Kennewick Irrigation District
and
Columbia Irrigation District
Pump Exchange Feasibility Study

Amon Wasteway Operational Spill

Kennewick Irrigation District
Concept Design Report

Yakima River Basin Water Enhancement Project
Upper Columbia Area Office
Yakima Project-Washington

DEPARTMENT OF THE INTERIOR
Bureau of Reclamation
Pacific Northwest Construction Office
Yakima, Washington

March 22, 2004
Amended August 20, 2004

KENNEWICK IRRIGATION DISTRICT AND COLUMBIA IRRIGATION DISTRICT
PUMP EXCHANGE FEASIBILITY STUDY

AMON WASTEWAY OPERATIONAL SPILL
KENNEWICK IRRIGATION DISTRICT CONCEPT DESIGN REPORT

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KENNEWICK IRRIGATION DISTRICT AND COLUMBIA IRRIGATION DISTRICT PUMP EXCHANGE FEASIBILITY STUDY

AMON WASTEWAY OPERATIONAL SPILL
KENNEWICK IRRIGATION DISTRICT CONCEPT DESIGN REPORT

Background:

The Amon Wasteway begins at the end of Kennewick Irrigation District (KID) Main Canal Division III. At this location the Main Canal Spillway is designed to deliver operational and emergency spills safely into the natural drainage way, commonly referred to as Amon Wasteway. The KID/Amon Wasteway structure is shown in attached photos and drawing. It has a design capacity of 275 cfs. Amon Siphon and Pumping Plant also draw water from the end of KID Main Canal Division III. Amon Pumping Plant spills water into Amon Wasteway when the pump drive water exceeds the flow needed by the Highland Feeder Canal. The Amon Pumping Plant was designed for a maximum of 148 cfs spill into the wasteway. Amon Pumping Plant drawings, schematic (Drawing 33-155-348) and photos are attached. Amon Wasteway flows north to the Yakima River; see the attached aerial photograph, Drawing 33-155-347. The same drainage way is also referred to as Leslie Drain and Amon Creek downstream (north) of Clodfelter Road. The drainage way is approximately 6 miles long. In addition to spills, natural flow and irrigation return flow come into Leslie Drain via tributary channels and springs between Clodfelter Road and Gage Pumping Plant. The Amon Wasteway is not only used for Division III Canal and Amon Pumping Plant operational spills, but also carries KID water to Gage Pumping Plant. Gage Pumping Plant serves 2100.35 acre-ft to fifteen Local Improvement Districts (LID's) off Leslie Drain. The Gage Pumping Plant consists of a single rotary screen and three vertical pumps. The three vertical pumps are rated 75, 100, and 125 hp. There is a 4-5 ft high check structure with one gate in Leslie Drain to provide turnout head to the pumps. The Gage Pumping Plant can draw 3820 gpm (8.5 cfs), and serves 600.1 acres, and was completed in 1992.

The best information on Amon Wasteway operational spills, was included in the June 1999 <u>KID Water Conservation Plan</u>. The report showed spills to be 19,060 acre-ft in 1986, and spill records from 1980 to 1990 of similar amounts. The report indicated that these spills could be substantially reduced with a pumped water exchange system. In order to substantiate this number, the Bureau of Reclamation and KID contracted with SCM Consultants, Inc, from Kennewick, WA, to monitor Amon Wasteway spill downstream of Amon Pump Wasteway at an established gaging station. The wasteway was monitored during the 2001 and 2002 irrigation seasons. The spills measured for 2001 and 2002 irrigation seasons were substantially less than the 19,060 acre-ft reported in the Water Conservation Plan.

Previous Studies by USGS and KID:

<u>Amon Wasteway USGS 1986 Flow Information</u>: Flow data collected by the USGS for the 1986 irrigation season used a gaging station in Amon Wasteway downstream of the Amon Pumping

Plant wasteway, and another gaging station at the confluence of Amon Wasteway with the Yakima River. The flows at the mouth were greater than those below Amon Pumping Plant in most cases. Most of the irrigation return flows come from Highland Feeder Canal 1.8 Lateral that enters a tributary just south of BNSF railroad and empties into the wasteway. Attached are graphs of USGS flow information for 1986.

KID Water Conservation Plan Operational Spill Data: KID operational spills for 1980 to 1990 are reported in the June 1999 KID Water Conservation Plan. The operational spill for Amon Wasteway in 1986 was measured by the USGS to be 19,060 acre-ft. This included 18,340 acre-ft from the Main Canal and 720 acre-ft from the Amon Pumping Plant. KID Water Conservation Plan reported an average spill into Amon Wasteway of 19,157 acre-ft for years 1980-1990. See attached pages 41, 42, and 92 and Table 3-3 from Conservation Plan. Attached KID report data also shows High Lift wasteway spills which flow into the lower reach of Amon Wasteway. Note that during the USGS and KID spill reporting years, KID was not diverting flows from Amon Wasteway for Gage Pumping Plant, LID 120 and Meadow Country Club and Golf Course lands. Thus reported spills were not rediverted for irrigation, but instead flowed to the mouth.

Amon Wasteway 2001 and 2002 Flow Measurement Devices:

Flow measurement in Amon Wasteway for the 2001 and 2002 irrigation seasons was accomplished by using a pressure transducer and datalogger installed in the existing stilling well located at the 1986 USGS gage site, downstream of the Amon Pumping Plant. The pressure transducer was installed in the existing stilling well at a known depth and reference to the existing staff gage. The board supporting the staff gage was replaced prior to the 2001 irrigation season. A Noshok Series 612 Submersible Pressure Transducer was used. The pressure transducer has a pressure range of 0 to 2 psi and an accuracy of 0.1% of full scale. The accuracy is equivalent to a depth measurement of 0.005 foot. The transducer was weighted and was suspended in the stilling well. A copy of the catalog cut sheet describing the transducer is attached. Data logging was accomplished by using a Logic Beach, Inc. Modulogger MNL-1. The datalogger ran on batteries and provided the loop power the pressure transducer requires. Power to the transducer was shutoff between measurements to save battery power. The MNL-1 took measurements every 15 minutes. Associated equipment used with the pressure transducer and data logger; were ML-300 Weatherproof Enclosure, ML-Batt Battery Pack and PSM-2 Sensor Excitation Power Supply.

Pressure/discharge relationships for the site were developed using a Pygmy current meter, wading rod, and other associated stream gaging equipment. Separate pressure/discharge curves were developed for 2001 and 2002 seasons, each with six/seven measurements taken at various flows. Equations used to develop each year's discharge curves are least squares fit for all measurements taken in the year. See Figure 1, Pressure vs. Flow 2001 & 2002, for the flow measurement points and developed pressure/discharge curves. Gaging took place immediately downstream from the stilling well where the channel was not undercutting the bank. June 24, 2001, due to low water surface the pressure transducer was above the water. SCM Consultants personnel modified the wasteway channel by moving rocks to raise the water surface level, 0.18 foot, to resubmerge the pressure transducer. Data prior to June 24, 2001 was considered

unreliable and is not used herein. Problems with shifting rocks that resulted in a lower water surface were also encountered in 2002 irrigation season.
In 2002, wasteway rock placed below the gage during the 2001 season was "blown out" by flushing flows at the beginning of the season. The attempt to rebuild a portion of the dam left a somewhat lower and more porous dam than that of the previous season. Thus the pressures are lower for flows in 2002 than they were in 2001, as shown on the pressure/discharge curves. During the 2002 season rocks from the rebuilt dam were also dislodged sometime between June and August, perhaps due to the high flow that occurred around June 10th. This is suspected because there are higher pressure readings in May for a given flow rate than those measurements completed in September and October. As a result the equation tends to calculate a higher flow rate than measured for the early 2002 season readings and a lower flow rate than measured for the late 2002 season readings.

Amon Pumping Plant spill was also monitored in 2002 and evaluated using the operator's log of flows for the Amon Pumping Plant 6-ft operational spill weir and wasteway gate. Flow rates were calculated using standard weir and orifice equations. Values were interpolated for weekends when measurements were not taken.

Results of 2001 and 2002 Measurements:

The 2001 irrigation season was a drought year (KID's water allocation was prorated and KID received 77% of its 100,274 acre-ft water right). Spill data is shown on a daily basis on Figure 2, Amon Wasteway Total Spill 2001. The total spill measured at the Amon wasteway gage from June 23-October 15, 2001 was 5,385 acre-ft. July 25 – August 4 data shows zero spills (See 2001 Spill Graph). Assuming this was due to gage malfunction, 10 cfs (180 ac-ft) has been added for this period. With this adjustment the 2001 spill was 5565 acre-ft. The average spill was 24.6 cfs for the 114 day period. If this average flow is extended for the full season it would give a total spill of 10,250 acre-ft.

The 2002 irrigation season was a normal water year (KID received 100% of 100,274 acre-ft). Spill data is shown on a daily basis on Figure 3, Amon Wasteway Total Spill 2002. The total spill measured at the Amon wasteway gage from June 23-October 15, 2002 was 5,945 acre-ft for average flow of 26 cfs. From April 26 to October 15 9,660 acre-ft was measured for an average spill of 27.5 cfs. If this flow is extended for the full season it would give a total spill of 12,000 acre-ft.

Also in 2002 the spill was measured from the Amon Pumping Plant over the 6' weir and the wasteway gate. See Figure 4, Amon Pump Spill & Wasteway Gate 2002 Irrigation Season, for daily Amon Pumping Plant spill. Amon Pumping Plant spill from April 1 to October 15, 2002 was 3826 acre-feet, for an average flow of 9.7 cfs. The 2002 spill from Division III Canal Spillway into Amon wasteway was calculated by subtracting the pump spill from total spill, giving 17.8 cfs, or 7,400 acre-ft for a full season.

1986, 2001 and 2002 KID Operational Spill Data at Amon Wasteway

Year	Measurement Period	Average Spill into Amon (measured)	Amon PP Spill Flow (measured)	Canal Spill Flow (calculated)	Full Season Spill (estimated)	Full Season Spill (estimated) Range ±20%
1986	3/15-10/15	44.5 cfs	1.7cfs	42.8	19,060 acre-ft	-
2001	6/23-10/15	24.6 cfs	-	-	10,250 acre-ft	8,540-12,300 acre-ft
2002	4/26-10/15	27.5 cfs	9.7 cfs	17.8 cfs	12,000 acre-ft	10,000-14,400 acre-ft

Conclusions:

The KID Amon wasteway spills measured in 2001 and 2002 are significantly less than the spills reported in the June 1999 KID Water Conservation Plan. Some of this difference may be attributable to gaging and data accuracy and varying portions of irrigation seasons for which data were collected. The margin of error for the measured flow for 2001 and 2002 irrigation seasons is between 10% to 20%. Margin of error for previous KID and USGS data is unknown. For the 2001 and 2002 irrigation seasons, the pressure transducer was placed in the same stilling well used by the USGS. The USGS had used a float recorder to measure flow in 1986. USGS measured the waterway flow in March 1986 and April 1987, months which were not included in our measuring seasons.

Another presumed reason for the decrease in spill is the district has grown increasingly urbanized in the last ten years. The increase in LID's has increased the number of water users in the district which has required the district to manage their use of water differently than in earlier years.

It is important to note that since 1992 part of the Amon spill is rediverted from Leslie Drain to serve 600.1 acres of KID land. On a per acre, entitlement basis; this requires approximately 2,100 acre-ft of the Amon Wasteway spill, in addition to a conveyance amount, to serve these KID lands.

It is also important to note that Amon spill is considered by some to be important to maintaining Amon Creek riparian and fish habitat in its lower reaches. Water quality is increasingly becoming an issue with the district trying to prevent *Acrolein* treatments from entering Amon Wasteway. The district will be testing a different more environmentally friendly chemical (*GreenClean* Aquatic Algaecide by BioSafe Systems) to treat algae in the future.

The pump exchange systems would provide much greater control of water at the end of KID Main Canal Division III, including capability to match flow and demand with no canal operational spills to Amon Wasteway. Amon Pumping Plant will continue to have operational spills, whenever the hydraulic pump drive flow exceeds the Highland Feeder Canal demand. It is reasonable to assume that with the pump exchange systems, Amon Wasteway flow could be regulated to meet irrigation and habitat flow requirements which may, or may not, be significantly less than the spills observed in 2001 and 2002.

ATTACHMENTS

Amon Wasteway Aerial Photo & Schematic of Irrigation Facilities

1	Amon Wasteway Aerial Photograph	Drawing 33-155-347
2	Amon Pumping Plant Detail	Drawing 33-155-348

Total Spill Data for Amon Wasteway 2001 & 2002 Irrigation Seasons

3	Pressure vs. Flow 2001 & 2002	Figure 1
4	Amon Wasteway Total Spill 2001	Figure 2
5	Amon Wasteway Total Spill 2002	Figure 3

Amon Pumping Plant Spill Data 2002 Irrigation Season

6	Amon Pump Spill & Wasteway Gate 2002 Irrigation Season	Figure 4

7 Amon Pumping Plant Wasteway Flow for 2002 Irrigation Season Spreadsheet

USGS and KID Data on Amon Wasteway 1980-1990

8 KID-Amon Wasteway Flows Below Pump USGS Records 1986-1987 Graph

9 Amon Wasteway Flows at Mouth USGS Records 1986-1987 Graph

10 Yakima River Diversions and Operational Spills are Averages for all Years of Record Table

11 Table 3-3 Diversion, Deliveries and Operational Spills, pg. 34-36, Table 3-6 Water Deliveries by Canal and Table 3-7 1986 Operational Spills pgs. 41, 42, 92. Kennewick Irrigation District Water Conservation Plan- Draft, June 1999, SCM Consultants.

Amon Wasteway Overflow Weir and Wasteway Structure Drawings and Photos

12	Amon Wasteway Overflow Weir and Wasteway Structure	Drawing No. 566-D-691
13	Amon Wasteway Overflow Weir and Wasteway Structure	Drawing No. 566-D-692

14 PHOTOGRAPHS

Photo No. 1: Overflow Weir/Spillway into Amon Wasteway at end of Division III Canal, looking downstream

Photo No. 2: Overflow Weir/Spillway into Amon Wasteway at end of Division III Canal, looking upstream

Photo No. 3: Overflow Weir/Spillway upstream gates into Amon Wasteway at end of Division III Canal, looking downstream

Photo No. 4: Amon Wasteway below Overflow Weir/Spillway at the end of Division III Canal, looking downstream

Amon Pumping Plant Drawings and Photos

15 Amon Pumping Plant General Arrangement Plans and Sections Drawing No. 566-D-536

16 PHOTOGRAPHS

Photo No. 5: Amon Pumping Plant, looking west
Photo No. 6: Amon Pumping Plant wasteway into Amon Wasteway, looking east
Photo No. 7: Amon Pumping Plant wasteway into Amon Wasteway, looking west
Photo No. 8: Amon Pumping Plant head gate into Highland Feeder Canal, looking north
Photo No. 9: Amon Pumping Plant, 6' overflow weir to wasteway chute
Photo No. 10: Amon Pumping Plant, 6' overflow weir staff gage
Photo No. 11: Amon Pumping Plant gate into wasteway chute

Amon Wasteway Gaging Station Photos and Equipment Specifications

17 PHOTOGRAPHS

Photo No. 12: Amon Wasteway, USGS gaging station, looking west
Photo No. 13: Amon Wasteway, USGS gaging station
Photo No. 14: Amon Wasteway, looking upstream from USGS gaging station
Photo No. 15: Amon Wasteway, looking downstream from USGS gaging station

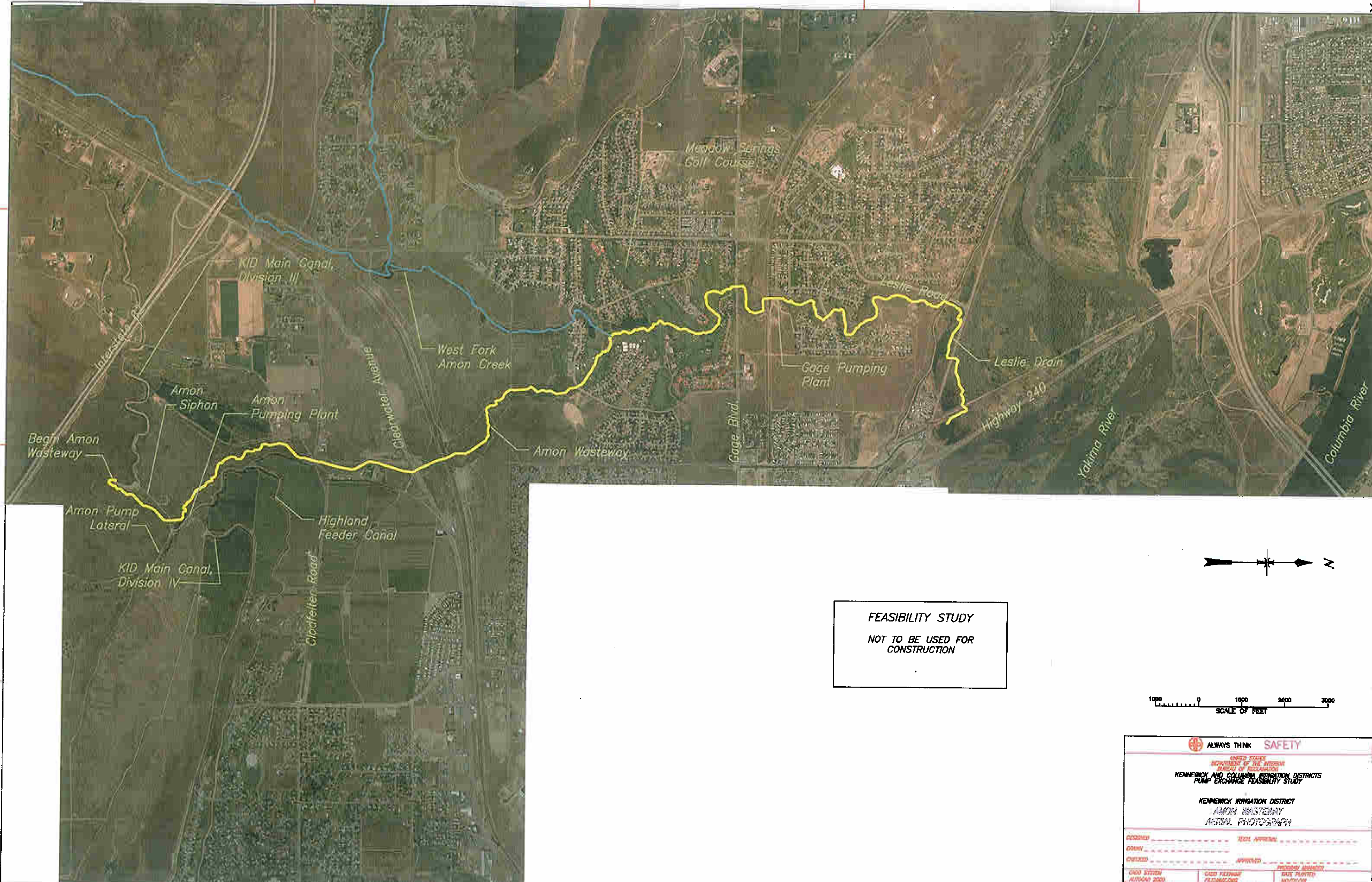
18 EQUIPMENT SPECIFICATIONS:
Pressure-Submersible Level Transducers
MNL Modulogger 'Mini' Data Logger

19 DRAFT DISTRIBUTION LETTER AND COMMENTS RECEIVED:

August 20, 2004, Draft distribution letter – internal review

AMON WASTEWAY

AERIAL PHOTO
AND
SCHEMATIC OF IRRIGATION FACILITIES



FEASIBILITY STUDY

NOT TO BE USED FOR CONSTRUCTION

1000 0 1000 2000 3000
SCALE OF FEET

ALWAYS THINK SAFETY

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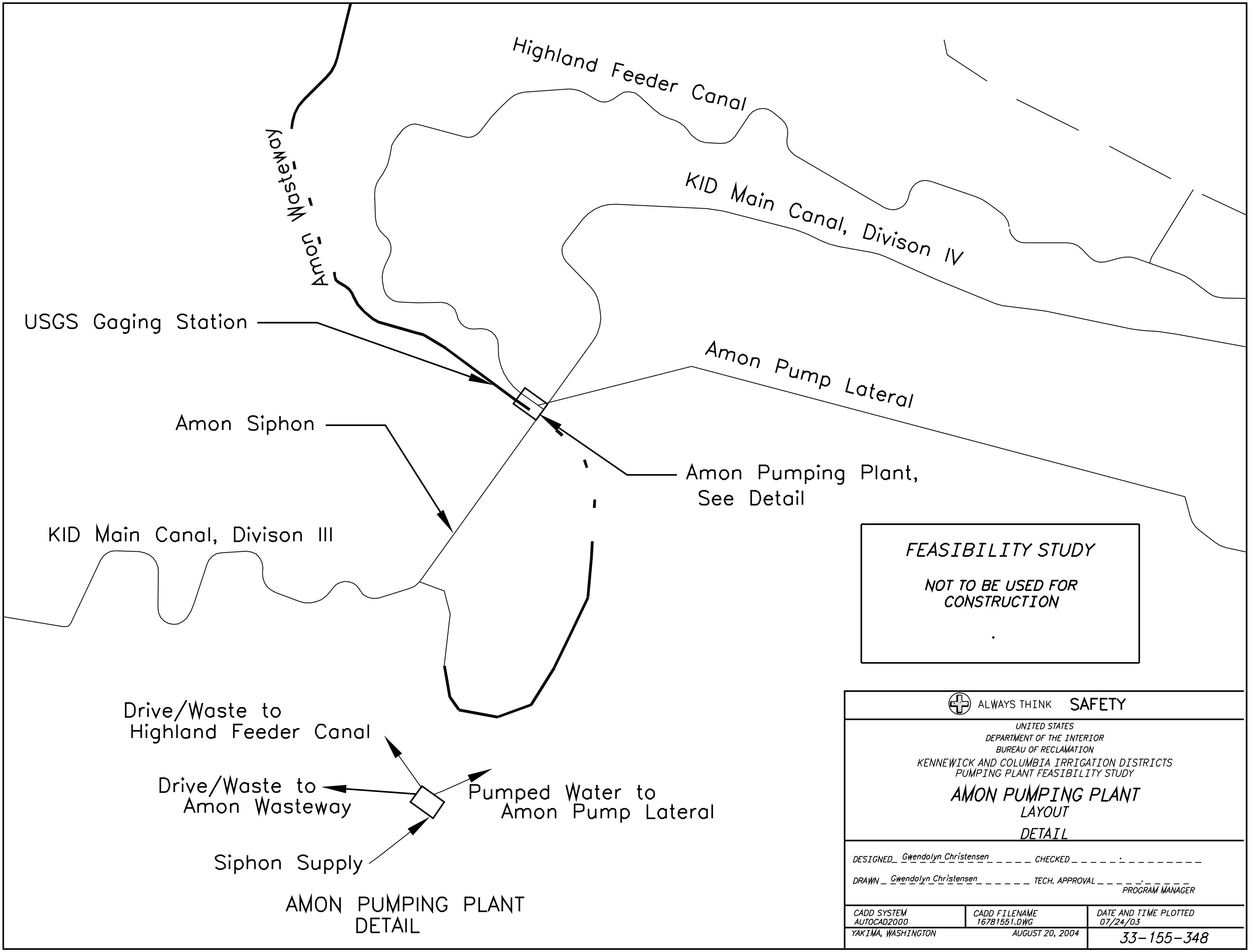
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KENNEWICK AND COLUMBIA IRRIGATION DISTRICTS
PUMP EXCHANGE FEASIBILITY STUDY

KENNEWICK IRRIGATION DISTRICT
AMON WASTEWAY
AERIAL PHOTOGRAPH

33-155-347



Highland Feeder Canal
KID Main Canal, Divison IV
Amon Wasteway
USGS Gaging Station
Amon Pump Lateral
Amon Siphon
Amon Pumping Plant, See Detail
KID Main Canal, Divison III
FEASIBILITY STUDY
NOT TO BE USED FOR CONSTRUCTION
Drive/Waste to Highland Feeder Canal
Drive/Waste to Amon Wasteway
Pumped Water to Amon Pump Lateral
Siphon Supply
AMON PUMPING PLANT DETAIL
ALWAYS THINK SAFETY
UNITED STATES
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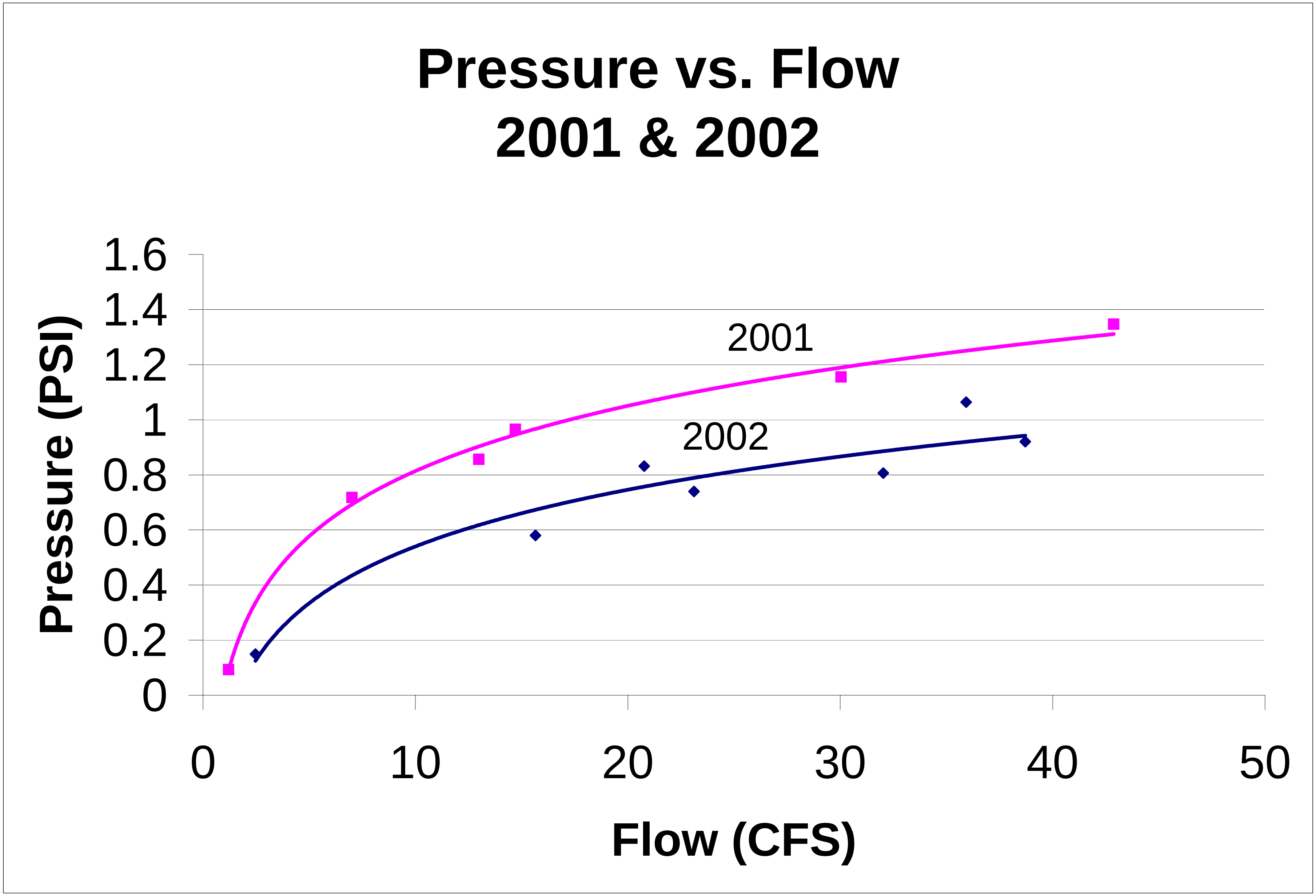
BUREAU OF RECLAMATION
KENNEWICK AND COLUMBIA IRRIGATION DISTRICTS
PUMPING PLANT FEASIBILITY STUDY
AMON PUMPING PLANT
LAYOUT
DETAIL
DESIGNED Gwendolyn Christensen
CHECKED
DRAWN Gwendolyn Christensen
TECH. APPROVAL
PROGRAM MANAGER
CADD SYSTEM AUTOCAD2000
CADD FILENAME 16781551.DWG
DATE AND TIME PLOTTED 07/24/03
YAKIMA, WASHINGTON
AUGUST 20, 2004
33-155-348

TOTAL SPILL DATA
FOR
AMON WASTEWAY

2001 AND 2002
IRRIGATION SEASONS



Pressure vs. Flow
2001 & 2002
Pressure (PSI)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2001
2002
0
10
20
30
40
50
Flow (CFS)

FIGURE 1

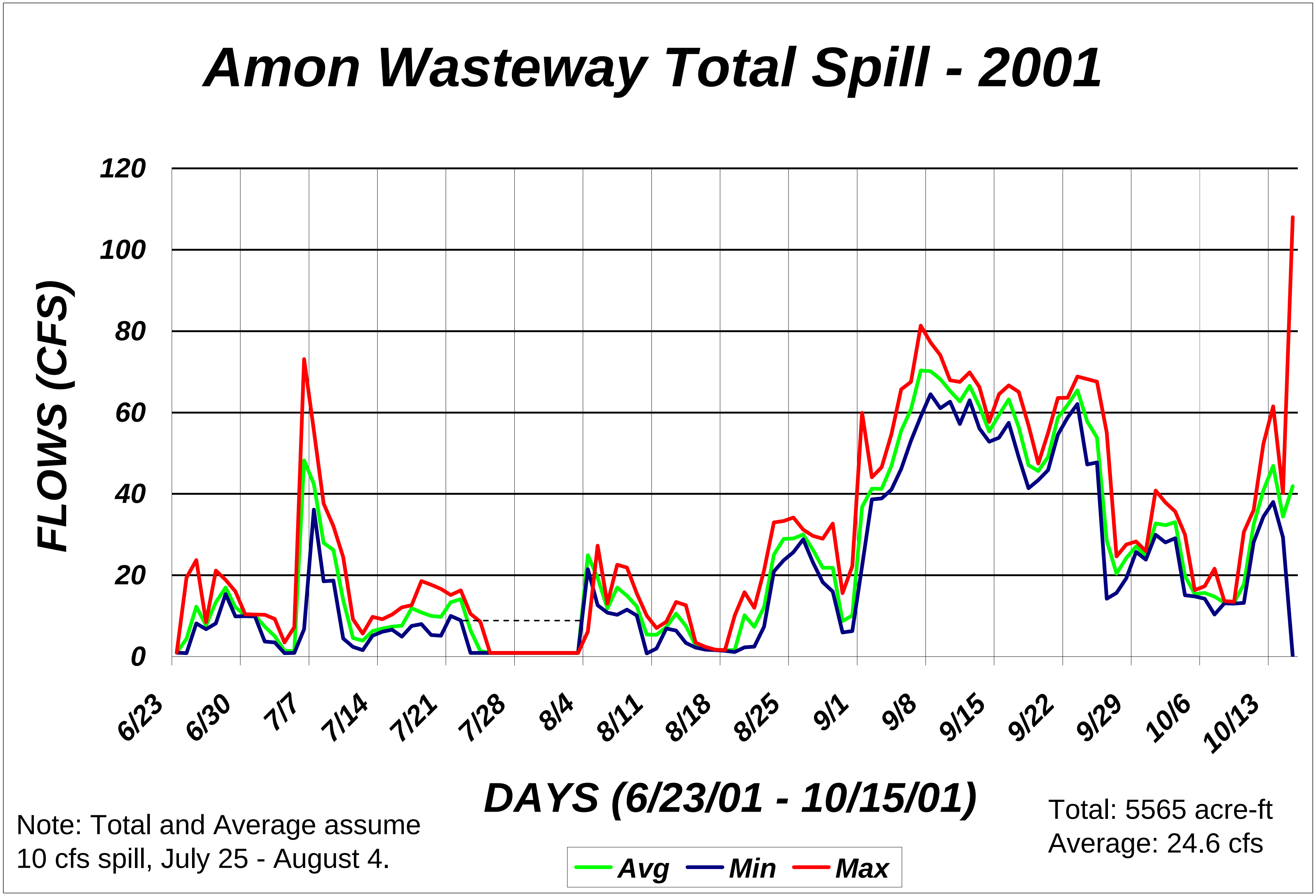

Amon Wasteway Total Spill - 2001
FLOWS (CFS)
120
100
80
60
40
20
0
6/23
6/30
7/7
7/14
7/21
7/28
8/4
8/11
8/18
8/25
9/1
9/8
9/15
9/22
9/29
10/6
10/13
DAYS (6/23/01 - 10/15/01)
Note: Total and Average assume
10 cfs spill, July 25 - August 4.
Total: 5565 acre-ft
Average: 24.6 cfs
Avg
Min
Max

FIGURE 2

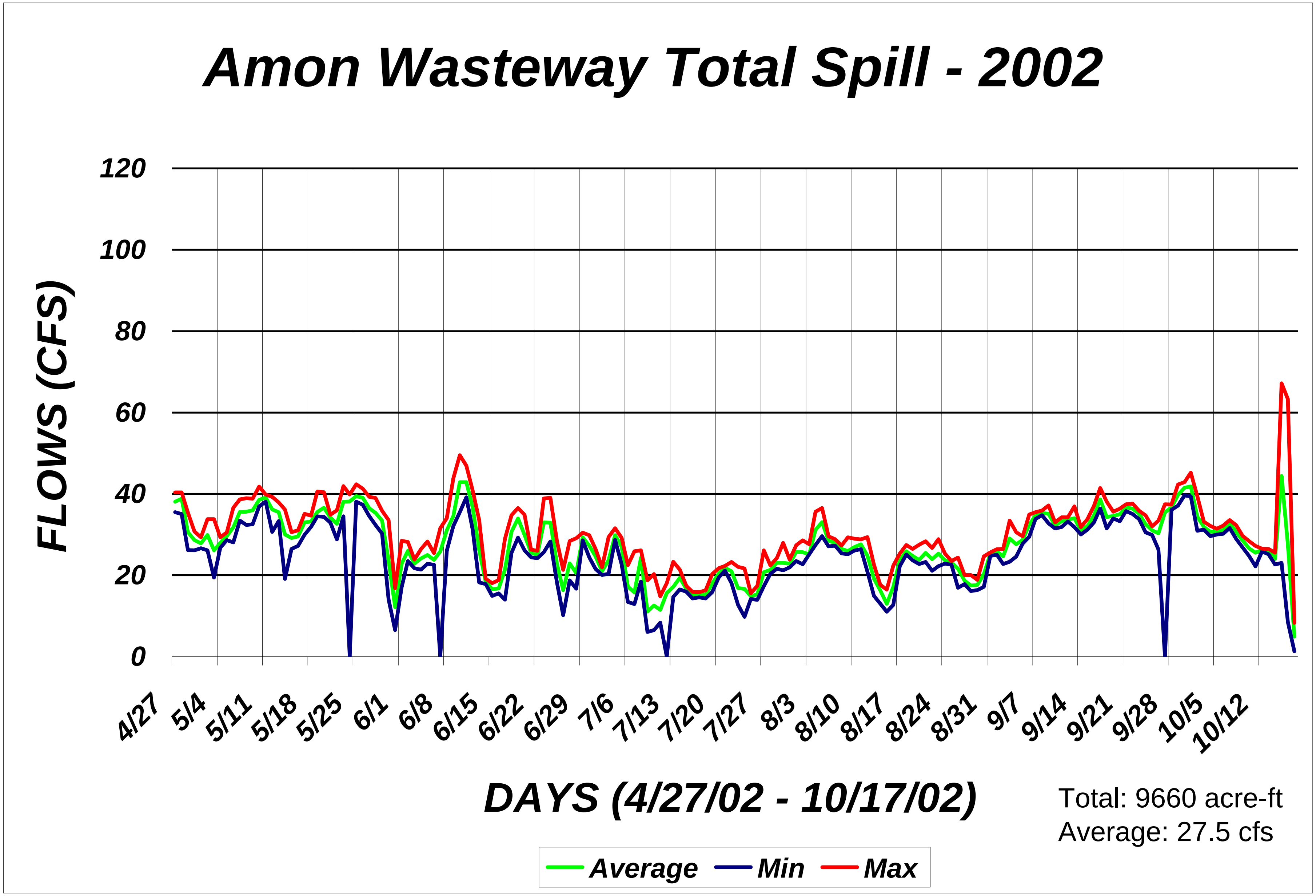


FIGURE 3

12/15/2004

AMON PUMPING PLANT SPILL DATA

2002 IRRIGATION SEASON

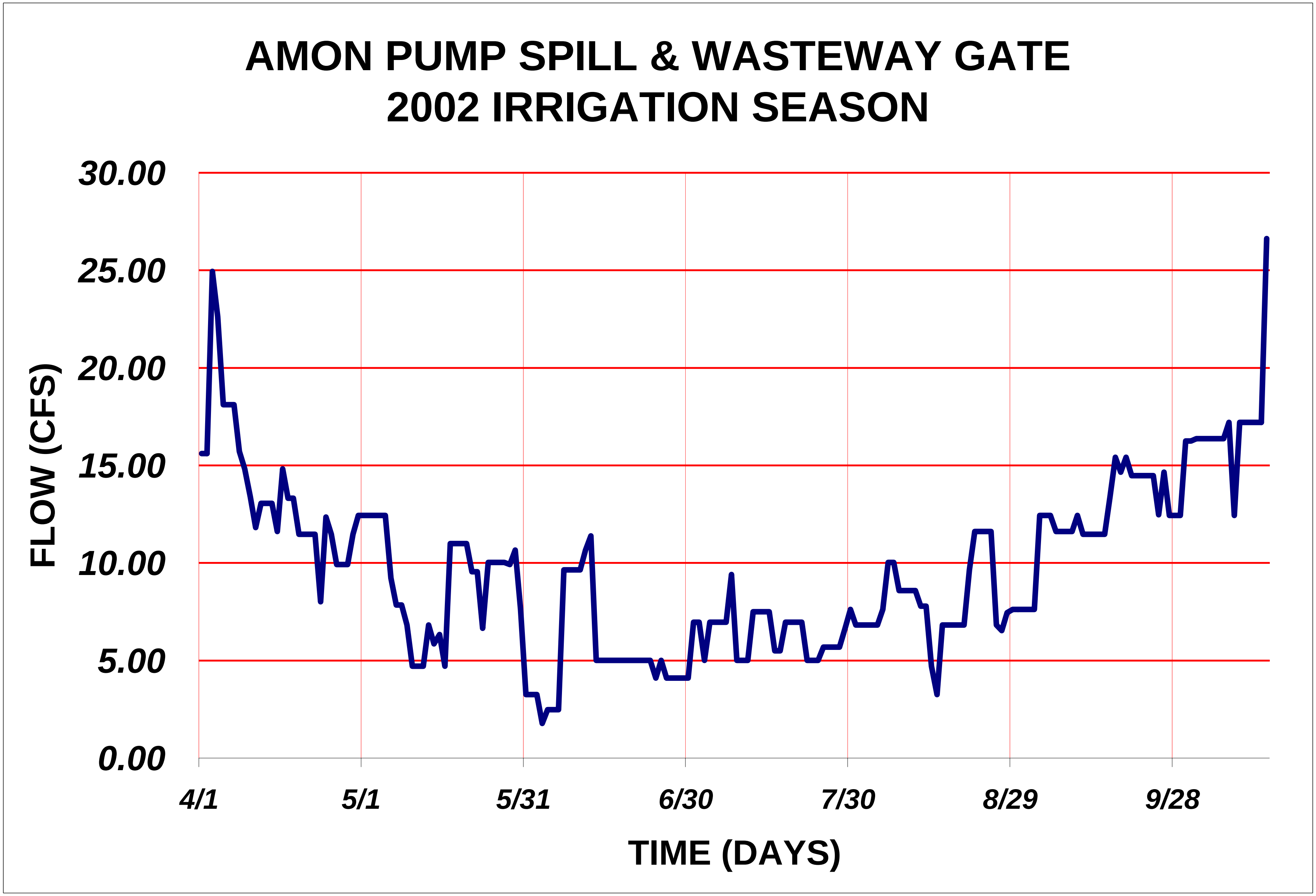


FIGURE 4

12/15/2004

Amon Pumping Plant Wasteway Flow 4/29/2003
For 2002 Irrigation Season

Gate									6' Weir				
Date	Stem	Verticle Gate Opening	Horizontal Gate Opening	Open Area	Head on 6' Weir	W.S. to Center Opening Height (h)	Q		Height (h)	Length	Q		Q total
	ft	ft	ft	sf	ft	ft	cfs		ft	ft	cfs		cfs
1-Apr	0.5	0.29	3.5	1.015	0.2	5.885	13.83185		0.2	6	1.77		15.60
2-Apr	0.5	0.29	3.5	1.015	0.2	5.885	13.83185		0.2	6	1.77		15.60
3-Apr	0.7	0.49	3.5	1.715	0.2	5.785	23.17164		0.2	6	1.77		24.94
4-Apr	0.65	0.44	3.5	1.54	0.2	5.81	20.8521		0.2	6	1.77		22.62
5-Apr	0.5	0.29	3.5	1.015	0.35	6.035	14.00702		0.35	6	4.10		18.11
6-Apr	0.5	0.29	3.5	1.015	0.35	6.035	14.00702	*	0.35	6	4.10		18.11
7-Apr	0.5	0.29	3.5	1.015	0.35	6.035	14.00702	*	0.35	6	4.10		18.11
8-Apr	0.45	0.24	3.5	0.84	0.35	6.06	11.616		0.35	6	4.10		15.72
9-Apr	0.45	0.24	3.5	0.84	0.3	6.01	11.56798		0.3	6	3.25		14.82
10-Apr	0.42	0.21	3.5	0.735	0.3	6.025	10.13461		0.3	6	3.25		13.39
11-Apr	0.42	0.21	3.5	0.735	0.2	5.925	10.05015		0.2	6	1.77		11.82
12-Apr	0.42	0.21	3.5	0.735	0.28	6.005	10.11777		0.28	6	2.93		13.05
13-Apr	0.42	0.21	3.5	0.735	0.28	6.005	10.11777	*	0.28	6	2.93		13.05
14-Apr	0.42	0.21	3.5	0.735	0.28	6.005	10.11777	*	0.28	6	2.93		13.05
15-Apr	0.4	0.19	3.5	0.665	0.25	5.985	9.138916		0.25	6	2.48		11.61
16-Apr	0.45	0.24	3.5	0.84	0.3	6.01	11.56798		0.3	6	3.25		14.82
17-Apr	0.4	0.19	3.5	0.665	0.35	6.085	9.214948		0.35	6	4.10		13.31
18-Apr	0.4	0.19	3.5	0.665	0.35	6.085	9.214948		0.35	6	4.10		13.31
19-Apr	0.38	0.17	3.5	0.595	0.3	6.045	8.21781		0.3	6	3.25		11.47
20-Apr	0.38	0.17	3.5	0.595	0.3	6.045	8.21781	*	0.3	6	3.25		11.47
21-Apr	0.38	0.17	3.5	0.595	0.3	6.045	8.21781	*	0.3	6	3.25		11.47
22-Apr	0.38	0.17	3.5	0.595	0.3	6.045	8.21781		0.3	6	3.25		11.47
23-Apr	0.38	0.17	3.5	0.595	0	5.745	8.011299		0	6	0.00		8.01
24-Apr	0.38	0.17	3.5	0.595	0.35	6.095	8.251726		0.35	6	4.10		12.35
25-Apr	0.38	0.17	3.5	0.595	0.3	6.045	8.21781		0.3	6	3.25		11.47
26-Apr	0.38	0.17	3.5	0.595	0.2	5.945	8.149555		0.2	6	1.77		9.92
27-Apr	0.38	0.17	3.5	0.595	0.2	5.945	8.149555	*	0.2	6	1.77		9.92
28-Apr	0.38	0.17	3.5	0.595	0.2	5.945	8.149555	*	0.2	6	1.77		9.92
29-Apr	0.38	0.17	3.5	0.595	0.3	6.045	8.21781		0.3	6	3.25		11.47
30-Apr	0.4	0.19	3.5	0.665	0.3	6.035	9.177011		0.3	6	3.25		12.43

1-May	0.4	0.19	3.5	0.665	0.3	6.035	9.177011		0.3	6	3.25		12.43
2-May	0.4	0.19	3.5	0.665	0.3	6.035	9.177011		0.3	6	3.25		12.43
3-May	0.4	0.19	3.5	0.665	0.3	6.035	9.177011		0.3	6	3.25		12.43
4-May	0.4	0.19	3.5	0.665	0.3	6.035	9.177011		0.3	6	3.25		12.43
5-May	0.4	0.19	3.5	0.665	0.3	6.035	9.177011		0.3	6	3.25		12.43
6-May	0.35	0.14	3.5	0.49	0.25	6.01	6.747988		0.25	6	2.48		9.22
7-May	0.35	0.14	3.5	0.49	0.15	5.91	6.691613		0.15	6	1.15		7.84
8-May	0.35	0.14	3.5	0.49	0.15	5.91	6.691613		0.15	6	1.15		7.84
9-May	0.3	0.09	3.5	0.315	0.25	6.035	4.347005		0.25	6	2.48		6.82
10-May	0.24	0.03	3.5	0.105	0.3	6.115	1.458574		0.3	6	3.25		4.71
11-May	0.24	0.03	3.5	0.105	0.3	6.115	1.458574		0.3	6	3.25		4.71
12-May	0.24	0.03	3.5	0.105	0.3	6.115	1.458574		0.3	6	3.25		4.71
13-May	0.3	0.09	3.5	0.315	0.25	6.035	4.347005		0.25	6	2.48		6.82
14-May	0.28	0.07	3.5	0.245	0.25	6.045	3.383804		0.25	6	2.48		5.86
15-May	0.28	0.07	3.5	0.245	0.28	6.075	3.39219		0.28	6	2.93		6.33
16-May	0.24	0.03	3.5	0.105	0.3	6.115	1.458574		0.3	6	3.25		4.71
17-May	0.37	0.16	3.5	0.56	0.3	6.05	7.737607		0.3	6	3.25		10.99
18-May	0.37	0.16	3.5	0.56	0.3	6.05	7.737607		0.3	6	3.25		10.99
19-May	0.37	0.16	3.5	0.56	0.3	6.05	7.737607		0.3	6	3.25		10.99
20-May	0.37	0.16	3.5	0.56	0.3	6.05	7.737607		0.3	6	3.25		10.99
21-May	0.34	0.13	3.5	0.455	0.3	6.065	6.294595		0.3	6	3.25		9.55
22-May	0.34	0.13	3.5	0.455	0.3	6.065	6.294595		0.3	6	3.25		9.55
23-May	0.28	0.07	3.5	0.245	0.3	6.095	3.397769		0.3	6	3.25		6.65
24-May	0.35	0.14	3.5	0.49	0.3	6.06	6.776		0.3	6	3.25		10.03
25-May	0.35	0.14	3.5	0.49	0.3	6.06	6.776		0.3	6	3.25		10.03
26-May	0.35	0.14	3.5	0.49	0.3	6.06	6.776		0.3	6	3.25		10.03
27-May	0.35	0.14	3.5	0.49	0.3	6.06	6.776		0.3	6	3.25		10.03
28-May	0.38	0.17	3.5	0.595	0.2	5.945	8.149555		0.2	6	1.77		9.92
29-May	0.38	0.17	3.5	0.595	0.25	5.995	8.183753		0.25	6	2.48		10.66
30-May	0.3	0.09	3.5	0.315	0.3	6.085	4.364976		0.3	6	3.25		7.62
31-May	0.16	-0.05	3.5	-0.175	0.3	6.155	0		0.3	6	3.25		3.25
1-Jun	0.16	-0.05	3.5	-0.175	0.3	6.155	0		0.3	6	3.25		3.25
2-Jun	0.16	-0.05	3.5	-0.175	0.3	6.155	0		0.3	6	3.25		3.25
3-Jun	0.1	-0.11	3.5	-0.385	0.2	6.085	0		0.2	6	1.77		1.77
4-Jun	0.2	-0.01	3.5	-0.035	0.25	6.085	0		0.25	6	2.48		2.48
5-Jun	0.2	-0.01	3.5	-0.035	0.25	6.085	0		0.25	6	2.48		2.48
6-Jun	0.2	-0.01	3.5	-0.035	0.25	6.085	0		0.25	6	2.48		2.48
7-Jun	0.4	0.19	3.5	0.665	0.1	5.835	9.023667		0.1	6	0.63		9.65
8-Jun	0.4	0.19	3.5	0.665	0.1	5.835	9.023667	*	0.1	6	0.63		9.65
9-Jun	0.4	0.19	3.5	0.665	0.1	5.835	9.023667	*	0.1	6	0.63		9.65

10-Jun	0.4	0.19	3.5	0.665	0.1	5.835	9.023667		0.1	6	0.63		9.65
11-Jun	0.38	0.17	3.5	0.595	0.25	5.995	8.183753		0.25	6	2.48		10.66
12-Jun	0.36	0.15	3.5	0.525	0.35	6.105	7.286905		0.35	6	4.10		11.39
13-Jun	0.1	-0.11	3.5	-0.385	0.4	6.285	0		0.4	6	5.01		5.01
14-Jun	0.1	-0.11	3.5	-0.385	0.4	6.285	0		0.4	6	5.01		5.01
15-Jun	0.1	-0.11	3.5	-0.385	0.4	6.285	0	*	0.4	6	5.01		5.01
16-Jun	0.1	-0.11	3.5	-0.385	0.4	6.285	0	*	0.4	6	5.01		5.01
17-Jun	0.1	-0.11	3.5	-0.385	0.4	6.285	0		0.4	6	5.01		5.01
18-Jun	0.1	-0.11	3.5	-0.385	0.4	6.285	0		0.4	6	5.01		5.01
19-Jun	0.1	-0.11	3.5	-0.385	0.4	6.285	0		0.4	6	5.01		5.01
20-Jun	0.1	-0.11	3.5	-0.385	0.4	6.285	0		0.4	6	5.01		5.01
21-Jun	0.1	-0.11	3.5	-0.385	0.4	6.285	0		0.4	6	5.01		5.01
22-Jun	0.1	-0.11	3.5	-0.385	0.4	6.285	0	*	0.4	6	5.01		5.01
23-Jun	0.1	-0.11	3.5	-0.385	0.4	6.285	0	*	0.4	6	5.01		5.01
24-Jun	0.1	-0.11	3.5	-0.385	0.35	6.235	0		0.35	6	4.10		4.10
25-Jun	0	-0.21	3.5	-0.735	0.4	6.335	0		0.4	6	5.01		5.01
26-Jun	0	-0.21	3.5	-0.735	0.35	6.285	0		0.35	6	4.10		4.10
27-Jun	0	-0.21	3.5	-0.735	0.35	6.285	0		0.35	6	4.10		4.10
28-Jun	0	-0.21	3.5	-0.735	0.35	6.285	0		0.35	6	4.10		4.10
29-Jun	0	-0.21	3.5	-0.735	0.35	6.285	0	*	0.35	6	4.10		4.10
30-Jun	0	-0.21	3.5	-0.735	0.35	6.285	0	*	0.35	6	4.10		4.10
1-Jul	0.25	0.04	3.5	0.14	0.4	6.21	1.959814		0.4	6	5.01		6.97
2-Jul	0.25	0.04	3.5	0.14	0.4	6.21	1.959814		0.4	6	5.01		6.97
3-Jul	0.2	-0.01	3.5	-0.035	0.4	6.235	0		0.4	6	5.01		5.01
4-Jul	0.25	0.04	3.5	0.14	0.4	6.21	1.959814		0.4	6	5.01		6.97
5-Jul	0.25	0.04	3.5	0.14	0.4	6.21	1.959814		0.4	6	5.01		6.97
6-Jul	0.25	0.04	3.5	0.14	0.4	6.21	1.959814	*	0.4	6	5.01		6.97
7-Jul	0.25	0.04	3.5	0.14	0.4	6.21	1.959814	*	0.4	6	5.01		6.97
8-Jul	0.3	0.09	3.5	0.315	0.4	6.185	4.400696		0.4	6	5.01		9.41
9-Jul	0	-0.21	3.5	-0.735	0.4	6.335	0		0.4	6	5.01		5.01
10-Jul	0	-0.21	3.5	-0.735	0.4	6.335	0		0.4	6	5.01		5.01
11-Jul	0	-0.21	3.5	-0.735	0.4	6.335	0		0.4	6	5.01		5.01
12-Jul	0.22	0.01	3.5	0.035	0.5	6.325	0.494469		0.5	6	7.00		7.49
13-Jul	0.22	0.01	3.5	0.035	0.5	6.325	0.494469		0.5	6	7.00		7.49
14-Jul	0.22	0.01	3.5	0.035	0.5	6.325	0.494469		0.5	6	7.00		7.49
15-Jul	0.22	0.01	3.5	0.035	0.5	6.325	0.494469		0.5	6	7.00		7.49
16-Jul	0.22	0.01	3.5	0.035	0.4	6.225	0.490545		0.4	6	5.01		5.50
17-Jul	0.22	0.01	3.5	0.035	0.4	6.225	0.490545		0.4	6	5.01		5.50
18-Jul	0.25	0.04	3.5	0.14	0.4	6.21	1.959814		0.4	6	5.01		6.97
19-Jul	0.25	0.04	3.5	0.14	0.4	6.21	1.959814		0.4	6	5.01		6.97

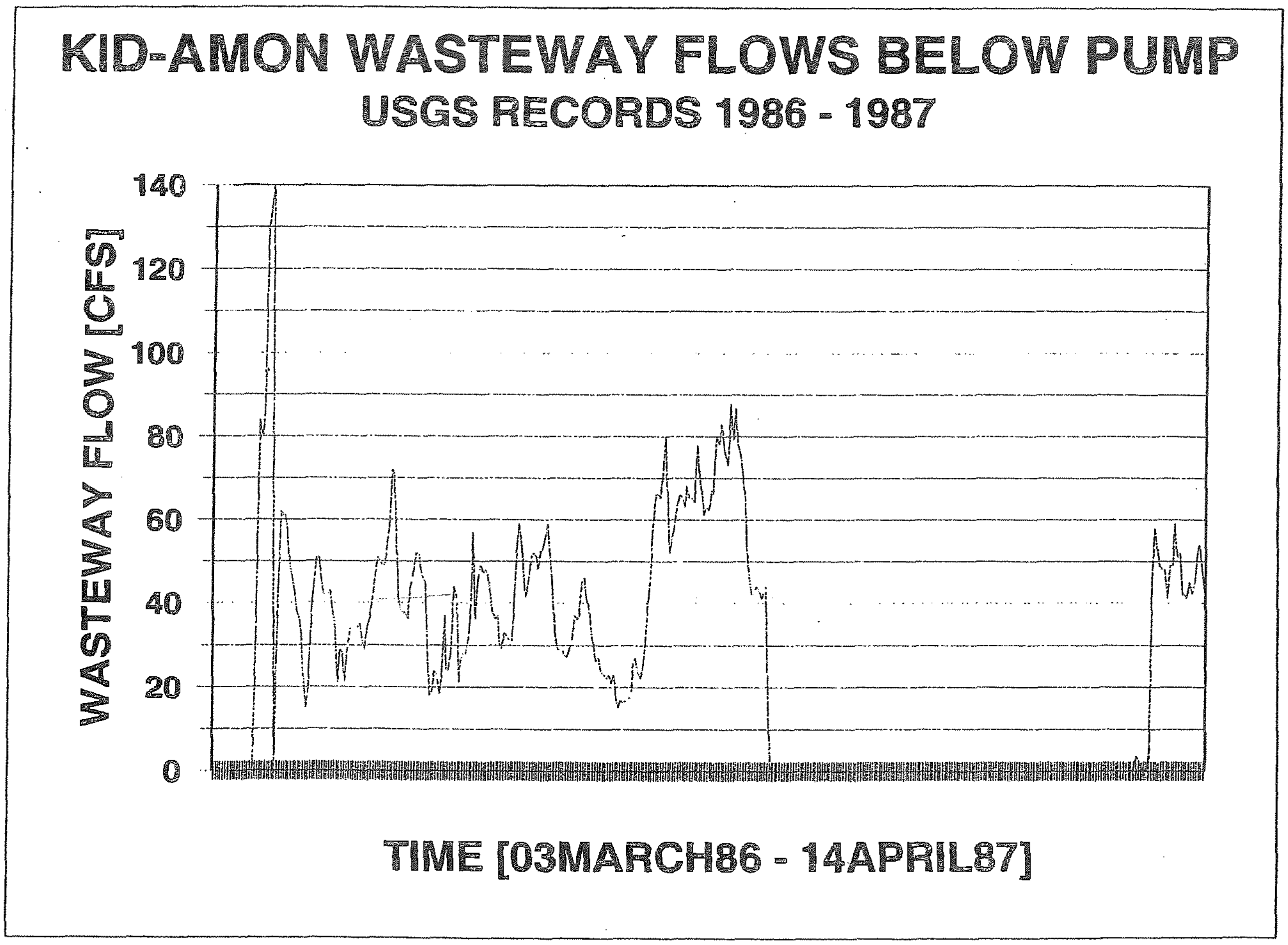
20-Jul	0.25	0.04	3.5	0.14	0.4	6.21	1.959814		0.4	6	5.01		6.97
21-Jul	0.25	0.04	3.5	0.14	0.4	6.21	1.959814		0.4	6	5.01		6.97
22-Jul	0.2	-0.01	3.5	-0.035	0.4	6.235	0		0.4	6	5.01		5.01
23-Jul	0.2	-0.01	3.5	-0.035	0.4	6.235	0		0.4	6	5.01		5.01
24-Jul	0	-0.21	3.5	-0.735	0.4	6.335	0		0.4	6	5.01		5.01
25-Jul	0.26	0.05	3.5	0.175	0.3	6.105	2.428968		0.3	6	3.25		5.68
26-Jul	0.26	0.05	3.5	0.175	0.3	6.105	2.428968		0.3	6	3.25		5.68
27-Jul	0.26	0.05	3.5	0.175	0.3	6.105	2.428968		0.3	6	3.25		5.68
28-Jul	0.26	0.05	3.5	0.175	0.3	6.105	2.428968		0.3	6	3.25		5.68
29-Jul	0.28	0.07	3.5	0.245	0.3	6.095	3.397769		0.3	6	3.25		6.65
30-Jul	0.3	0.09	3.5	0.315	0.3	6.085	4.364976		0.3	6	3.25		7.62
31-Jul	0.3	0.09	3.5	0.315	0.25	6.035	4.347005		0.25	6	2.48		6.82
1-Aug	0.3	0.09	3.5	0.315	0.25	6.035	4.347005		0.25	6	2.48		6.82
2-Aug	0.3	0.09	3.5	0.315	0.25	6.035	4.347005		0.25	6	2.48		6.82
3-Aug	0.3	0.09	3.5	0.315	0.25	6.035	4.347005		0.25	6	2.48		6.82
4-Aug	0.3	0.09	3.5	0.315	0.25	6.035	4.347005		0.25	6	2.48		6.82
5-Aug	0.3	0.09	3.5	0.315	0.3	6.085	4.364976		0.3	6	3.25		7.62
6-Aug	0.35	0.14	3.5	0.49	0.3	6.06	6.776		0.3	6	3.25		10.03
7-Aug	0.35	0.14	3.5	0.49	0.3	6.06	6.776		0.3	6	3.25		10.03
8-Aug	0.32	0.11	3.5	0.385	0.3	6.075	5.330585		0.3	6	3.25		8.58
9-Aug	0.32	0.11	3.5	0.385	0.3	6.075	5.330585		0.3	6	3.25		8.58
10-Aug	0.32	0.11	3.5	0.385	0.3	6.075	5.330585		0.3	6	3.25		8.58
11-Aug	0.32	0.11	3.5	0.385	0.3	6.075	5.330585		0.3	6	3.25		8.58
12-Aug	0.32	0.11	3.5	0.385	0.25	6.025	5.308603		0.25	6	2.48		7.78
13-Aug	0.32	0.11	3.5	0.385	0.25	6.025	5.308603		0.25	6	2.48		7.78
14-Aug	0.24	0.03	3.5	0.105	0.3	6.115	1.458574		0.3	6	3.25		4.71
15-Aug	0.2	-0.01	3.5	-0.035	0.3	6.135	0		0.3	6	3.25		3.25
16-Aug	0.3	0.09	3.5	0.315	0.25	6.035	4.347005		0.25	6	2.48		6.82
17-Aug	0.3	0.09	3.5	0.315	0.25	6.035	4.347005		0.25	6	2.48		6.82
18-Aug	0.3	0.09	3.5	0.315	0.25	6.035	4.347005		0.25	6	2.48		6.82
19-Aug	0.3	0.09	3.5	0.315	0.25	6.035	4.347005		0.25	6	2.48		6.82
20-Aug	0.3	0.09	3.5	0.315	0.25	6.035	4.347005		0.25	6	2.48		6.82
21-Aug	0.4	0.19	3.5	0.665	0.1	5.835	9.023667		0.1	6	0.63		9.65
22-Aug	0.4	0.19	3.5	0.665	0.25	5.985	9.138916		0.25	6	2.48		11.61
23-Aug	0.4	0.19	3.5	0.665	0.25	5.985	9.138916		0.25	6	2.48		11.61
24-Aug	0.4	0.19	3.5	0.665	0.25	5.985	9.138916		0.25	6	2.48		11.61
25-Aug	0.4	0.19	3.5	0.665	0.25	5.985	9.138916		0.25	6	2.48		11.61
26-Aug	0.3	0.09	3.5	0.315	0.25	6.035	4.347005		0.25	6	2.48		6.82
27-Aug	0.26	0.05	3.5	0.175	0.35	6.155	2.438895		0.35	6	4.10		6.54
28-Aug	0.26	0.05	3.5	0.175	0.4	6.205	2.448781		0.4	6	5.01		7.46

29-Aug	0.3	0.09	3.5	0.315	0.3	6.085	4.364976		0.3	6	3.25		7.62
30-Aug	0.3	0.09	3.5	0.315	0.3	6.085	4.364976		0.3	6	3.25		7.62
31-Aug	0.3	0.09	3.5	0.315	0.3	6.085	4.364976		0.3	6	3.25		7.62
1-Sep	0.3	0.09	3.5	0.315	0.3	6.085	4.364976		0.3	6	3.25		7.62
2-Sep	0.3	0.09	3.5	0.315	0.3	6.085	4.364976		0.3	6	3.25		7.62
3-Sep	0.4	0.19	3.5	0.665	0.3	6.035	9.177011		0.3	6	3.25		12.43
4-Sep	0.4	0.19	3.5	0.665	0.3	6.035	9.177011		0.3	6	3.25		12.43
5-Sep	0.4	0.19	3.5	0.665	0.3	6.035	9.177011		0.3	6	3.25		12.43
6-Sep	0.4	0.19	3.5	0.665	0.25	5.985	9.138916		0.25	6	2.48		11.61
7-Sep	0.4	0.19	3.5	0.665	0.25	5.985	9.138916		0.25	6	2.48		11.61
8-Sep	0.4	0.19	3.5	0.665	0.25	5.985	9.138916		0.25	6	2.48		11.61
9-Sep	0.4	0.19	3.5	0.665	0.25	5.985	9.138916		0.25	6	2.48		11.61
10-Sep	0.4	0.19	3.5	0.665	0.3	6.035	9.177011		0.3	6	3.25		12.43
11-Sep	0.38	0.17	3.5	0.595	0.3	6.045	8.21781		0.3	6	3.25		11.47
12-Sep	0.38	0.17	3.5	0.595	0.3	6.045	8.21781		0.3	6	3.25		11.47
13-Sep	0.38	0.17	3.5	0.595	0.3	6.045	8.21781		0.3	6	3.25		11.47
14-Sep	0.38	0.17	3.5	0.595	0.3	6.045	8.21781		0.3	6	3.25		11.47
15-Sep	0.38	0.17	3.5	0.595	0.3	6.045	8.21781		0.3	6	3.25		11.47
16-Sep	0.42	0.21	3.5	0.735	0.3	6.025	10.13461		0.3	6	3.25		13.39
17-Sep	0.48	0.27	3.5	0.945	0.25	5.945	12.94341		0.25	6	2.48		15.42
18-Sep	0.48	0.27	3.5	0.945	0.2	5.895	12.88887		0.2	6	1.77		14.66
19-Sep	0.48	0.27	3.5	0.945	0.25	5.945	12.94341		0.25	6	2.48		15.42
20-Sep	0.46	0.25	3.5	0.875	0.25	5.955	11.99471		0.25	6	2.48		14.47
21-Sep	0.46	0.25	3.5	0.875	0.25	5.955	11.99471		0.25	6	2.48		14.47
22-Sep	0.46	0.25	3.5	0.875	0.25	5.955	11.99471		0.25	6	2.48		14.47
23-Sep	0.46	0.25	3.5	0.875	0.25	5.955	11.99471		0.25	6	2.48		14.47
24-Sep	0.46	0.25	3.5	0.875	0.25	5.955	11.99471		0.25	6	2.48		14.47
25-Sep	0.46	0.25	3.5	0.875	0.1	5.805	11.84268		0.1	6	0.63		12.47
26-Sep	0.48	0.27	3.5	0.945	0.2	5.895	12.88887		0.2	6	1.77		14.66
27-Sep	0.4	0.19	3.5	0.665	0.3	6.035	9.177011		0.3	6	3.25		12.43
28-Sep	0.4	0.19	3.5	0.665	0.3	6.035	9.177011		0.3	6	3.25		12.43
29-Sep	0.4	0.19	3.5	0.665	0.3	6.035	9.177011		0.3	6	3.25		12.43
30-Sep	0.48	0.27	3.5	0.945	0.3	5.995	12.99773		0.3	6	3.25		16.25
1-Oct	0.48	0.27	3.5	0.945	0.3	5.995	12.99773		0.3	6	3.25		16.25
2-Oct	0.5	0.29	3.5	1.015	0.25	5.935	13.89048		0.25	6	2.48		16.37
3-Oct	0.5	0.29	3.5	1.015	0.25	5.935	13.89048		0.25	6	2.48		16.37
4-Oct	0.5	0.29	3.5	1.015	0.25	5.935	13.89048		0.25	6	2.48		16.37
5-Oct	0.5	0.29	3.5	1.015	0.25	5.935	13.89048		0.25	6	2.48		16.37
6-Oct	0.5	0.29	3.5	1.015	0.25	5.935	13.89048		0.25	6	2.48		16.37
7-Oct	0.5	0.29	3.5	1.015	0.25	5.935	13.89048		0.25	6	2.48		16.37

8-Oct	0.5	0.29	3.5	1.015	0.3	5.985	13.94887		0.3	6	3.25		17.20	
9-Oct	0.4	0.19	3.5	0.665	0.3	6.035	9.177011		0.3	6	3.25		12.43	
10-Oct	0.5	0.29	3.5	1.015	0.3	5.985	13.94887		0.3	6	3.25		17.20	
11-Oct	0.5	0.29	3.5	1.015	0.3	5.985	13.94887		0.3	6	3.25		17.20	
12-Oct	0.5	0.29	3.5	1.015	0.3	5.985	13.94887		0.3	6	3.25		17.20	
13-Oct	0.5	0.29	3.5	1.015	0.3	5.985	13.94887		0.3	6	3.25		17.20	
14-Oct	0.5	0.29	3.5	1.015	0.3	5.985	13.94887		0.3	6	3.25		17.20	
15-Oct	0.7	0.49	3.5	1.715	0.3	5.885	23.37106		0.3	6	3.25		26.62	
16-Oct														
17-Oct														
18-Oct													1929.59	3826.369
19-Oct														
20-Oct														
21-Oct														

USGS AND KID DATA
ON
AMON WASTEWAY

1980 -1990



NOTES:

FLOWS ARE MEASURED DAILY AVERAGES

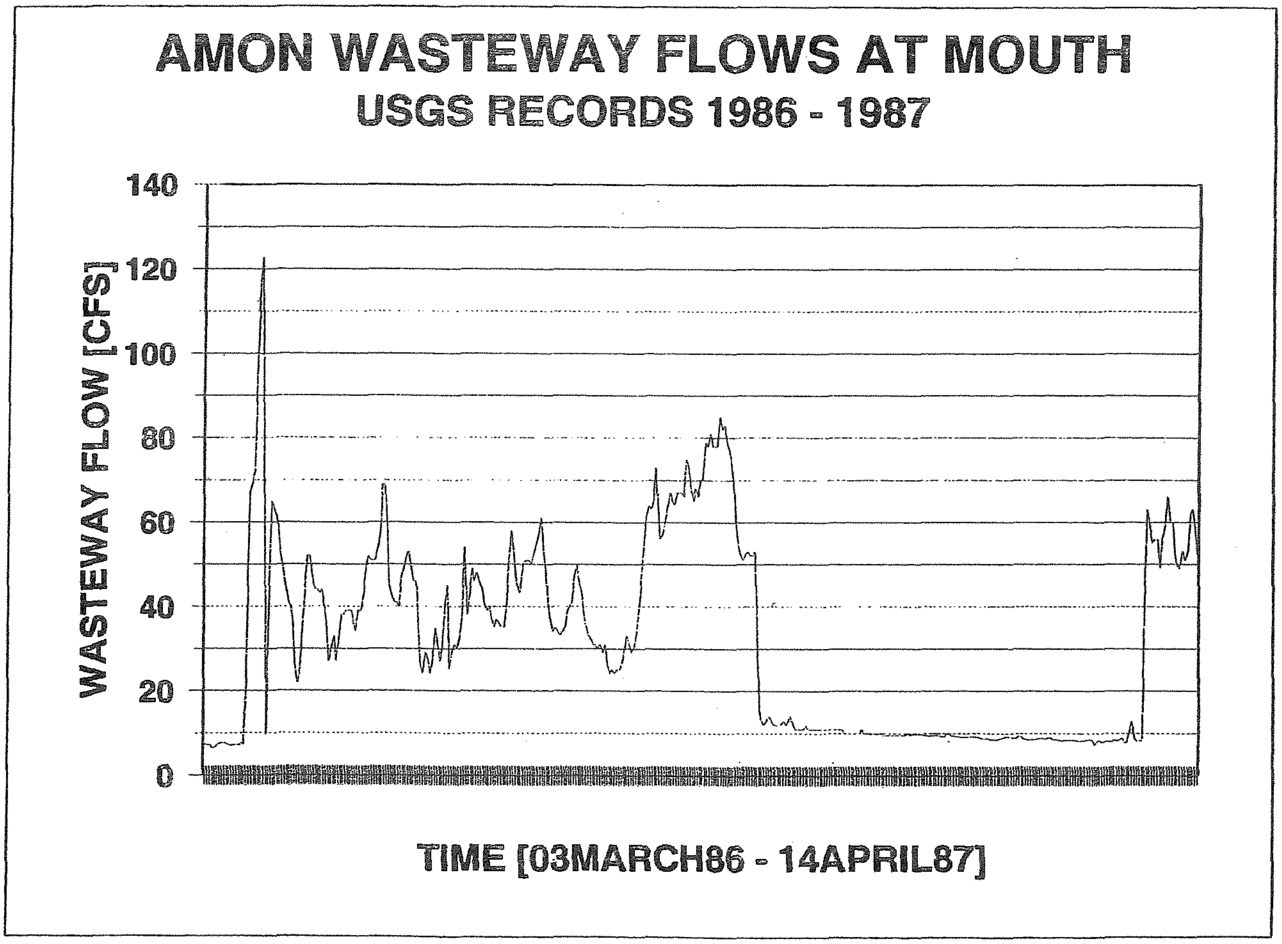
MAXIMUM WASTEWAY FLOW...................... 140 CFS

MINIMUM WASTEWAY FLOW .... 0 CFS

AVERAGE WASTEWAY FLOW .... 36.8 CFS

MAXIMUM KID DIVERSION @ HYROMET... 297 CFS

MINIMUM KID DIVERSION @ HYDROMET.. 0 CFS



NOTES:

FLOWS ARE MEASURED DAILY AVERAGES

MAXIMUM WASTEWAY FLOW......................	123	CFS
MINIMUM WASTEWAY FLOW	6.5	CFS
AVERAGE WASTEWAY FLOW	24.7	CFS
MAXIMUM KID DIVERSION @ HYROMET...	297	CFS
MINIMUM KID DIVERSION @ HYDROMET..	0	CFS

Yakima River Diversions and Operational Spills are Averages for all Years of Record

Month	Yakima River Diversion	Operational Spills					
		Amon Wasteway		Badger East Wasteway	Hover Wasteway	Highlift Wasteway	Lowlift Wasteway
		Main Canal Spillway	Amon Pump Weir				
March	1986	625	17	9	8	7	3
April	10830	2645	92	83	125	203	123
May	14921	3302	106	99	180	350	192
June	15447	2419	113	86	153	311	212
July	17128	2211	120	88	122	299	203
August	16836	2461	122	97	152	349	230
September	13902	3191	102	96	167	339	194
October	5781	1583	48	46	61	141	83
Total	96831	18437	720	604	968	1999	1240

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TABLE 3-3
DIVERSIONS, DELIVERIES AND OPERATIONAL SPILLS

YEAR		MONTH: MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPT	OCT	ANNUAL
1970	DIVERSIONS									
	CHANDLER	200	10,475	15,969	16,013	17,974	17,947	13,754	6,129	98,461
	MAXIMUM FLOW	69	230	292	293	304	307	271	210	307
	MINIMUM FLOW	0	87	97	151	224	278	182	0	0
1971	DIVERSIONS									
	CHANDLER	367	11,851	15,737	15,422	18,445	18,240	12,651	5,911	98,624
	MAXIMUM FLOW	97	285	297	286	312	316	277	214	316
	MINIMUM FLOW	0	30	80	227	279	268	185	0	0
1972	DIVERSIONS									
	CHANDLER	686	12,668	15,771	16,100	17,921	16,832	13,980	5,121	99,079
	MAXIMUM FLOW	98	274	288	289	300	298	263	183	300
	MINIMUM FLOW	0	98	219	256	275	250	206	0	0
1973	DIVERSIONS									
	CHANDLER	823	14,301	17,485	15,915	19,048	17,738	15,081	5,173	105,564
	MAXIMUM FLOW	88	310	297	303	315	310	276	214	315
	MINIMUM FLOW	0	99	267	70	300	270	207	0	0
1974	DIVERSIONS									
	CHANDLER	1,141	9,973	15,527	18,212	17,957	17,969	15,751	4,907	101,437
	MAXIMUM FLOW	105	242	284	315	301	301	290	208	315
	MINIMUM FLOW	0	27	224	288	279	282	229	0	0
1975	DIVERSIONS									
	CHANDLER	1,188	10,630	15,798	17,114	16,330	17,671	15,110	6,383	100,224
	MAXIMUM FLOW	90	240	274	305	321	313	273	233	321
	MINIMUM FLOW	0	106	238	261	0	258	243	0	0
1976	DIVERSIONS									
	CHANDLER	1,005	11,235	16,548	16,154	19,897	16,461	13,553	6,742	101,595
	MAXIMUM FLOW	103	267	303	304	341	323	241	245	341
	MINIMUM FLOW	0	108	239	106	298	234	201	0	0
1977	DIVERSIONS									
	CHANDLER	8,450	11,951	11,631	14,414	15,785	15,521	11,778	5,090	94,620
	MAXIMUM FLOW	209	255	226	261	261	256	287	201	261
	MINIMUM FLOW	0	147	52	204	252	244	57	0	0
1978	DIVERSIONS									
	CHANDLER	740	9,715	14,571	14,511	15,309	11,675	12,347	0	78,868
	MAXIMUM FLOW	100	227	256	288	312	301	223	0	312
	MINIMUM FLOW	0	100	219	94	63	42	201	0	0
1979	DIVERSIONS									
	CHANDLER	655	8,823	11,564	15,130	16,233	15,483	13,803	5,254	86,945
	MAXIMUM FLOW	82	218	273	289	275	265	237	234	289
	MINIMUM FLOW	0	69	0	59	260	229	228	0	0
1980	DIVERSIONS									
	CHANDLER	518	9,870	14,164	13,706	15,872	15,313	11,498	6,171	
	CID*	0	203	291	282	326	315	236	127	
	TOTAL DIVERSION	518	10,073	14,455	13,988	16,198	15,628	11,734	6,298	88,891
	WATER DELIVERED									
	NEW LANDS	0	3,176	5,145	5,412	6,766	6,739	4,461	1,394	
	OLD LANDS	0	1,439	2,331	2,452	3,066	3,054	2,021	632	
	TOTAL DELIVERED	0	4,615	7,476	7,864	9,832	9,793	6,482	2,026	48,088
	OPERATIONAL SPILLS	110	2,138	3,047	2,710	2,612	3,056	3,329	1,297	18,299
	MAXIMUM FLOW	73	235	240	249	282	273	236	250	282
	MINIMUM FLOW	0	76	212	150	235	230	150	0	0

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TABLE 3-3
DIVERSIONS, DELIVERIES AND OPERATIONAL SPILLS

YEAR		MONTH: MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPT	OCT	ANNUAL
1981	DIVERSIONS									
	CHANDLER	1,355	9,404	13,226	13,480	16,955	16,713	13,752	4,078	
	CID*	0	187	262	267	336	332	273	81	
	TOTAL DIVERSION	1,355	9,591	13,488	13,747	17,291	17,045	14,025	4,159	90,701
	WATER DELIVERED									
	NEW LANDS	0	2,881	4,848	5,093	7,118	7,042	5,531	1,430	
	OLD LANDS	0	1,305	2,197	2,308	3,225	3,191	2,506	648	
	TOTAL DELIVERED	0	4,186	7,045	7,401	10,343	10,233	8,037	2,078	49,323
	OPERATIONAL SPILLS	801	2,703	3,876	2,955	3,609	3,370	4,156	1,927	23,397
	MAXIMUM FLOW	91	243	242	262	289	283	273	155	289
	MINIMUM FLOW	0	91	53	0	258	253	186	0	0
1982	DIVERSIONS									
	CHANDLER	2,031	7,738	16,618	15,652	17,209	17,076	11,225	5,024	
	CID*	0	154	330	311	341	339	223	100	
	TOTAL DIVERSION	2,031	7,892	16,948	15,963	17,550	17,415	11,448	5,124	94,370
	WATER DELIVERED									
	NEW LANDS	0	1,735	6,140	6,808	6,610	6,767	3,619	1,178	
	OLD LANDS	0	786	2,782	3,085	2,995	3,066	1,640	534	
	TOTAL DELIVERED	0	2,521	8,922	9,893	9,605	9,833	5,259	1,712	47,745
	OPERATIONAL SPILLS	366	2,543	4,326	3,780	3,893	4,328	3,586	1,782	24,604
	MAXIMUM FLOW	84	293	299	283	312	304	265	190	312
	MINIMUM FLOW	0	0	244	232	236	260	0	0	0
1983	DIVERSIONS									
	CHANDLER	2,095	8,868	13,718	12,734	15,864	16,711	15,120	6,139	
	CID*	0	176	272	253	315	332	300	122	
	TOTAL DIVERSION	2,095	9,044	13,990	12,987	16,179	17,043	15,420	6,261	93,018
	WATER DELIVERED									
	NEW LANDS	0	2,383	4,988	5,652	6,683	6,745	5,032	1,625	
	OLD LANDS	0	1,080	2,260	2,561	3,028	3,056	2,280	736	
	TOTAL DELIVERED	0	3,463	7,248	8,213	9,711	9,801	7,312	2,361	48,110
	OPERATIONAL SPILLS	858	3,577	3,652	2,975	3,612	3,562	4,465	2,243	24,944
	MAXIMUM FLOW	77	206	255	258	294	293	293	181	294
	MINIMUM FLOW	0	71	204	0	225	266	215	0	0
1984	DIVERSIONS									
	CHANDLER	0	8,779	14,263	14,150	17,784	17,683	13,635	5,782	
	CID*	0	174	283	281	353	351	271	115	
	TOTAL DIVERSION	0	8,953	14,546	14,431	18,137	18,034	13,906	5,897	93,903
	WATER DELIVERED									
	NEW LANDS	0	1,651	4,898	5,238	7,453	7,753	5,399	1,847	
	OLD LANDS	0	748	2,219	2,373	3,377	3,513	2,446	837	
	TOTAL DELIVERED	0	2,399	7,117	7,611	10,830	11,266	7,845	2,684	49,753
	OPERATIONAL SPILLS	0	3,019	4,138	2,998	2,626	2,132	3,984	1,604	20,501
	MAXIMUM FLOW	0	231	255	259	312	329	292	225	329
	MINIMUM FLOW	0	0	219	56	254	252	157	0	0
1985	DIVERSIONS									
	CHANDLER	3,013	9,874	15,951	16,102	17,746	16,941	12,500	4,868	
	CID*	0	196	317	320	352	336	248	97	
	TOTAL DIVERSION	3,013	10,070	16,268	16,422	18,098	17,277	12,748	4,965	98,860
	WATER DELIVERED									
	NEW LANDS	0	3,448	6,116	6,695	7,872	7,330	3,907	1,473	
	OLD LANDS	0	1,562	2,771	3,034	3,567	3,321	1,770	667	
	TOTAL DELIVERED	0	5,010	8,887	9,729	11,439	10,651	5,677	2,140	53,534
	OPERATIONAL SPILLS	1,069	2,877	4,117	3,028	2,009	3,198	3,732	1,977	22,007
	MAXIMUM FLOW	113	259	267	303	309	293	262	171	309
	MINIMUM FLOW	0	0	250	236	275	260	176	0	0
1986	DIVERSIONS									
	CHANDLER	2,876	10,977	15,227	17,525	18,060	18,022	14,222	5,272	
	CID*	0	218	302	348	358	358	282	105	
	TOTAL DIVERSION	2,876	11,195	15,529	17,873	18,418	18,380	14,504	5,377	104,151
	WATER DELIVERED									
	NEW LANDS	0	3,495	5,060	6,694	6,930	7,252	4,345	1,084	
	OLD LANDS	0	1,584	2,293	3,033	3,140	3,286	1,969	491	
	TOTAL DELIVERED	0	5,079	7,353	9,727	10,070	10,538	6,314	1,575	50,656
	OPERATIONAL SPILLS	2,170	3,076	3,805	3,376	3,875	3,119	5,295	2,120	26,836
	MAXIMUM FLOW	144	233	291	297	298	297	292	311	311
	MINIMUM FLOW	0	116	233	288	292	289	170	0	0

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TABLE 3-3
DIVERSIONS, DELIVERIES AND OPERATIONAL SPILLS

YEAR		MONTH								
		MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPT	OCT	ANNUAL
1987	DIVERSIONS									
	CHANDLER	1,833	13,121	16,667	17,165	18,189	17,715	15,148	4,532	
	CID*	0	260	331	341	361	352	301	90	
	TOTAL DIVERSION	1,833	13,381	16,998	17,506	18,550	18,067	15,449	4,622	106,405
	WATER DELIVERED									
	NEW LANDS	0	4,204	5,712	6,451	6,981	6,835	5,182	1,820	
	OLD LANDS	0	1,905	2,588	2,923	3,163	3,097	2,348	825	
	TOTAL DELIVERED	0	6,109	8,300	9,374	10,144	9,932	7,530	2,645	54,034
	OPERATIONAL SPILLS	840	4,275	4,333	3,454	3,115	3,785	4,189	2,014	26,005
	MAXIMUM FLOW	111	277	285	300	302	293	278	169	302
	MINIMUM FLOW	0	126	266	278	288	278	233	0	0
1988	DIVERSIONS									
	CHANDLER	6,432	13,014	14,416	14,634	16,669	18,577	14,793	6,926	
	CID*	0	258	286	290	331	369	294	137	
	TOTAL DIVERSION	6,432	13,272	14,702	14,924	17,000	18,946	15,087	7,063	107,426
	WATER DELIVERED									
	NEW LANDS	0	3,757	5,055	5,328	7,000	7,182	4,719	1,902	
	OLD LANDS	0	1,702	2,291	2,414	3,172	3,254	2,138	862	
	TOTAL DELIVERED	0	5,459	7,346	7,742	10,172	10,436	6,857	2,764	50,776
	OPERATIONAL SPILLS	788	3,809	3,919	3,855	2,953	3,297	3,550	1,659	23,830
	MAXIMUM FLOW	199	240	255	274	286	309	298	227	309
	MINIMUM FLOW	0	204	215	218	262	288	217	0	0
1989	DIVERSIONS									
	CHANDLER	1,545	10,517	14,682	16,909	18,086	17,717	14,595	5,578	
	CID*	0	209	291	336	359	352	290	111	
	TOTAL DIVERSION	1,545	10,726	14,973	17,245	18,445	18,069	14,885	5,689	101,575
	WATER DELIVERED									
	NEW LANDS	0	2,909	4,914	7,478	7,486	6,807	5,050	2,195	
	OLD LANDS	0	1,318	2,227	3,388	3,392	3,084	2,288	995	
	TOTAL DELIVERED	0	4,227	7,141	10,866	10,878	9,891	7,338	3,190	53,531
	OPERATIONAL SPILLS	692	3,698	6,011	3,164	2,591	3,880	4,743	2,207	27,006
	MAXIMUM FLOW	89	251	268	298	298	300	260	215	300
	MINIMUM FLOW	0	90	20	267	288	258	226	0	0
1990	DIVERSIONS									
	CHANDLER	2,251	14,767	15,664	15,745	18,494	18,819	15,116	6,698	
	CID*	0	293	311	312	367	373	300	133	
	TOTAL DIVERSION	2,251	15,060	15,975	16,057	18,861	19,192	15,416	6,831	109,643
	WATER DELIVERED									
	NEW LANDS	0	5,227	5,283	6,675	7,693	6,562	5,209	2,533	
	OLD LANDS	0	2,368	2,394	3,025	3,486	2,973	2,360	1,148	
	TOTAL DELIVERED	0	7,595	7,677	9,700	11,179	9,535	7,569	3,681	56,936
	OPERATIONAL SPILLS	672	3,312	4,456	3,097	2,293	3,571	3,995	2,142	23,538
	MAXIMUM FLOW	152	268	263	285	312	319	260	224	319
	MINIMUM FLOW	0	163	116	252	286	262	237	0	0
1991	DIVERSIONS									
	CHANDLER	2,684	12,147	15,273	17,225	18,103	17,645	14,888	8,959	
	CID*	0	241	303	342	359	350	295	178	
	TOTAL DIVERSION	2,684	12,388	15,576	17,567	18,462	17,995	15,183	9,137	108,992
	WATER DELIVERED									
	NEW LANDS	0	3,679	4,479	6,078	6,604	6,229	5,457	2,975	
	OLD LANDS	0	1,667	2,030	2,754	2,992	2,822	2,473	1,348	
	TOTAL DELIVERED	0	5,346	6,509	8,832	9,596	9,051	7,930	4,323	51,587
	MAXIMUM FLOW	131	244	258	298	305	304	285	232	305
	MINIMUM FLOW	0	142	238	268	240	259	216	0	0
1992	DIVERSIONS									
	CHANDLER	3,122	11,195	13,902	15,856	15,945	15,247	12,351	8,349	
	CID*	0	222	276	315	316	303	245	166	
	TOTAL DIVERSION	3,122	11,417	14,178	16,171	16,261	15,550	12,596	8,515	97,809
	WATER DELIVERED									
	NEW LANDS	0	3,687	5,888	6,291	5,979	5,477	3,872	1,937	
	OLD LANDS	0	1,671	2,668	2,851	2,709	2,482	1,754	878	
	TOTAL DELIVERED	0	5,358	8,556	9,142	8,688	7,959	5,626	2,815	48,143
	MAXIMUM FLOW	155	206	256	286	267	258	233	216	286
	MINIMUM FLOW	0	160	205	248	244	231	180	0	0

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the Highland Feeder Canal. The total is less than that shown for 1986 in Table 3-3 because CID canal water withdrawals have been excluded.

TABLE 3-6

WATER DELIVERIES BY CANAL

Canal	Water Deliveries (Acre Feet)
Main Canal	
Div I, II	6,100
Div III	3,794
Division IV	14,222
Badger East Lateral	6,339
Badger West Lateral	416
Amon Pump Laterals	2,647
Highland Feeder	16,118
Totals	**49,636**

Operational Spills

Operation of the KID's open canal system requires that water spill continuously from the ends of the canals. This water is called operational spill. Operational spill allows ditchriders to make water delivery changes without adversely impacting other water deliveries. Estimates of 1986 operational spills from the KID's canal system are shown in Table 3-7. Operational spill from the Badger West Lateral was assumed to be zero since it is very small and unmeasured.

TABLE 3-7

1986 OPERATIONAL SPILLS

Canal	Volume Spilled (Acre Feet)
Badger East Lateral	861
Badger West Lateral	0
Amon Wasteway	19,060
Division IV	3,033
Lowlift Canal	1,932

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TABLE 3-7 (CONT'D)

1986 OPERATIONAL SPILLS

Canal	Volume Spilled (Acre Feet)
Highlift Canal	1,932
Total	**26,836**

Subtracting seepage and evaporation losses, water deliveries and operations spills from the total diversion leaves 10,837 acre feet of water unaccounted for. This represents about 10.6% of the KID's 1986 water diversion. Operational spills accounted for 26.3% of KID's 1986 diversion, delivered water accounted for 48.6% of KID's 1986 diversion, seepage losses accounted for 13.8% of KID's 1986 diversion and evaporation losses accounted for 0.7% of KID's 1986 diversion.

Deep Percolation of Applied Irrigation Water

The KID is located in a semi-arid climate with an annual average precipitation rate of 8 inches and an evaporation rate of more than 45 inches per year. The majority of the precipitation occurs during the winter when water use by plants and evaporation are at there lowest. For purposes of calculating deep percolation it has been assumed that winter precipitation will furnish 4 ½ inches of water for agricultural crops and 1½ inches of water for lawns.

Since 1988 the Bureau of Reclamation has measured the water requirements (evapotranspiration, ET) for crops typical of the KID area at their Legrow Agrimet weather station site. The Legrow site is located across the Columbia River from KID's Hover Wasteway.

Average ET rates for crops typically grown in the KID over the 1988 to 1998 period were:

- Alfalfa 39.8"
- Pasture/Lawns 33.3"
- Apples 37.9"

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other water conservation improvements the benefits of this measure are not dependant on proper operation by district personnel.

Simply removing the KID's diversion from the Yakima River does not conserve water. Completion of the project will however require construction of facilities identified herein as water conservation measures. Those facilities include a regulating reservoir and canal piping.

The regulating reservoir would allow the regulation of water to the Highland Feeder Canal and the majority of the KID's urban areas. In Section 3.2, Historical Water Use, it was noted that 80% of all operational spills occur at Amon Wasteway. Over the 11 years from 1980 through 1990 (inclusive) the average operational spill to Amon Wasteway was 19,157 acre feet. Of these volumes an average of 720 acre feet (Refer to Table 6-1, 6' Weir) is excess water from the hydraulic drive pumps at Amon Pump Station. This water would not be conserved as a result of the regulating reservoir. Potentially the remaining 18,437 acre feet (Refer to Table 6-1, Main Canal Spillway) could be conserved with a regulating reservoir.

Piping the Badger East Lateral would eliminate operational spills. Over the 1980 to 1990 time period the Badger East Wasteway spilled an average of 604 acre feet (Refer to Table 6-1) annually.

Piping of the Main Canal, Badger East Lateral and Badger West Lateral would also reduce the KID's annual diversion. Table 6-1 identified the combined estimated seepage and evaporation losses for these canals to be 10,137 acre feet per year.

Measure 1 would conserve 29,178 acre feet of water. Leaving two thirds in the river would amount to 19,542 acre feet. The estimated monthly diversion reductions are outlined in Table 6-6.

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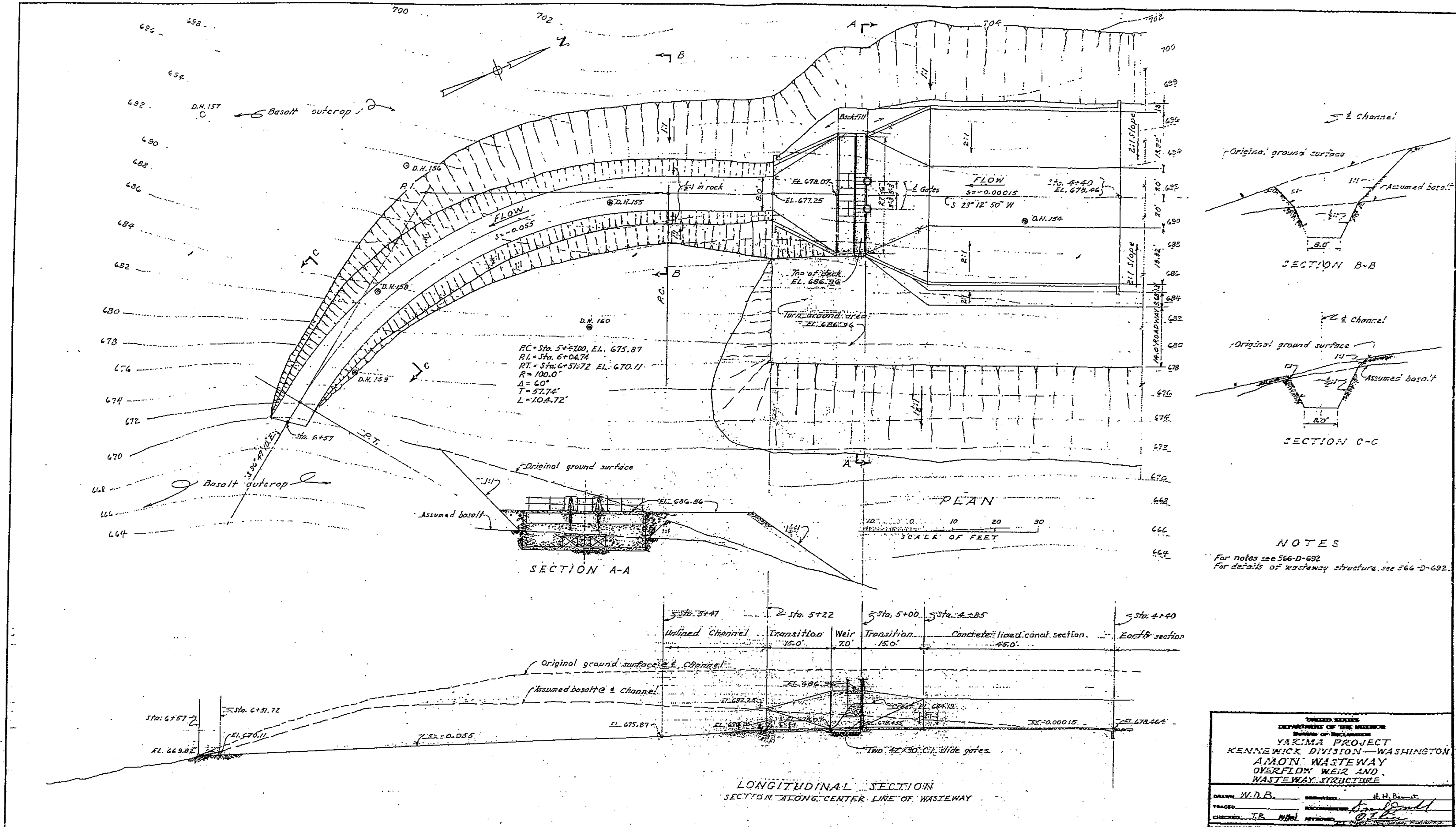
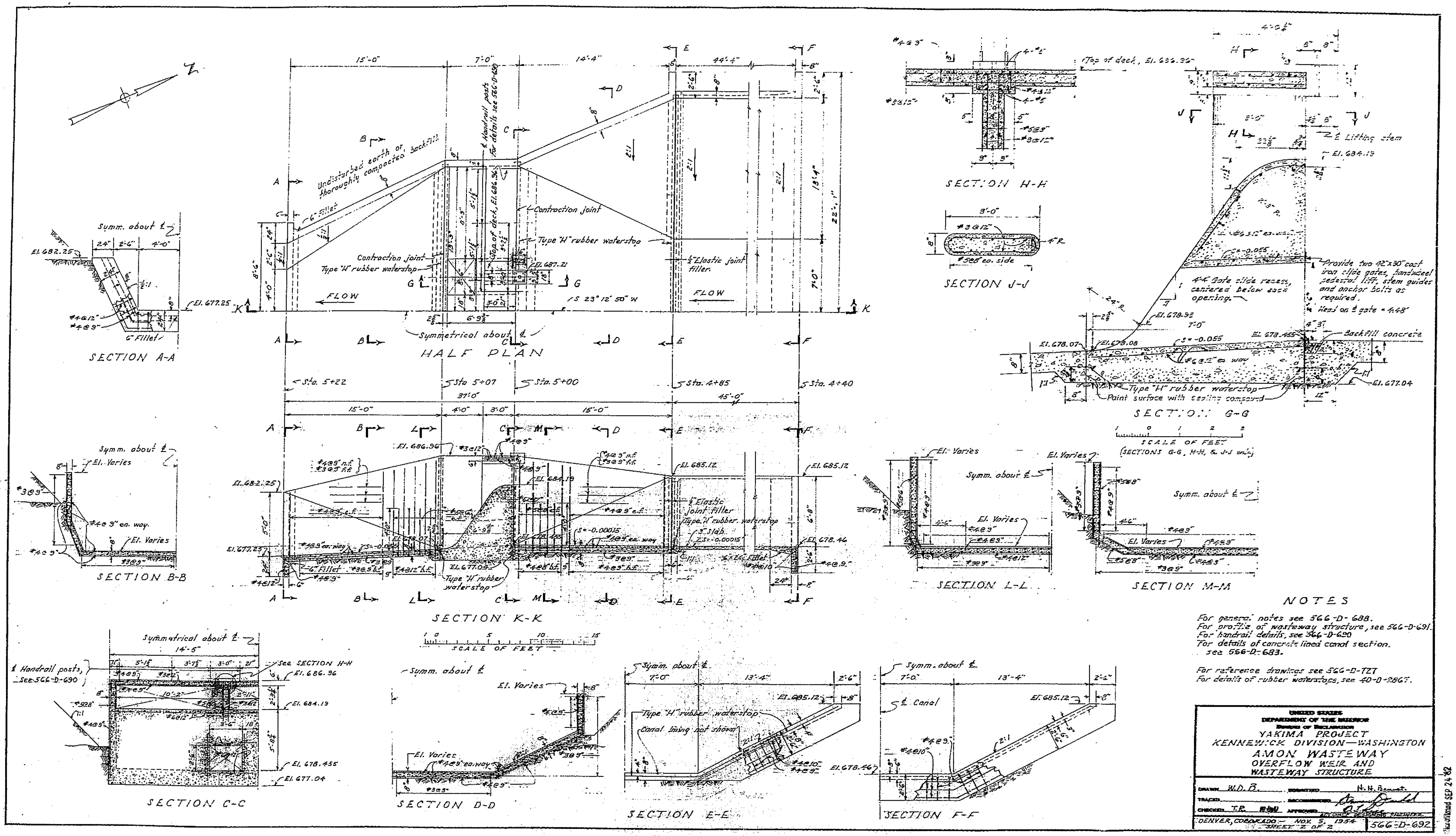
AMON WASTEWAY
OVERFLOW WEIR AND WASTEWAY STRUCTURE

DRAWINGS AND PHOTOS


PLAN
SCALE OF FEET
SECTION A-A
SECTION B-B
SECTION C-C
Original ground surface
Assumed basalt
8.0'
Basalt outcrop
FLOW
Sta. 4+40
EL. 678.46
Top of deck
EL. 686.96
Turn around area
EL. 686.96
P.C. = Sta. 5+47.00, EL. 675.87
P.I. = Sta. 6+04.74
P.T. = Sta. 6+51.72 EL. 670.11
R = 100.0'
Δ = 60°
T = 57.74'
L = 104.72'
NOTES
For notes see 566-D-692
For details of wasteway structure, see 566-D-692.
Sta. 5+47
Sta. 5+22
Sta. 5+00
Sta. 4+85
Sta. 4+40
Unlined Channel
Transition 15.0'
Weir 7.0'
Transition 15.0'
Concrete lined canal section 45.0'
Earth section
Original ground surface @ ℄ Channel
Assumed basalt @ ℄ Channel
Sta. 6+57
Sta. 6+51.72
EL. 676.11
EL. 669.82
EL. 675.87
EL. 686.96
Two 42"x30" C.I. slide gates
LONGITUDINAL SECTION
SECTION ALONG CENTER LINE OF WASTEWAY
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
YAKIMA PROJECT
KENNEWICK DIVISION—WASHINGTON
AMON WASTEWAY
OVERFLOW WEIR AND
WASTEWAY STRUCTURE
DRAWN W.D.B.
CHECKED T.R.
DENVER, COLORADO, NOV. 5, 1954
SHEET 1 OF 2
566-D-691


HALF PLAN
SECTION A-A
SECTION B-B
SECTION C-C
SECTION D-D
SECTION E-E
SECTION F-F
SECTION G-G
SECTION H-H
SECTION J-J
SECTION K-K
SECTION L-L
SECTION M-M
Undisturbed earth or thoroughly compacted backfill
Contraction joint
Type "H" rubber waterstop
½" Elastic joint filler
FLOW
Symmetrical about ℄
S 23° 12' 50" W
Sta. 5+22
Sta. 5+07
Sta. 5+00
Sta. 4+85
Sta. 4+40
El. 682.25
El. 677.25
El. 686.96
El. 685.12
El. 684.13
El. 678.455
El. 677.04
Top of deck, El. 686.96
SCALE OF FEET
(SECTIONS G-G, H-H, & J-J only)
Provide two 42"x30" cast iron slide gates, handwheel pedestal lift, stem guides and anchor bolts as required.
Head on ℄ gate = 4.48'
Backfill concrete
Paint surface with sealing compound
Canal lining not shown
℄ Canal
℄ Lifting stem
NOTES
For general notes see 566-D-688.
For profile of wasteway structure, see 566-D-691.
For handrail details, see 566-D-690
For details of concrete lined canal section. see 566-D-683.
For reference drawings see 566-D-727
For details of rubber waterstops, see 40-D-2867.
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BUREAU OF RECLAMATION
YAKIMA PROJECT
KENNEWICK DIVISION—WASHINGTON
AMON WASTEWAY
OVERFLOW WEIR AND
WASTEWAY STRUCTURE
DRAWN W.D.B.
SUBMITTED H. N. Bennett
TRACED
RECOMMENDED
CHECKED T.R.
APPROVED
DENVER, COLORADO — NOV. 5, 1954
SHEET 2 OF 2
566-D-692

PROJECT: KID Main Canal, Division III
DESCRIPTION: ***Overflow*** **Weir/Spillway into Amon Wasteway at end of Division III Canal, looking downstream.**
USBR PHOTO BY: Wendy Christensen
PHOTO 1 DATE: March 12, 2001

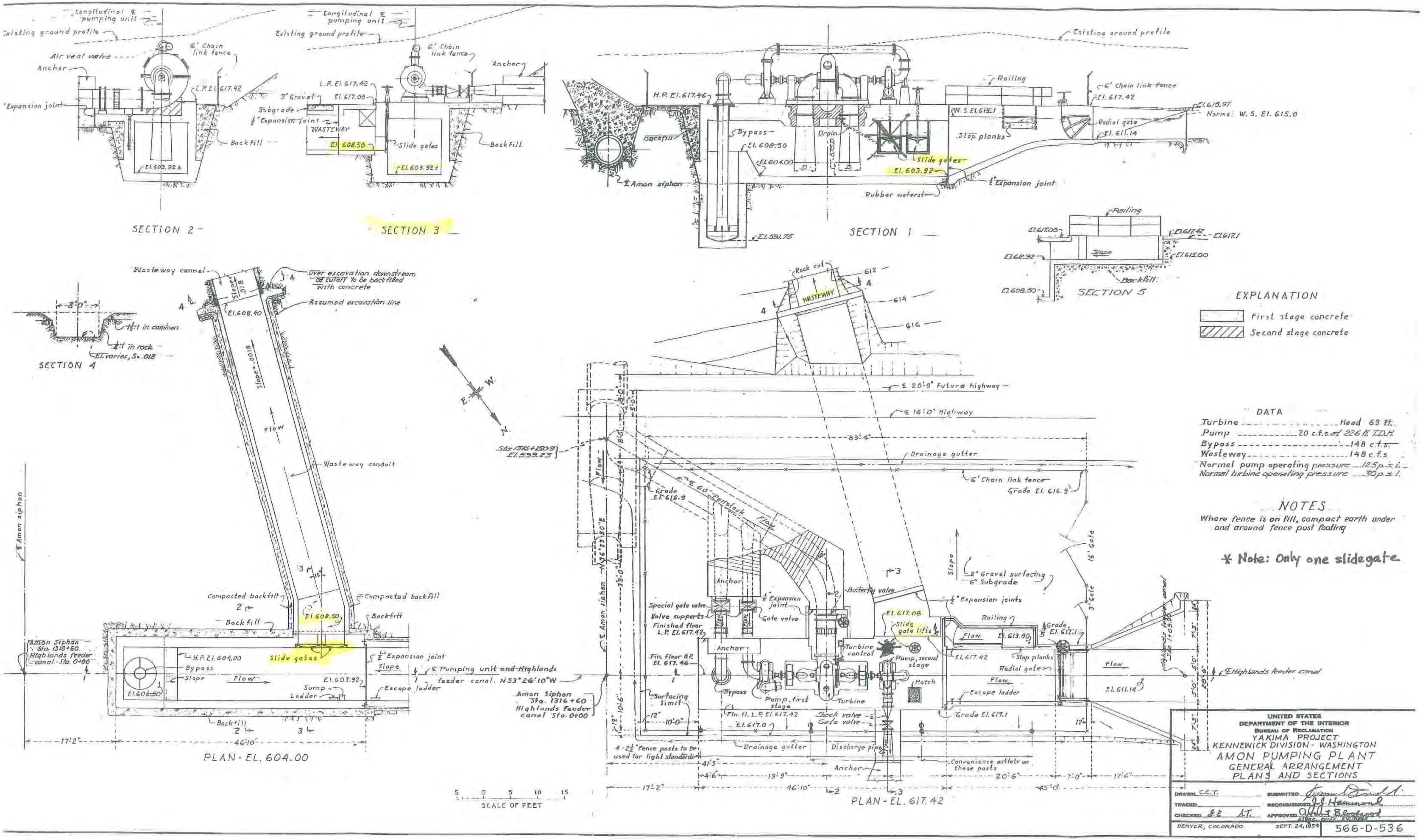
PROJECT: KID Main Canal, Division III
DESCRIPTION: Overflow Weir/Spillway into Amon Wasteway at end of Division III Canal, looking upstream.
USBR PHOTO BY: Wendy Christensen
PHOTO 2 DATE: March 12, 2001

PROJECT: KID Main Canal, *Division III*
DESCRIPTION: Overflow Weir/Spillway upstream gates into Amon Wasteway at end of Division III Canal, looking downstream.
USBR PHOTO BY: Wendy Christensen
PHOTO 3 DATE: March 12, 2001

PROJECT: KID Main Canal, Division III
DESCRIPTION: Amon Wasteway below Overflow Weir/Spillway at the end of Division III Canal, looking downstream.
USBR PHOTO BY: Wendy Christensen
PHOTO 4 DATE: March 12, 2001

AMON PUMPING PLANT

DRAWINGS AND PHOTOS


SECTION 2
SECTION 3
SECTION 1
SECTION 4
SECTION 5
PLAN - EL. 604.00
PLAN - EL. 617.42
Existing ground profile
Longitudinal ℄ pumping unit
Air vent valve
Anchor
Expansion joint
6' Chain link fence
L.P. El. 617.42
Backfill
El. 603.92±
2" Gravel
Subgrade
½" Expansion joint
WASTEWAY
El. 608.50
Slide gates
H.P. El. 617.46
Bypass
El. 604.00
Drain
Railing
W.S. El. 615.1
Stop planks
Radial gate
El. 611.14
El. 615.97
Normal W.S. El. 615.0
El. 603.92
Rubber waterstop
½" Expansion joint
℄ Amon siphon
El. 591.75
Wasteway cannel
Over excavation downstream of cutoff to be backfilled with concrete
Assumed excavation line
El. 608.40
Slope = .0018
Flow
Wasteway conduit
Compacted backfill
½" Expansion joint
Amon Siphon Sta. 1318+60. Highlands feeder canal - Sta. 0+00
H.P. El. 604.00
Sump
Ladder
Escape ladder
℄ Pumping unit and Highlands feeder canal. N 53°26'10" W
Amon Siphon Sta. 1316+60 Highlands feeder canal Sta. 0+00
Sta. 1316+15.09 El. 599.23
Rock cut
℄ 20'-0" Future highway
℄ 16'-0" Highway
Drainage gutter
6' Chain link fence
Grade El. 616.9
℄ 60" Penstock
Special gate valve
Valve supports
Finished floor L.P. El. 617.42
Fin. floor H.P. El. 617.46
Surfacing limit
Gate valve
Butterfly valve
Turbine control
Pump, second stage
Pump, first stage
Turbine
Hatch
Check valve
Gate valve
Discharge pipe
Convenience outlets on these posts
2" Gravel surfacing
6" Subgrade
½" Expansion joints
El. 617.08
Slide gate lifts
El. 613.00
El. 617.1
Grade El. 617.1
℄ Highlands feeder canal
4-2½" Fence posts to be used for light standards
16' Gate
3' Gate
SCALE OF FEET
EXPLANATION
First stage concrete
Second stage concrete
DATA
Turbine — Head 63 ft.
Pump — 20 c.f.s. at 226 ft. T.D.H.
Bypass — 148 c.f.s.
Wasteway — 148 c.f.s.
Normal pump operating pressure — 125 p.s.i.
Normal turbine operating pressure — 30 p.s.i.
NOTES
Where fence is on fill, compact earth under and around fence post footing
* Note: Only one slidegate.
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
YAKIMA PROJECT
KENNEWICK DIVISION - WASHINGTON
AMON PUMPING PLANT
GENERAL ARRANGEMENT
PLANS AND SECTIONS
DRAWN C.C.T.
SUBMITTED
RECOMMENDED
TRACED
CHECKED
APPROVED
DENVER, COLORADO
SEPT. 24, 1954
566-D-536

PROJECT: KID Main Canal, *Division III*
DESCRIPTION: Amon Pumping Plant, looking west.
USBR PHOTO BY: Wendy Christensen
PHOTO 5 DATE: April 1, 2002

PROJECT: KID Main Canal, Division III
DESCRIPTION: Amon Pumping Plant wasteway into Amon Wasteway, looking east.
USBR PHOTO BY: Wendy Christensen
PHOTO 6 DATE: March 12, 2001

PROJECT: KID Main Canal, Division III
DESCRIPTION: Amon Pumping Plant wasteway into Amon Wasteway, looking west.
USBR PHOTO BY: Wendy Christensen
PHOTO 7 DATE: March 12, 2001

PROJECT: KID Main Canal, Division III
DESCRIPTION: Amon Pumping Plant head gate into Highland Feeder Canal, looking north.
USBR PHOTO BY: Wendy Christensen
PHOTO 8 DATE: March 12, 2001

PROJECT: KID Main Canal, Division III
DESCRIPTION: Amon Pumping Plant, 6' overflow weir to wasteway chute.
USBR PHOTO BY: Wendy Christensen
PHOTO 9 DATE: March 12, 2001

PROJECT: KID Main Canal, Division III
DESCRIPTION: Amon Pumping Plant, 6' overflow weir staff gage.
USBR PHOTO BY: Wendy Christensen
PHOTO 10 DATE: March 12, 2001

PROJECT: ***KID Main Canal, Division III***
DESCRIPTION: Amon Pumping Plant gate into wasteway chute.
USBR PHOTO BY: Wendy Christensen
PHOTO 11 **DATE: March 12, 2001**

AMON WASTEWAY GAGING STATION

PHOTOS
AND
EQUIPMENT SPECIFICATIONS

PROJECT: KID Main Canal, Division III
DESCRIPTION: Amon Wasteway, USGS gaging station, looking west.
USBR PHOTO BY: Wendy Christensen
PHOTO 12 DATE: March 12, 2001

PROJECT: KID Main Canal, Division III
DESCRIPTION: Amon Wasteway, USGS gaging station
USBR PHOTO BY: Wendy Christensen
PHOTO 13 DATE: March 12, 2001

PROJECT: KID Main Canal, Division III
DESCRIPTION: Amon Wasteway, looking upstream from USGS gaging station.
USBR PHOTO BY: Wendy Christensen
PHOTO 14 DATE: March 12, 2001

PROJECT: KID Main Canal, Division III
DESCRIPTION: Amon Wasteway, looking downstream from USGS gaging station.
USBR PHOTO BY: Wendy Christensen
PHOTO 15 DATE: March 12, 2001

CE

Submersible Level Transducers

SERIES 612

SUBMERSIBLE LEVEL TRANSDUCERS

NOSHOK Series 612 Submersible Level Transducers were designed to provide a previously unequalled level of performance. Utilizing diffused semiconductor and thin film technologies, Series 612 transducers are accurate, shock resistant and extremely stable over long periods of time. Reverse polarity protection, short circuit protection and lightning protection have been installed as standard features.

Advanced manufacturing techniques combined with technologically advanced standard features allow NOSHOK to offer a level of performance previously found on transducers costing hundreds of dollars more.

A final electrical output and calibration inspection is performed on all NOSHOK transducers prior to shipment to ensure 100% "out of the box" reliability.

FEATURES

- Advanced diffused semiconductor and sputtered thin film sensor for maximum stability
- High accuracy and long term stability
- Ranges from 0 inH_2O to 50 inH_2O through 0 psi to 500 psi
- Corrosion resistant stainless steel construction
- Nosecone standard
- Optional 6 VDC input .5 to 2.5 output for field applications

APPLICATIONS

- Irrigation
- Food and beverage
- Waste water
- Water distribution
- Level and depth
- Bore hole
- Offshore
- R&D

SPECIFICATIONS

Output signals	4 mA to 20 mA, 2-wire; 0 Vdc to 5 Vdc and 0 Vdc to 10 Vdc, 3-wire; 0.5 Vdc to 2.5 Vdc, 3-wire
Pressure ranges	0 inH_2O to 50 inH_2O through 0 psig to 500 psig
Proof pressure	2 times range
Burst pressure	4 times range
Accuracy	± 0.25 % Full Scale (best fit straight line) Includes the combined effects of linearity, hysteresis and repeatability ± .125 % Full Scale (optional)
Repeatability	≤ ± 0.05 % Full Scale
Hysteresis	≤ ± 0.1 % Full Scale
Stability	≤ ± 0.2 % Full Scale for 1 year, non accumulating
Load limitations	≤ (VPower–10)/0.020 Amp–(0.043 Ω x length of cable in feet) Voltage output ≥ 100,000 Ω
Wetted materials	Housing: 316 stainless steel Cap: Polyamide, 316 stainless steel with weighted nose cone Cable: Polyurethane, Teflon available on special versions
Power supply	10 Vdc to 30 Vdc for current output 14 Vdc to 30 Vdc for voltage output 6 Vdc for 0.5 Vdc to 2.5 Vdc output
Temperature ranges	Compensated 32 °F to 122 °F/0 °C to 50 °C Effect ± 0.01 %/°F for zero and span Storage -22 °F to 175 °F/-30 °C to 80 °C Medium -14 °F to 175 °F/-10 °C to 80 °C
Response time	≤ 1 ms (between 10 % to 90 % Full Scale)
Durability	>100,000,000 Full Scale cycles
Environmental protection	NEMA 6P, IP68
Electromagnetic rating	CE compliant to EMC norm EN61326: 1997/A1: 1998 RFI, EMI and ESD protection
Electrical protection	Reverse polarity protection, short circuit and lightning protection
Shock	Less than ± 0.05 % Full Scale effect for 100 g's @ 20 ms on any axis
Vibration	Less than ± 0.01 % Full Scale effect for 15 g's @ 0 Hz to 2000 Hz on any axis
Weight	Approximately 7 oz. with standard nosecone – cable extra

ORDERING INFORMATION

SERIES 612												
PRESSURE RANGES	0 inH$_2$0 to 50 inH$_2$0	50 IN	0 psig to 2 psig (4.6 ftH$_2$O)	2	0 psig to 20 psig (46.2 ftH$_2$O)	20	0 psig to 150 psig (346.3 ftH$_2$O)	150				
	0 inH$_2$0 to 100 inH$_2$0	100 IN	0 psig to 3 psig (6.9 ftH$_2$O)	3	0 psig to 25 psig (57.7 ftH$_2$O)	25	0 psig to 200 psig (461.3 ftH$_2$O)	200				
	0 inH$_2$0 to 150 inH$_2$0	150 IN	0 psig to 5 psig (11.5 ftH$_2$O)	5	0 psig to 30 psig (69.2 ftH$_2$O)	30	0 psig to 300 psig (692.5 ftH$_2$O)	300				
	0 inH$_2$0 to 200 inH$_2$0	200 IN	0 psig to 10 psig (23.1 ftH$_2$O)	10	0 psig to 60 psig (138.5 ftH$_2$O)	60	0 psig to 350 psig (807.9 ftH$_2$O)	350				
	0 inH$_2$0 to 400 inH$_2$0	400 IN	0 psig to 15 psig (34.6 ftH$_2$O)	15	0 psig to 100 psig (230.8 ftH$_2$O)	100	0 psig to 500 psig (1154.2 ftH$_2$O)	500				
	psig = Gauge Pressure		Other ranges available on special request									
ACCURACY	1	± 0.25 % Full Scale	2	± 0.125 % Full Scale								
OUTPUT SIGNALS	1	4 mA to 20 mA, 2-wire	5	0 Vdc to 10 Vdc, 3-wire								
	2	0 Vdc to 5 Vdc, 3-wire	11	0.5 Vdc to 2.5 Vdc, 3-wire								
PROCESS CONNECTIONS	N	Nose cone	W	Nose cone w/added weight (1.1 lbs.)								
	T	NPT adapter, 1/2 " NPT male outer thread with 1/4 " NPT female inner thread attached to transmitter process connection with straight thread and O-ring seal										
ELECTRICAL CONNECTIONS		Submersible cable (specify length in feet)										

Please consult your local NOSHOK Distributor or NOSHOK, Inc. for availability and delivery information.

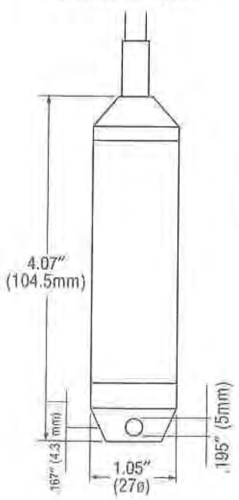
EXAMPLE

612 5 1 1 N 50'

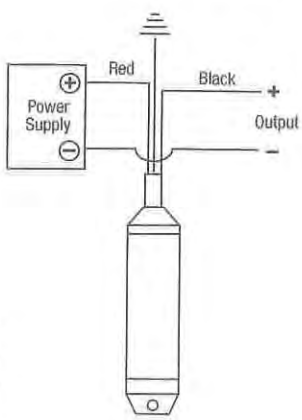
Series	612	612
Pressure Range	0 psig to 5 psig	5
Accuracy	± 0.25 %	1
Output Signal	4 mA to 20 mA, 2-Wire	1
Process Connection	Nosecone	N
Electrical Connection	Submersible Cable	50'

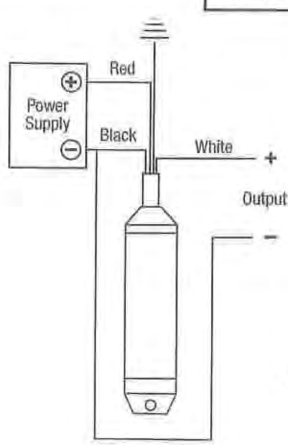
Optional Accessories	
Moisture filter	612-Filter-Element
Desiccant Cartridge	612-Desiccant Cartridge
Cable Clamp	612-Cable Clamp

Dimensions



Wiring Diagrams and Electrical Connections



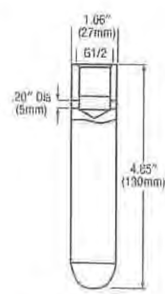


2-WIRE WIRING DIAGRAM

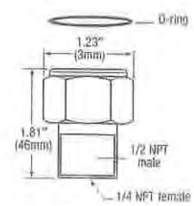
Series 612	4 mA to 20 mA 2-Wire
+ Supply	Red
+ Output	Black

3-WIRE WIRING DIAGRAM

Series 612	Voltage Output
+ Supply	Red
Common	Black
+ Output	White



Weighted nosecone



NPT adapter

MNL-1 Modulogger 'Mini' Data Logger

ModuLogger™ 'MINI' (continued)

configuration, front-end completion circuitry and rugged suppression protection circuitry to insure reliable, accurate signal conditioning. The innovative Cal-Check™ self-calibration feature has been enhanced within the Mini to include User-programmable self-calibration cycles for both analog input channels and the system Analog to Digital Converter. Precision trimmed, temperature stabilized references insure accurate Cal-Check performance over time and temperature.

Digital Inputs and Alarm Outputs

In addition to the analog inputs, a General Purpose Digital Input is provided for logging of events or hi-speed counting of digital signals from flow meters, encoders, or other pulse-train type sources. Available alarms include: two isolated relay outputs, a TTL output, a Status LED and a 5Vdc regulated output.

User Interface

Enable, Stop and Reset switches as well as LED status indicators are provided at one end of the MiniLogger module. Input and Output wiring is handled through pluggable terminal strips which allow for simple mass connection and disconnection of wiring.

Applications

Designed for portable, plant floor, remote site, and long-term remote data collection applications, the Mini incorporates low-power circuitry providing up to 4 weeks of operation from its optional plug-on D-cell battery pack. A low-voltage transformer (provided) can be used for indefinite logging.

With its compact package design, it's perfect for incorporation into OEM equipment for performance and operational profiling.

Specifications

Data Storage Memory: Redundant battery backed up SRAM. Apx 16,000 samples internal, 80,000 with expanded memory option (internal)

Data Memory Backup: Lithium cell, 1 year @ 25°C

Memory Utilization: User programmable; Stop when Full, Stop & Continue Processing, Rotary (FIFO) memory

A/D Converter: 12 bit plus sign (13 bit) SAR converter. Programmable first-order filtering and 50/60 Hz noise rejection

A/D Converter Accuracy: +/- 0.1% RDG + 1 bit

Sampling Throughput Rate: 150+ Samples per Second (analog input to memory); rate dependent on number and type of channels and logger program

Analog Input Channels: 4 individually programmable inputs

Specifications (continued)

THERMOCOUPLE:

Type: J, K, E, T, R, S

Accuracy: +/- 0.2 to 1.0° C depending on range and type (+/- 5°C for R and S type)

Cold Junction Compensation (CJC) Range: -10 to 60°C

CJC Accuracy: +/- 0.5°C

DC VOLTAGE:

Full Scale Ranges: +/- 20mV, +/- 40mV, +/- 50mV, +/- 60mV, +/- 100mV, +/- 200mV, +/- 1V, +/- 2V, +/- 5V, +/- 10V, +/- 30V

Accuracy: +/-0.3% F.S., 0.5% for Hi and Med ranges

Common Mode Range: 3.5 VDC, Full Differential Input

Input Resistance: >2.5M for 5, 10, and 30VDC; >10M for all other ranges

DC CURRENT:

Full Scale Ranges: +/- 200uA , +/- 400uA, +/- 500uA , +/- 1mA, +/- 2mA, +/- 11mA, +/- 22mA

Accuracy: +/- 0.3% of Rdg

Input Resistance: 100 ohms (all ranges)

DIGITAL INPUT:

One General Purpose Digital Input channel. User programmable, Event or high-speed Counter. Contact closure or TTL driven signal input (15VDC max)

Outputs:

2 - low-voltage N/O relays; 500mA rated
1 - Current limited TTL digital output
1 - 100mA 5VDC regulated output

Real-Time Clock: Date and Time, 24 hour, battery backed up.

Glitch Recovery: Hardware watchdog reset followed by software restart of last operation.

Power Consumption: 9 VDC nominal. Apx 5mA between readings; apx 50 mA during readings; provided by 6 internal D-cells.

External Power: 9-32 VDC, 10-26 VAC from any semi-regulated external source (120VAC wall adapter included). Fuse and Transzorb protected.

Operating Temperature/Humidity: -10 to 60°C (14 to 140° F). 90% non-condensing

Enclosure/Dimensions/Weight: Dust Sealed. 8.8"W x 4.8"H x 2.2"H (3.8"H w/ Battery Pack attached). 1.5lbs (3lbs with batt)

Shock and Vibration: The Mini will withstand the shock and vibration conditions encountered in normal commercial shipping and handling.

Need More Capability?

For applications requiring greater input/ouput capacity, request literature on the Logic Beach HyperLogger or ModuLogger data logging and alarming products.

Need Less Capability?

For applications needing only a digital counter/event input (no analog) ask about the MNL-2, designed specifically for tipping bucket rain gages or flow logging applications.

OEMS.

Contact us about incorporating the MiniLogger into your equipment for logging equipment status, inventory levels and system performance and/or alarming on level, flow, temperature, and more.

Contact Logic Beach for configuration assistance.

4010.10405 9/02

8363-6F Center Dr., La Mesa, CA 91942 | Tel: (619) 698-3300 | Fax: (619) 469-8604 | Email: applications@logicbeach.com

MNL-1 Modulogger 'Mini' Data Logger

Features

- 4 universal analog inputs accept t'couples, Vdc or mAdc
- Full differential, bipolar inputs
- 4 user-programmable outputs
- 1 Hi-Speed Counter/ Event input
- 16,000 Sample Capacity (80,000 optional)
- Conditional logging, math, integrals, delta logging and much more
- Communicate via RS-232, Ethernet, RF, or modem
- Low power for battery or line-powered use
- Real-Time trending to a PC via serial link
- Includes HyperWare for programming, communications and data analysis
- Flexible programming via graphic drag and drop icons

The Authority in Unrestricted Data Logging

ModuLogger™ 'MINI'

The Mini is a low-cost, self-contained portable data logging and alarming system designed for field, production floor and lab data collection. The logger is user-configurable and programmed via the included HyperWare software program. HyperWare provides for graphic programming of the Mini, serial communications, real-time trending, graphic plotting and spreadsheet conversion of collected data. After field data collection, the Mini's memory is downloaded to a PC running the provided HyperWare software. The data can then be further manipulated, plotted, via the included plotter program and/or converted to CSV or Excel file formats.

As a self-contained, battery powered, stand-alone unit, the Mini can be remotely deployed or incorporated into equipment where it reliably samples digital and analog inputs, storing them to memory. Easily programmed, the MiniLogger has powerful processing capabilities for data reduction (averaging, min/max, etc) mathematical manipulation (algebraic, trig, time integrals, etc.), and conditional data logging capabilities.

MiniLogger Hardware
The Mini is a ruggedly packaged module that contains the system microprocessor, data storage memory, Analog to Digital converter, signal conditioning circuitry for inputs and outputs, User-switches, RS-232 port and Cold Junction Compensation circuitry. Optional features include sensor loop power, telephone modem, removable PCMCIA memory card expansion and front panel display for current readings and system or user-defined messages.

Analog Input Channels
The MiniLogger can accept up to four universal, software-configurable, analog type inputs: 6 thermocouple types, 11 ranges of VDC or 7 ranges of DC current. Each channel can be individually configured for a different input signal type and sampling strategy. An additional analog channel is used for Cold Junction Compensation for thermocouple applications, which may be used as a system temperature, resistance, thermistor, or contact closure input when thermocouples are not used.

Each analog input channel is a full differential input, software programmable gain and

LOGIC BEACH INCORPORATED
8363-6F Center Dr., La Mesa, CA 91942 | Tel: (619) 698-3300 | Fax: (619) 469-8604 | Email: applications@logicbeach.com

United States Department of the Interior

BUREAU OF RECLAMATION
Pacific Northwest Construction Office
3701 River Road
Yakima, Washington 98902-7306

IN REPLY REFER TO:

AUG 20 2004

NCO-3173
PRJ-8.10

MEMORANDUM

To: Upper Columbia Area Office
Attn: UCA-1203 (Al Scherzinger)

From: John Manfredi
Acting Project Construction Engineer

Subject: Kennewick Irrigation District and Columbia Irrigation District
Pump Exchange Feasibility Study
Amon Wasteway Operational Spill
Concept Design Report

Enclosed is the Concept Design Report for Amon Wasteway Operational Spill. Please review and send comments by August 30, 2004. Please contact Wendy Christensen at 509-575-5946 with questions or comments.

Attachments

cc: UCA-1205 (S. Isley) (w/attach.)
LCA-1005 (D. Crammond) (w/attach.)
NCO-3110 (w/attach.)

To: Wendy Christensen
From: Dar Crammond
Re: Amon Wasteway Analysis

Following up on our telephone call of August 24, 2004, this is a list of some issues that I identified in the report. I also had a few minor edits that appear as marginal notes on the copy I returned to you.

Place of Use: The report indicates that since 1986, KID has used an increasing amount of Amon Wasteway water for irrigation and municipal service. My concern is that the LIDs served by Gage pumping plant, LID 120, Meadow Country Club, and the 600.1 acres of KID lands are all valid places of use. That is a two step analysis: Are they within the boundaries of KID? Are they classed as irrigable? I think that for us to provide water for these uses, they need to have a clear water right, clear land status designation, and clear contract authorization. I'm assuming that this is a formality only. Chuck Garner or someone else at KID can answer these questions. One point of caution: serving the LIDs with water designated for irrigation and incidental domestic use could open a can of worms. Reclamation policy is to provide water for Municipal and Industrial use at a higher rate than irrigation. These subdivisions are getting a freebie – water for irrigation has a significant subsidy built in that should not, under current Reclamation policy, be extended to LIDs.

Amon wasteway habitat: The report indicates that some amount of water may be earmarked to maintain the habitat requirements in the wasteway. This could be a base flow amount, or an amount necessary to hit some water quality goal. I understand that you have a biologist looking at the relative values of the habitat as well as the false attraction problems that the wasteway may cause. Habitat enhancements like this are an unavoidable, but incidental benefit of standard gravity irrigation systems of this vintage. Habitat maintenance is not a primary purpose for project water delivered to KID. If the plan is to commit, intentionally, to habitat flow enhancement, there are water right and contract issues that must be addressed. I ask that you keep me posted on this aspect of the plan.

Call me with any questions. Dar Crammond 509.575.5848.x244

From: Dar Crammond
To: Christensen, Wendy; Isley, Stan
Date: 9/2/2004 7:36:48 AM
Subject: Fwd: Re: Amon Wasteway Operational Spill

Wendy:

On the issue of the KID quantity:

Stan has it right: "84,674 af (1905-priority) at the KID Main Canal headworks and an additional 18,000 af (1891-priority), of which 15,600 af can be diverted at the KID Main Canal headworks and 2400 af may be diverted at Wanawish Dam . . ."

However, the Wanawish water can go either through the KID main canal at Chandler or at Wanawish. Therefore, the maximum they can divert is 102,674 af of irrigation water. The power water is not at issue.

My guess is the 109 Kaf is either a recent historic max. Their old entitlement was up around 122 Kaf.

So, to reiterate, 102,674 should be your design parameter.

Another item: note that the purpose in the CFO includes "other US/ KID purposes", which could be our entree into fish, wildlife, and habitat use.

DAR

CC: Scherzinger, Alan

From: Stan Isley
To: Christensen, Wendy
Date: 9/2/2004 12:46:08 AM
Subject: Fwd: Re: Amon Wasteway Operational Spill

9-2-04

Hi Wendy;

I'm writing you back finally with some comments on the draft concept design report for Amon Wasteway operational spill you sent me last week. I have attached Dar's reply and comments below for reference.

I agree with Dar that it's a good idea to confirm that the 600.1 acres served by the LID's are indeed within the authorized IRRIGABLE acreage for KID. The court confirmed the KID water right based on the irrigable acreage standard (not an actually-irrigated standard). As Dar notes, probably Chuck Garner could confirm that for us. Dar is also right that the type of water use by KID may not meet the Federal Water Supply Contract & RRA standards - but that's something global that Reclamation needs to address at some point. I defer to you genuine Reclamation staffers on that issue.

If Amon Wasteway provides important wetland and wildlife habitat under historic operating conditions; and if proposed system modifications (pump exchange) will largely eliminate that habitat; perhaps Reclamation & KID may need to consider mitigation for that loss of habitat. One option might be to dedicate a minimum spill quantity as habitat-maintaining flow in the Amon Wasteway down to its Yakima River confluence. That's possible, though it would require some water right modification to add a purpose of use. Or perhaps KID could assign that water to the State Trust Water Right Program for wasteway flow maintenance. It does create an issue that is somewhat thorny for us to wrestle with. A permanent transfer of a portion of KID's right to the trust would reduce its entitlement that its prorationing level in drought years is calculated from. That wouldn't be acceptable. Perhaps under YRBWEP, a portion of KID's water right (conservation savings) could be assigned to wasteway flow maintenance instead of mainstem target flow increases. Perhaps it's not worth trying to maintain artificial flows in this ephemeral, or at best intermittent, drainage channel.

Of course, WDFW is in a court battle with SVID right now about maintenance of wetland and wildlife habitat in a little creek called Rocky Ford Creek that runs through Grandview. SVID says it's just a small district drain, and WDFW says it's an important drainage that provides refuge habitat for salmon fry and provides wetland habitat for wildlife. WDFW wants us to maintain these rare and important fish fry refugia in the lower river reach. We'll see how that issue plays out.

There's probably a way to do it, if you decide to dedicate some flow to habitat maintenance in Amon Wasteway. Dar and I might be able to come up with an idea, if it's necessary.

I note that on page 3 of your report, in the first and second paragraphs of the 'Results of 2001 and 2002 Measurements' section, you describe the KID allocation or water right entitlement as 109,375 acre-feet. I'm at a loss as to how you've derived that number. I looked at the KID Conditional Final Order and I see that KID is confirmed a right to 84,674 af (1905-priority) at the KID Main Canal headworks and an additional 18,000 af (1891-priority), of which 15,600 af can be diverted at the KID Main Canal headworks and 2400 af may be diverted at Wanawish Dam, for the purposes of "irrigation and other US/KID purposes". Of course, there's an additional 128,343 af confirmed to KID to power 2 hydraulic pumps at the Chandler pumping plant, but that hydro water isn't relevant here. I just don't understand how you got the 109,375 af. I get a total of 100, 274 af (84,674 + 15,600). Does that 109,375 af figure include some other water rights? Dar? Maybe you know the answer...

The report looks good to me other than my above comments. I too marked up the copy of your report you sent me, correcting some very minor typos, etc. I think I'll put my marked up copy on Al Scherzinger's desk. He can send it on to you if he thinks my edits are important. Or you can call him and and ask him to send it to you. I hope my comments here are still relevant to you and somehow helpful. Thanks for letting me look over your report. Take care.

Stan

Attachment

CC: Crammond, Dar; Scherzinger, Alan