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Washington Phase II Fish Diversion Screen Evaluations in the Yakima River Basin

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Summary

Pacific Northwest National Laboratory (PNNL) evaluated 21 Phase II screen sites in the Yakima River Basin as part of a multi-year study for the Bonneville Power Administration (BPA) on the effectiveness of fish screening devices. The sites were examined in 1997, 1998, 1999, and 2000 to determine if they were being effectively operated and maintained to provide fish a safe, efficient return to the Yakima River. Data were collected to determine if velocities in front of the screens and in the bypass met current National Marine Fisheries Service (NMFS) criteria to promote safe and timely fish bypass and whether bypass outfall conditions allowed fish to safely return to the river.

Based on the results of our studies in 2000, we conclude that:

- in general, water velocity conditions at the screen sites met fish passage criteria set forth by the NMFS.
- most facilities were efficiently protecting juvenile fish from entrainment, impingement, or migration delay.
- automated cleaning brushes generally functioned properly; chains and other moving parts were well greased and inoperative.
- removal of sediment build-up and accumulated leafy and woody debris are areas that continue to improve.

Acknowledgments

The successful completion of this project depended on the involvement and cooperation of many people. Ken Barnhart, Bonneville Power Administration (BPA), directed the project. John Easterbrooks, Bill Werst, and Pat Schille, Washington Department of Fish and Wildlife (WDFW), provided valuable background information on the sites and also comments on the operation and maintenance of individual sites. Student Rebecca Wahl assisted during field evaluations and data entry/interpretation.

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1.0 Introduction

Over the years, irrigation has played an important role in the development of the middle Columbia River Basin. Water has been diverted from western rivers since the mid-1850s to irrigate crops. During the 1920s, some of these diversions were equipped with fish protection devices, but it wasn't until the Mitchell Act of 1938 provided funding to protect fish that screening irrigation diversions and evaluating their effectiveness truly got underway (Bryant and Parkhurst 1950).

In more recent history, the Bonneville Power Administration (BPA) and the Northwest Power Planning Council (NPPC) expanded screening efforts to protect and enhance fish populations. The Council's Columbia River Fish and Wildlife Program (Program) lists fish protection through effective screening of irrigation diversions as an essential element in their plan to restore declining steelhead *(Oncorhynchus mykiss)* and salmon runs (NPPC 1984, 1987, 1994).

Research on the effectiveness of fish screening devices initiated changes in design and operating procedures of screening facilities over the years. For example, maximum allowable screen size openings decreased as protecting fish at their earliest developmental stages became a national concern. Such new requirements for fish protection are developed by the National Marine Fisheries Service (NMFS) and adopted by individual state agencies. Changes in the regulations require that older, less-efficient screening facilities be updated or replaced. Through a regional Conservation and Electric Power Plan implemented under the Pacific Northwest Electric Power Planning and Conservation Act, the BPA and the Bureau of Reclamation funded construction of and improvements to fish passage and protection facilities at irrigation diversions in the Yakima River Basin. Construction and enhancements of the Phase II screens are part of this plan. In addition, BPA has established a monitoring and evaluation program to ensure that new and updated screening facilities meet current fish protection standards.

At BPA's request, Pacific Northwest National Laboratory (PNNL) staff has conducted a number of fish screen evaluations in the Yakima Basin since 1985. Initially, staff monitored Phase I screening facilities to determine whether fish that entered irrigation canals were diverted back to the river safely (Neitzel et al. 1985, 1986, 1988, 1990a, and 1990b). Additional studies examined water velocities in front of the screens to determine whether NMFS criteria were being met (Abernethy et al. 1990). Two studies conducted at PNNL's Aquatic Laboratory in Richland, Washington, used modular drum screens constructed by the Washington Department of Fish and Wildlife (WDFW) to determine fish survival through submerged orifices and the relative effectiveness of two screen configurations at bypassing fish (Abernethy et al. 1996; Neitzel et al. 1997). The methods currently used for evaluating screening facilities were developed while conducting these earlier studies (Blanton et al. 1998, 1999).

In 1999, 20 Phase II sites were evaluated. The John Cox site was included in 2000 for a total of 21 sites. These evaluations addressed three main questions:

1. Are screens designed, operated, and maintained to meet NMFS criteria standards over a wide range of conditions?

2. Do velocities/flows meet NMFS criteria?

3. Are screens effective at protecting fish from injury and from unnecessary migration delay?

This report presents the results of the 2000 surveys and compares them with findings from earlier surveys.

2.0 Methods

Twenty-one operating screen sites in the Yakima, Naches, and Tieton river basins were evaluated three times between May 22 and October 4, 2000 (Figure 1). Three types of data were collected at each site. These included water velocity measurements, underwater video, and general data (i.e., screen submergence, bypass conditions, fish presence, operator aids) as described below.

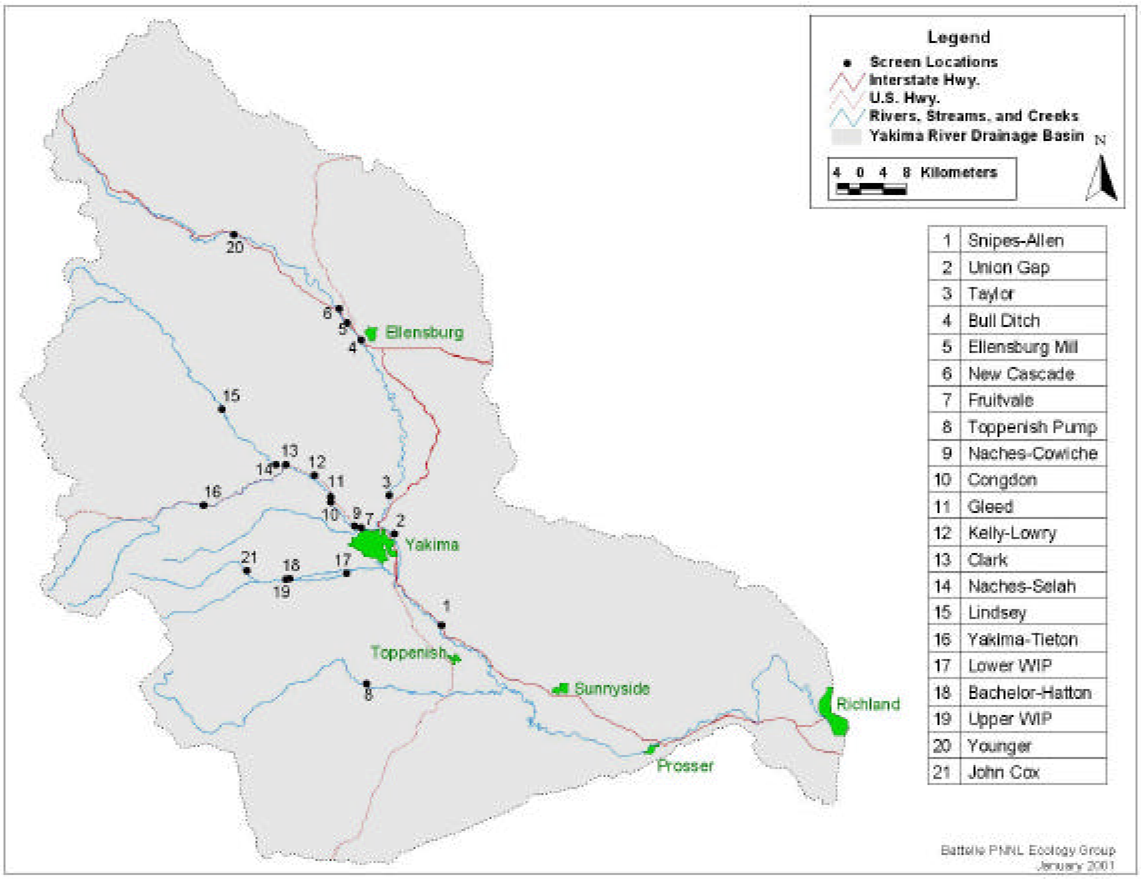

Figure 1. Yakima River Basin Phase II Screening Facilities

2.1 Water Velocity Measurements

2.1.1 Equipment

Water velocities in front of the screens and in the bypass were measured at most sites with a Marsh-McBirney Model 511® electromagnetic water current meter. The meter used a bi-directional probe that allowed measurement of flows in two directions (approach and sweep) simultaneously. Output was read visually from a panel gauge. The probe was securely mounted to a horizontal metal arm that extended approximately 12 in. from a vertical pole. The length of the horizontal arm and its position on the vertical pole were adjustable. The probe support assembly was positioned at least 12 in. downstream or outside the probe's sensors to minimize interference from the vertical pole when taking velocity readings. Figure 2 shows the Marsh-McBirney probe on the right.

During the last evaluation period of the year, water velocities were measured at eight sites using a SonTek Acoustic Doppler Velocimeter (ADV). The ADV emits sound at a specific frequency. The frequency of this sound increases or decreases depending on whether the water is flowing toward or away from the ADV receiver. The difference between the frequency emitted and the frequency received is used to calculate the velocity of the water. The probe uses three receivers extending out an angle from the transmitter to calculate the three-dimensional water velocity at a known point (10 cm) below the probe. Velocities are typically recorded at each sampling point along the screen for 20 seconds at a rate of 10 per second and stored in a computer file.

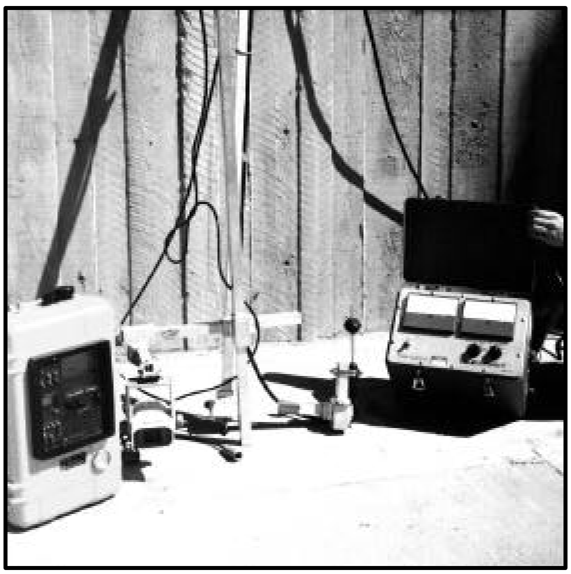

Figure 2. Photograph of Video Equipment and Marsh-McBirney Probe, Left and Right, Respectively

2.1.2 Probe Positioning

Velocity measurements were taken in front of all screens. The vertical pole was placed close to the front of the screen, but was never in contact with the screen face. The bottom of the pole rested on the concrete forebay floor (usually on the raised sill), but the pole was not allowed to come in contact with metal (e.g., walking platform, gantry, or girder) to reduce the likelihood of electrical interference. The probe was pointed upstream and positioned within 3 in. of the screen face. Because the screens are constructed at an angle to the canal flow, all measurements were taken with the axes of the probe oriented parallel (sweep) and perpendicular (approach) to the screen face, not to canal flow. Measurements were taken across the screen face at 0.2 and 0.8 of the water depth when the forebay depth was ≥4 ft. Measurements were taken only at 0.6 of the water depth where forebay depth was <4 ft. Velocity measurements were generally taken at either three or five evenly spaced positions across each screen or panel. Velocities were also measured in the bypasses. One measurement was recorded immediately inside the vertical slot bypass entrance usually at either the mid-water or high-water depth.

2.1.3 Data Collection and Analysis

Flow measurements were taken in front of every screen during site visits, except where noted. Power to drum screens and cleaning brushes was disconnected whenever possible to minimize the likelihood of electrical interference. Average sweep and approach velocities at each site were calculated for each visit.

2.2 Underwater Video

2.2.1 Equipment

An underwater video system was used to investigate screen seal condition and to monitor debris build-up and fish presence. The system consisted of a high-sensitivity remote camera (Sony, model HVM-352®) with a wide-angle lens (70º Sony, model VCL-06HS®). The camera was housed in a water-resistant case (Sony, model WPC-140®) and connected by 66 ft of quadraxial cable to an 8-mm cam-corder (Sony, model CCD-FX710 Handycam Hi-8®) in a weatherproof housing (Figure 2). The case was fitted with external weatherproof controls, a 4-in. black and white monitor, and internal battery power supply for the system. The underwater camera operates at extremely low light levels (<1 lux), so that artificial light sources were not necessary to obtain video images during daylight hours.

2.2.2 Camera Positioning

The camera was securely mounted on a vertical pole and adjusted as needed at each site. The camera was usually angled slightly downward to observe the area between the screen and the bottom seal where there was a potential for gaps to occur. The camera was usually moved from upstream to downstream, following the side and bottom seal/screen interfaces. Where there were signs of excessive debris or fish, images were also recorded showing the forebay area and/or bypass.

2.2.3 Data Collection and Analysis

Video footage was not recorded on all visits in 2000. On several occasions, high turbidity or lack of water precluded video analysis at some sites. In June, the camera was not working, and video surveys were performed in July instead. Written observations were made in the field when something of interest was seen with the camera (i.e., faulty seals, gaps, fish). All videotapes were later reviewed in detail, and images of interest were digitally captured using Optimas software.

2.3 General Data

Additional data collected during each evaluation included the following:

- general site descriptions and photographs
- screen and seal conditions
- screen submergence levels
- cleaning system operation and the incidence of headloss across the screen face
- bypass flow conditions
- bypass outfall flow conditions
- fish presence
- observations of debris in the forebay or bypass
- presence or absence of operator control aids such as water gauges and drum submergence marks on screen frames.

3.0 Results and Discussion

This section presents the overall results first, then describes each site in more detail. The site-by-site descriptions are organized into three groups: rotary drum screens, flat-plate screens, and vertical traveling screens.

3.1 Overall

The NMFS criteria define several conditions concerning velocity (NMFS 1995). These include:

- maintaining a uniform flow distribution over the screen surface to minimize approach velocity
- keeping approach velocities ≤0.4 ft/s
- achieving sweep velocities that are greater than approach velocities
- effecting a bypass flow greater than or equal to the maximum flow velocity vector resultant upstream of the screens.

In addition, there should be a gradual and efficient acceleration of flow into the bypass entrance to minimize delay by emigrating salmonids. Screen operators should try to achieve these criteria at all sites. We generally compared our field measurements of water velocity, underwater video, and general data collection results for each screen site to the NMFS criteria. This section contains the results of these comparisons by site.

3.1.1 Water Velocity Measurements

In general, water velocity conditions at the 21 screen sites met fish passage criteria set forth by the NMFS. Although velocities often fluctuated from one sampling location to the next, average sweep velocities typically exceeded approach velocities (Table 1). Sweep velocities typically did not increase toward the bypass. Mean approach velocities were below the NMFS criteria of ≤0.4 ft/s at most sites.

Water velocities at each site were often highly variable, both spatially and temporally. Flows were typically not uniform over screen surfaces. Often, there were distinct differences between top and bottom approach velocity values, but a distinct pattern was difficult to discern. Either the top or bottom approach velocities tended to be higher along all the screens at a site, with the bottom velocity often increasing slightly just before the bypass. There were no obvious patterns to the fluctuations of approach velocity observed at flat plate screens.

Table 1. Summary of Problem Areas Identified at Yakima River Basin Phase II Screen Sites in 1998 (19 sites), 1999 (20 sites), and 2000 (21 sites)

Screen Type	Screen Site	≥10% of Approach Velocities >0.4 ft/s			Bypass Velocities Slower than Sweep Velocities			Damaged Screen or Seal			Submergence Outside Criteria at Least Once			Excessive Sand, Silt, or Woody Debris			Bypass Outfall Sometimes <1 ft Deep		
		1998	1999	2000	1998	1999	2000	1998	1999	2000	1998	1999	2000	1998	1999	2000	1998	1999	2000
Drum screens	Bachelor-Hatton	♦		∇	♦		∇	♦	■		♦	■	∇	♦		∇			
	Clark										♦		∇	♦					
	Congdon				♦							■							
	John Cox			∇			∇						∇						∇
	Kelly-Lowry							♦					∇		■	∇			
	Lindsey	♦						♦	■	∇	♦								
	Lower WIP					■						■		♦	■				
	Naches-Cowiche		■											♦					
	New Cascade								■	∇		■	∇			∇			
	Snipes-Allen											■							
	Taylor									∇	♦			♦					
	Toppenish Pump	♦	■					♦	■				∇	♦	■	∇			
	Upper WIP				♦				■	∇	♦			♦	■	∇			
Vertical plate screens	Bull Ditch		■	∇							♦								
	Ellensburg Mill		■	∇	♦	■			■					♦	■				
	Fruitvale			∇						∇	♦	■		♦					
	Naches-Selah		■	∇			∇	♦	■	∇				♦			♦		
	Union Gap		■	∇		■	∇		■	∇									
	Yakima-Tieton						∇	♦		∇									
	Younger																		
Vertical traveling screen	Gleed		■	∇				♦						♦	■				
Sites with problems		3	7	8	4	3	5	7	8	8	7	6	6	11	6	5	1	0	1
% Sites with problems		16	35	38	21	15	24	37	40	38	37	30	29	58	30	24	5	0	5

Overall, 90% of all approach velocity measurements met criteria of ≤0.4 ft/s (virtually the same as the 89% reported for 1999). However, approach velocities were always within criteria at only 6 of 21 screen sites (29%) evaluated in 2000 (Table 2). Areas of screen (i.e., top, bottom, upstream, downstream) that exceeded these criteria were dependent on factors at the individual sites.

Table 2. Percent of Approach Velocity Measurements that Exceeded the NMFS Criteria of 0.4 ft/s by Screen Site in 1997, 1998, 1999, and 2000

	Percent of Approach Velocity Measurements >0.4 ft/s			
Screen Site	1997	1998	1999	2000
Bachelor-Hatton	12.5	34.1	0	15.4
Clark	0	0	(a)	0
Congdon	31.1	4.4	8.3	7.1
John Cox	(c)	(c)	(d)	39.3
Kelly-Lowry	3.3	0	0	0
Lindsey	3.3	0	0	0
Lower WIP	8.3	ND(b)	0	0
Naches-Cowiche	6.6	0	12.5	2.6
New Cascade	4.2	ND(a)	0	1.4
Snipes-Allen	3.3	0	0	0
Taylor	4.2	0	0	0
Toppenish Pump	43.0	60	25.4	9.4
Upper WIP	17.5	9.4	2.5	3.3
Bull Ditch	36.1	2.9	14.7	22.2
Ellensburg Mill	0	0	33.3	25.9
Fruitvale	12.5	(a)	0	17.5
Naches-Selah	5.5	2.8	27.8	28.7
Union Gap	2.3	5.	22.9	12.5
Yakima-Tieton	10.5	5.2	2.1	1.4
Younger	(c)	(c)	0	8.3
Gleed	(a)	(a)	14.3	17.5

(a) No data; electrical interference prevented velocity measurements.
(b) No data; flooded in May and nearly dry by July 1998.
(c) Not sampled in 1997 or 1998.
(d) Not sampled in 1999.

Sites such as Naches-Selah, where greater than 10% of the approach velocities measured exceeded criteria, indicate potential problems that may be the result of flow imbalance, poorly sized screens, or over-use by the irrigator. Some sites, such as Toppenish Pump, have been able to dramatically decrease the percentage of approach velocities exceeding 0.4 ft/s since 1998 when 60% of the measured approach velocities exceeded the criteria.

Averaging velocities for each screen site presented a clearer picture of the flows at these sites (Table 3; Figure 3). Considering only averages, sweep velocity was greater than approach velocity at all sites.

The ratio of sweep velocities to approach velocities at the flat plate screens was generally greater than at drum screens (Table 3). This should help minimize the time it takes for fish to reach the bypass. Bypass flows were usually faster than the average flow past the screens; only four sites had average bypass velocities less than their average sweep velocities (Table 1, Figure 3).

Table 3. Mean Sweep and Approach Velocities (± standard deviation) at Phase II Fish Screen Facilities in the Yakima Basin in 2000

Site	Mean Sweep Velocity ± S.D.	Mean Approach Velocity ± S.D.	Ratio of Approach to Sweep
Bachelor-Hatton	1.16 ± 0.7	0.26 ± 0.15	4.46
Clark	0.49 ± 0.08	0.37 ± 0.1	1.32
Congdon	0.61 ± 0.23	0.29 ± 0.12	2.10
John Cox	0.42 ± 0.18	0.29 ± 0.18	1.45
Kelly-Lowry	0.43 ± 0.18	0.24 ± 0.08	1.79
Lindsey	0.35 ± 0.1	0.15 ± 0.05	2.33
Lower WIP	0.35 ± 0.17	0.17 ± 0.06	2.06
Naches-Cowiche	0.59 ± 0.3	0.19 ± 0.1	3.11
New Cascade	0.9 ± 1.46	0.28 ± 0.55	3.21
Snipes-Allen	0.66 ± 0.98	0.1 ± 0.09	6.6
Taylor	0.27 ± 0.17	0.14 ± 0.11	1.93
Toppenish Pump	0.88 ± 0.48	0.28 ± 0.1	3.06
WIP Upper	0.95 ± 0.51	0.21 ± 0.09	4.52
Bull Ditch	0.39 ± 0.7	0.26 ± 0.25	1.5
Ellensburg Mill	0.44 ± 0.16	0.24 ± 0.15	1.83
Fruitvale	0.97 ± 0.4	0.19 ± 0.28	5.11
Naches-Selah	1.32 ± 0.34	0.34 ± 0.21	3.88
Union Gap	1.19 ± 0.46	0.17 ± 0.26	7
Yakima-Tieton	1.77 ± 1.45	0.11 ± 0.56	16.09
Younger	1.21 ± 0.96	0.16 ± 0.28	7.56
Gleed	0.31 ± 0.46	0.13 ± 0.39	2.39

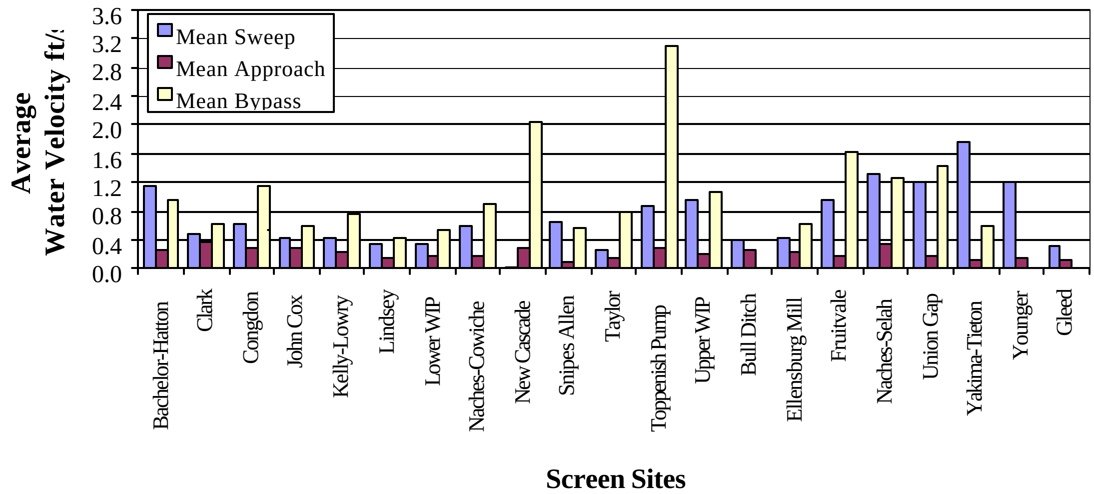

Figure 3. Mean Approach, Sweep, and Bypass Velocities (ft/s) at Phase II Fish Screen Facilities in the Yakima Basin in 2000

3.1.2 Underwater Video

Underwater video was used to monitor and document sediment and debris accumulation in front of a screen and to provide a permanent record of conditions. This is important because debris can severely decrease seal life, cause drag on screen motors, and provide cover for predator fish species. Most often, it is impossible to see this debris from above the water's surface. Although a pole can be placed in the water to gauge the depth of accumulated sediments, one cannot determine exactly the kind of debris present and how it is affecting water flow through or past the screen.

Most of the visible screen seals were in good condition. Bottom frame seals were sometimes buried in debris or plants/algae and could not be evaluated. All drum screen seals that were classified as in "good condition" were tight against the screen and not cracked or punctured in any way. Many rubber seals were covered in algae, but this was not considered a problem. A number of the drum screen sites had expanding foam insulation placed between the concrete sides of the facility and the metal "cheeks" of the drum frame. This blocked off an area that could have entrained small fish, although they could not normally have moved into the aftbay through this route. Flat plate screen seals were generally in good condition with the exception of some panels showing loose or missing caulking (e.g., Naches-Selah and Union Gap).

3.1.3 General Data

In 2000, most sites were operating in a manner that would be expected to provide safe passage for juvenile salmonids. Some sites, such as Taylor, are well maintained, well designed, and rarely exceed criteria, while others such as Bachelor-Hatton have had various problems over the past several years. Most screens were properly sealed to prevent fish entrainment and injury, although potential problems were identified in 2000 at several screen sites. Eight sites had loose or damaged seals or caulking that might have allowed fish to be entrained or caused physical damage to them (Table 1).

Automated cleaning brushes generally functioned properly; chains and other moving parts were well greased and operative. The Washington Department of Fish and Wildlife's screen shop staff were prompt in repairing and/or cleaning screens. Removal of sediment build-up and accumulated leafy and woody debris are areas that continue to improve. In 1998, 58% of the sites evaluated had excessive silt or debris problems, while in 2000, only 24% of the sites had these problems.

3.1.3.1 Screen Submergence Levels

Canal operating conditions are designed to provide water levels that cover between 65 and 85% of a drum screen's diameter. At higher water levels, fish may roll over the top of the screen and enter the canal. Lower water levels can prevent the screen from efficiently removing debris from the forebay area.

Percent screen submergence was calculated only at the 13 drum screen sites for each evaluation. Drum screens met the 65 to 85% submergence guidelines 79% of the time, quite a bit better than the 61% observed in 1999. Levels exceeded the 85% submergence criteria at 5 of 11 drum screen sites (Bachelor-Hatton, Clark, John Cox, Kelly-Lowery, and New Cascade). Most of these sites experienced high levels for only one evaluation period; however, the New Cascade site exceeded the criteria during two of the three surveys. Water levels at drum screen sites were below 65% submergence at only one site, Toppenish Pump, during our evaluations in 2000.

Flat plate screen sites do not have the same roll over and debris removal issues to contend with as rotary drum screens. However, should a screen become completely submerged, fish can freely enter the irrigation canals by swimming over the top of the screen. Total screen submergence was observed at the Fruitvale screen. However, there were no reports of over-topping at the Fruitvale site in the operator's logbook.

3.1.3.2 Bypass Outfall Conditions

The NMFS established a number of guidelines and criteria concerning bypass conduit design and outfall conditions (NMFS 1995). These criteria state that, "for diversions 25 cfs and greater, the required pipe diameter shall be greater than or equal to 24 in. (61 cm) and that the minimum depth of open-channel flow in the bypass conduit shall be greater than or equal to 9 in. (23 cm), unless otherwise approved by the NMFS." Pipe diameter criteria exist primarily to minimize debris clogging and sediment deposition and to facilitate cleaning. For screens with a diversion flow of less than 25 cubic feet per second (cfs), the requirements are a 10-in. diameter pipe and a minimum allowable water depth in the pipe of 1.8 in. (4.6 cm).

All screens with bypasses that were evaluated, with the exception of Clark, Lindsey, and Lower WIP, are designed and built for diversion flows ≥25 cfs. However, many sites had bypass pipes with diameters much smaller than the NMFS criteria. All sites appeared to normally meet the minimum requirements for in-pipe water depth.

3.1.3.3 Operator Control Aids

Although not required, visual operator control aids are extremely useful for maintenance and operations personnel periodically inspecting sites. They complement the operating criteria and help "flag" operational or procedural problems. Operator aids include marks indicating submergence level on drum screen frames; water depth or elevation gauges in the forebay, aftbay, and irrigation canal; and marks indicating how far headgate, bypass weir, or canal intakes are open. Providing highly visible indicators of screen system operation as it relates to NMFS criteria or of proper water diversion to the canal can save time and reduce incidences of operator error that may result in fish impingement, entrainment, or stranding at a site.

Most sites were equipped with gauges measuring elevation or water depth, although gauges were not always present both in front of and behind the screens. Drum screen submergence marks were present at most sites, but were difficult to read late in the season due to algae growth. We recommend regular cleaning of these marks to facilitate operator adjustments and evaluation.

3.2 Rotary Drum Screens

3.2.1 Bachelor-Hatton

The Bachelor-Hatton site was evaluated 5/25/00, 6/26/00, and 9/15/00, although no water was running through the facility in September. Approach velocities were generally within the NMFS criteria (Figures 4 and 5). Sweep velocity did not increase toward the bypass. Bypass velocities were greater than mean sweep velocities in May but not in June at this site. Water flowed smoothly over the bypass weir and through the outfall during the May and June evaluations.

The gap noted last year between the seal and the bottom of screen 2 was still present in 2000. A video survey could not be performed in June. Water was no longer running through the facility by July 25 when we went out to perform a video survey. Videotape of the site in September showed one of the bolts holding the bottom seal in place at screen 3 had broken off. This could potentially allow the seal to move away from the drum in that spot. Screen submergence was above NMFS criteria in May, with approximately 90% submergence, and within the criteria in June with 71% submergence.

Sediments were only 3 in. or so deep near the screens, but there was still a fair amount of twigs and debris that accumulated in front of the seals and in the bypass (Figure 6). There was up to 6 inches of sediment accumulation in the bypass as well. The accumulation of sediment in the bypass may indicate bypass velocities were not fast enough to flush the sediment through, or there was too much debris to allow proper flow. Bypass outfall conditions were good for fish passage in May and marginal in June. There is a small pool immediately in front of the outfall, and when the river level is high, fish coming out of the bypass can easily move into the river. However, when the river level is low, as in June, there is a ridge of gravel between the main channel and the outfall pool that is covered by only a couple of inches of water, making passage into the main channel more difficult. If possible, a deeper channel should be created to allow fish easier access to the main channel of the river, even during lower river levels.

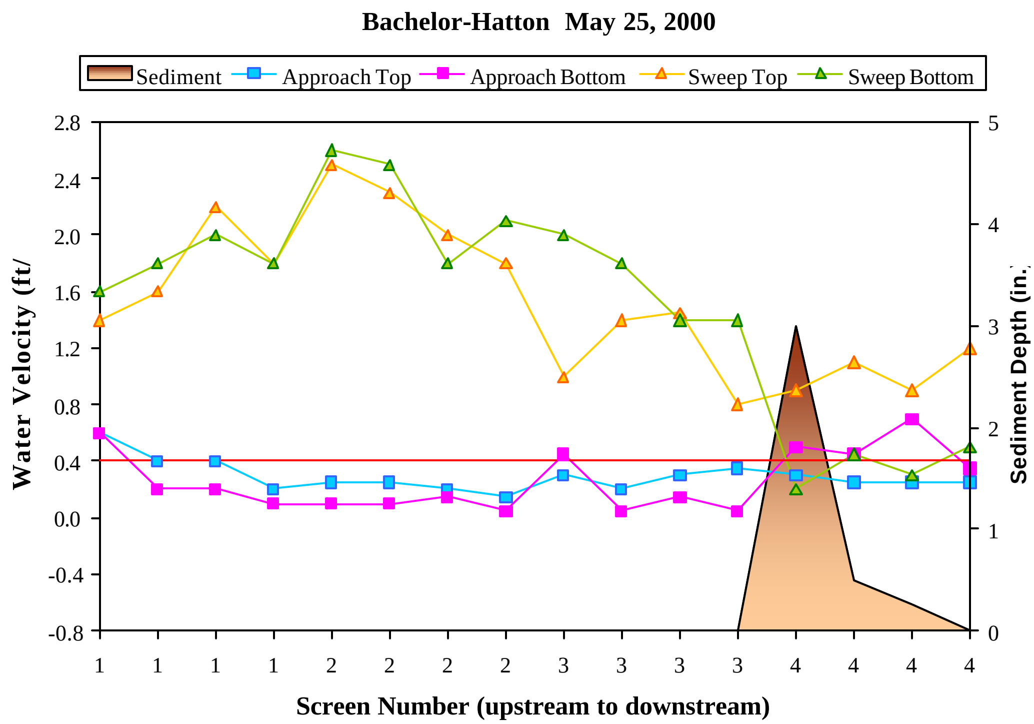

Figure 4. Water Velocities and Sediment Depths at Bachelor-Hatton, 5/25/00

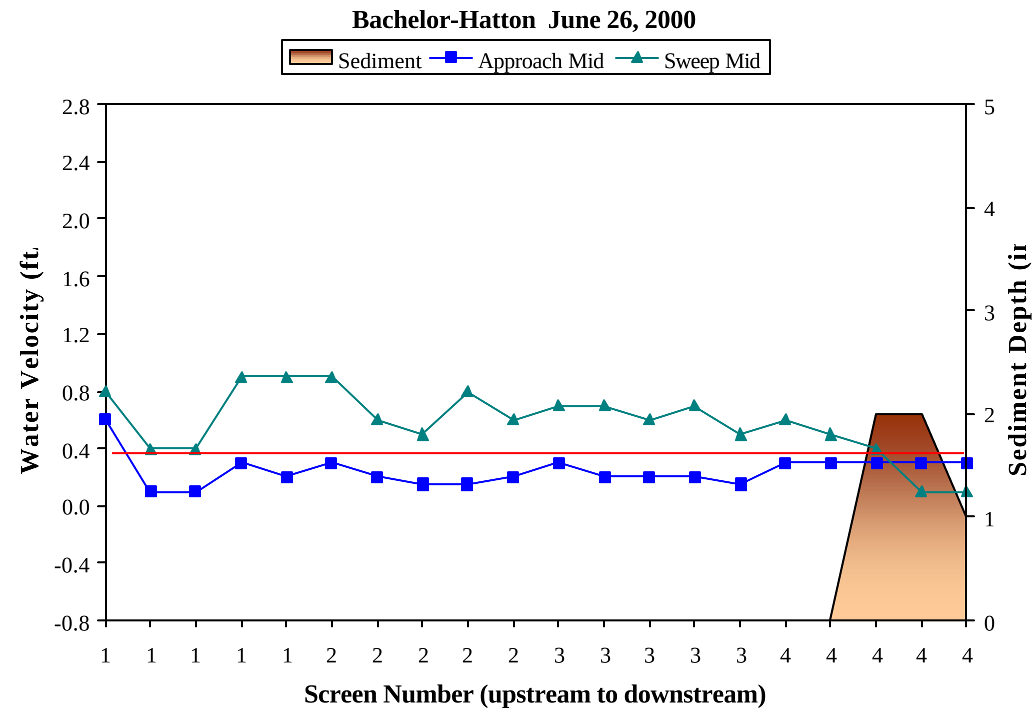

Figure 5. Water Velocities and Sediment Depths at Bachelor-Hatton, 6/26/00

Figure 6. Woody Debris in Front of the Bottom Seal of Screen Number 1 at Bachelor-Hatton on 5/25/00

There are no operator control aids such as submergence marks painted on the screen frames or gauges provided for measuring weir depth. One staff gauge was present in the aftbay to track water levels. Unidentified fish were seen in the forebay in May and in both forebay and aftbay in June.

3.2.2 Clark

Clark was evaluated 5/23/00, 6/23/00, and 9/22/00. Marks showing percent submergence were faded and obscured with algae even in May, and could not be easily read below the 90% mark. The site did not appear to collect a lot of debris in front of the screen. Water plants were abundant in the forebay, and occasionally obscured the bottom seal during video taping occasionally. Drum screens and seals were generally in good condition. There may be enough algae built up on the screens to limit flow and could have been the cause for the 2 in. headloss observed across the screens in May and June.

Electrical interference prevented the collection of velocity measurements with the Marsh-McBirney probe during the first two surveys. The Sontek ADV is not affected by electrical interference, and flow was measured using the ADV in September. During that survey, sweep was greater than approach, but did not increase toward the bypass. Mean approach was less than 0.4 ft/s. Screen submergence was above the NMFS criteria of 85% in May, but was within criteria in June and September. The single drum screen operates off a paddle wheel and rotates very slowly. The site logbook noted on 8/15/00 there was not enough flow to run the paddle wheel.

Conditions at the outfall pipe appeared to be good at the Clark site, although apparently a beaver dam just downstream of the bypass outfall caused extremely high stream levels in May, preventing any observations related to the outfall.

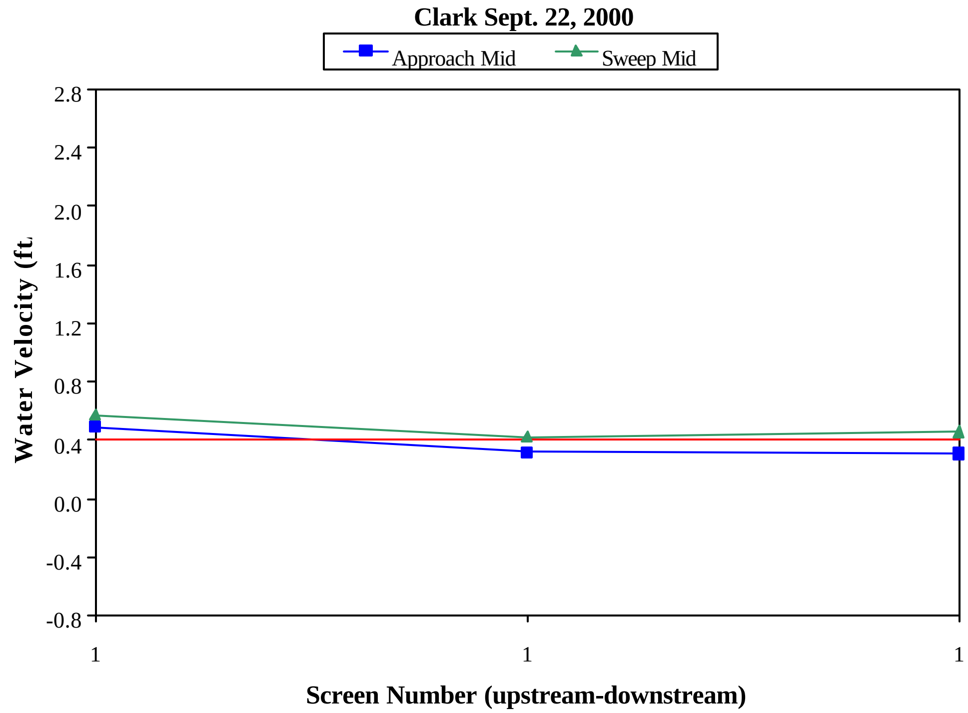

Figure 7. Water Velocities at the Clark Site, 9/22/00

3.2.3 Congdon

The Congdon screen site was evaluated 5/24/00, 6/22/00, and 10/4/00. Ninety-three percent of the recorded approach velocities met NMFS criteria at the Congdon site. In general, sweep velocities were greater than approach velocities and increased near the bypass (Figures 8, 9, and 10). The only places sweep velocities were less than approach velocities or where approach velocities exceeded criteria were in front of Screen 1 (farthest upstream) in June and September.

Mean sweep velocities were lower than bypass velocities and screen submergence was between 65 and 85% during each of the surveys in 2000. Water always flowed smoothly over the bypass weir and ran freely through the outfall pipe, although it did seem to surge through the outfall in June. During the June survey, we dropped a lemon into the water at the weir and timed its travel to the outfall to make sure there was no significant obstruction in the outfall pipe causing the surging. Based on this test, there did not seem to be any obstructions of the pipe. Surging may be caused by entrainment of air in the downwell. The outfall was always submerged. The seals were in good condition, and screens always turned smoothly. There were no debris or silt problems observed at Congdon in 2000.

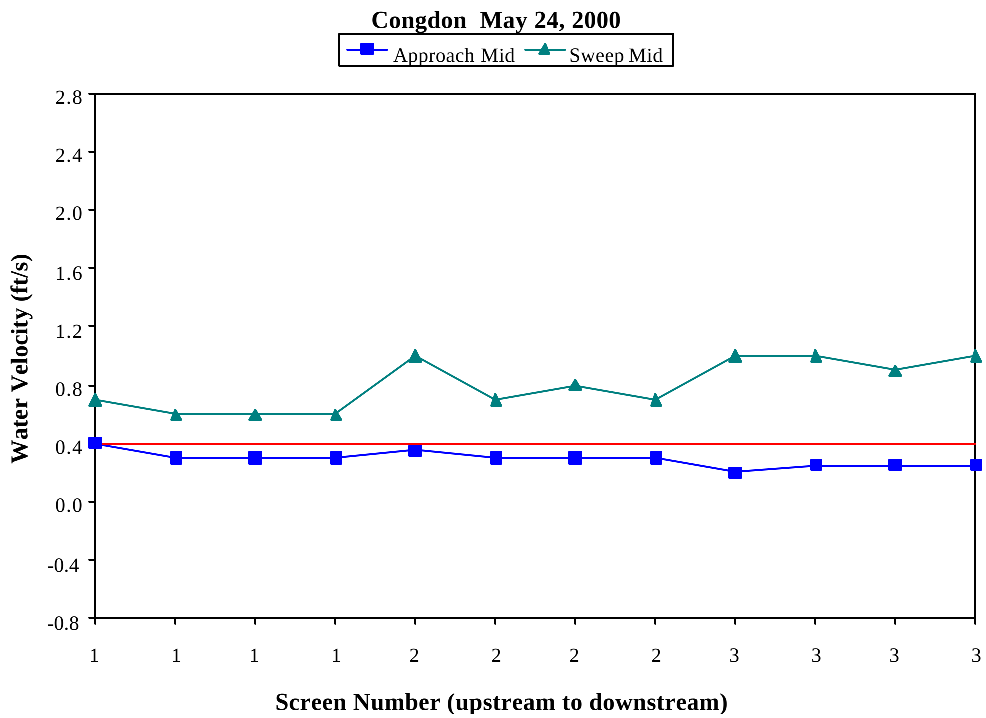

Figure 8. Water Velocities at the Congdon Site, 5/24/00

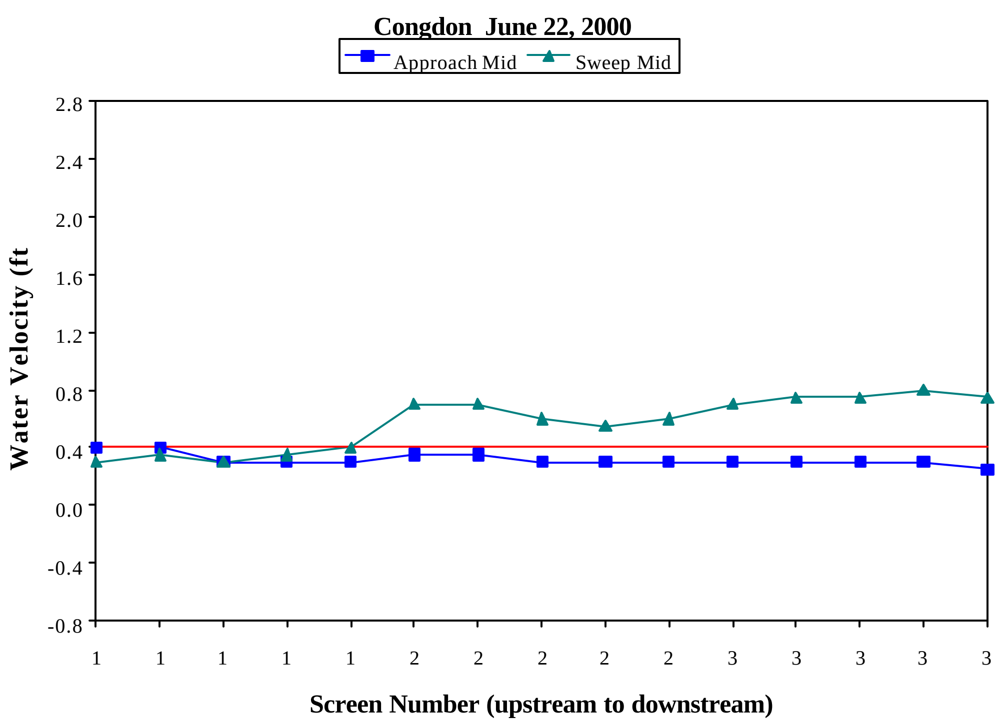

Figure 9. Water Velocities at the Congdon Site, 6/22/00

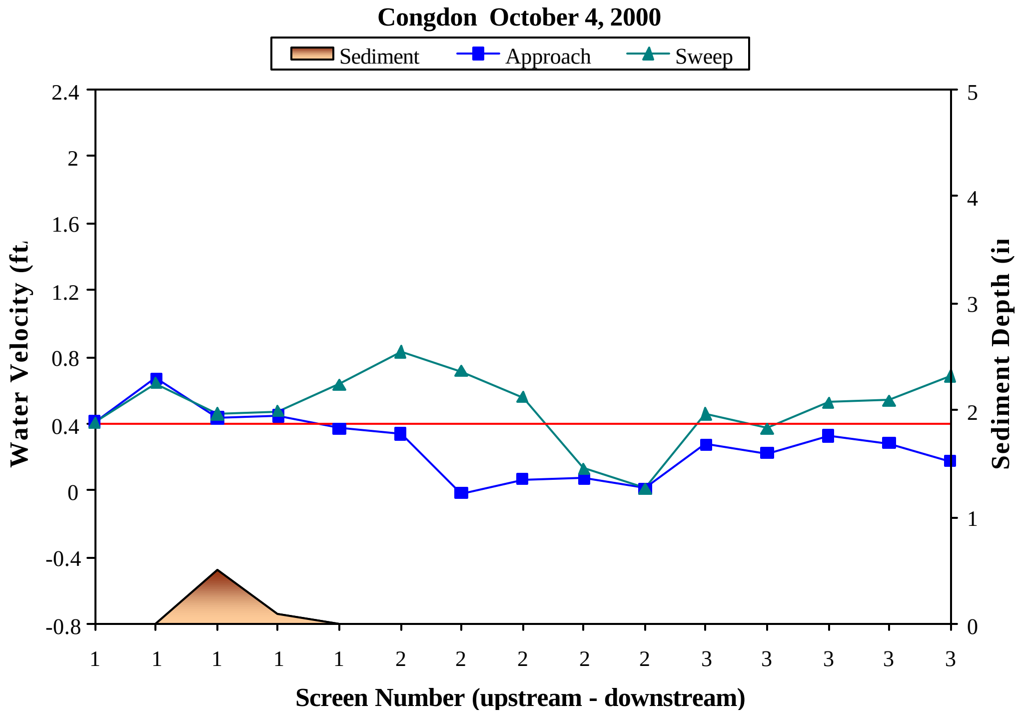

Figure 10. Water Velocities and Sediment Depths at the Congdon Site, 10/4/00

3.2.4 John Cox

The John Cox site was evaluated for the first time in 2000. It was visited on 5/25/00, 6/26/00, and 9/15/00. Measurements using the Marsh-McBirney probe indicated approach velocities were below 0.4 ft/s in May but exceeded 0.4 ft/s in June (Figures 11 and 12). Approach exceeded sweep across most of screen 1 in June, as well as being above the NMFS criteria of 0.4 ft/s at all measuring points. Bypass velocities were greater than sweep velocities in May but not in June. Sweep also increased toward the bypass in May but not in June. This site had little flow through it in September, but equipment problems prevented accurate measurement of velocities. All screens and seals looked good.

There are no drum submergence marks at John Cox. In May, the water was backed up into the downwell, but bypass velocities were greater than sweep velocities, indicating good movement of water toward the stream. High water levels in the stream also covered the outfall pipe so much that we could not find it in May. In September, there was less than 1 ft of water in front of the outfall, and only 6 in. of water in the outfall pipe. In both May and June there was approximately 1 in. of headloss across the screens. A video survey could not be performed during the June evaluation, so an effort was made to videotape the site on July 25. By then, the screens had been turned off and remained off for the rest of the season. There was some accumulation of sediment and woody debris at the upstream end of screen 1; otherwise, the site was clean.

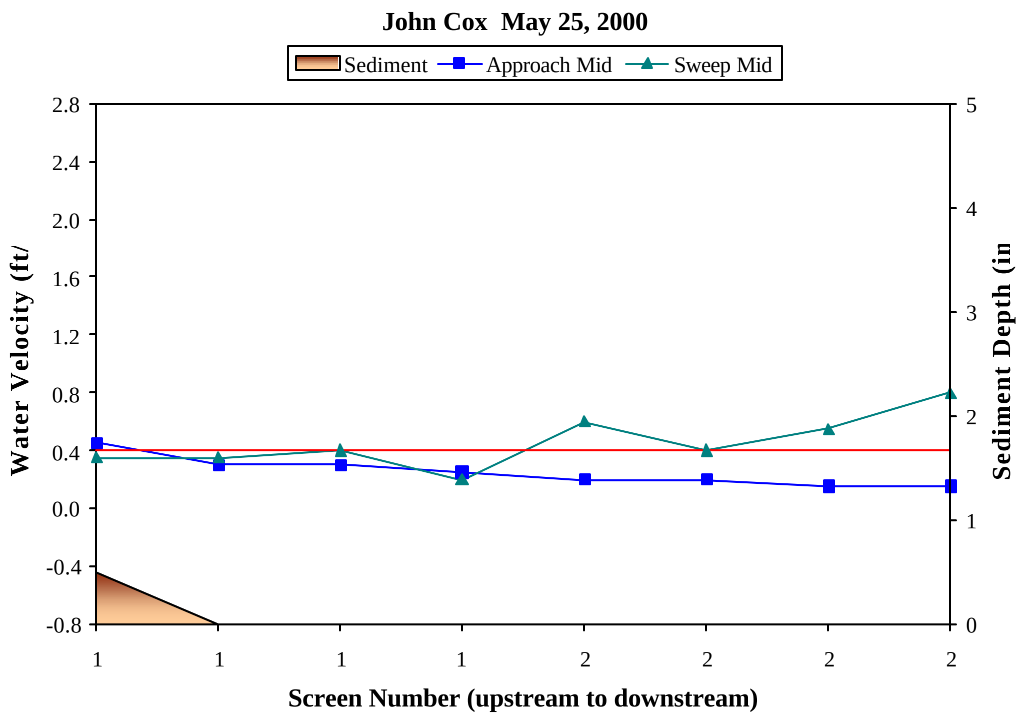

Figure 11. Water Velocities and Sediment Depths at the John Cox Site, 5/25/00

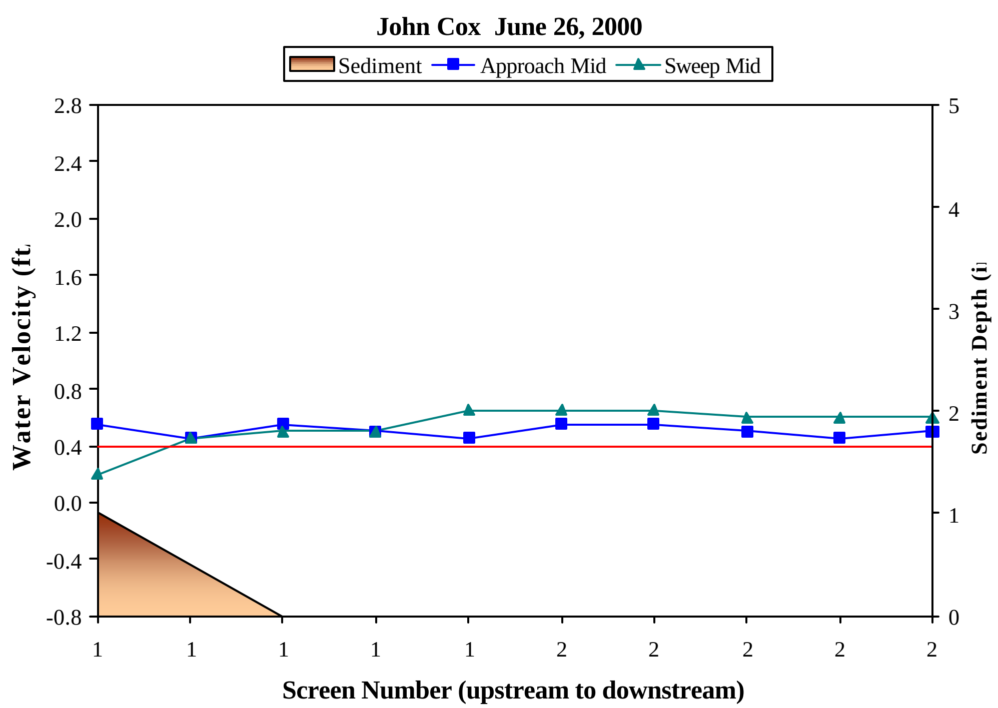

Figure 12. Water Velocities and Sediment Depths at the John Cox Site, 6/26/00

3.2.5 Kelly-Lowry

The Kelly-Lowry screen site was evaluated 5/24/00, 6/21/00, and 9/22/00. All approach velocities recorded at this site in May and June met NMFS criteria (Figures 13 and 14). Sweep velocities exceeded approach velocities in May and equaled them in June. Sweep velocities increased toward the bypass in June only. Bypass velocities were always higher than mean sweep velocities. Equipment problems prevented measurement of velocities in September. Screen submergence levels were between 65 and 85% in May and June, but were slightly higher than 85% in September.

The screens appeared brown because of algae/diatom growth, but the growth did not appear to affect headloss across the screens. The drums turned evenly, moving the smaller debris into the canal. The seals were in good condition. Some drum screen sites had expanding foam insulation between the concrete wall and the "cheek" of the drum frame. This site could benefit from that kind of gap sealing because the gap between the metal frame and the concrete wall is over ¼ in. wide. Apparently, most sites will have this type of gap sealed with the expanding foam insulation in 2001 (Bill Werst, WDFW, personal communication). Water always ran freely over the bypass weir.

The trashrack often had a lot of sticks and garbage accumulated and did not appear to be cleaned regularly in-season, and this caused up to 6 in. of headloss across the trashrack in June. The amount of debris and sediment in the forebay in 2000 was much less than in 1999, but still covered the bottom seals in places.

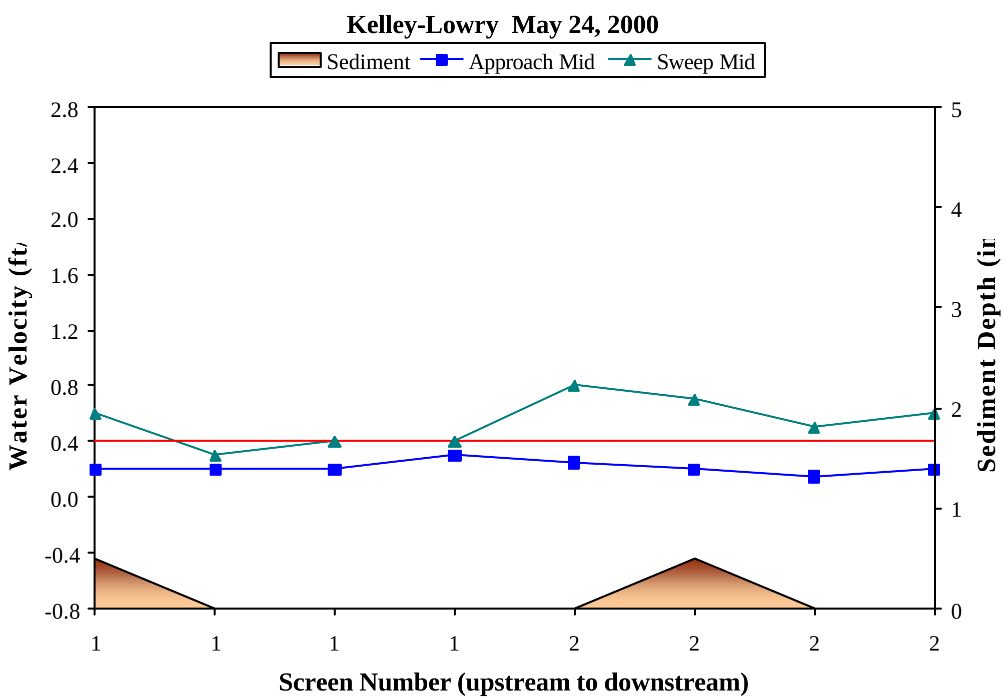

Figure 13. Water Velocities and Sediment Depths at the Kelly-Lowry Site, 5/24/00

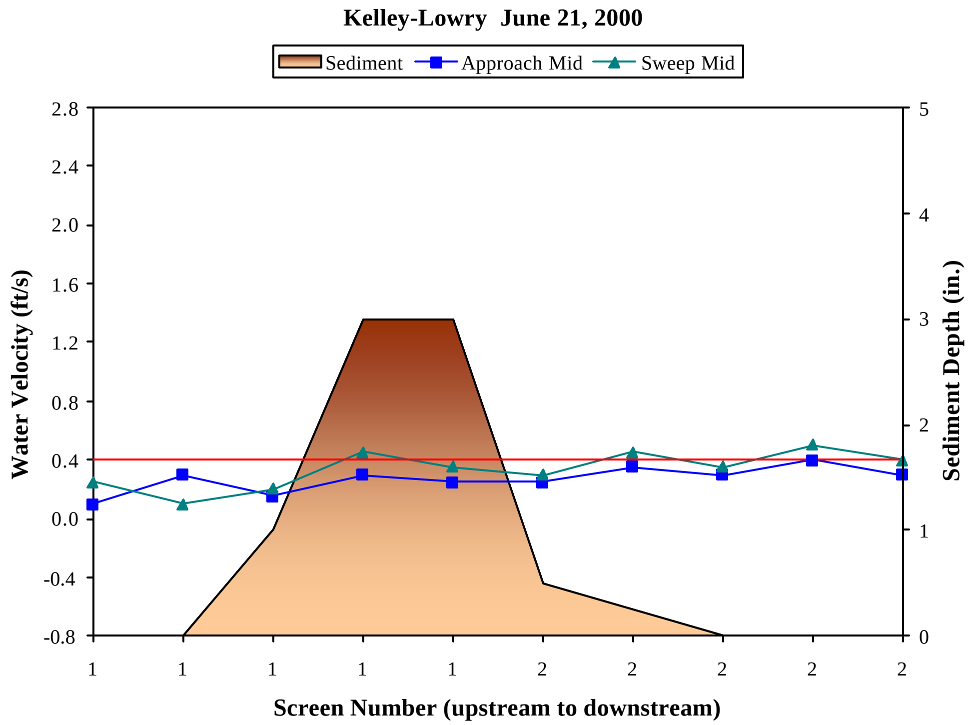

Figure 14. Water Velocities and Sediment Depths at the Kelly-Lowry Site, 6/21/00

3.2.6 Lindsey

The Lindsey screen site was evaluated 5/23/00, 6/21/00, and 9/18/00. All recorded approach velocities at this site met NMFS criteria (Figures 15, 16, and 17). Mean sweep velocities were greater than mean approach velocities, but did not increase near the bypass in May and June. Mean bypass velocities exceeded sweep velocities. Screen submergence levels were within criteria.

The side seals were in good condition, and the screen always rotated evenly. A small gap between the bottom seal and drum was noticed in June. A note in the logbook indicated a dent in the right side of the screen had been filled on 9/1/00 (Figure 18). Water ran freely behind the bypass weir. Levels of silt and woody debris were not a problem, though there were some leaves and sticks in the forebay. The bypass was operating effectively and discharged into water over 1 ft deep. One small fish of unknown species was noted in the forebay in September.

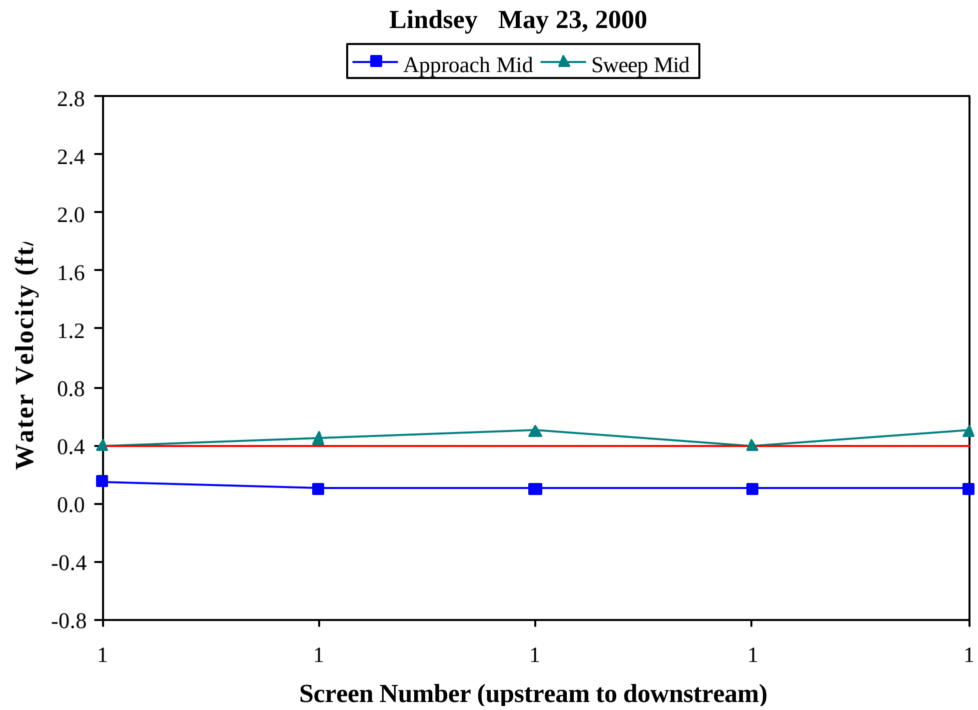

Figure 15. Water Velocities at the Lindsey Site, 5/23/00

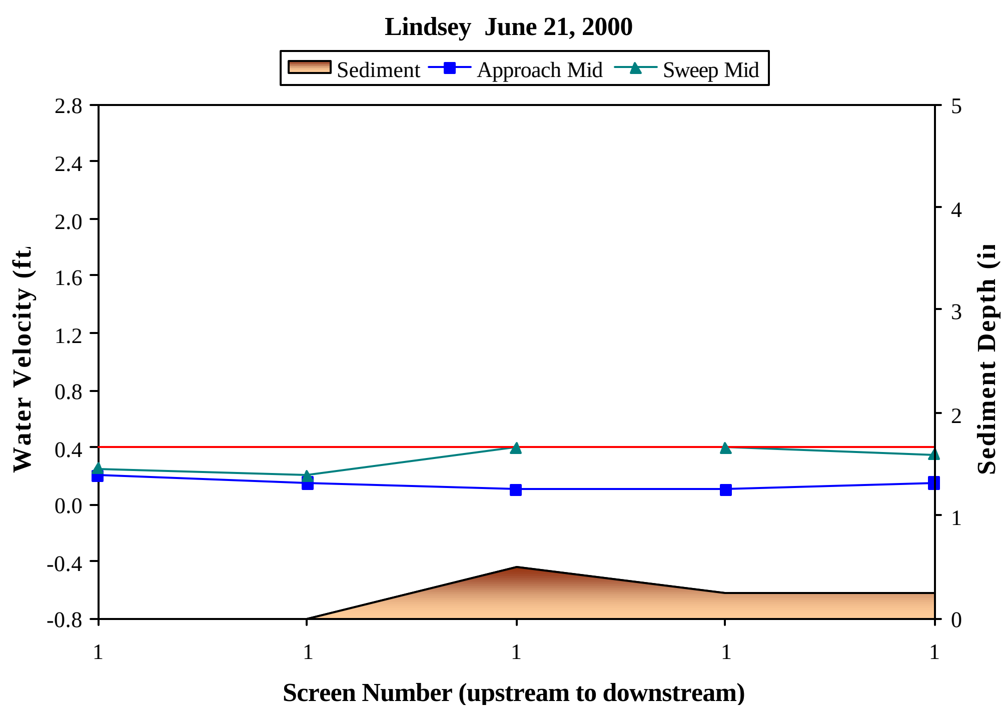

Figure 16. Water Velocities and Sediment Depth at the Lindsey Site, 6/21/00

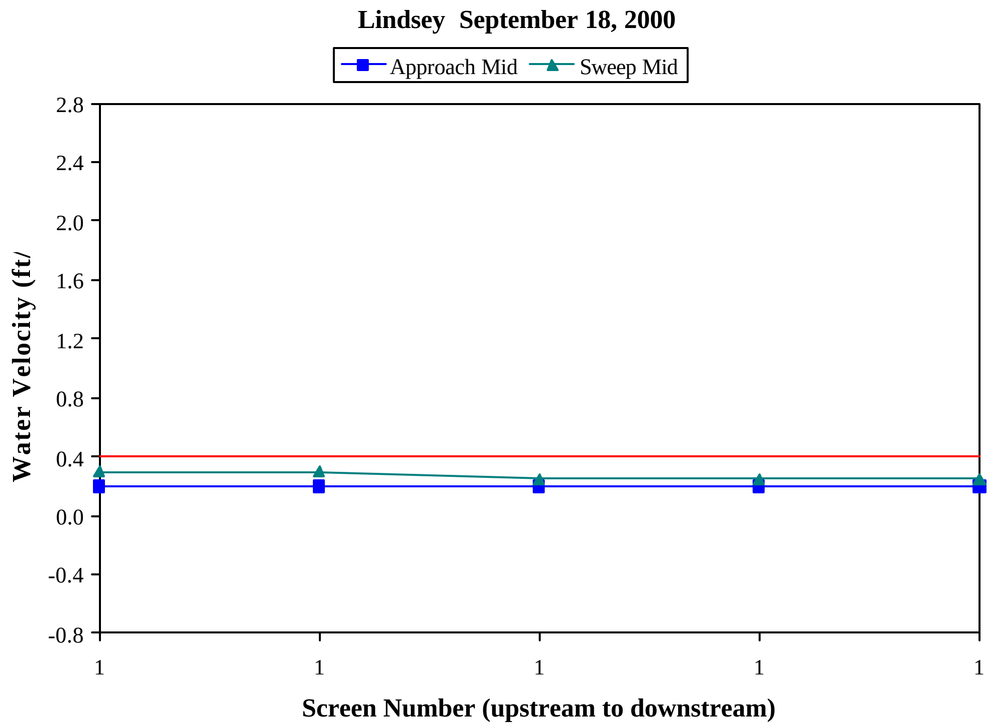

Figure 17. Water Velocities at the Lindsey Site, 9/18/00

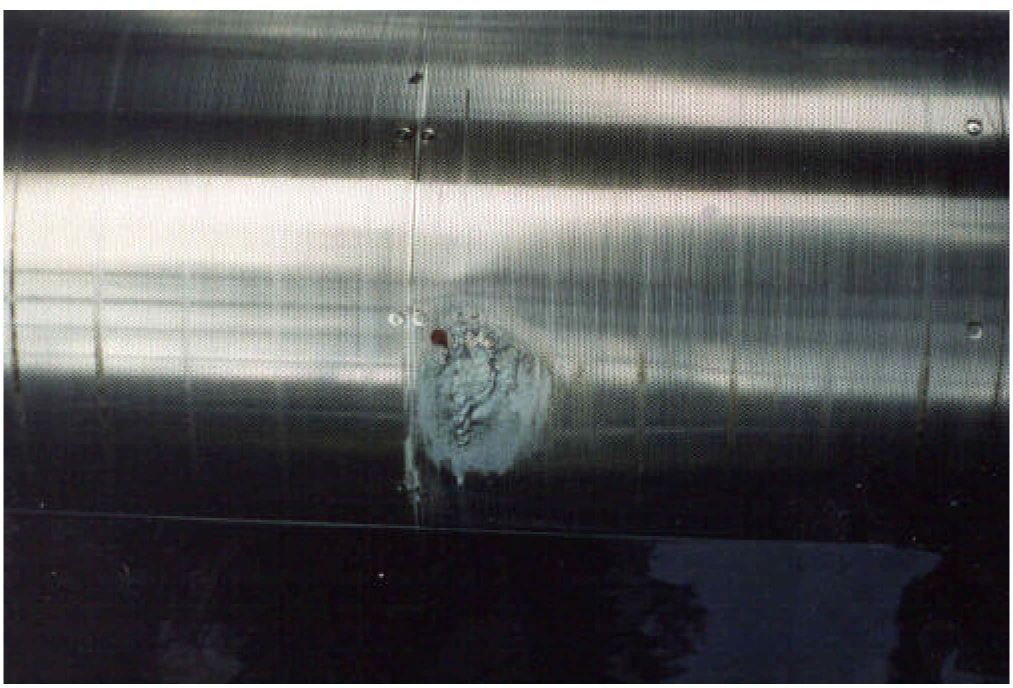

Figure 18. Photograph of Patched Screen at Lindsey, 9/18/00

3.2.7 Lower WIP

Lower WIP was visited 5/25/00, 6/26/00, and 9/15/00. The facility was shut down for the season before our September survey. All approach velocities met NMFS criteria. Mean sweep velocities were greater than mean approach velocities, but only increased toward the bypass in June (Figures 19 and 20). The bypass velocity was greater than the sweep velocity in June but not in May. Lots of small fish (not salmonids) were observed in both the forebay and aftbay in June and in the forebay in September.

Screen submergence met criteria in both May and June. The screen seals and screening appeared to be in good condition, and the drums were turning evenly. Water was running over the bypass weir, and the bypass was running smoothly into water over 1 ft deep. Some sand accumulation was noted in the aftbay in May, but this did not seem to cause any problems.

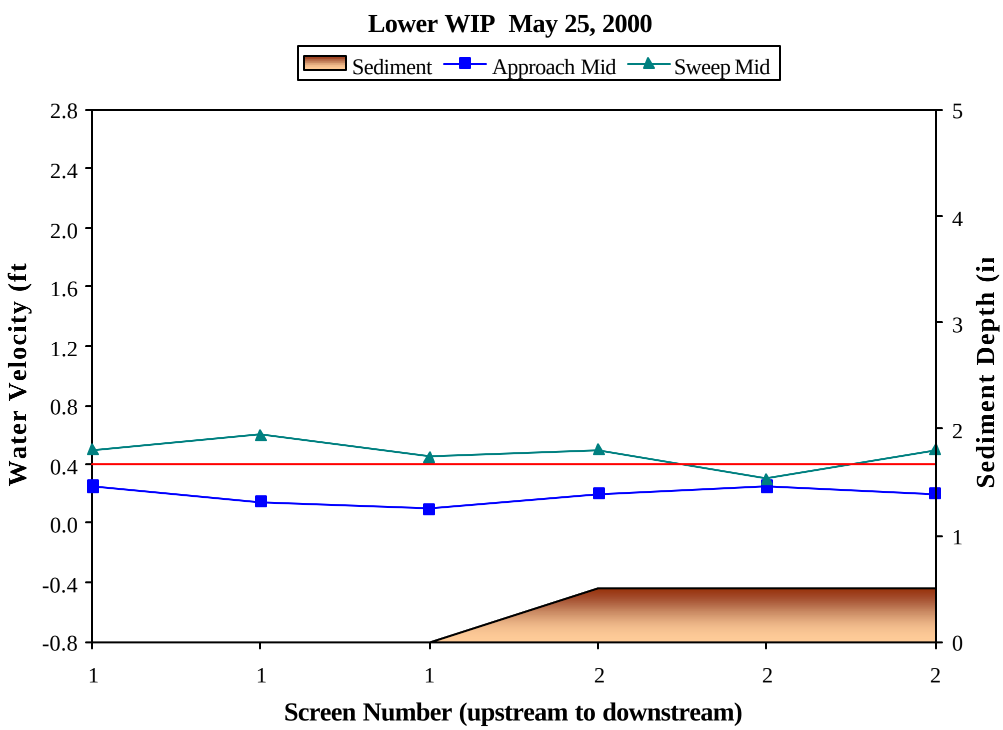

Figure 19. Water Velocities and Sediment Depths at the Lower WIP Site, 5/25/00

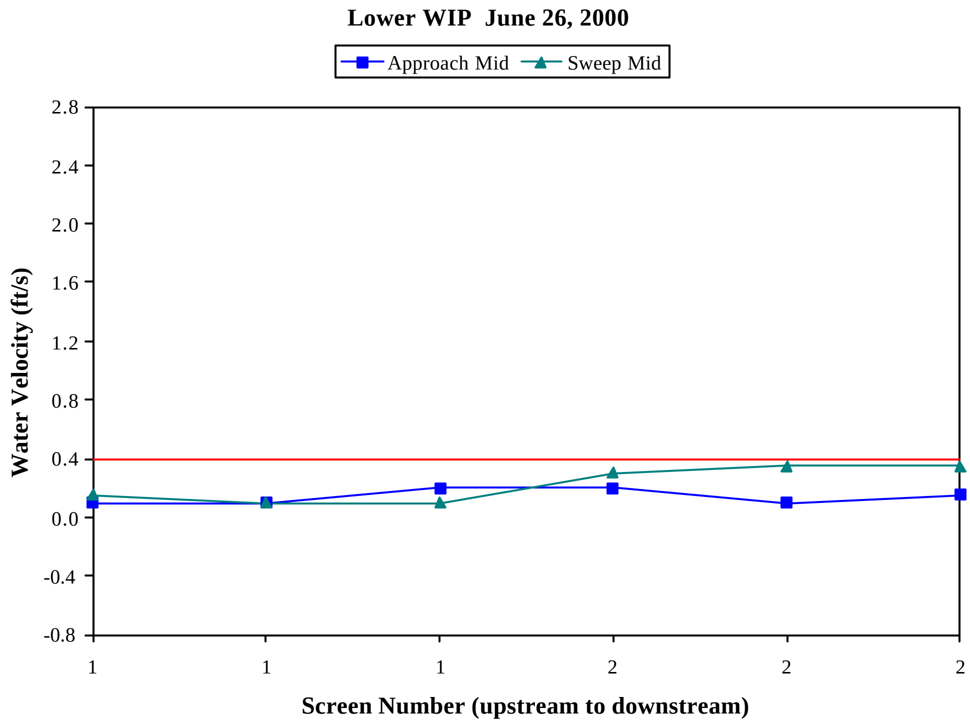

Figure 20. Water Velocities at the Lower WIP Site, 6/26/00

3.2.8 Naches-Cowiche

The Naches-Cowiche site was evaluated 5/24/00, 6/22/00, and 10/4/00. Only 2.6% of the recorded approach velocities exceeded 0.4 ft/s, down from 12% in 1999 (Figures 21, 22, and 23). Mean sweep velocities were greater than mean approach velocities, although they did not increase near the bypass. Bypass velocities were higher than mean sweep velocities. Screen submergence levels were within the bounds set by NMFS criteria (83, 78, and 65% in May, June, and September, respectively).

A 12-in.-tall "stop log" was used in front of screen 1 this year to try to limit the amount of sediment accumulating against the bottom seals and screens (Bill Werst, WDFW, personal communication). This prevented measurement of any sediment in front of the screens until the September visit, when the "stop logs" had been removed. As can be seen in Figure 23, there was a significant accumulation of sediment later in the season. Screens and seals were in good condition and drums turned evenly. Water always flowed smoothly over the weir. Conditions for fish at the outfall site were always good.

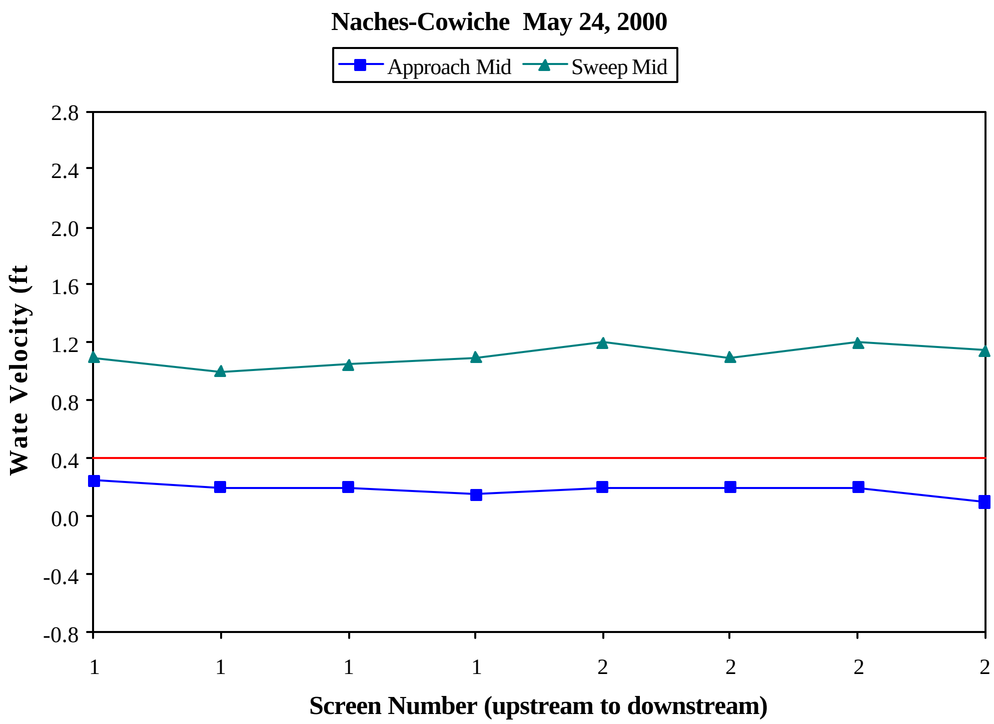

Figure 21. Water Velocities at the Naches-Cowiche Site, 5/24/00

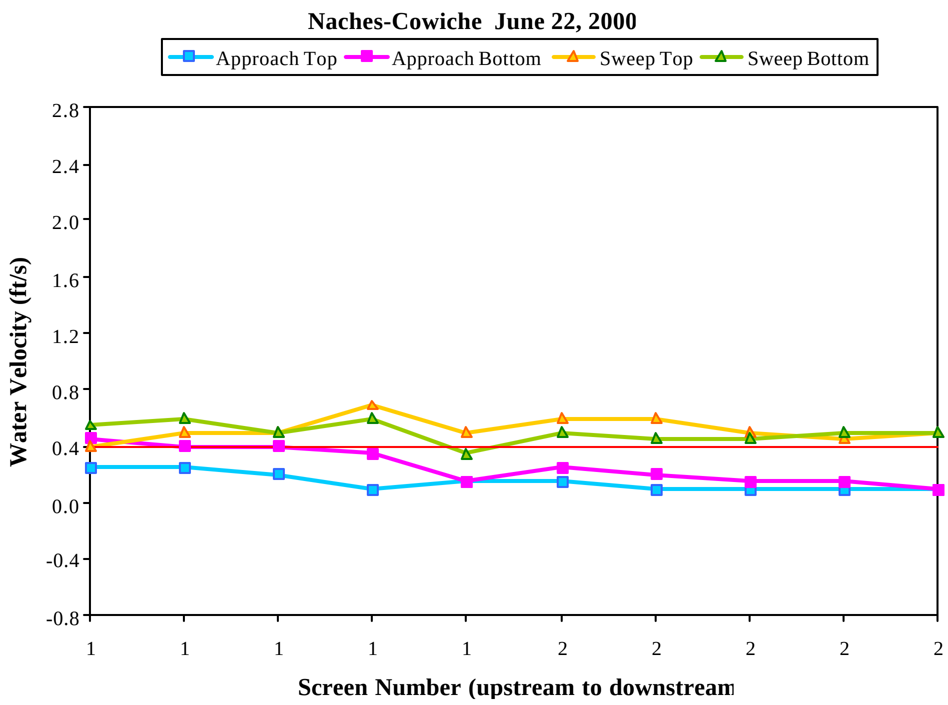

Figure 22. Water Velocities at the Naches-Cowiche Site, 6/22/00

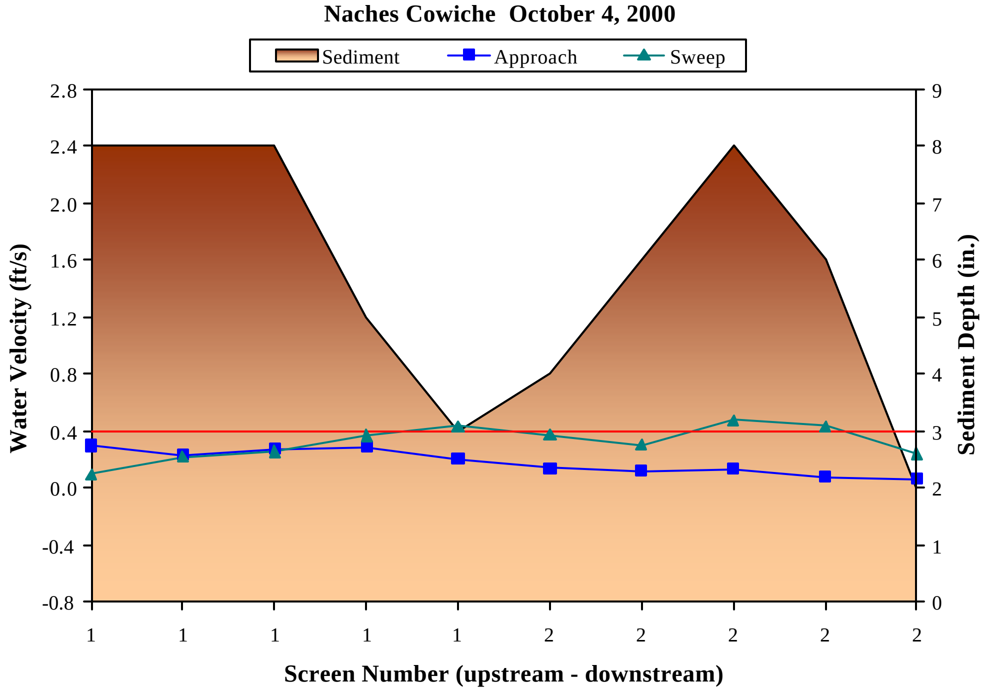

Figure 23. Water Velocities and Sediment Depths at the Naches-Cowiche Site, 10/4/00

3.2.9 New Cascade

New Cascade was evaluated on 5/22/00, 6/20/00, and 9/21/00. In the past, electrical interference has limited our ability to measure water velocities at this site. We used the Marsh-McBirney probe at this site to collect data that seemed to be reasonable. The approach velocities measured at New Cascade in May and June were at or below the 0.4 ft/s NMFS criteria. In September, problems with the Marsh-McBirney probe prevented accurate measurements of flow velocities. Sweep velocities in May and June were consistently below the approach velocities at the first five drum screens and then increased for the final three screens further downstream (Figures 24 and 25). Mean sweep velocities appeared to be quite low because of the negative values for the first several screens. These negative or upstream sweep flows could have been real or could have been an artifact of whatever has caused electrical interference in the past. We will try to use the ADV system at this site next year, since it is not affected by electrical noise, to determine if this flow pattern is real. If it is real, it could cause delay in fish emigration downstream. Aluminum cans, sand, and aquatic plants accumulated throughout the summer, and in places, the aquatic plants obscured the bottom seals. Abundant small fish were observed in the forebay in June and September, but none were seen in the aftbay.

Screen submergence exceeded NMFS criteria during all three evaluations. Bypass velocities exceeded mean sweep velocities; however, many sweep velocities were negative. The screen material generally looked good. Some of the expanding insulation placed between the concrete and "cheek" of the frame was coming loose at one end and floating adjacent to the drum. Screen 8 had notches of material broken off the downstream seal (Figure 26). Water in the downwell was somewhat turbulent in May and June, causing bubbles of air to surge from the outfall pipe. Outfall conditions for fish were always within NMFS criteria.

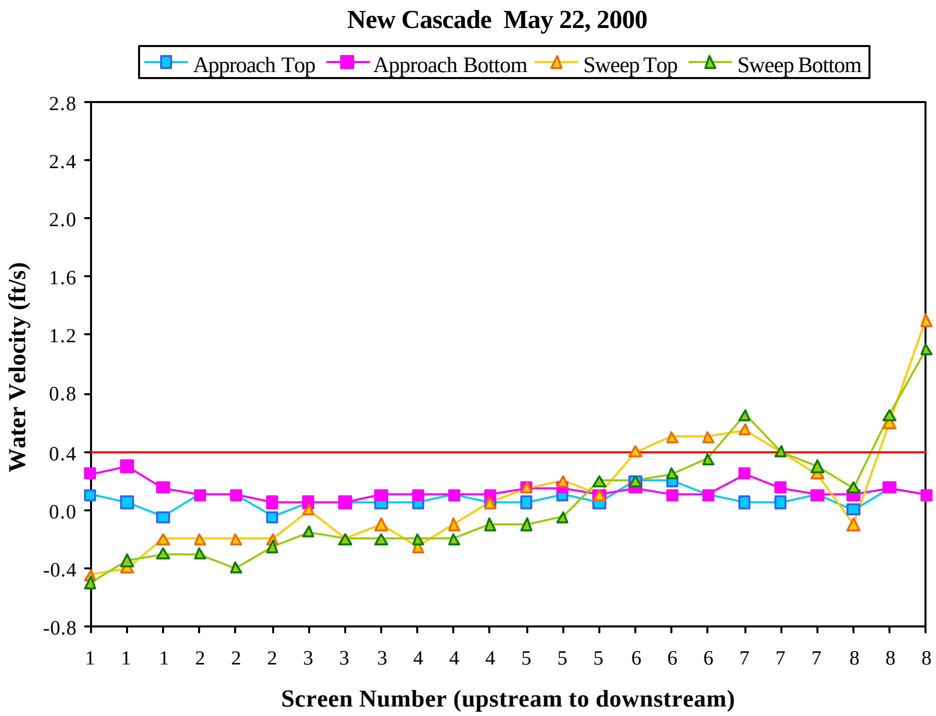

Figure 24. Water Velocities at the New Cascade Site, 5/22/00

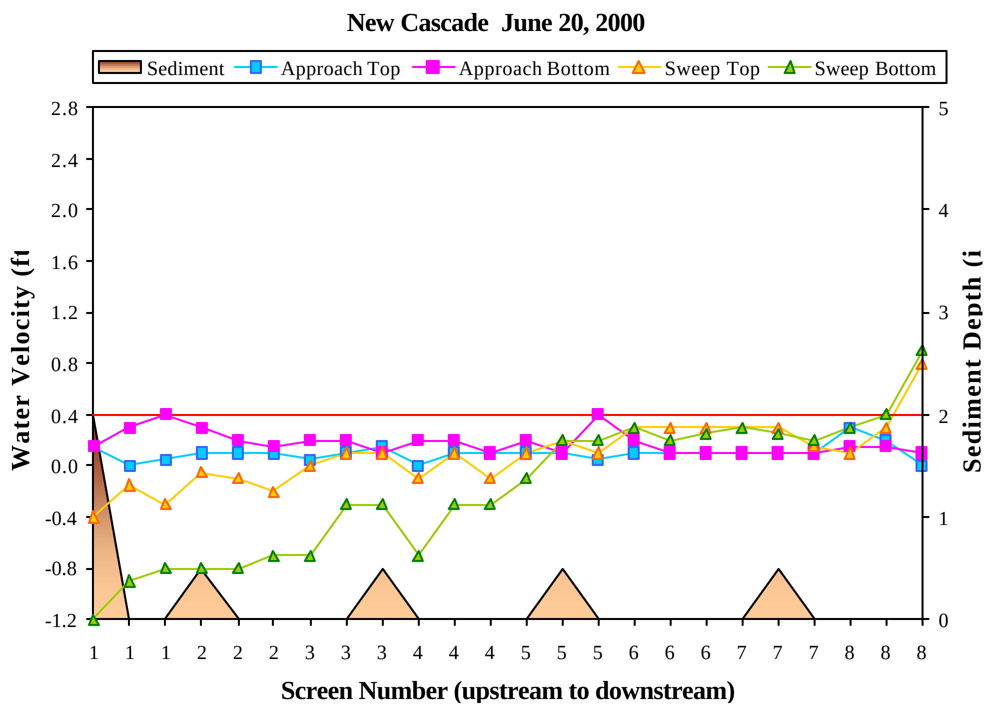

Figure 25. Water Velocities and Sediment Depths at the New Cascade Site, 6/20/00

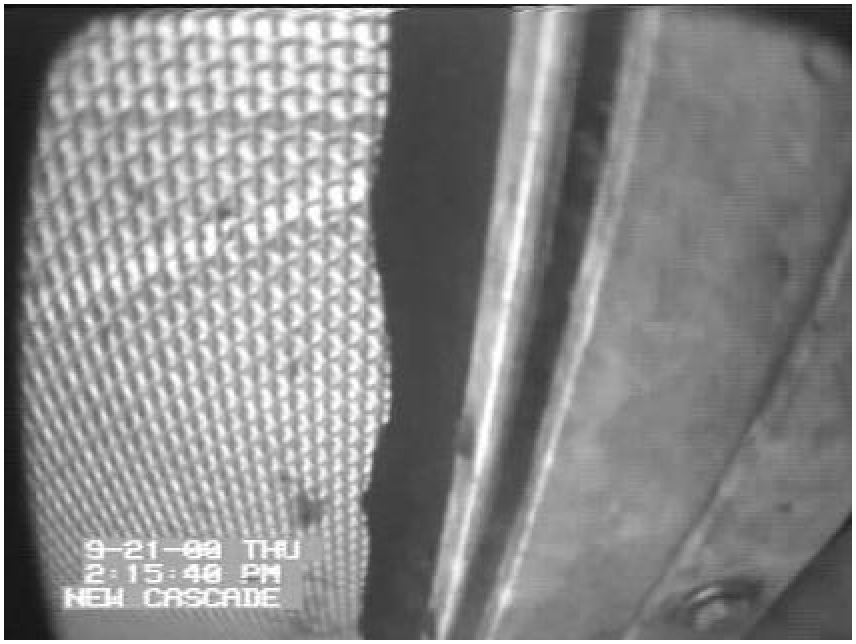

Figure 26. Notched Side Seal on Screen 8 at the New Cascade Site, 9/21/00

3.2.10 Snipes-Allen

The Snipes-Allen site was evaluated 5/26/00, 6/22/00, and 9/18/00. Approach velocities recorded in May and June were below 0.4 ft/s (Figures 27, 28, and 29). In June, maintenance crews stopped flow over the weir and through the bypass because the outfall pipe had been vandalized with logs and rocks plugging up the outlet. The drum screens were still turning, and apparently water was still moving into the canal (Figure 28) until the outfall was repaired on June 23. We measured water velocities (Figure 28) but they were not representative of typical conditions. Sweep velocities were slightly higher in May and slightly lower in June than their corresponding mean approach velocities. Sweep did not tend to increase near the bypass, although the bypass velocity was higher than the sweep velocity in May. Equipment problems prevented accurate measurement of sweep and possibly approach velocities in September.

Screen submergence was within the criteria of 65 to 85% during all three evaluations. Although the screens were brown with algae, they rotated evenly, and the seals were in good condition. Water behind the bypass weir flowed relatively smoothly in May and September, although surges of bubbles at the outlet indicate some air being entrained in the downwell. As discussed above, no water went through the bypass during our June visit. The outfall was submerged in May and September.

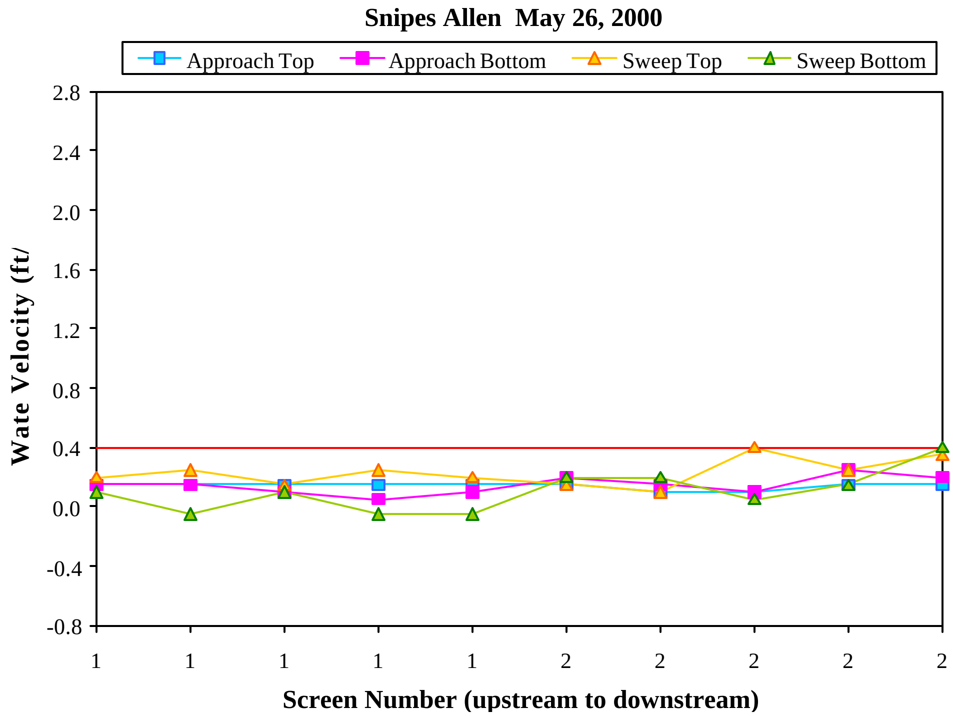

Figure 27. Water Velocities at the Snipes-Allen Site, 5/26/00

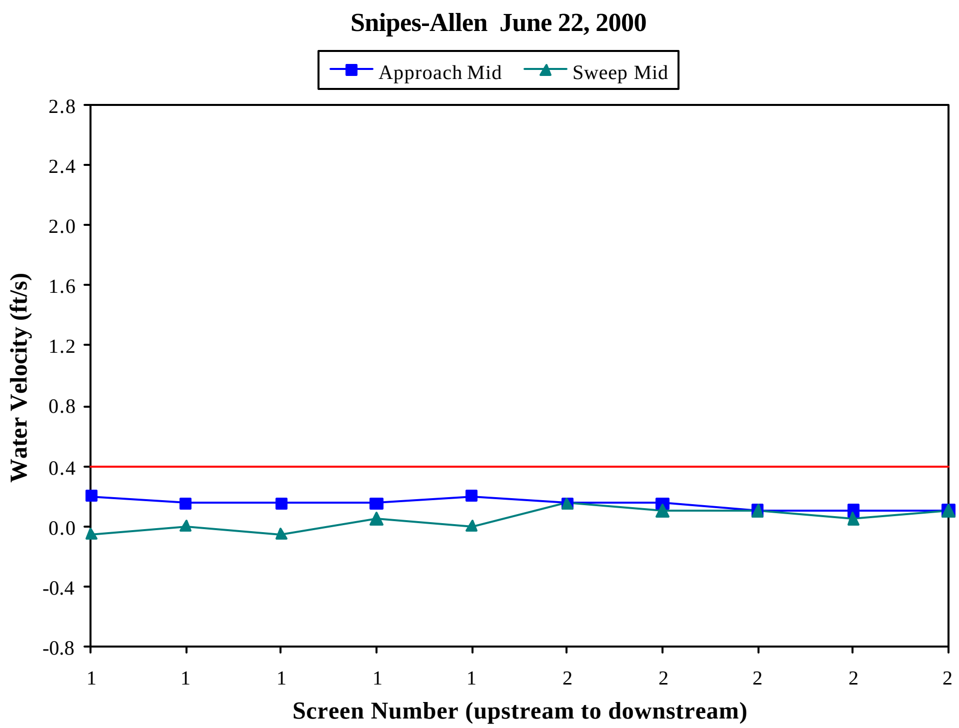

Figure 28. Water Velocities at the Snipes-Allen Site, 6/22/00

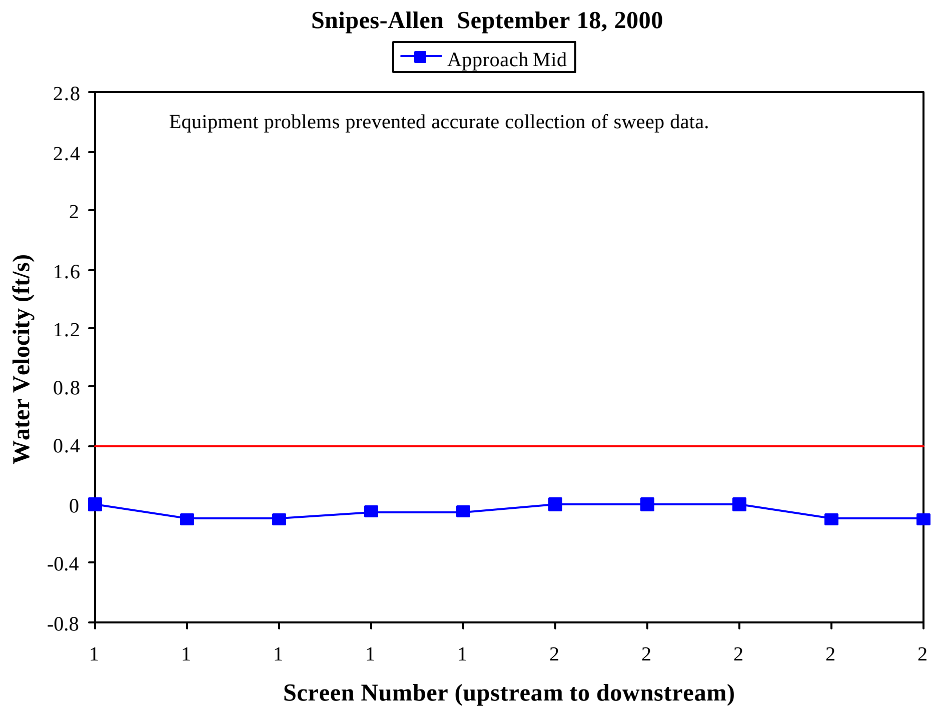

Figure 29. Water Velocities at the Snipes-Allen Site, 9/18/00

3.2.11 Taylor

The Taylor site was evaluated 5/24/00, 6/20/00, and 9/22/00. All approach velocities recorded met NMFS criteria, and sweep velocities were greater than approach velocities. Sweep velocities did not increase toward the bypass in May or June (Figures 30, 31, and 32). In September, screen 1 had been turned off, screen 2 was still turning, and there was no water flowing over the weir (Figure 31). However, water was flowing below the stoplogs into the aftbay in September. Bypass velocities exceeded mean sweep velocities at this site in May and June; there was no flow through the bypass in September. Screen submergence was 80% in May and June and 37% in September. The site logbook indicated the screens were almost overtopped in May and June, but the headgates were used to lower the water levels.

Screen 2 no longer exhibited the rough jerking motion noted the past 2 years. The bottom seal for screen 2 does not fit snugly against the drum, causing numerous small gaps along its length. Side seals and the bottom seal along screen 1 all looked good. Debris was not a problem, and silt deposition was relatively low. Water flowed freely behind the bypass weir, and the outfall was running smoothly and discharged into an area that was over 1 ft deep. The outfall is generally overgrown with brush and grasses and is often hard to observe. Fish were seen in the forebay in September, a snake was seen in June in the forebay, and there was a fish in the aftbay in May at this site.

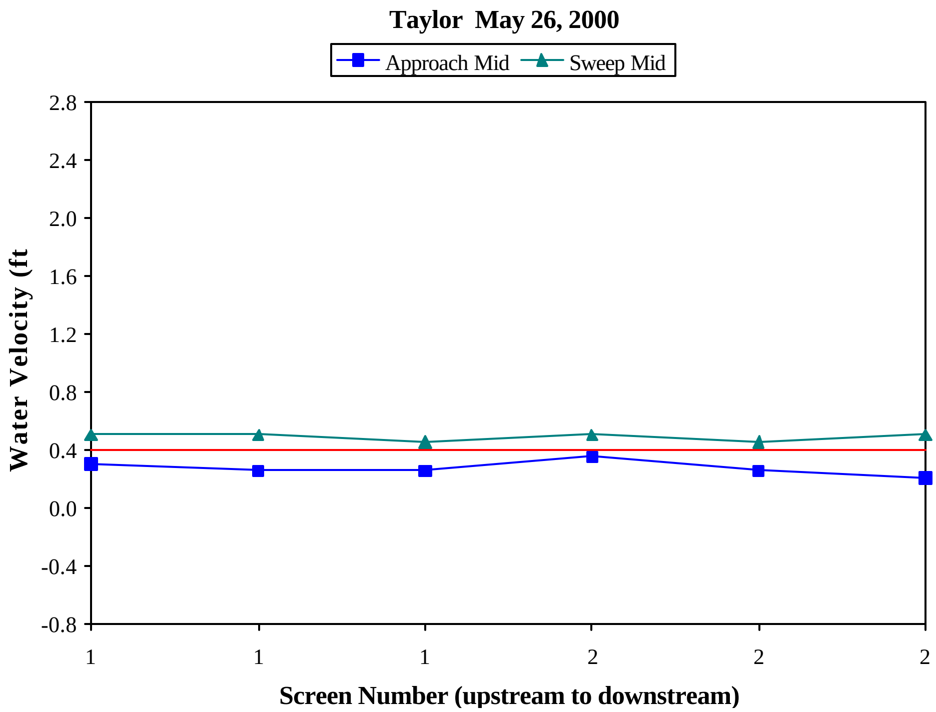

Figure 30. Water Velocities and Sediment Depths at the Taylor Site, 5/26/00

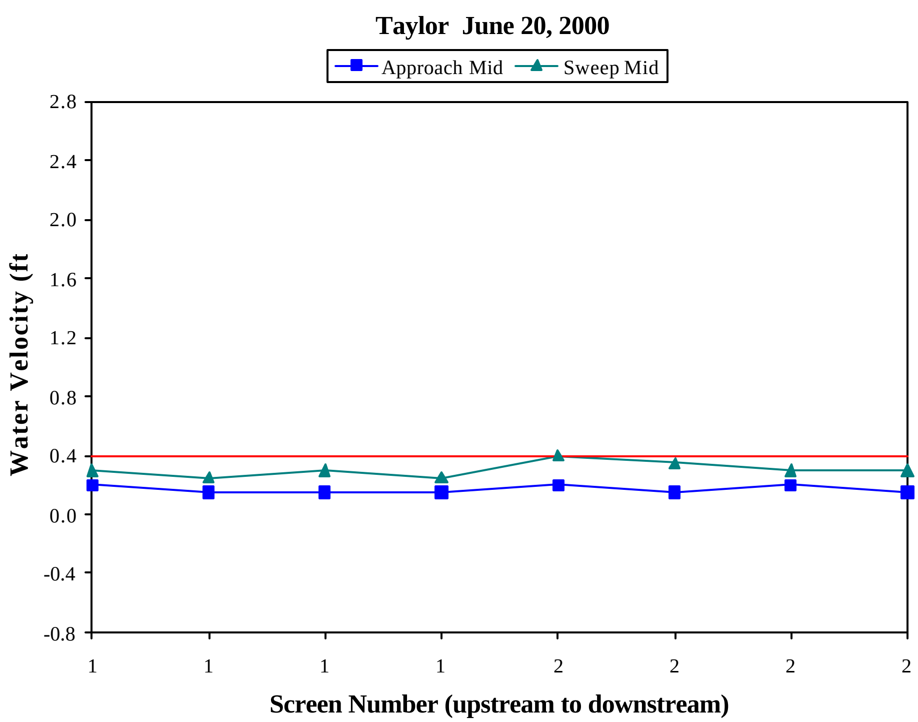

Figure 31. Water Velocities at the Taylor Site, 6/22/00

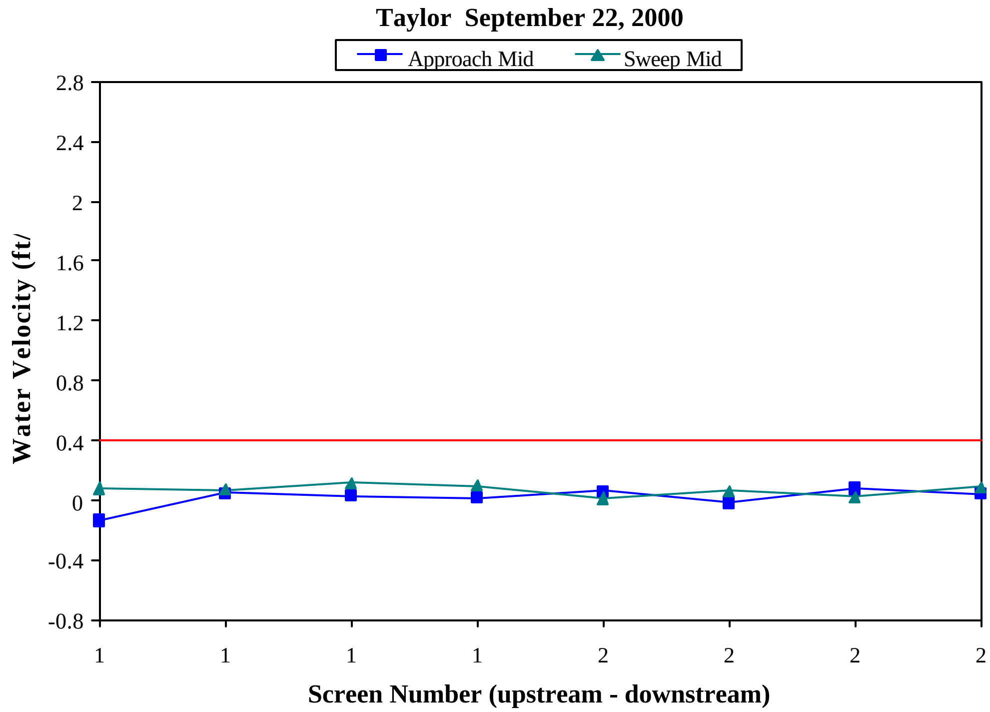

Figure 32. Water Velocities at the Taylor Site, 9/22/00

3.2.12 Toppenish Pump

This site was evaluated 5/26/00, 6/26/00, and 9/15/00. Almost 91% of the approach velocities measured at this site in 2000 met the NMFS criteria (Figures 33, 34, and 35). Approach velocities have been steadily improving since 1998, when 60% of the approach velocities exceeded 0.4 ft/s. Sweep velocities were generally greater than approach velocities and increased toward the bypass. Bypass velocities exceeded sweep velocities by a large margin. Screen submergence was approximately 52, 70 and 68% in May, June, and September, respectively.

Screens were partially covered in brown algae and diatoms, but seemed to be functioning normally. All screens turned smoothly, and seals were generally in good condition. Water was too turbid during all three evaluations to observe the bottom seal very well. There is no standard weir here; a stoplog is used in the bypass entrance to control flow. Water flowed freely through the bypass entrance, but sometimes formed a “whirlpool” in front of the entrance to the outfall pipe. Conditions were acceptable for fish bypass. Some woody debris accumulated near the bottom seals, but did not pose a problem. Sediment tended to accumulate near the upstream screens, and occasionally got close to the bottom seal. Small fish were observed in the aftbay in both June and September.

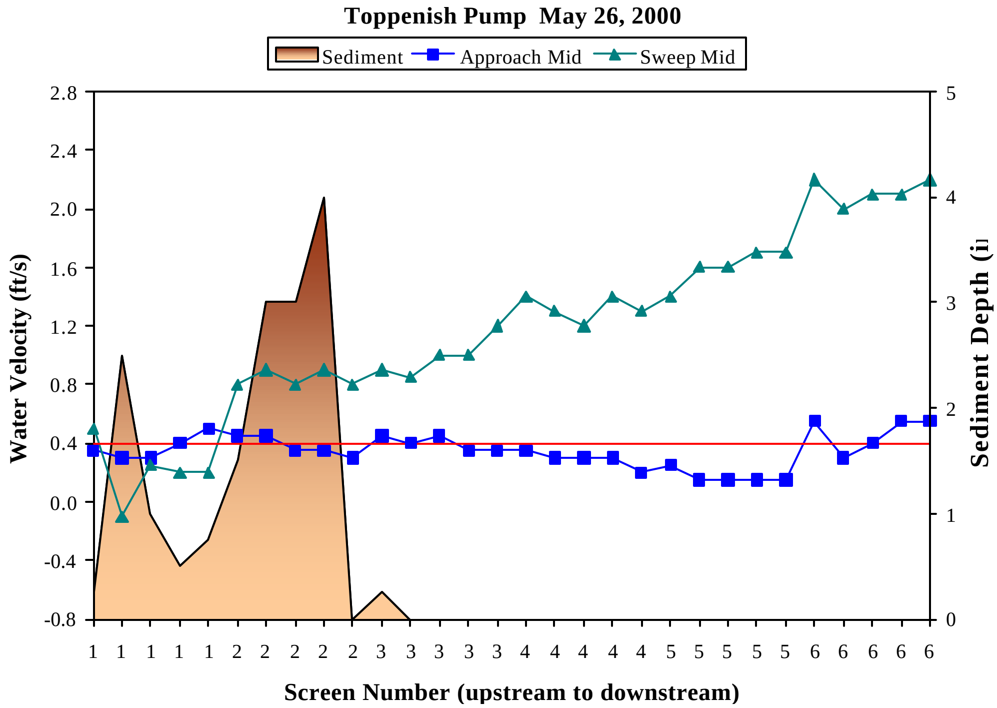

Figure 33. Water Velocities and Sediment Depths at the Toppenish Pump Site, 5/26/00

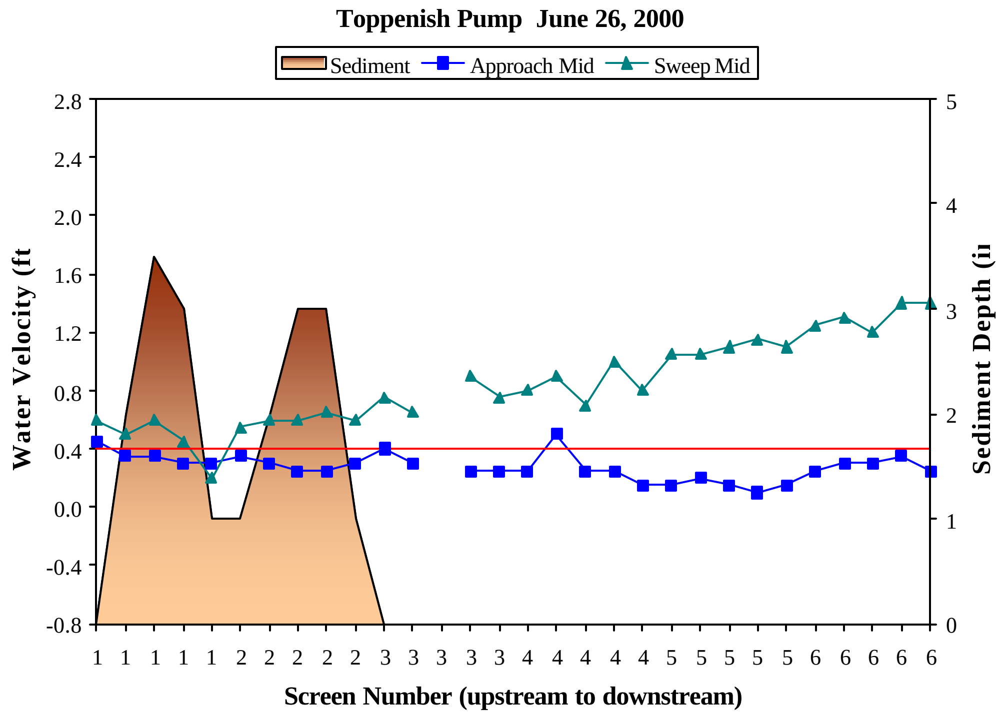

Figure 34. Water Velocities and Sediment Depths at the Toppenish Pump Site, 6/26/00

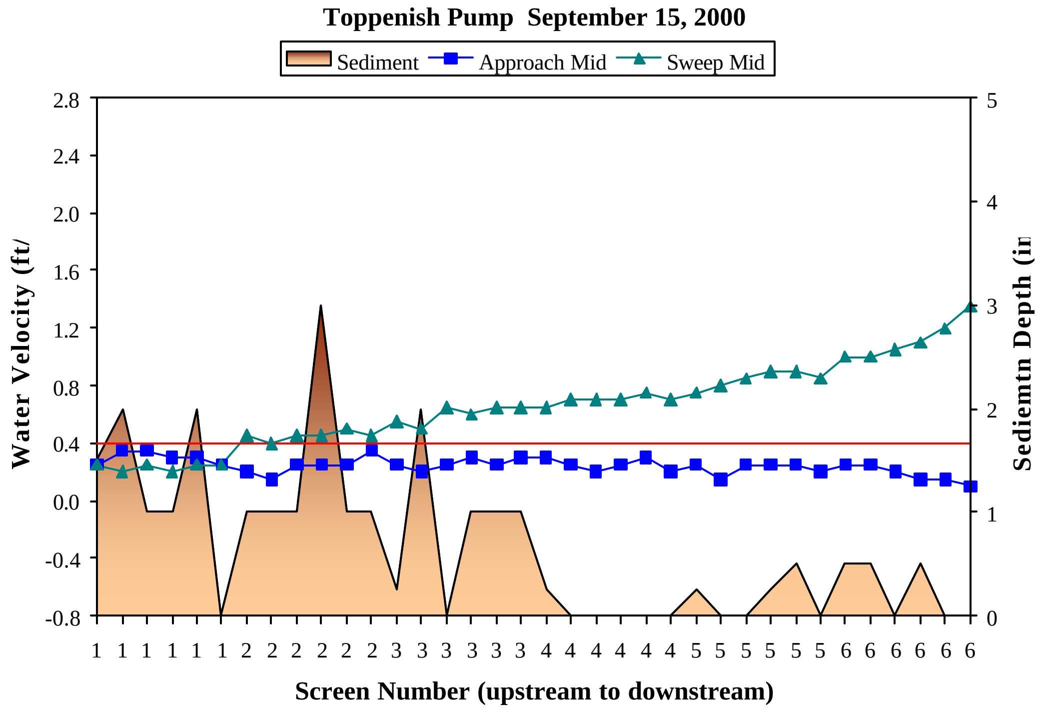

Figure 35. Water Velocities and Sediment Depth at the Toppenish Pump Site, 9/15/00

3.2.13 Upper WIP

The Upper WIP site was visited 5/25/00, 6/26/00, and 9/15/00. Ninety-seven percent of the approach velocities met NMFS criteria (Figures 36, 37, and 38). Sweep velocities always exceeded approach velocities; however, they decreased toward the bypass. Mean sweep velocities were less than bypass velocities in May and September, but not in June. Screen submergence levels were very consistent, ranging from 78 to 80%.

Seal and screen conditions could be improved somewhat at this site. There was uneven growth of algae on the screens, possibly indicating uneven rubbing against the bottom seal. The side seal of screen 2 had several small terrestrial plants (not aquatic plants) growing near the top of the seal in September. There also appeared to be a gap between the seal and the drum at the upstream end of screen 3. Woody debris and silt obscured the bottom seal at screen 4 during the video surveys and also accumulated in the bypass entrance. One 8-ft-long branch was pulled from the bypass when it got stuck on the video camera. Adequate water was bypassed in May and June, but in September most of the water was taken into the canal, and there was only a couple of inches of water in the streambed itself. Immediately in front of the outfall pipe, water was at least 1 ft deep, however. Water ran freely behind the bypass weir.

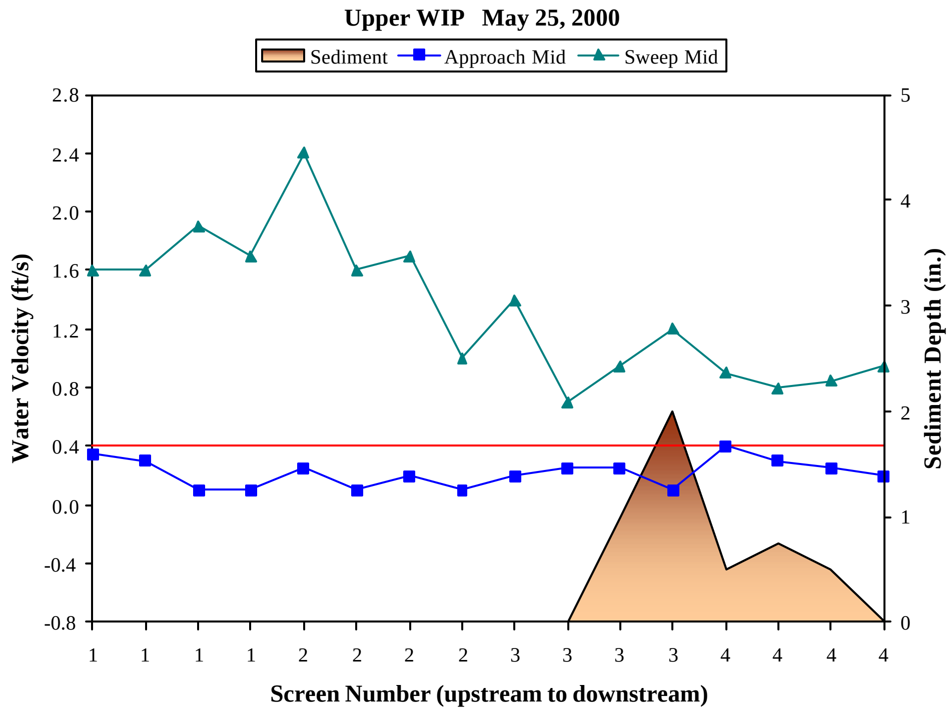

Figure 36. Water Velocities and Sediment Depths at the Upper WIP Site, 5/25/00

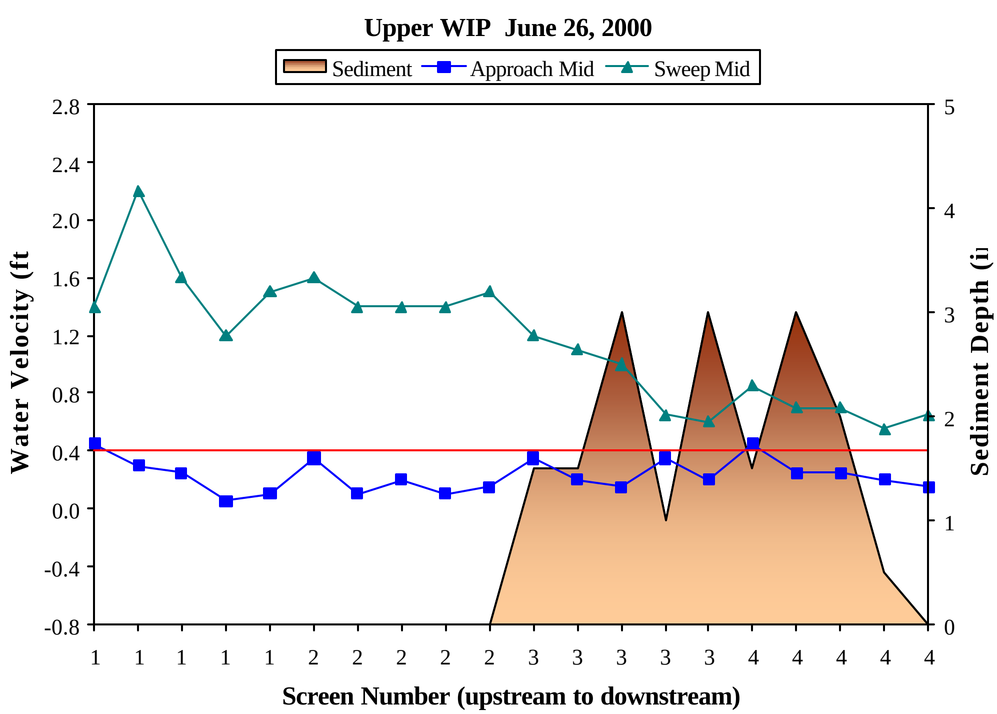

Figure 37. Water Velocities and Sediment Depths at the Upper WIP Site, 6/26/00

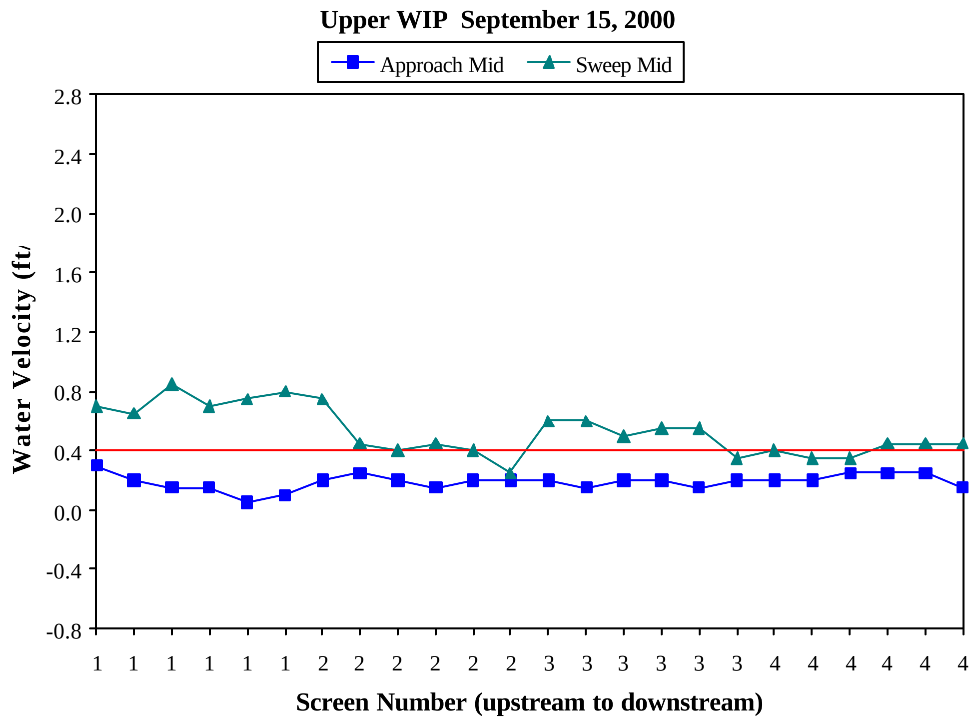

Figure 38. Water Velocities at the Upper WIP Site, 9/15/00. Sediment depth was not measured.

3.3 Flat Plate Screens

3.3.1 Bull Ditch

The Bull Ditch site was evaluated 5/23/00, 6/20/00, and 9/21/00. At least 22% of the recorded approach velocities exceeded 0.4 ft/s in 2000. Mean sweep velocities were higher than mean approach velocities (Figures 39 and 40). Sweep at the downstream end of panel 2 actually eddied around to move upstream in the upper portion of the panel. Overall, bottom sweep values were often less than corresponding approach velocities. Equipment problems prevented velocity measurements in September, but a video survey and visual inspection were performed. Water levels were fairly high with 88% of the screen submerged in May and June.

The screens were generally in good condition. Some caulking was missing in places along both the bottom and side seals. Woody debris and sediment tend to accumulate on the bottom in front of the downstream screen panel. The cleaning brushes were unable to permanently move the leaves and twigs off of the screen; eddies around the brushes seemed to push the loose material back onto the screen. This resulted in debris build-up, but this did not seem to cause headloss across the screen. This site was much cleaner at the surface in 2000 – sandbags that were on the walkways in 1999 had been removed by the first visit in May.

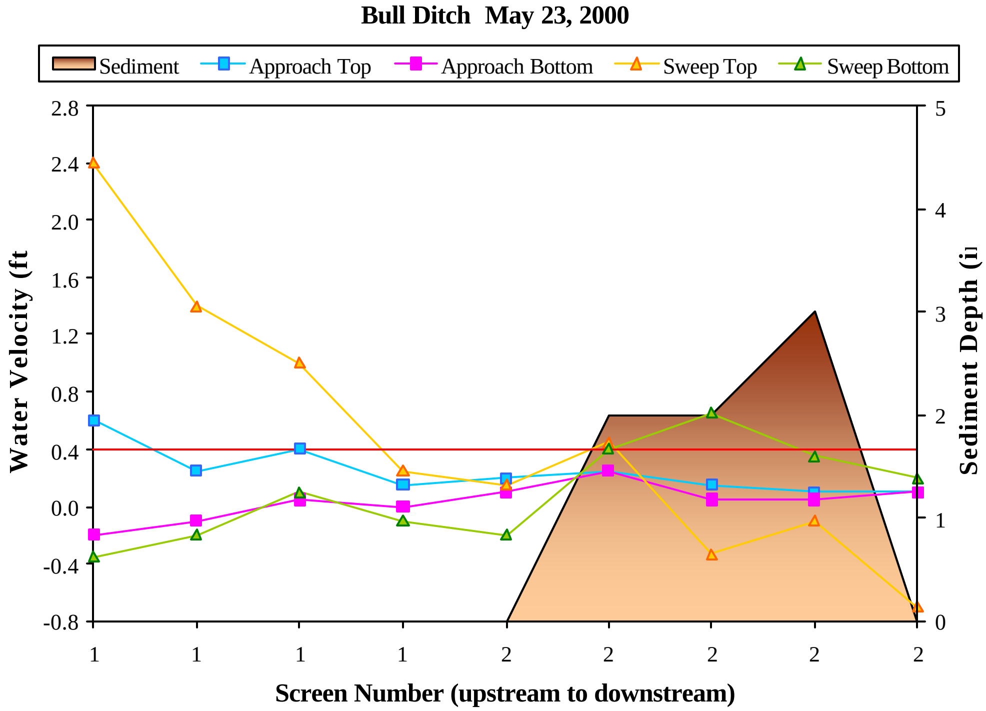

Figure 39. Water Velocities and Sediment Depths at the Bull Ditch Site, 5/23/00

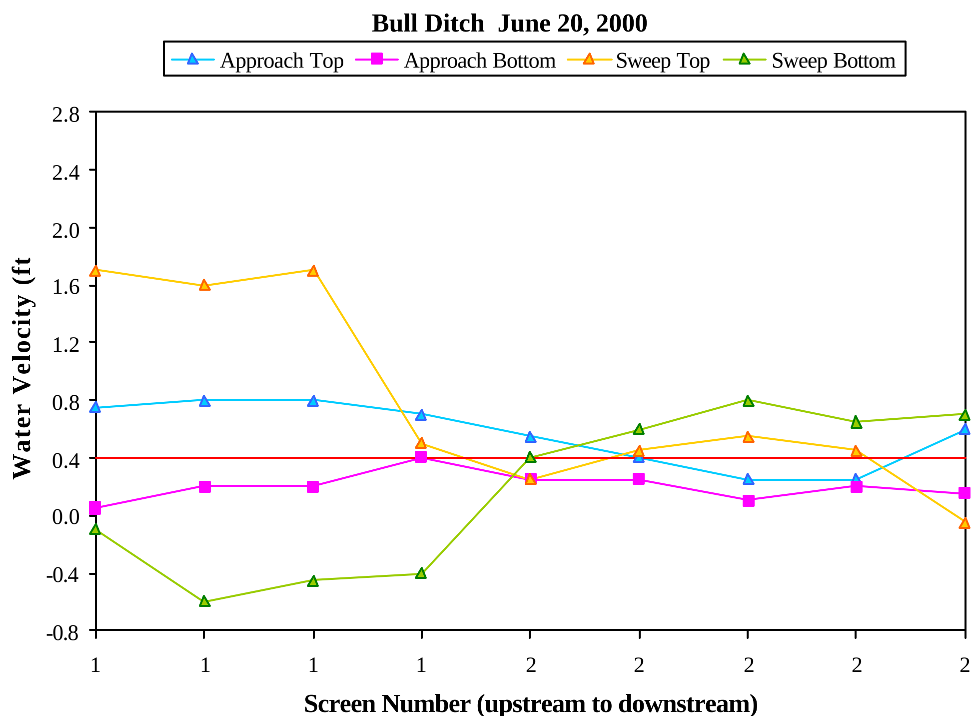

Figure 40. Water Velocities at the Bull Ditch Site, 6/20/00. Sediment depth was not measured.

3.3.2 Ellensburg Mill

The Ellensburg Mill site was evaluated 5/22/00, 6/19/00, and 9/21/00. Screen submergence levels during all three evaluations were below NMFS criteria, with submergences of 49, 51, and 59% in May, June, and September, respectively. This site often has low water levels. Equipment problems prevented measurements of velocity in September, but a video survey and visual inspection were performed. In May and June, mean sweep velocities were higher than mean approach velocities (Figures 41 and 42). Twenty-six percent of the measured approach velocities were greater than 0.4 ft/s. Sweep did not generally increase near the bypass. In May and June, bypass velocities were greater than the mean sweep velocities.

The screens were in fairly good condition, although build-up of algae along screen 1 near the bottom may have been plugging some of the screen openings. This same build-up, along the bottom seal in particular, made it difficult to inspect the bottom seal. Some caulking may have been missing along the bottom in places. The weir was set in flush mode each time the site was visited, with fairly turbulent flow in the downwell. Conditions at the outfall were good for fish passage in 2000. Several fish were noted in the forebay in June.

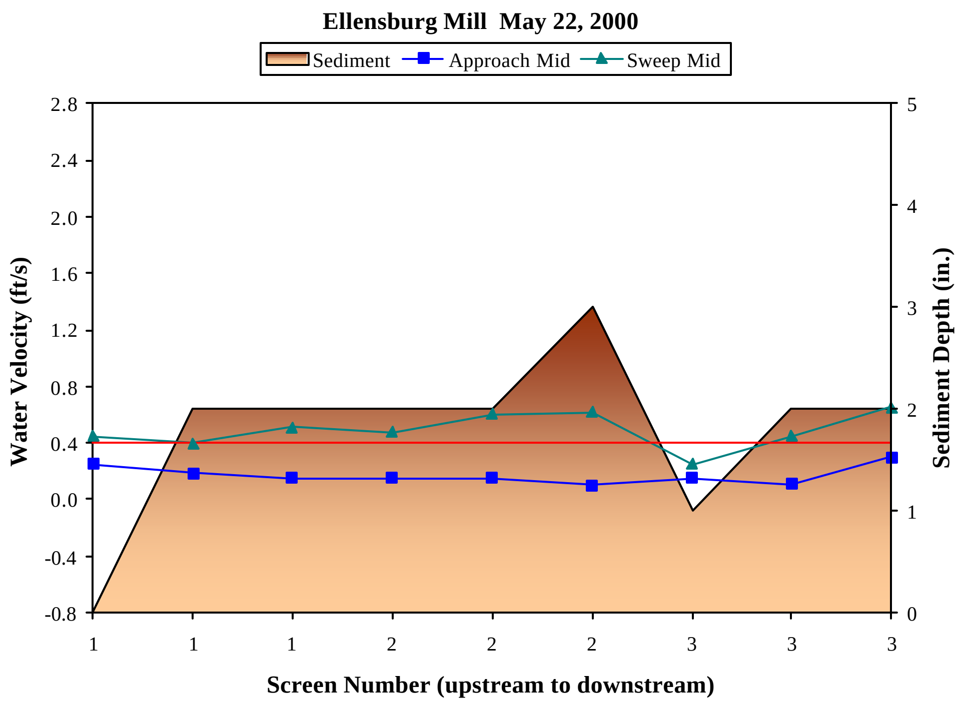

Figure 41. Water Velocities and Sediment Depths at the Ellensburg Mill Site, 5/22/00

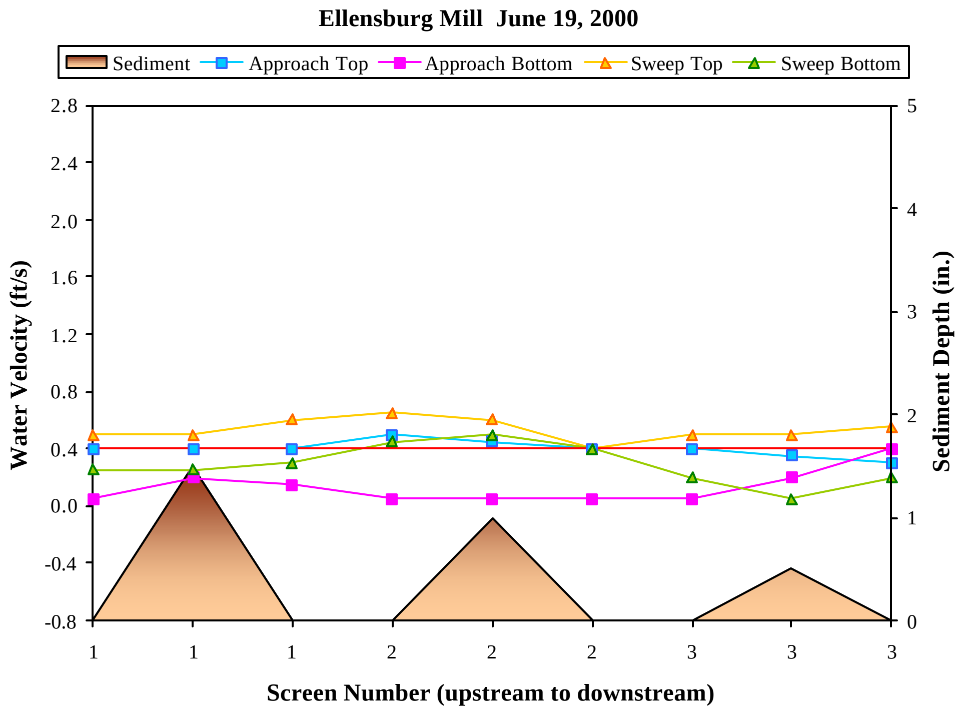

Figure 42. Water Velocities and Sediment Depths at the Ellensburg Mill Site, 6/19/00

3.3.3 Fruitvale

The Fruitvale site was evaluated 5/24/00, 6/22/00, and 9/22/00. Electrical interference kept us from collecting any reliable water velocities in the past. We decided to try to measuring velocities in May and June using the Marsh-McBirney probe and then used the Sontek ADV system in September. The results are presented in Figures 43, 44, and 45. Almost 83% of the measured approach velocities were below 0.4 ft/s. Mean sweep velocities were greater than mean approach velocities during all surveys. Sweep velocities did not increase consistently toward the bypass. Bypass velocities were greater than mean sweep velocities.

Screen submergence levels were at least 100% during each evaluation with water levels above the top of the screening material but not above the metal plate attached to the top of the screens. The logbook contained no records of screen overtopping. Adequate water always flowed over the bypass weir, and outfall conditions were good for fish passage. Water flowed freely behind the bypass weir, and the outfall was running smoothly, with the exception of some entrapped air in May. There were tools at this site to help measure water depths over the weir.

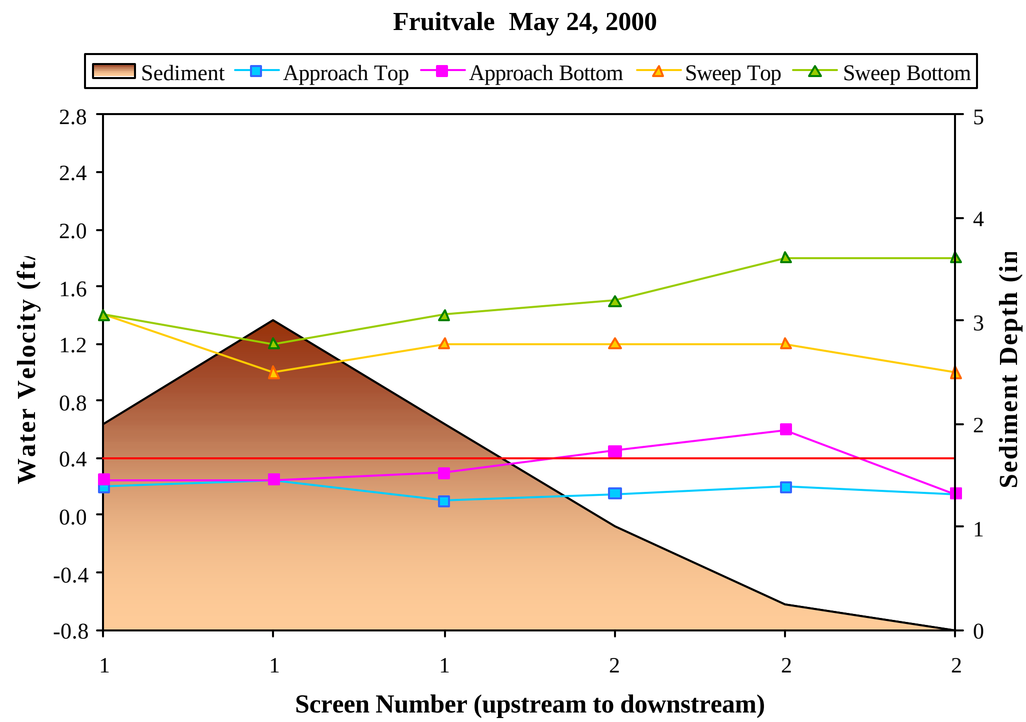

Figure 43. Water Velocities and Sediment Depth at the Fruitvale Site, 5/24/00

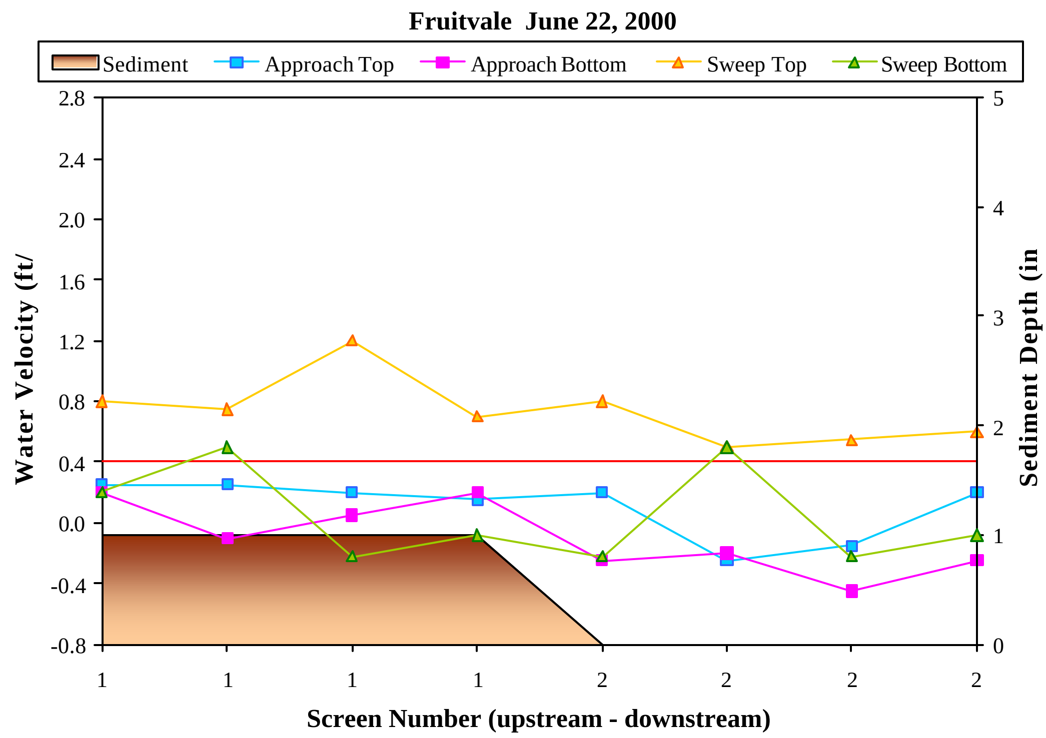

Figure 44. Water Velocities and Sediment Depth at the Fruitvale Site, 6/22/00

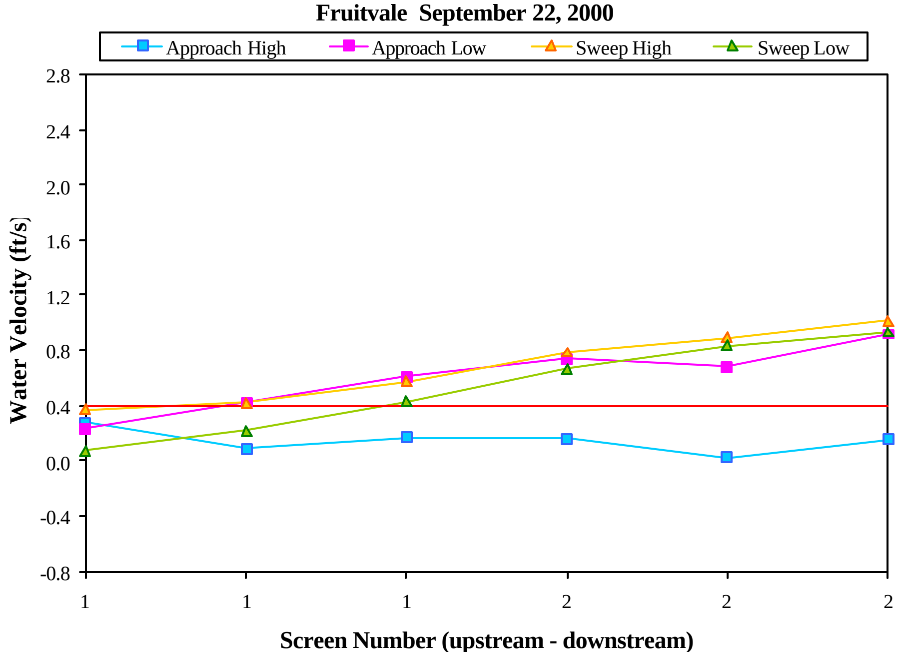

Figure 45. Water Velocities at the Fruitvale Site, 9/22/00. Sediment depth was not measured.

Sediment accumulated in front of the screens but did not appear to cover any part of them in May. Sediment levels were lower in June in front of the screens, but the logbook noted silt build-up in the upstream portion of the aftbay in June and removal of silt by the city of Yakima in July. Sediment depth was not measured during the September visit. A couple of small fish (not salmonids) were seen in front of the screens, and one small fish was seen behind the screen in September.

3.3.4 Naches-Selah

This site was evaluated 5/23/00, 6/21/00, and 10/4/00. Almost 29% of the approach velocities at Naches-Selah were greater than 0.4 ft/s (Figures 46, 47, and 48). This was similar to 1999 when 28% of the approach values were greater than 0.4 ft/s. The highest approach velocities were in October, when over 69% of the approach velocities exceeded 0.4 ft/s. Mean sweep velocities were generally much greater than their corresponding mean approach velocities. Bypass velocities were higher than the mean sweep velocities in May and June, but not in October. Screen submergence values for this flat plate screen were 90 and 85% in May and June, respectively. They were not measured in September. The submergence marks became much harder to read as summer progressed.

A new trash boom was added to the forebay to minimize debris piling up along the screens. The screens were in generally in fair condition. Two perforated plate patches were noted, apparently covering damaged portions of the bar screening. The bottom and side seals were missing caulking in several places as well. Adequate amounts of water flowed over the weir at all times, and outfall conditions were good for fish passage. Although the outfall pipe was never submerged, there was always at least 1 ft of water at the outfall. Sedimentation was not excessive at Naches-Selah. Silt accumulated only near the bypass entrance where sweep velocities dropped. Large numbers (20 to 50) of fish, including salmonids, were observed in the aftbay on October 4.

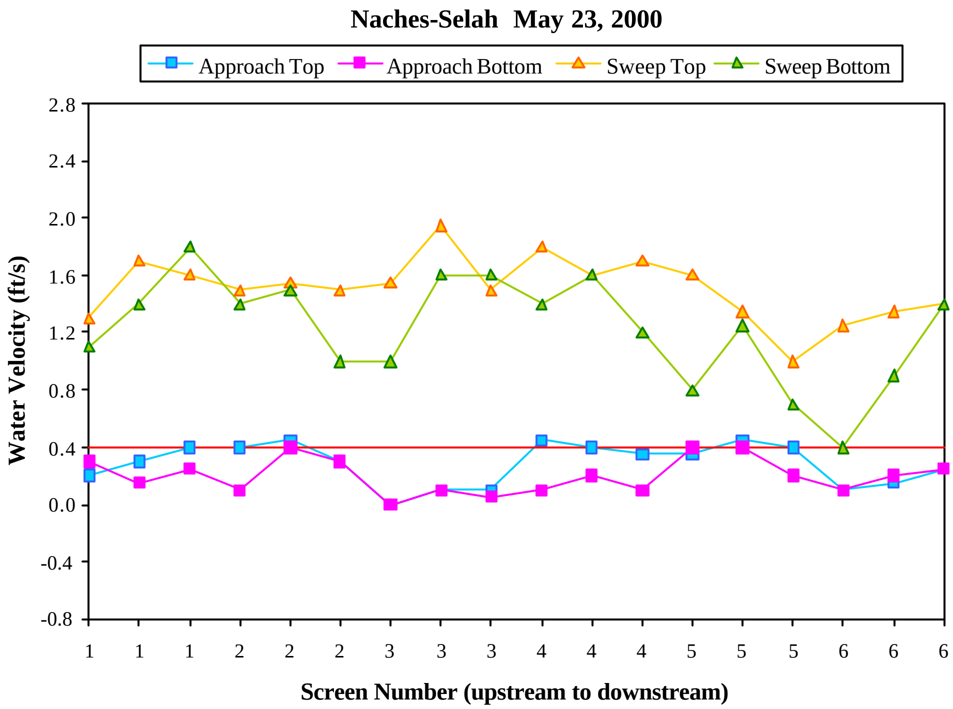

Figure 46. Water Velocities at the Naches-Selah Site, 5/23/00

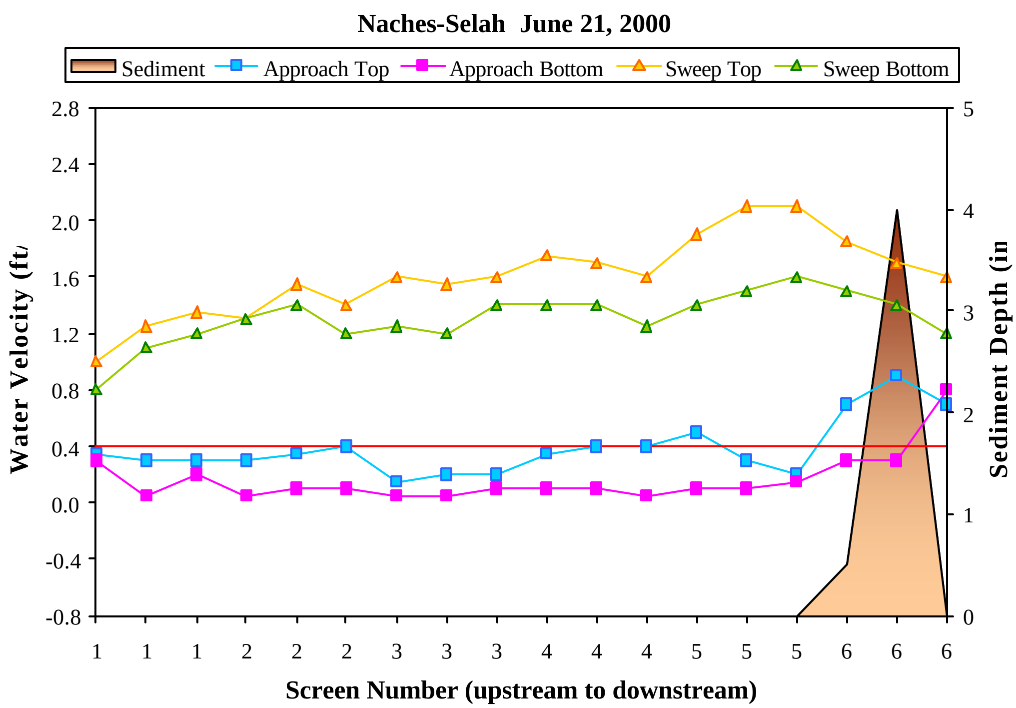

Figure 47. Water Velocities and Sediment Depths at the Naches-Selah Site, 6/21/00

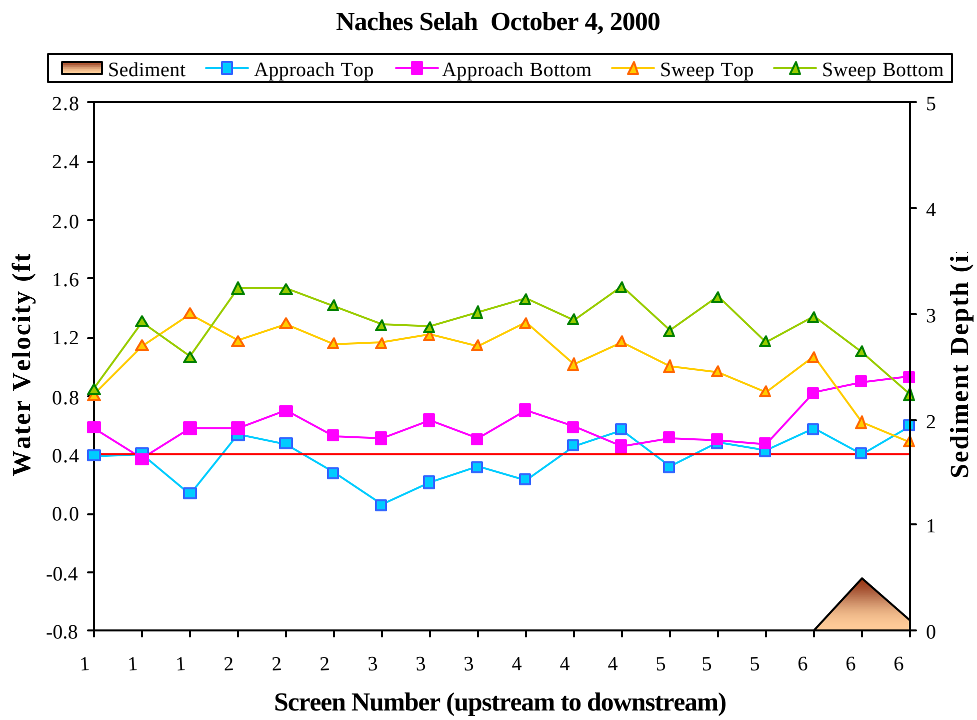

Figure 48. Water Velocities and Sediment Depth at the Naches-Selah Site, 10/4/00

3.3.5 Union Gap

The Union Gap site was evaluated 5/25/00, 6/22/00, and 10/4/00. Approach velocities in 2000 were lower than in 1999, with only 12.5% of the approach velocities exceeding 0.4 ft/s (Figures 49, 50, and 51). Mean sweep velocities were always substantially higher than mean approach velocities. In May, sweep velocities increased slightly near the bypass; in June they remained relatively constant; and in October they decreased slightly near the bypass. Bypass velocities were greater than mean sweep values during each survey. Screen submergences at this flat plate site were 94 and 92% in May and June, respectively.

The screens were in good condition. Some caulking was missing in places along the bottom, and there appeared to be cracks developing in some of the side seals near the top. Adequate amounts of water always flowed over the bypass weir, and all other outfall conditions were good for fish passage. Sedimentation was very minor at this site. The cleaning system was set on a 20-minute delay in 2000 and appeared to be much more successful at keeping debris from building up on the screens. Water seems to surge through the bypass, possibly because of an airlock that is broken periodically as air moves up the pipe from the outfall. There did not seem to be any obstructions in the bypass pipe in June, based on measuring how long it took for a lemon to travel from the weir to the outfall. This surging could pose a problem to fish being returned to the river through the bypass pipe. Putting an air pressure release tube in at this site (similar to that at Naches-Cowiche) should help solve this problem.

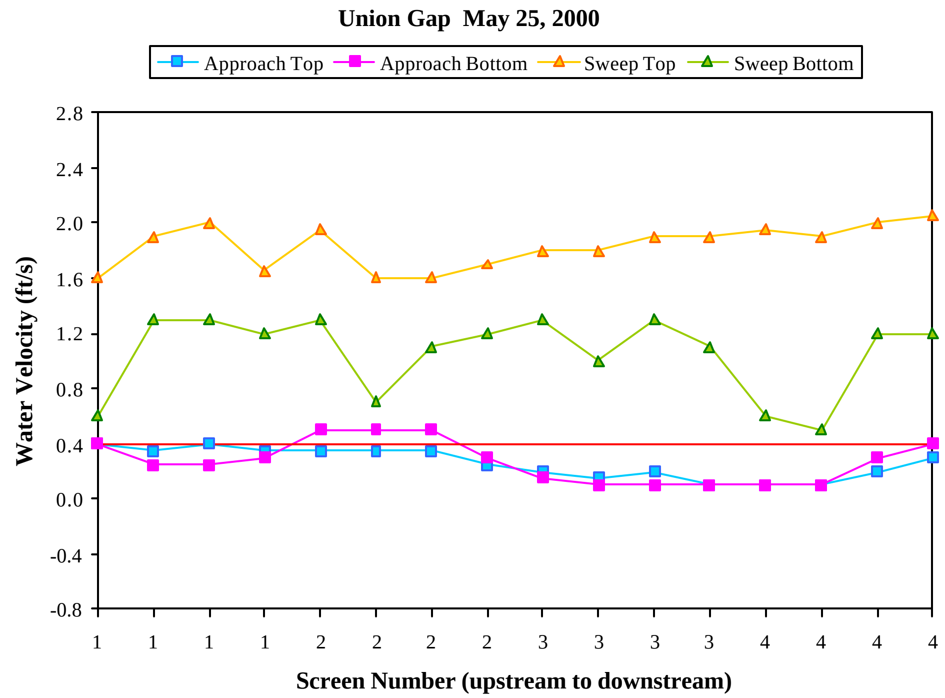

Figure 49. Water Velocities at the Union Gap Site, 5/25/00

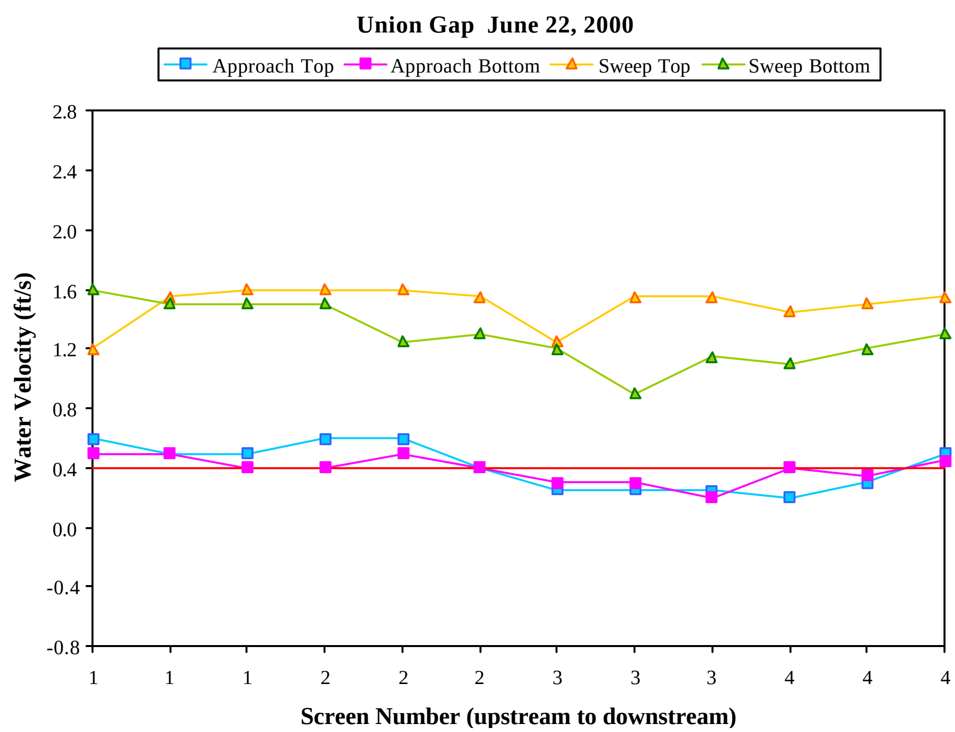

Figure 50. Water Velocities at the Union Gap Site, 6/22/00

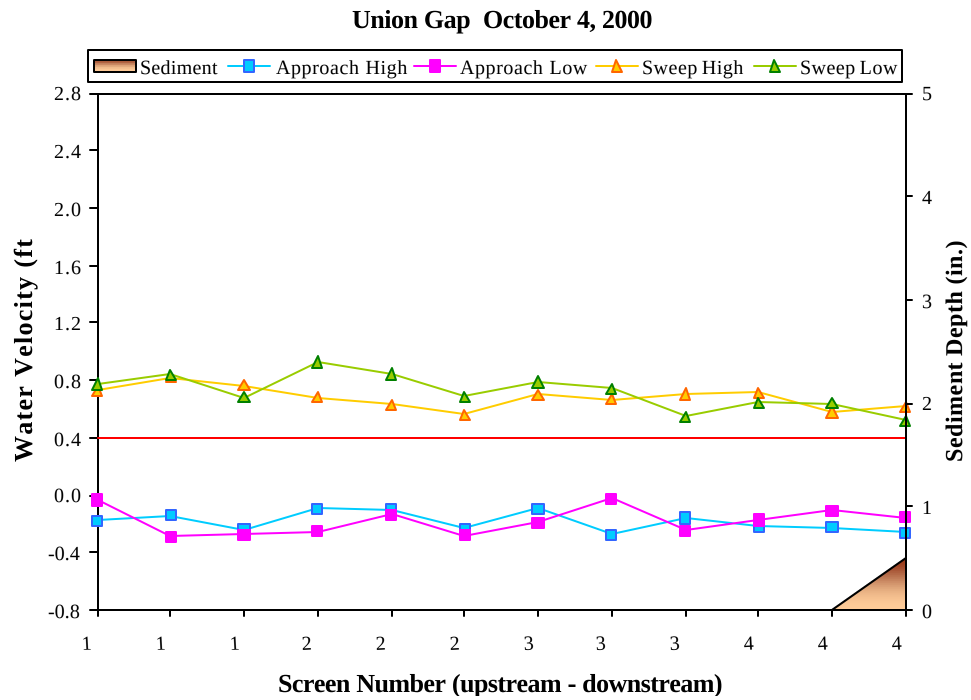

Figure 51. Water Velocities at the Union Gap Site, 10/4/00

3.3.6 Yakima-Tieton

The Yakima-Tieton site was evaluated 5/23/00, 6/21/00, and 9/18/00. Velocity measurements were not made in May, and equipment problems prevented accurate measurement of sweep velocities in September. Over 98% of the recorded approach velocities in June were less than 0.4 ft/s (Figures 52 and 53). Water flows very quickly at this site, and sweep velocities were much higher than their corresponding approach velocities. Sweep velocities were higher than the bypass velocity. Sweep velocities also decrease toward the bypass, but were generally high enough to mitigate this condition. Screen submergence at Yakima-Tieton was 87% in June.

Water flowed under the weir gate during each of the evaluations this year. Boards are set in place for the water to flow over instead of the weir gate, and there was 12 in. of water in June flowing over the boards and below the weir gate. Water flowed smoothly through the bypass, and outfall conditions were adequate for fish passage.

The screens were in good condition. Screen seals were missing caulking in a number of places along both bottom and side seals. On screen 4 the side seal may be starting to lose some caulking. Screens 5, 6, 7, 8, 10, 11, and 12 all appeared to be missing caulking along portions of the bottom seal and in a few places possibly along the side seal. Although there was never excessive sand, silt, or woody debris, there was a lot of leaf litter and small twigs that accumulated on the screens between brushings, especially in May. Generally, silt accumulated along the downstream half of the screen, though it was rarely greater than 4 in. deep.

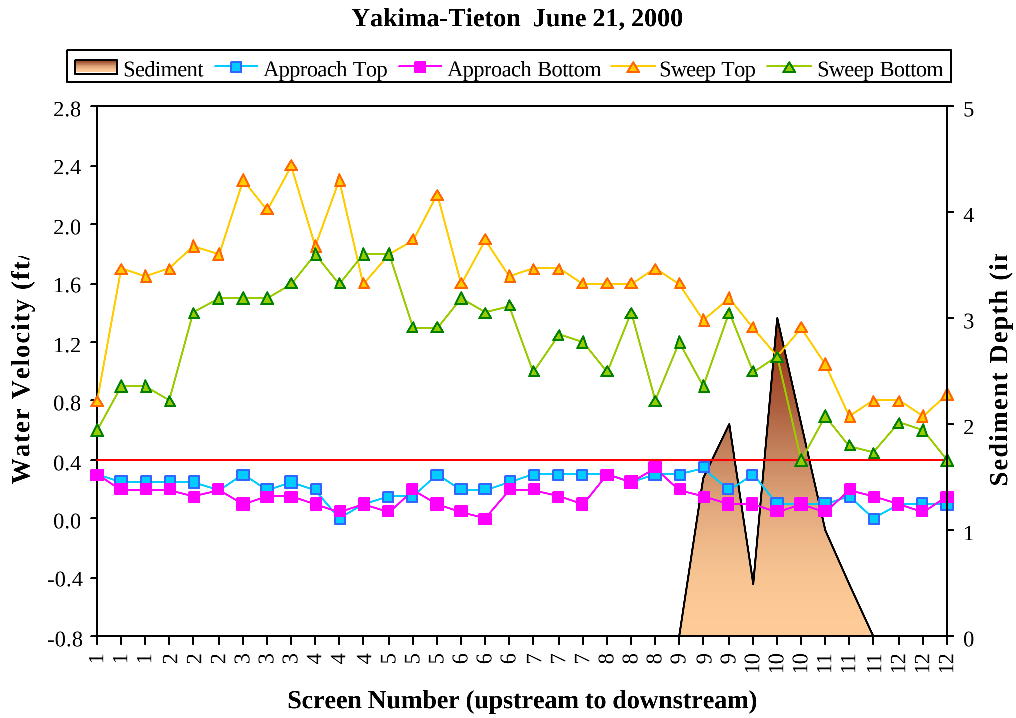

Figure 52. Water Velocities and Sediment Depths at the Yakima-Tieton Site, 6/21/00

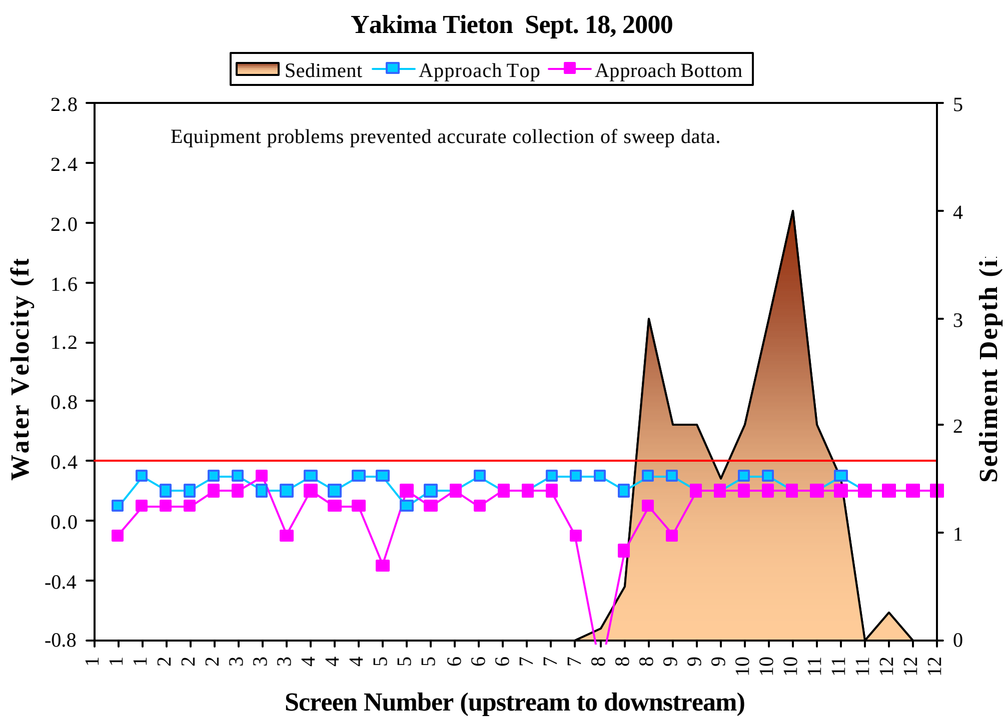

Figure 53. Water Velocities and Sediment Depths at the Yakima-Tieton Site, 9/18/00

3.3.7 Younger

The Younger site was evaluated on 5/22/00, 6/20/00, and 9/21/00. Most approach velocities were below NMFS criteria of 0.4 ft/s and the one exception may have been caused by eddies from the brushes cleaning the screens (Figures 54 and 55). The cleaning brushes run continuously and affect water velocities. Brushes are run by a hydraulic paddle-wheel system. The facility had been shut down for the season prior to our visit in September, and no water was moving into the canal. Mean sweep velocities exceeded mean approach velocities during both surveys. Submergence was approximately 50% in May and 70% in June. Screen and seal conditions were good. This site has no bypass. Debris was not a problem at Younger during the 2000 evaluations.

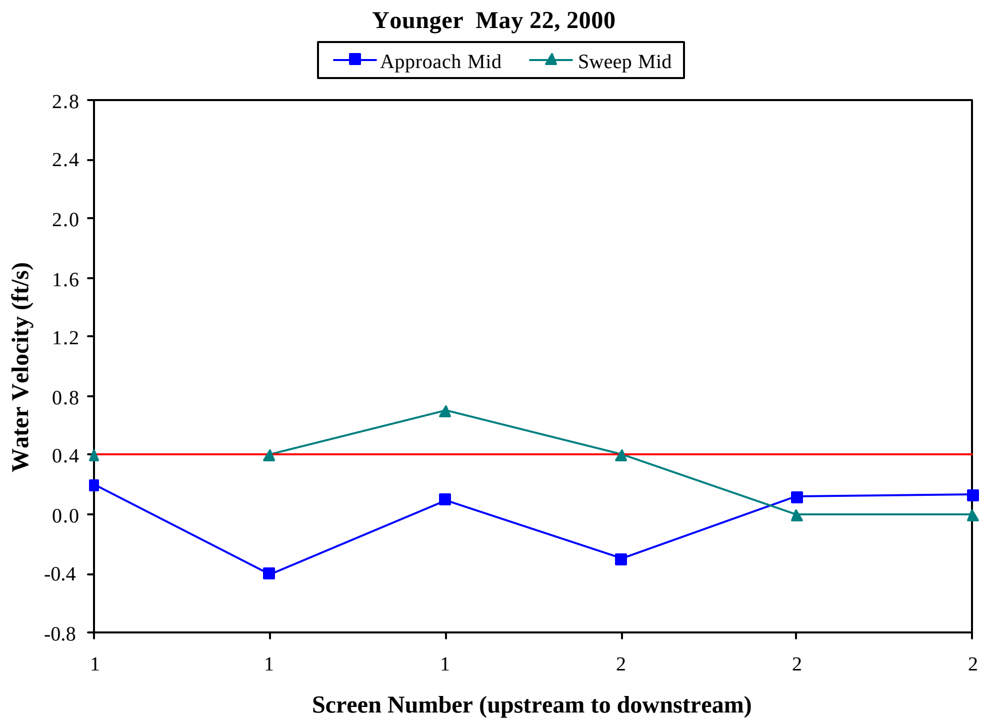

Figure 54. Water Velocities at the Younger Site, 5/22/00

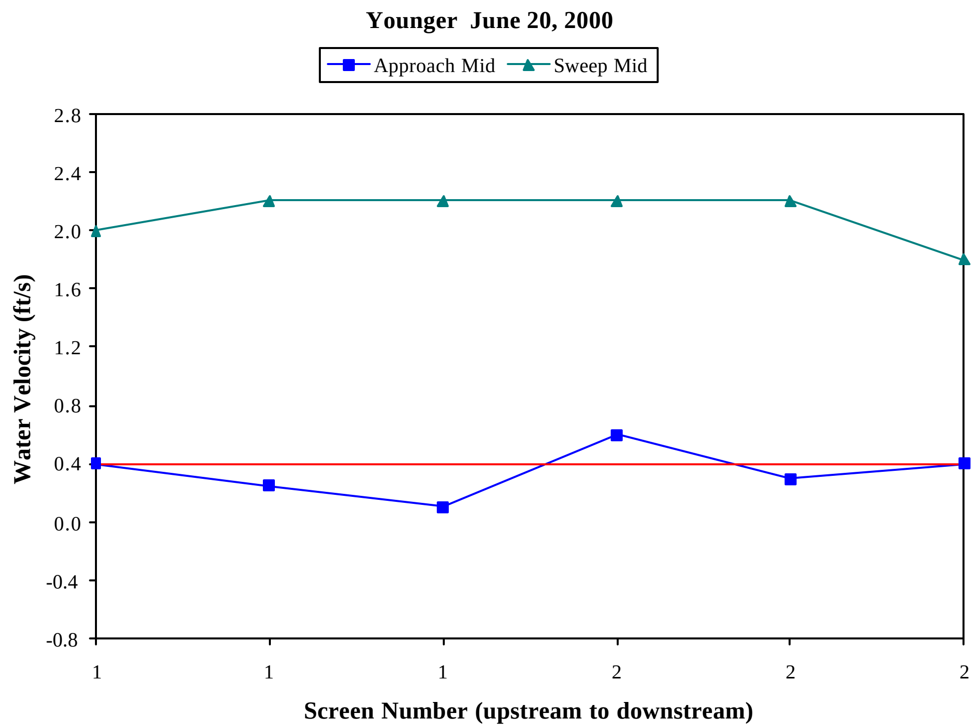

Figure 55. Water Velocities at the Younger Site, 6/20/00

3.4 Vertical Traveling Screen

3.4.1 Gleed

The Gleed site was evaluated 5/24/00, 6/22/00, and 10/4/00. In the past, electrical interference with the Marsh-McBirney probe prevented us from collecting much water velocity data. We tried once again this year using the same probe in May and June and the ADV system in October. The velocity data we were able to collect in May and October look reasonable, although the data collected in June is highly variable (Figures 56, 57, and 58). The variability in June could be due to electrical interference or water swirling around the steel plates put on the stream side of the facility to prevent branches and other large debris from damaging the screens. A third possibility is that changes on 6/19/00 to the height of steel plates protecting the screens could have caused the variability.

Mean sweep was either equal to mean approach velocities (May and October) or lower than mean approach velocities (June). About 17.5% of the approach velocities at Gleed exceeded 0.4 ft/s. Approach velocities were below the NMFS criteria of 0.4 ft/s in May and October, but if our measurements are correct, greatly exceeded it in places near the bottom in June. There is no bypass at this site. Sedimentation was not a major problem this year, and woody debris was less than in previous years.

Screen submergence was 73% in June. Screen and seal condition was generally good. All four screens had been replaced with nylon material by our first visit in May.

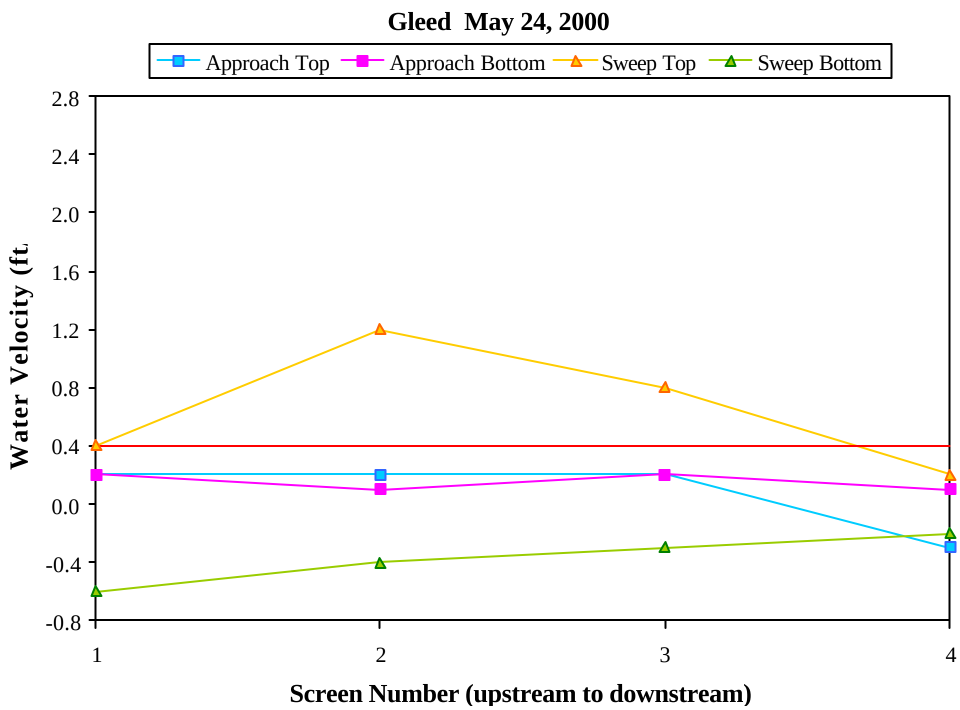

Figure 56. Water Velocities and Sediment Depths at the Gleed Site, 5/24/00

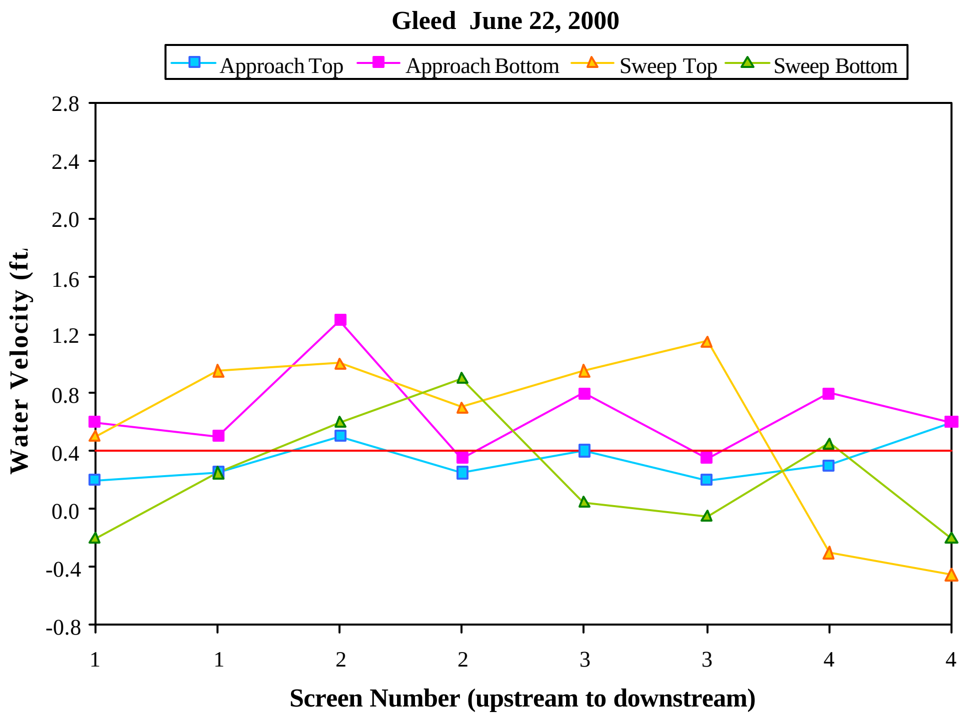

Figure 57. Water Velocities at the Gleed Site, 6/22/00

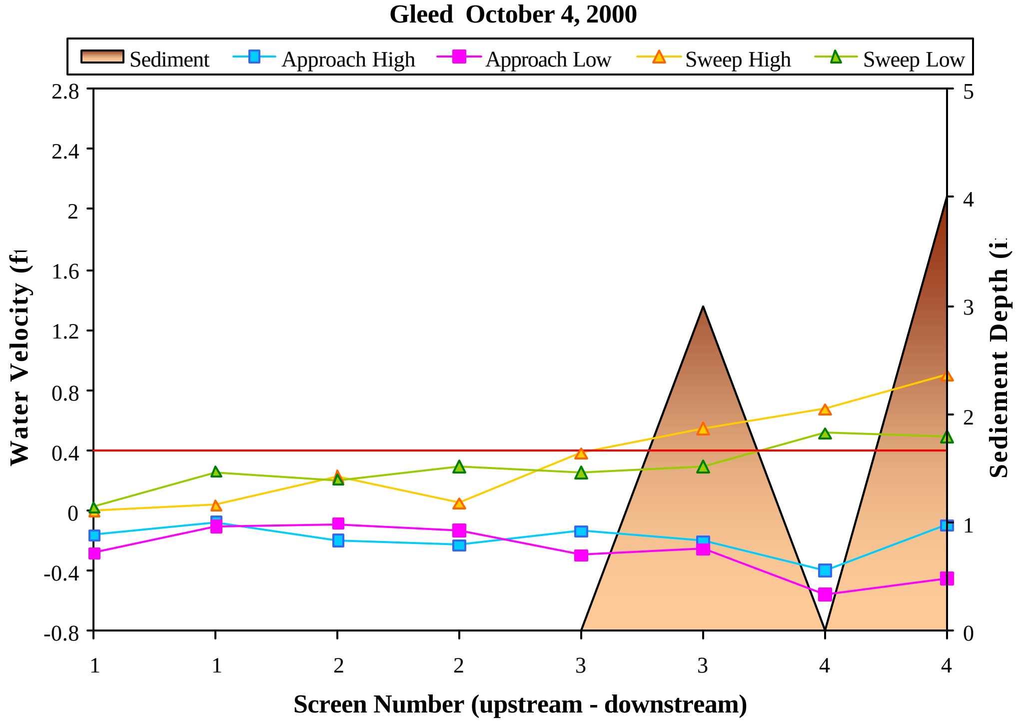

Figure 58. Water Velocities and Sediment Depths at the Gleed Site, 10/4/00

4.0 Conclusions

Our 2000 evaluation of Phase II screening facilities indicate they were generally operated and maintained to effectively provide fish a safe and efficient return to the river. Approach velocities at the drum screen sites were generally within NMFS limits. Flat plate screen sites and the traveling screen at Gleed did not meet these criteria as often. Sweep velocities were generally lower than bypass velocities and greater than approach velocities, which should have helped move fish back out into the river without delays. Sites were generally well maintained; drum screens moved smoothly, chains were greased, and automatic brushes removed most debris. Sediment and debris was still a problem at some sites, but overall has improved over the past several years.

Continued periodic, regular screen evaluations will increase the effectiveness of screen operation and maintenance practices by confirming the effectiveness (or ineffectiveness) of screen operating procedures at individual sites. Where procedures are being followed and problems still occur, evaluation results will suggest means to better protect fish at screening facilities. There has been a progressive improvement in the design, construction, maintenance, and effectiveness of these Phase II fish screen facilities during the past several years, in part, as a result of regular screen evaluations and the rapid feedback of information necessary to improve operations of these important fish protection devices.

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