 1+00)



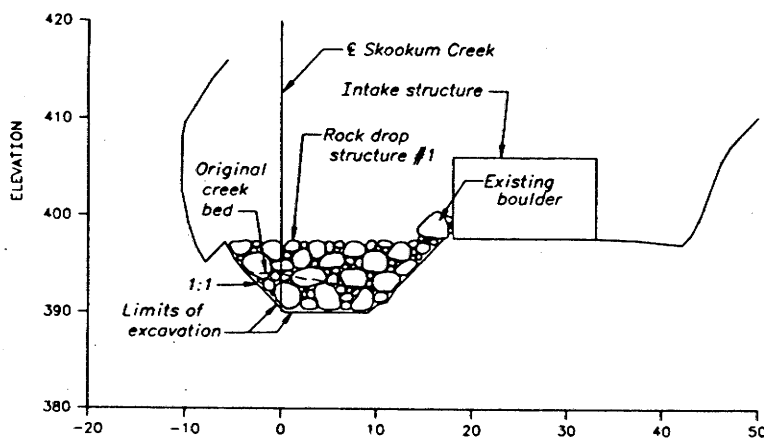
SECTION C-C
(STA. 1+15)



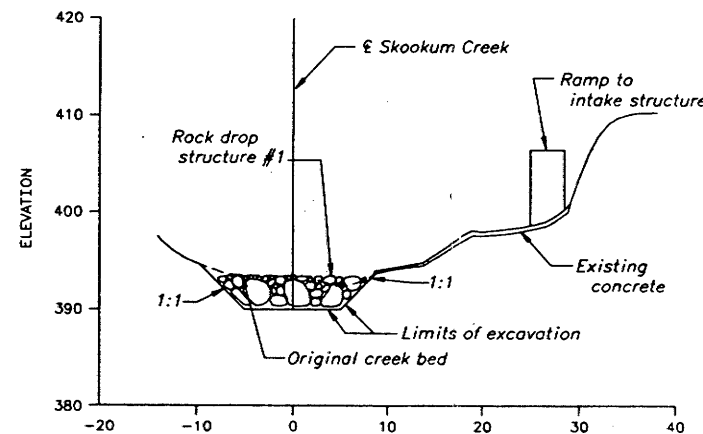
SECTION D-D
(STA. 1+30)



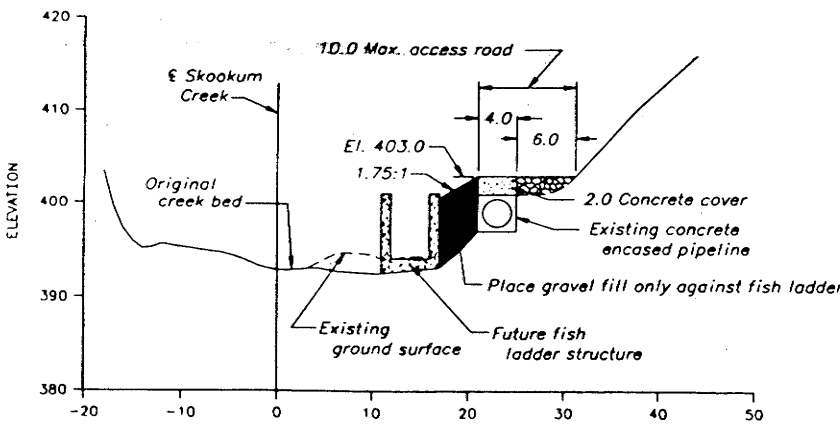
SECTION E-E
(STA. 1+50)



SECTION F-F
(STA. 2+00)



SECTION H-H
(STA. 2+25)



SECTION J-J
(STA. 2+50)

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NOTES

Sections B-B, and E-E are intended to show the creek bed only, there should be no construction in these areas at this time.
 For general notes, see 2.

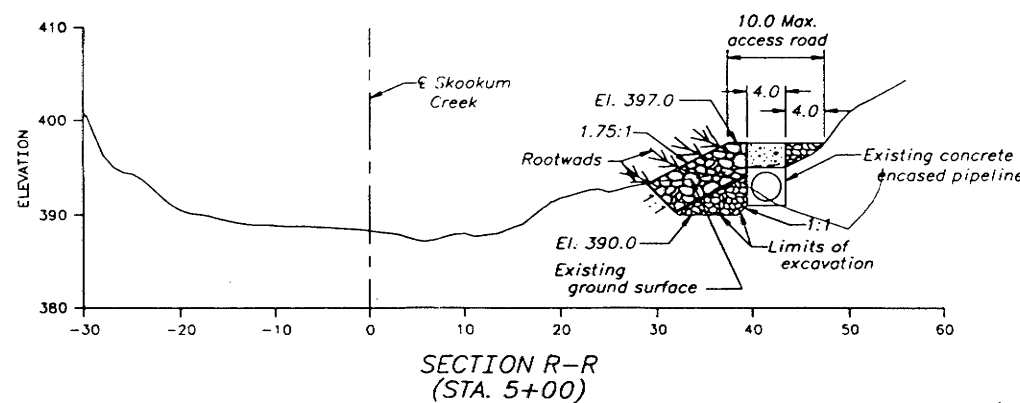
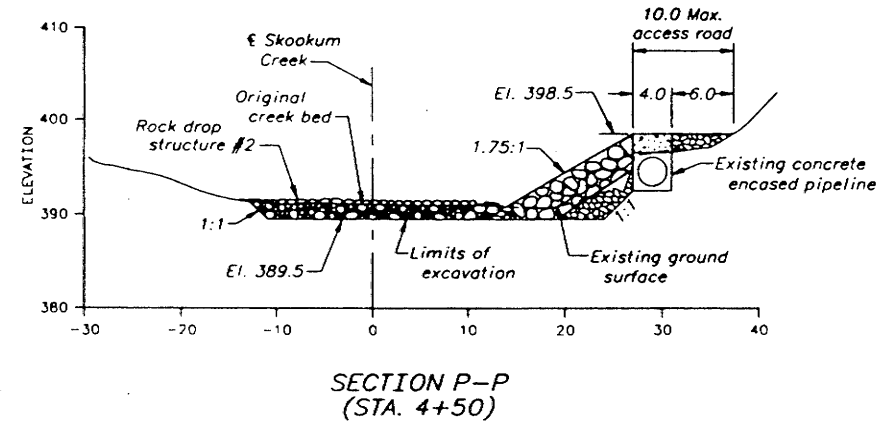
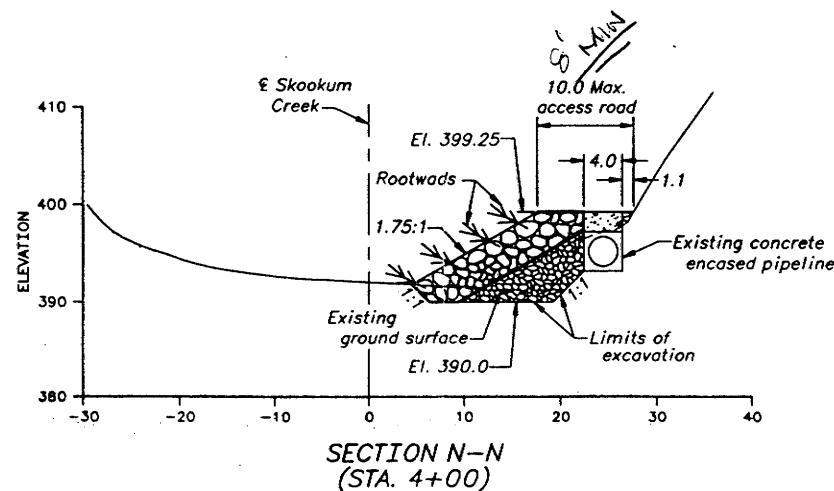
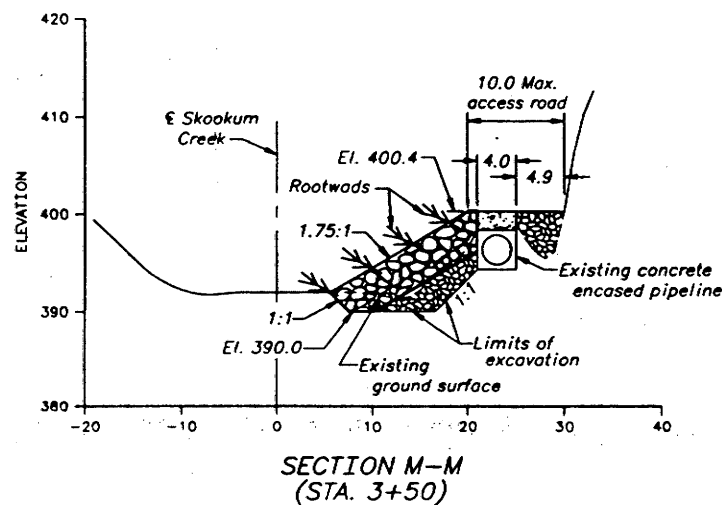
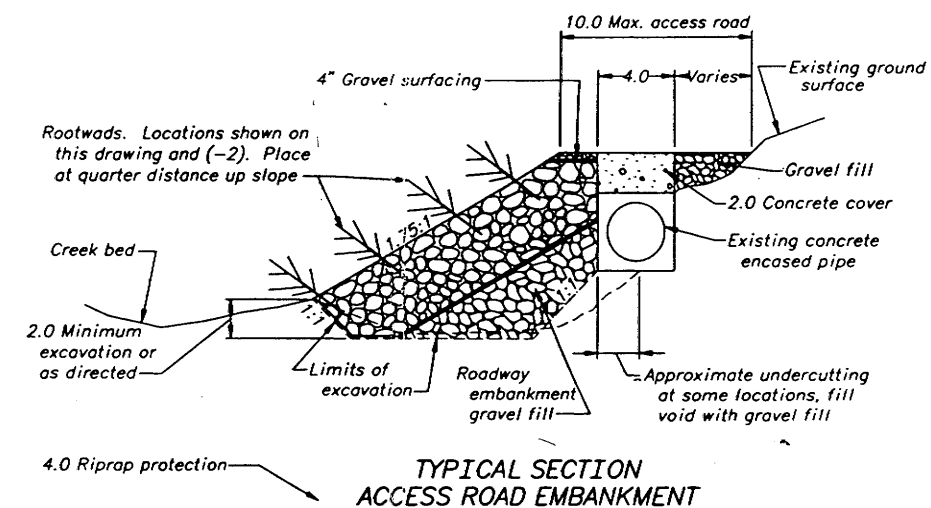
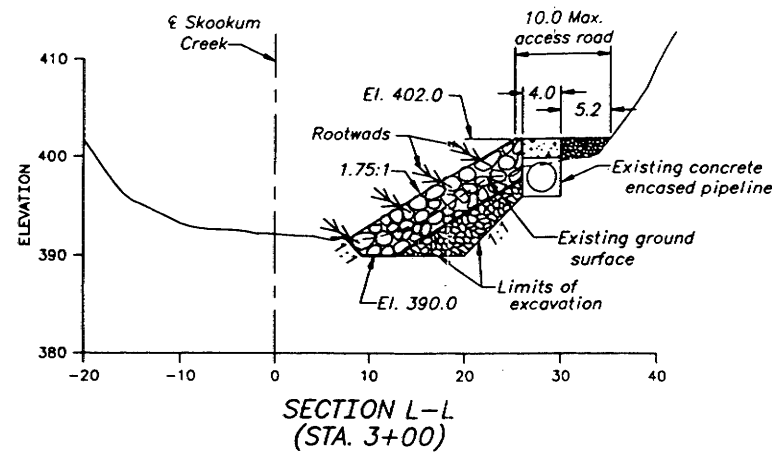
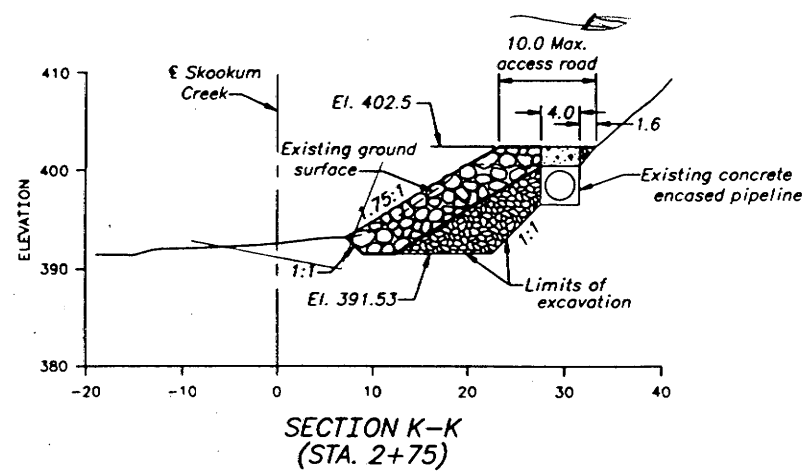
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 LUMMI INDIAN RESERVATION - WASHINGTON

**SKOOKUM CREEK FISH HATCHERY
 ROCK DROP STRUCTURE
 SECTIONS**

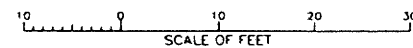
DESIGNED P. J. WITLER CHECKED F. TAN / J. SUBITSCHER
 DRAWN C.S. WALSH / L. WHITFIELD TECH. APPR. _____
 APPROVED _____

CADD SYSTEM: AUCAD 14.01 CADD TITLE: 0A-57-5 DATE AND TIME PLOTTED: MARCH 24, 2000, 10:58
 DENVER, COLORADO SHEET 2 OF 3 MARCH 30, 1999



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NOTE
For general notes, see 2.



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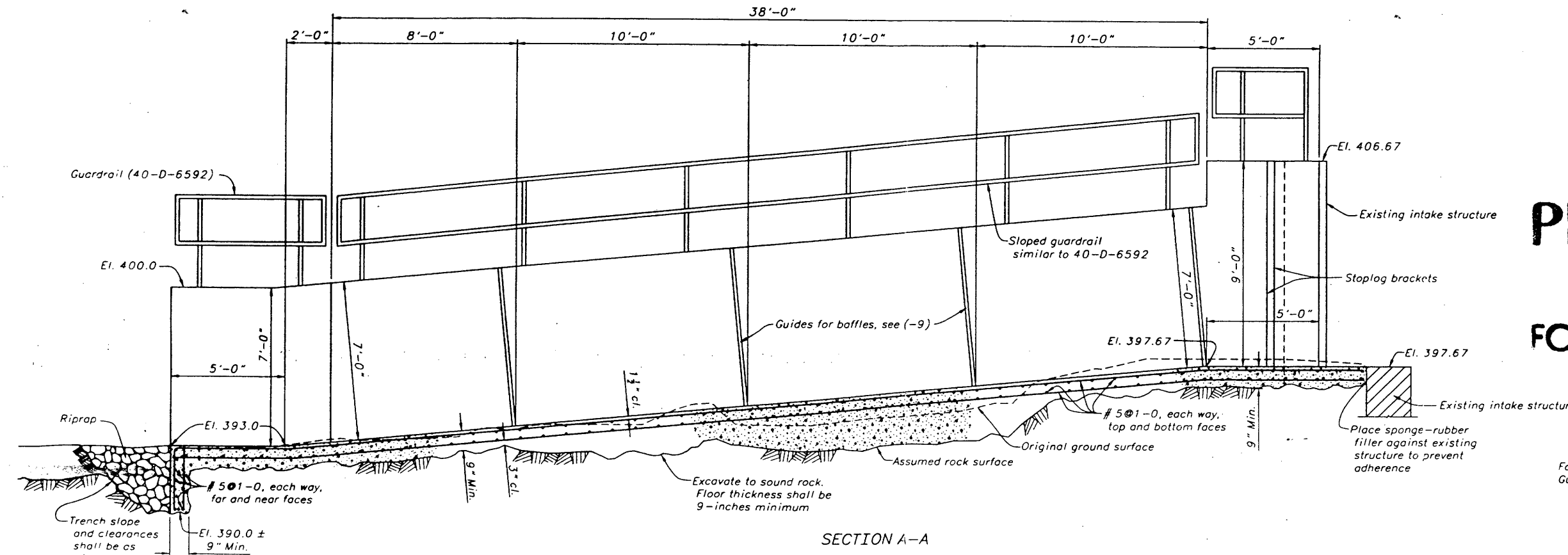
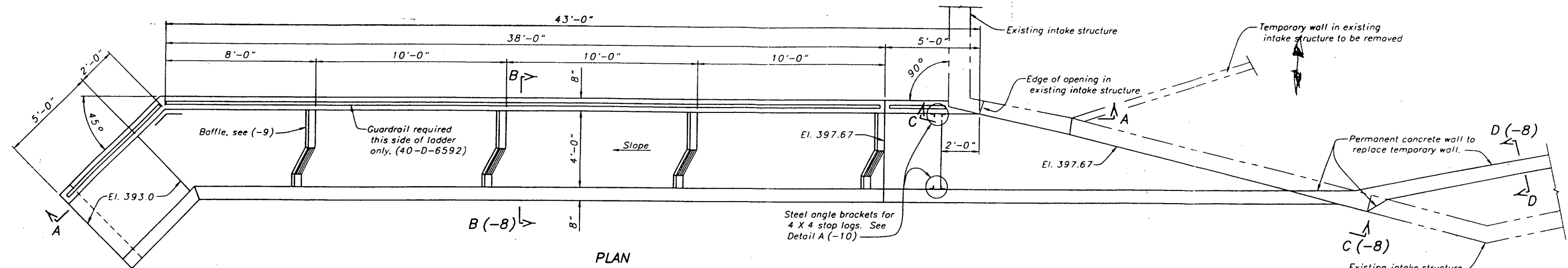
**SKOOKUM CREEK FISH HATCHERY
ACCESS ROAD
SECTIONS**

DESIGNED R. J. WITTLER
DRAWN C. S. WALSH/J. WHITFIELD
CHECKED F. TAN/J. MUBITSCHEK
TECH APPR

APPROVED

CADD SYSTEM: AutoCAD 14.01
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DATE AND TIME PLOTTED: MARCH 24, 2000 10:27
SHEET 3 OF 3

OA-57-6

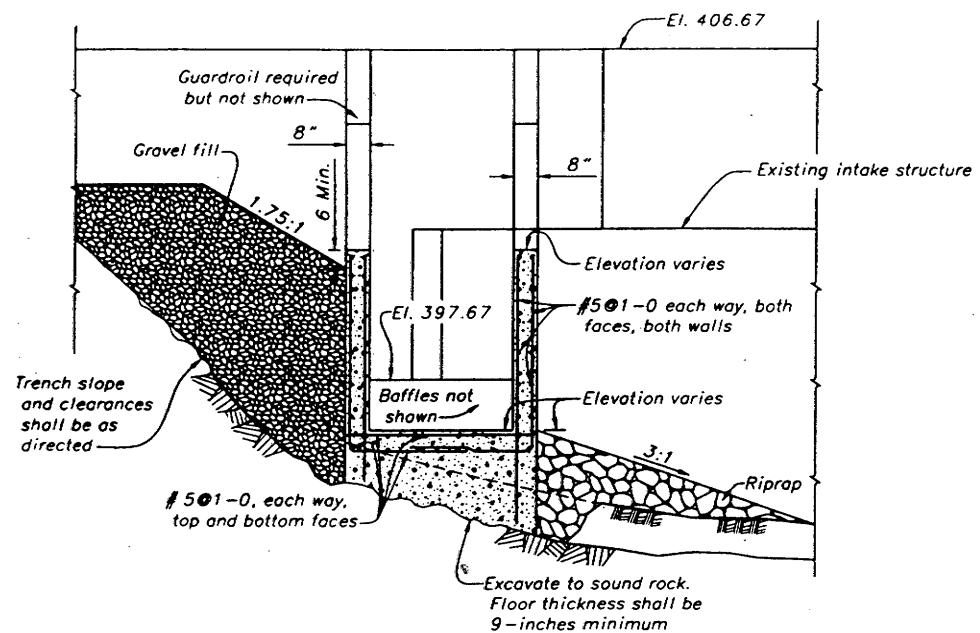


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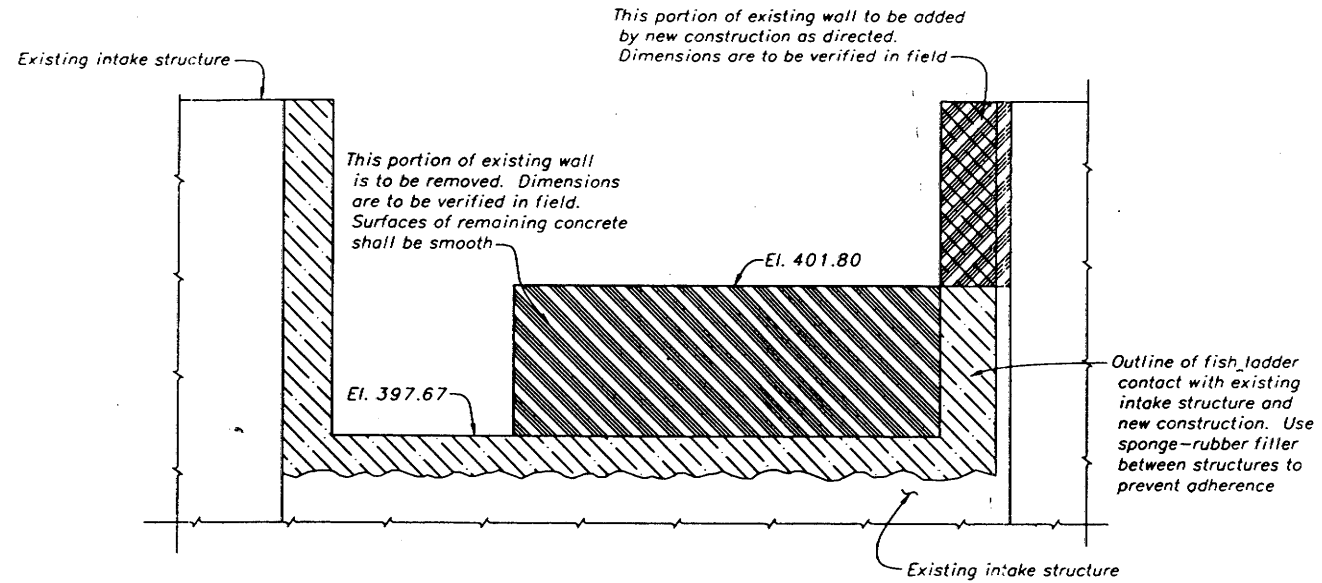
NOTES

For general notes, see drawing OA-57-2.
 Guardrail details to be similar to those on drawing 40-D-6592 except: 1. Use adhesive anchors in lieu of expansion anchors. 2. Fabricate guardrail for sloped concrete surface where required.

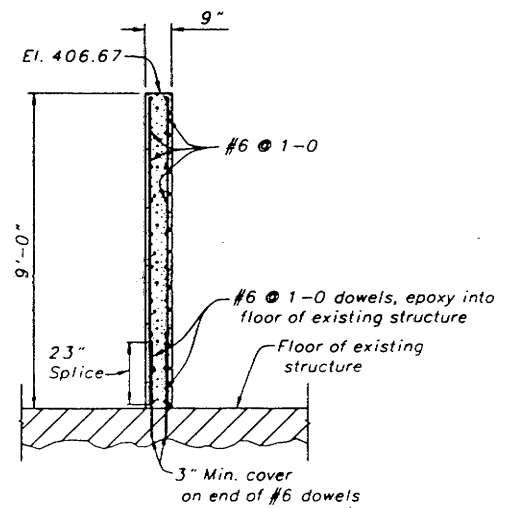
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UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION NATIVE AMERICAN ASSISTANCE PROGRAM SALMON ENHANCEMENT PROGRAM LUMMI INDIAN RESERVATION - WASHINGTON SKOOKUM CREEK FISH HATCHERY FISH LADDER STRUCTURE PLAN, SECTIONS AND DETAIL		
DESIGNED BY CAMPBELL	CHECKED BY JAY L. SHEPARD	DATE AND TIME PLOTTED
DRAWN BY CAMPBELL	TECH APPR	MARCH 24, 2009 09:40
APPROVED _____		
CADD SYSTEM	CADD FILENAME	DATE AND TIME PLOTTED
PLotted By: J. L. CAMPBELL	DS2772.DWG	MARCH 24, 2009 09:40
SHEET 012 OF 012 SHEETS 12 OF 12		
OA-57-7		



SECTION B-B (-7)



SECTION C-C (-7)



SECTION D-D (-7)

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NOTES

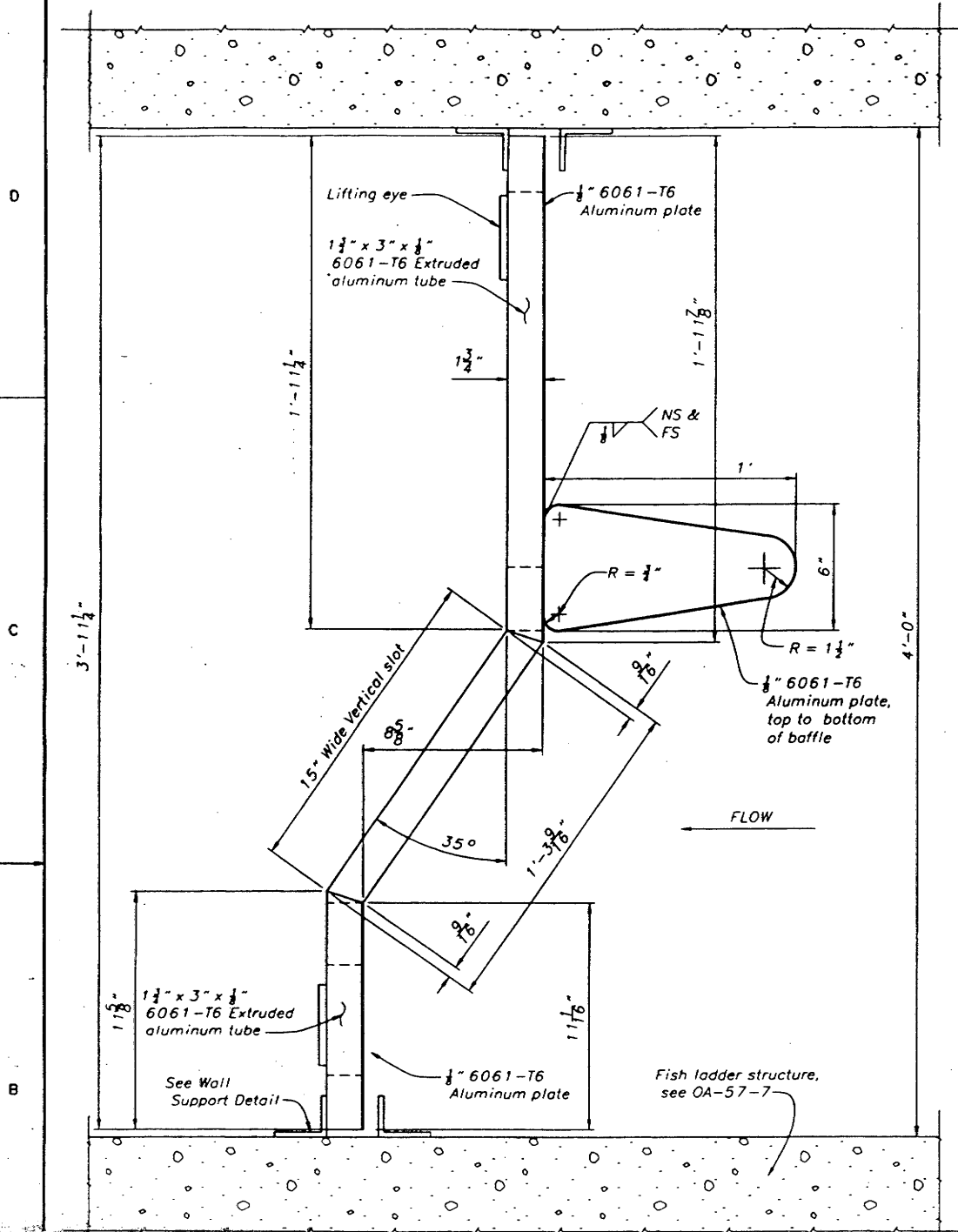
For general notes, see drawing OA-57-2

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 LUMMI INDIAN RESERVATION - WASHINGTON
SKOOKUM CREEK FISH HATCHERY
 FISH LADDER STRUCTURE
 PLAN, SECTIONS AND DETAIL

DESIGNED BY CAMPBELL _____ CHECKED BY JAY L. G. SHEPARD / J. W. B. / SC-10
 DRAWN BY CAMPBELL _____ TECH APPR _____
 APPROVED _____

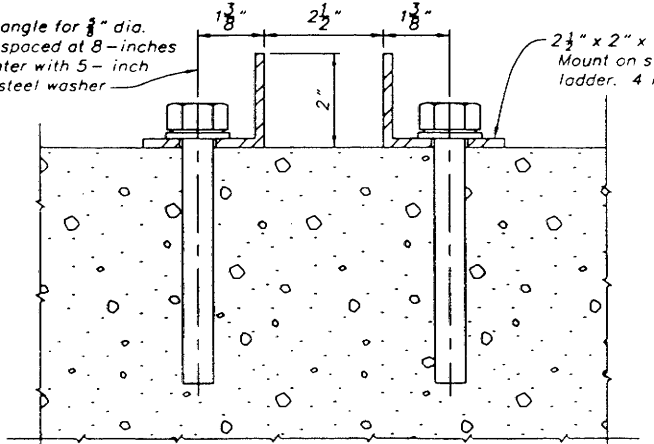
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 SHEET 2 OF 2 / SHEET 2 OF 2 / OA-57-8



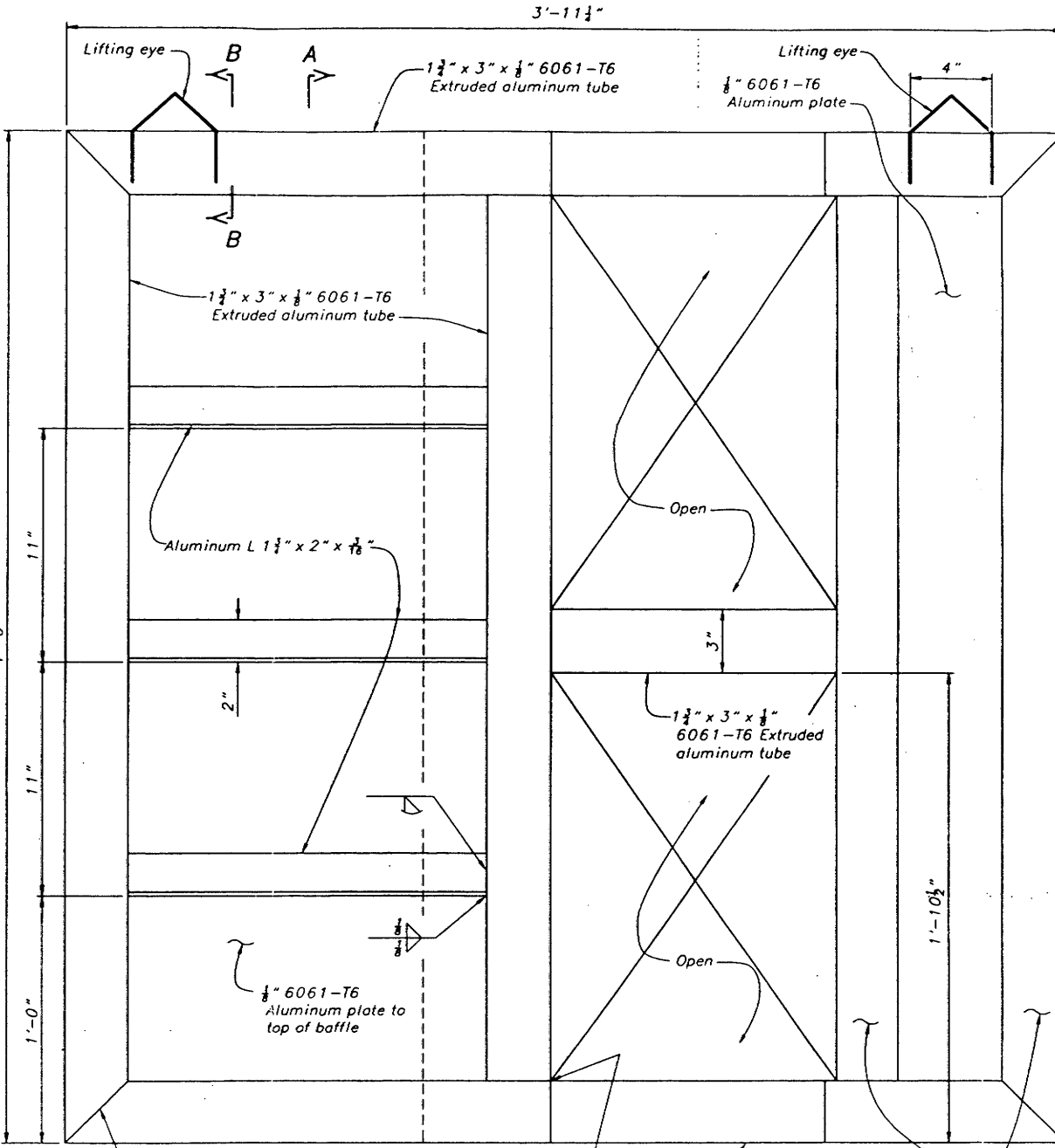
PLAN
4 Baffles Req'd
For locations, see (-7)

5/8" Dia. hole in angle for 3/8" dia. adhesive anchor spaced at 8 inches maximum on center with 5 inch embedment and steel washer

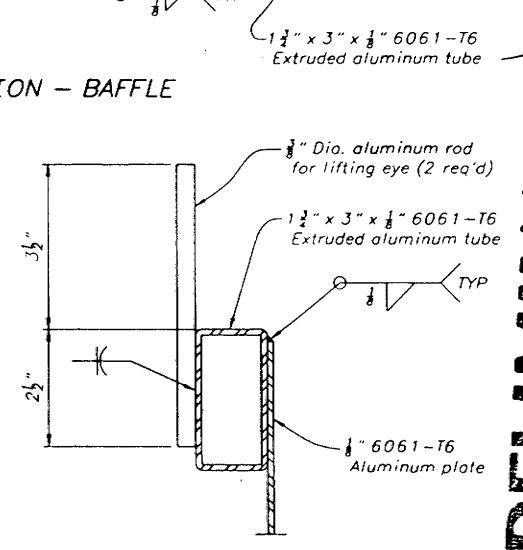
2 1/2" x 2" x 1/8" x 4'-0" Long steel angle. Mount on sidewalls of fish ladder. 4 req'd per baffle



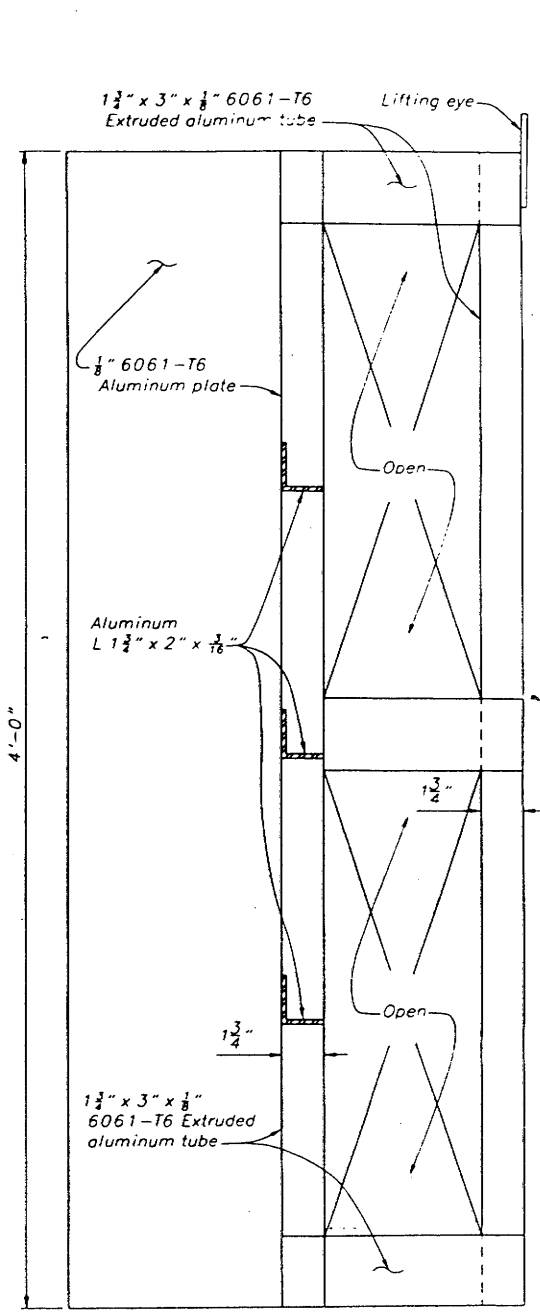
WALL SUPPORT DETAIL



ELEVATION - BAFFLE



SECTION B-B



SECTION A-A

NOTES

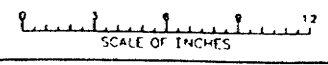
For General Notes, see OA-57-2
Galvanize all ferrous metalwork after fabrication.
Dimensions, welds and details shown are typical for similar conditions.

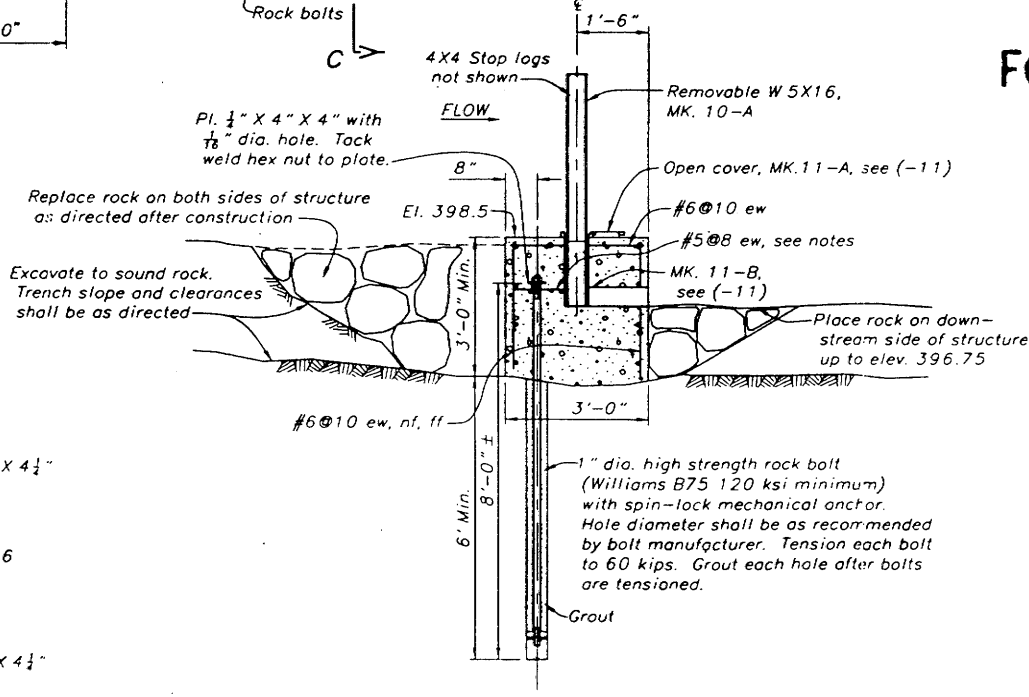
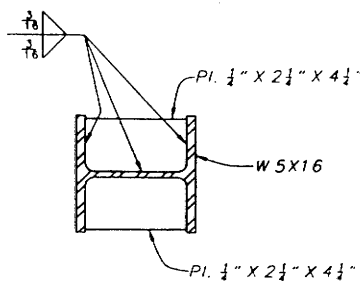
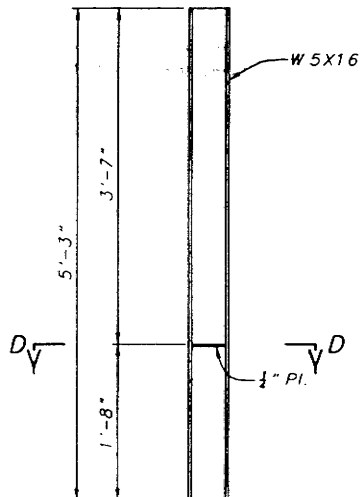
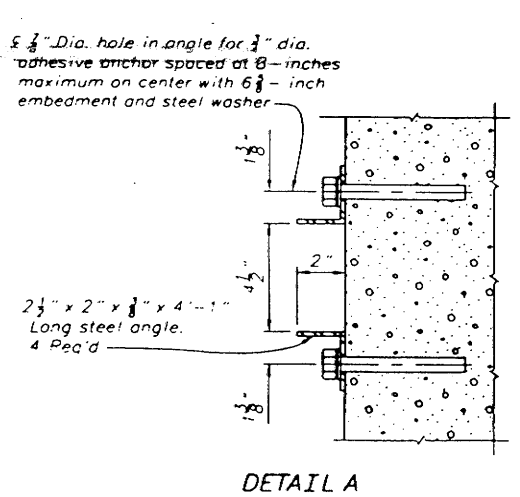
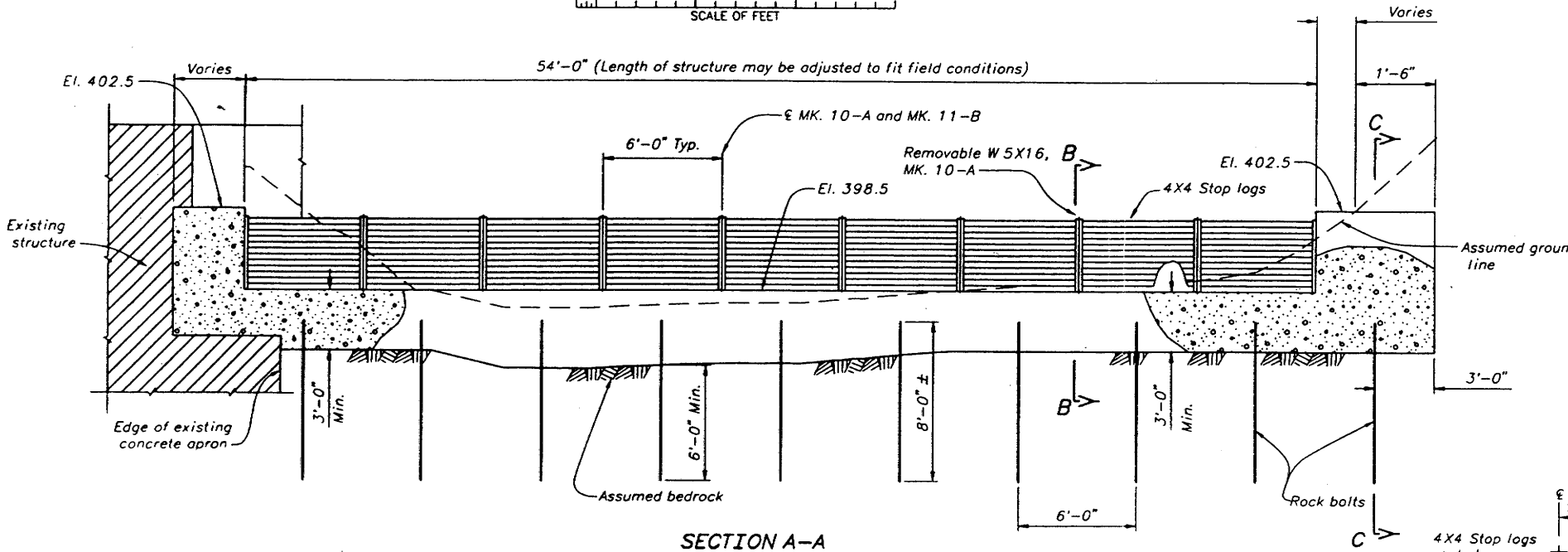
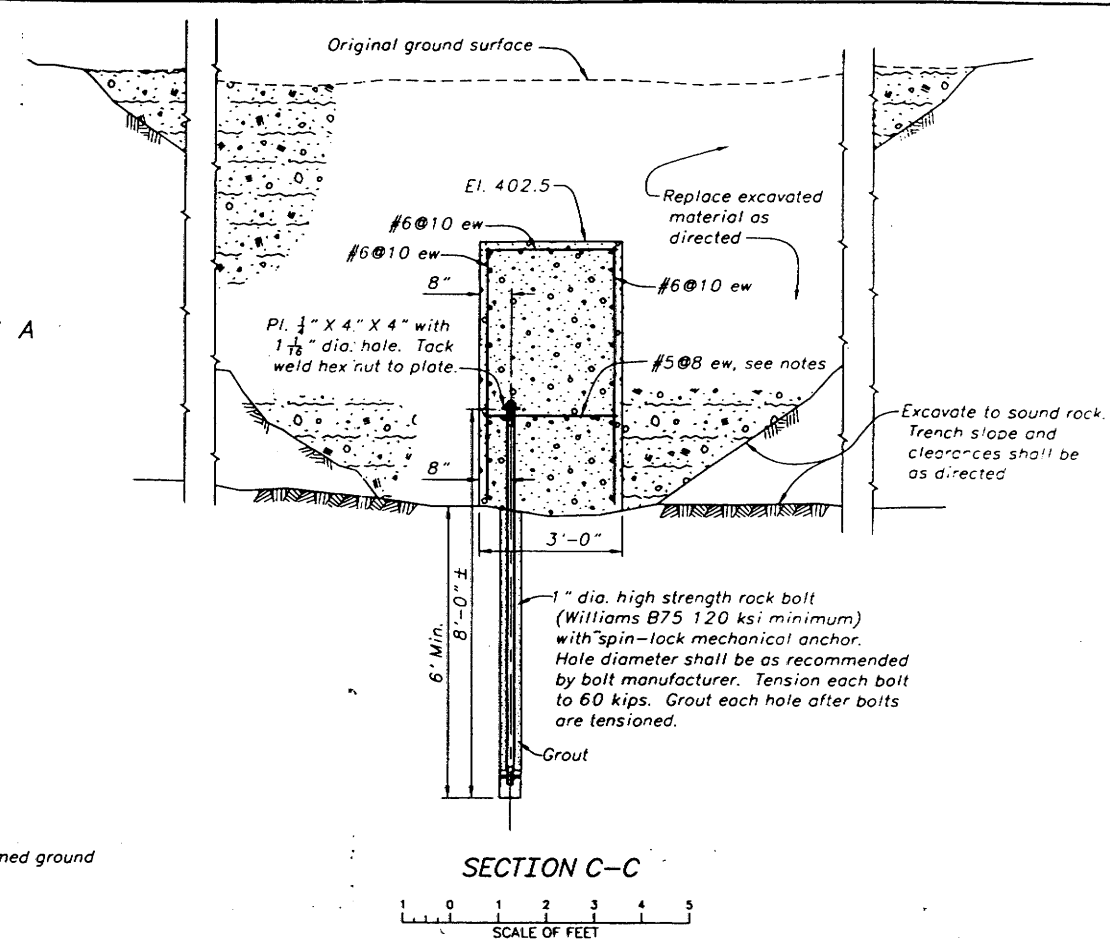
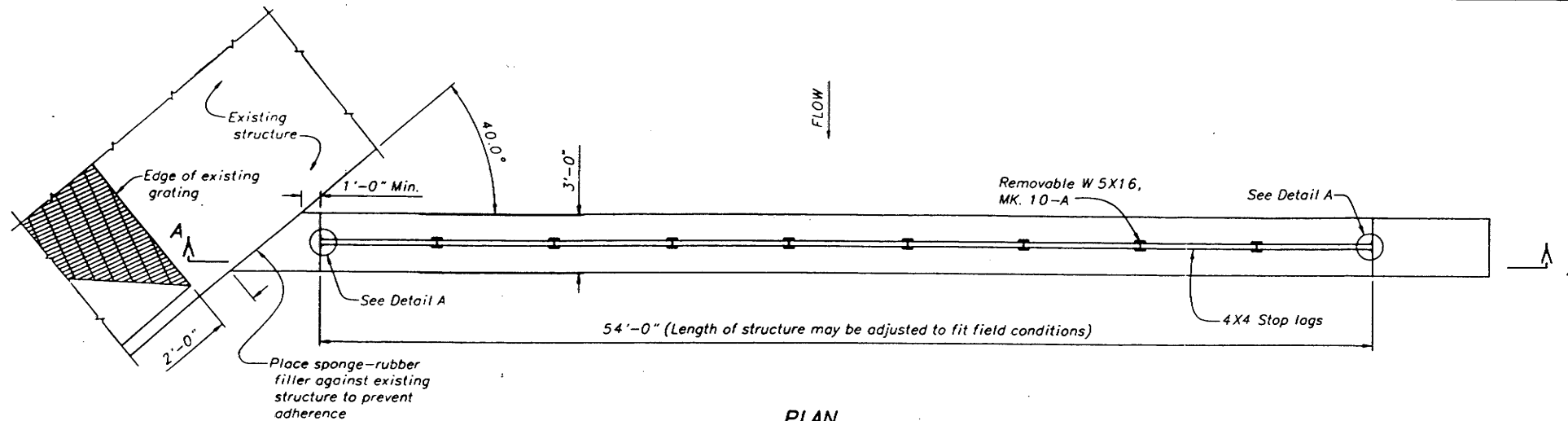
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SALMON ENHANCEMENT PROGRAM
LUMMI INDIAN RESERVATION - WASHINGTON
SKOOKUM CREEK FISH HATCHERY
FISH LADDER BAFFLE
PLAN, ELEVATION, SECTIONS AND DETAIL

DESIGNED BY CAMPBELL CHECKED BY SHEPARD / KUBI'S
DRAWN BY CAMPBELL TECH APPR
APPROVED
CADD SYSTEM CADD TITLE DATE AND TIME PLOTTED
AUTOCAD 14.01 04579.DWG MARCH 6, 2000 14:57
D:\PROJECTS\16_1999\ 04579.DWG 03/06/2000 14:57
SCALE: 1" = 1'-0" 1" = 1'-0" 1" = 1'-0"

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NOTES

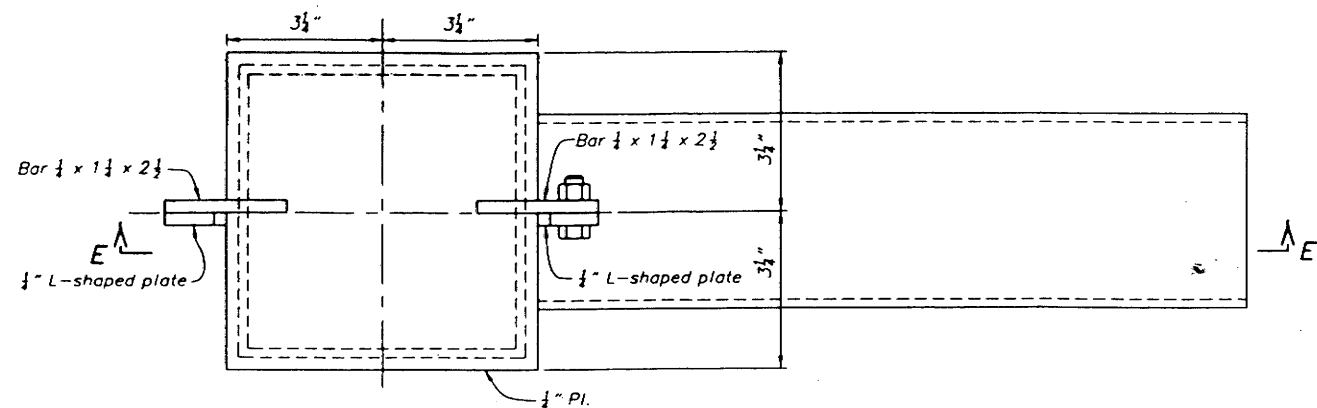
For general notes, see drawing OA-57-2.

Install top of rock bolts at a constant elevation that conforms to dimensions given. Place #5 reinforcement at a level just below the top of the rock bolts. Galvanize all ferrous metalwork after fabrication. Dimensions, welds and details shown are typical for similar conditions. All metalwork shown on this drawing is steel unless otherwise noted.

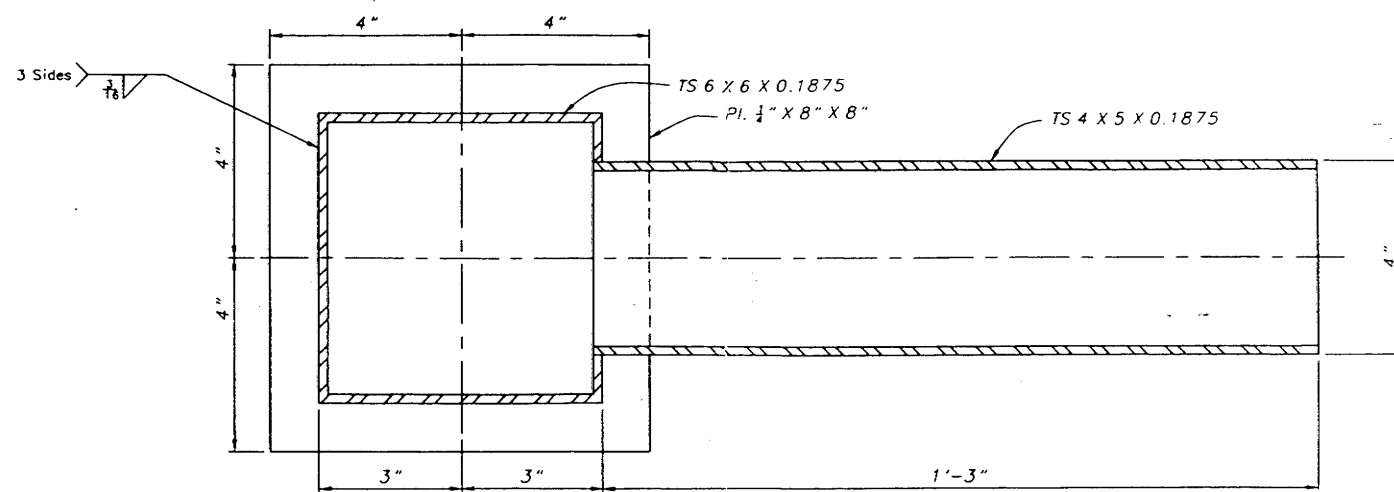
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SALMON ENHANCEMENT PROGRAM
LUMMI INDIAN RESERVATION - WASHINGTON
SKOOKUM CREEK FISH HATCHERY
STOPLOG STRUCTURE
PLAN, SECTIONS AND DETAIL

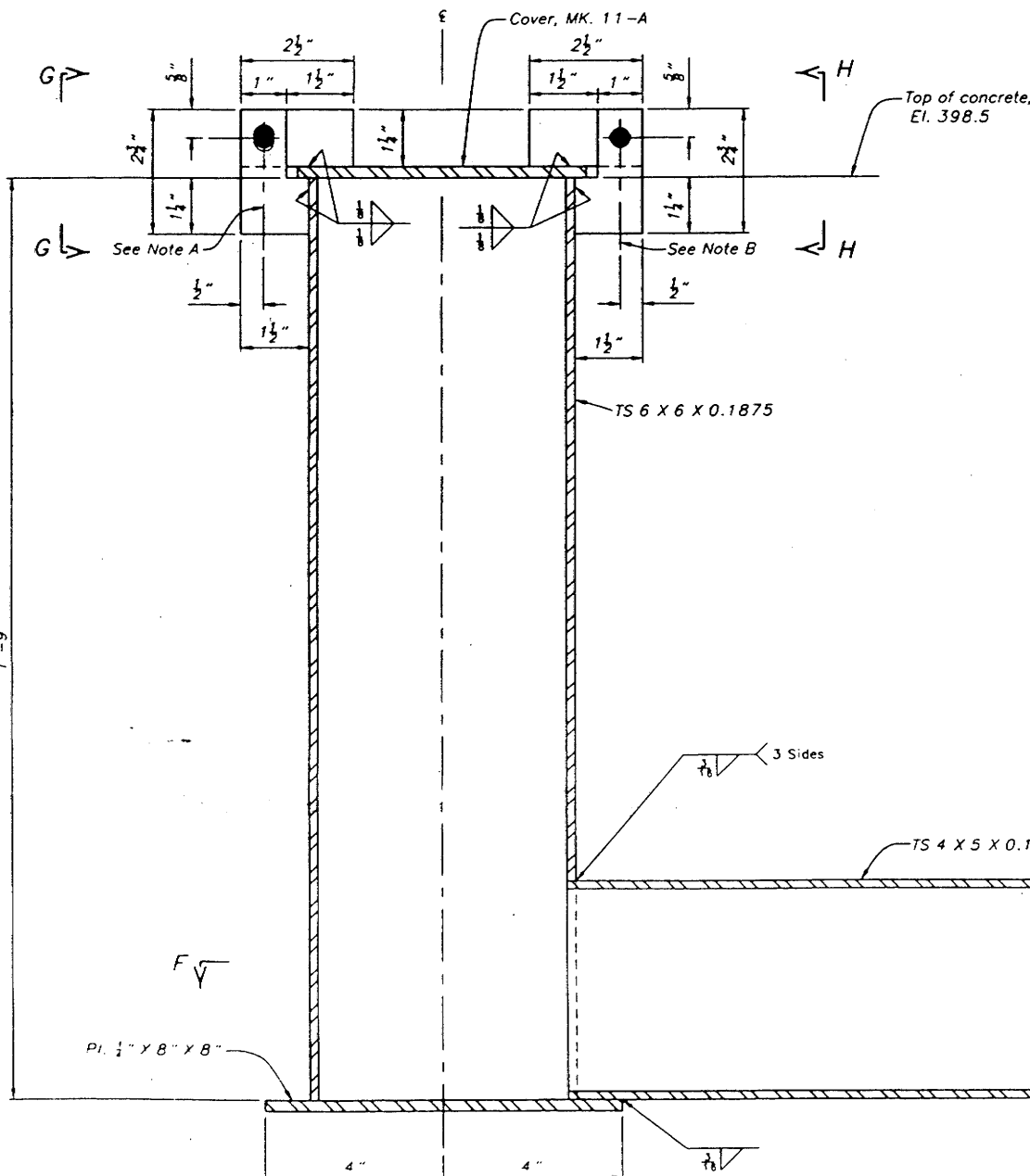
DESIGNED J. RUBITSCHKE / M. CAMPBELL CHECKED F. TAYLOR / G. SHEPARD
DRAWN M. CAMPBELL TECH APPR. _____
APPROVED _____
DATE AND TITLE PLOTTED
MARCH 22, 2009 09:59
OA-57-10



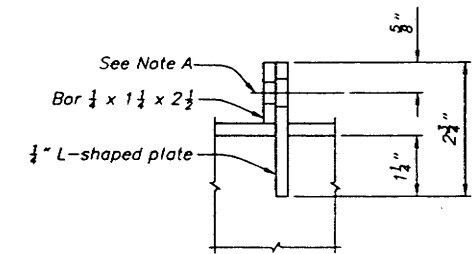
PLAN - COVER
 MK. 11-A, 8 REQ'D
 For locations, see OA-57-10



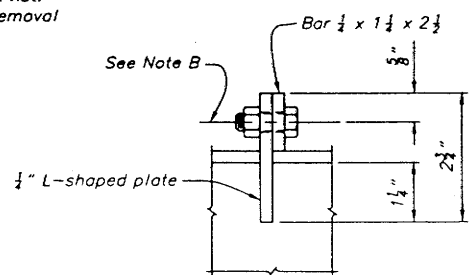
SECTION F-F



SECTION E-E
 MK. 11-B, 8 REQ'D
 For locations, see OA-57-10



ELEVATION G-G



ELEVATION H-H

Note A: $\epsilon \frac{7}{16}$ " Hole in Bar $\frac{1}{2}$ X $1\frac{1}{2}$ X $2\frac{1}{2}$ and $\frac{7}{16}$ " X $\frac{8}{16}$ " slotted hole in L-shaped plate

Note B: $\epsilon \frac{7}{16}$ " Hole for $\frac{1}{2}$ " bolt with hex. nut. Tack weld nut on bolt to prevent removal

PRELIMINARY
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NOTES

Galvanize all ferrous metalwork after fabrication.
 Dimensions, welds and details shown are typical for similar conditions.
 All metalwork shown on this drawing is steel unless otherwise noted.

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 BUREAU OF RECLAMATION
 NATIVE AMERICAN ASSISTANCE PROGRAM
 SALMON ENHANCEMENT PROGRAM
 LUMMI INDIAN RESERVATION - WASHINGTON
SKOOKUM CREEK FISH HATCHERY
 STOPLOG STRUCTURE
 PLAN AND SECTIONS

DESIGNED E. TAN / C. SHERARD CHECKED J. HUBBARD
 DRAWN M. CAMPBELL TECH ADDD
 APPROVED _____

CADD SYSTEM: AutoCAD R14.01
 CADD PLOTTER: QDS711B.DWG
 DATE AND TITLE PLOTTED: MARCH 22, 2000, 08:52
 SHEET 2 OF 2

**Skookum Creek Fish Hatchery Water Supply Intake Modification with
Channel and Fish Passage Improvement**

**Salmon Enhancement Program
Lummi Indian Reservation
Lummi, Washington**

Attachment C

Cost Estimate (Feasibility Level)

Revised March 2000

FEATURE:

27-Mar-2000

PROJECT:

**Skookum Creek Fish Hatchery
Channel Modification and
Access Road Widening
(Concept Design) Revised 3/27/2000**

**Native American Assistance Program
Salmon Enhancement Program**

LOCATION:

Lummi Indian Reservation - Washington

FILENAME:

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PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Furnish and Place Riprap in Channel (D10 = 6", D50 = 3 ft., D100 = 4.5 ft.). Placed as directed, not dumped.		350	C.Y.	\$45.00	\$15,750
	2	Furnish and Place Access Road Subbase Material (Placed as directed, CLEAN (Washed) Subbase material, 3" to 12" size.)		450	C.Y.	\$45.00	\$20,250
	3	Furnish and Install Geofabric (Mirafi 1160N. Placed after foundation preparation and at bottom of new riprap.)			S.F.	\$5.00	
	4	Foundation Preparation for Rock Drop Structure (Remove gravel and cobble material from exist. creek bed and dispose on creek bank, and move large rock on creek bed, as directed. Quantity will vary from 50 cy to 200 cy.)		200	C.Y.	\$25.00	\$5,000
	5	Foundation Preparation for Access Road Widening (Excavate gravel and cobble material from exist. creek bank, and dispose on creek bank as directed)		480	C.Y.	\$25.00	\$12,000
	6	Furnish and Place Access Road Surfacing		30	C.Y.	\$45.00	\$1,350
	7	Furnish and Place Riprap on Roadway Bank (D10 =6", D50 = 2 ft., D100 = 4 ft.). Placed as directed, not dumped.		500	C.Y.	\$45.00	\$22,500
	8	Furnish and Place Concrete (Cement included)		75	C.Y.	\$700.00	\$52,500
	9	Furnish and Place Reinforcing Steel		4,000	Lbs	\$0.90	\$3,600
	10	Furnish and Install Rock Anchor Bolts		80	LinFt	\$45.00	\$3,600
	11	Furnish and Install Miscellaneous Metalwork (Fishscreen and handrail)		2,500	Lbs	\$6.00	\$15,000
	12	Mobilization, +/- 8%		1	L.S.		\$12,000
		Subtotal					\$163,550
		Unlisted Items (+/- 15%)		1	L.S.		\$24,450
		Contract Cost					\$188,000
		Contingencies (+/- 25%)		1	L.S.		\$47,000
		Field Cost					\$235,000

QUANTITIES

PRICES

BY F. Tan		BY Daniel L. Maag	CHECKED
DATE PREPARED 03/27/2000	APPROVED	DATE 03/27/2000	PRICE LEVEL