Final Report – OWEB Grant #201-625B
Exhibit B

Calapooia Watershed Council
Thompson's Mill Flow and Habitat Assessment
June 2002-June 2004

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Summary

Extensive monitoring of various physical and biological parameters was conducted within the Thompson's Mill channel complex in 2002. Fish traps operated in fishways on Sodom Ditch and the Calapooia reach demonstrated that adult spring chinook salmon migrate past the subject facilities from mid-May through early July and prefer Sodom Ditch as their upstream route of passage. Application of the "Oregon Method" approach to determining the minimum flow needs for adult salmon passage on Sodom Ditch and the Calapooia reach indicates that 57 and 14 cfs, respectively, is needed at these locations to accommodate chinook migration. Spawning by winter steelhead and Pacific lamprey was documented in Sodom Ditch in 1999, 2001-03. In 2002, steelhead fry were present in abundance throughout Sodom Ditch in early June but had virtually disappeared by the middle of July. Excessive water temperature is believed to constitute the primary limiting factor for juvenile steelhead in Sodom Ditch. Pacific lamprey juveniles representing multiple age classes are abundant throughout the summer in Sodom Ditch, despite the marginal conditions. Salmonid use potential is higher in the Calapooia reach due to the presence of cooler water temperature regimes. Recommended flow management strategies presented in this report are based on information gained from the subject monitoring and are designed to optimize passage and survival opportunities for spring chinook and winter steelhead.

During 2003, further refinements were made to the water distribution model. The Technical Committee developed rationale for recommending 12 cfs as the amount to convert from the Mills historical water rights to a new instream water right.

The fishways at Sodom dam and Shear dam were assessed by a contracted engineering firm, Inter-fluve, Inc. Their draft recommendations for improving fish passage will be further refined as the next steps to improve fish passage will take place once Oregon State Parks assumes ownership of the property.

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Chapter 1: Introduction and Project Objectives

Background

The Calapooia Watershed is located in the Willamette River Valley in Western Oregon. The watershed encompasses 231,800 acres with 94% private ownership. The Calapooia River stretches over 72 miles from its headwaters at Tidbits Mountain in the Cascades to its mouth at Bryant and Monteith Parks in Albany.

Four dams on the lower Calapooia River, one located near the City of Brownsville (Brownsville Dam) and 3 located within the Thompson's Mill channel complex (Sodom, Shear, and the Mill race) have impeded fish passage for decades. In recent years, interest in resolving the fish passage deficiencies associated with these structures has increased due in part to the 1999 listing of spring chinook and winter steelhead as *Threatened* under the Endangered Species Act (ESA). The fish passage issues associated with the Mill are complicated by the Mill's historic water rights, hydroelectric power generation at the Mill, irrigation water rights, municipal water rights, historical significance of the Mill, and the complexity of channels and diversion structures (hereafter referred to as waterworks).

Thompson's Mill, one of Oregon's oldest grain mills (1858), is a testament to the ingenuity of Oregon's early pioneers. Its dam complex, plus the mill itself, represents advanced pioneer technology that has stood the test of time, drought, and floods (see attached map). Located on the Calapooia River, it has also been a long-standing fish passage problem for salmon and steelhead in the Willamette Basin.

Almost 50 years ago, the Oregon State Game Commission's annual report noted that Sodom Dam (one of the Mills complex of dams) has "blocked salmon and steelhead for many years." In the decades since then there have been numerous documented instances of spring chinook and winter steelhead being blocked or delayed at the dams associated with the Mill. Although dams on two key channels of the Calapooia ("Sodom" and "Shear" dams) have long been equipped with fish ladders, there have been numerous instances of the ladders being damaged by floods, blocked with debris, or boarded up by the mill operator to divert available flow to the Mill for hydromechanical and/or hydroelectric power.

The extent of the fish passage problem associated with the Mill varies from year to year with flow, with the most critical situation being spring and early summer low flow periods. Fish species affected by the operation of the Mill facilities include spring chinook salmon, and winter steelhead, as well as cutthroat trout and other species indigenous to the Willamette system. The greatest impact has been on spring chinook because they migrate later in the spring when flows are typically lower and Mill-associated water diversions become more problematic for fish passage.

In June of 1999, spring chinook adults were observed stranded below one of the dams after flashboards were installed to divert more water toward the mill, and the fish ladder was blocked off. With cooperation from the owner, Dave Babits, Oregon Department of Fish and Wildlife (ODFW) mounted several rescue efforts. A total of 25 adult spring chinook were captured and transported upstream.

In 2001, the newly-formed Thompson's Mill Working Group (TMWG), consisting of an array of private and public agencies, organizations, and companies, put together an arrangement with Babits that resulted in the Mill not operating during the important fish passage time, May through early October. This plan was put into effect to provide optimum fish passage and survival conditions in the various channels associated with the Mill.

During this so-called "non-generation period", ODFW and the Oregon Water Resources department (OWRD), with assistance from Babits, spent considerable time monitoring various physical and biological parameters within the Mill channel complex. Specifically, the agencies monitored flows, temperatures, physical stream habitat, and, of course, fish, all to the extent possible with no project-specific funding. Funding requests were unsuccessful for the 2001 monitoring season, except for enough money provided by the local utility, Pacificorps, and the Oregon Water Trust, to replace the owner's usual hydroelectric-generated revenues.

Much was learned in 2001 relative to how the water moves through the Mill complex, how fish interact with the system, and future potential water management of the site. For example, even though the agencies could not monitor adult fish passage in the dam fishways, flows were effectively managed to optimize upstream passage conditions. Snorkel surveys conducted in the upper Calapooia basin later that summer documented the presence of substantially more adult spring chinook than had been observed previously since routine sampling began in the mid 1990's. This finding provides some evidence that agency efforts to improve fish passage through the system were beneficial.

In 2002, OWEB funding provided the opportunity for the agencies and the TMWG to more fully study how the system functions and the future potential optimum fish passage and survival of all life stages of native fish. New monitoring efforts enabled ODFW staff and volunteers to monitor fish passage at both fishways in the system and conduct extensive physical and biological sampling throughout the channel complex, including the adjoining reaches of the lower and middle mainstem Calapooia River. These investigations generated valuable information that will better enable all concerned to accommodate the needs of fish under a wide range of possible operational scenarios.

In summary, ODFW is optimistic that the collaborative efforts of the TMWG will continue to produce substantive positive results. Not only has the Group been successful in securing immediate short term relief for fish and other aquatic resources, but it has made a commitment to pursuing a long term resolution to the complicated and challenging fish passage issues at hand.

Collaborative Process

In March 2002, the Calapooia Watershed Council (Council) was invited to participate with the Thompson's Mill Working Group (TMWG) to develop a plan for the management and operation of the Thompson's Mill and associated waterworks. The TMWG was formed at the Governor of Oregon's request in January of 1999 to carry out the mission of the Oregon Plan for Salmon and Watersheds by avoiding a lengthy court battle regarding managing the Mill property while also meeting the requirements of the ESA. Collaboration between resource agency staff and other entities, both public and private, has been ongoing in an effort to develop strategies for resolving the natural resource conflicts. This relationship was formalized with the

signing of a Cooperative Agreement in January 2003 that outlines each organization's role and responsibilities in developing a solution to the conflict.

In March 2002, the TMWG submitted a proposal to OWEB to fund an assessment of the Thompson's Mill flow issues and fish habitat. The Council became responsible for implementing the OWEB funded project and did so in the spirit of collaboration to assist with exploring potential future options to address the fish passage barriers associated with the Mill.

In July of 2002, the TMWG formed a separate Technical Committee to address the implementation of the OWEB Habitat Assessment Grant. Monthly meetings of the Technical Committee are coordinated and facilitated by the Council Coordinator. Table 1 provides descriptions of the issues of key stakeholders participating in the Technical Committee. Attachment C provides descriptions of contributions to the project and hours of in-kind given by agency staff and others.

Table 1. Thompson's Mill Key Stakeholders

Key Stakeholders	Stakeholder Issues
Thompson's Mill Owner	• Water rights at the Mill for generating hydroelectric power. The Mill's water rights are some of the oldest in Oregon dating back to 1800s. During summer months, the Mill owns the rights to the entire flow of the Calapooia River. • How to comply with ESA requirements while maintaining Mill operations. • Lack of clear options for improving fish passage and managing flows. • Expense of retrofitting dams and the Mill to address fish passage.
Calapooia Irrigators District	• Loss of previous agreement to pay Mill Owner to not exercise their full water rights during summer months to protect their own irrigation. (This was illegal and has ceased). • Concerns over if Mill property purchased by the State and the Mill water rights transferred to instream rights, potential loss of irrigation during summer months.
Boston Mill Historic Society	• Desire to see Thompson's Mill preserved as state historic site due to the uniqueness of the property. • Want to see the Mill managed as a regional tourist attraction to show visitors how people lived during Oregon's settlement period, tours of Mill and living history exhibit.
Oregon Water Trust	• Interested in purchasing some of the historic water rights and transferring them to instream rights in order to protect water quality and wildlife habitat during critical low flow periods.
Oregon Dept. of Fish and Wildlife	• Fish passage and water availability during critical times for fish passage and survival during low flow summer months.
NOAA Fisheries	• Must enforce ESA at the Mill (fish passage, juvenile salmonid survival, fish screens), but waiting for the outcome of this process before taking action. • Fish passage and water availability during critical times for fish passage and survival during low flow summer months need to be resolved.
Oregon Water Resources Department	• Manage and enforce water rights including of parties not part of the TMWG. • Responsible for working with Mill Owner to undergo re-authorization of hydroelectric license (by December of 2006).
Oregon Parks and Recreation Department	• Interested in purchasing the property due to its unique qualities and rarity of this type of structure. • Need to know how the flows at the Mill must be managed to accommodate fish, farmers, and flows and whether it is realistic for the state to be the manager of this complex property.
Calapooia Watershed Council	• Only group at the table without a specific stake in the outcome. The Council represents all interested parties and is a neutral player at the table. • Interested in supporting a fair, open, honest and productive process and assisting with reaching a workable solution.

Project Description

The Thompson's Mill Technical Committee met over the course of 1½ years (from July 2002 to February 2004) to discuss data collection, data gaps and future data needs. Out of these discussions several project options were pursued. Two state agencies played key roles in the implementation of the projects: Oregon Water Resources Department (OWRD) and Oregon Department of Fish and Wildlife (ODFW). Two separate tracks of data collection were undertaken:

1. Assessment of low flow conditions in the watershed specifically related to the Calapooia and Sodom channels and irrigation withdrawals;

2. Assessment of fish passage and conditions for fish survival in the system specifically related to the Calapooia and Sodom channels upstream of the Mill.

In the spring of 1999 ODFW operated fish traps in the fishways of Sodom and Shear dams in an effort to learn more about how adult salmonids, specifically ESA-listed spring chinook and winter steelhead, interact with these facilities. Subsequent investigations, most notably those funded by OWEB and described in this report, augment these and other earlier efforts and have provided resource managers with the information needed to more effectively manage the system for the benefit of the Calapooia basin's native fish resources.

During winter 2002-03, the Technical Committee met to discuss summer 2003 monitoring options. Over the course of these discussions and after reviewing data collecting during Summer 2002, the Committee decided the most pressing need for monitoring and assessment at the site was to develop an understanding of the fish passage alternatives for the Mill dams. To accomplish this task, the Committee worked with several engineering and fish passage staff from ODFW to develop a Scope of Work to hire an engineering firm to develop fish passage alternatives and costs for the Sodom and Shear dams. Inter-fluve, Inc. met the Committee's qualifications and was hired to complete the tasks outlined in Attachment A - Scope of Work. The completed project report from Inter-fluve, Inc is Attachment B. The Inter-fluve report is in draft form due to landowner concerns over the timing of the report's release for review. Review of the draft by the Technical Committee and TMWG is planned for 2004.

Table 2. Thompson's Mill Assessment Data Collection

Agency Collecting Data	**Data**	**Timeframe**
ODFW	Fish passage at Sodom and Shear dams	Spring/Summer 2002
ODFW	Temperature	Summers 2002-03
ODFW	Oregon Method for determining fish passage	Spring 2003
ODFW	Physical and biological surveys of Calapooia and Sodom channels	Summer 2002
WRD	Summer low flows with instream gaging stations	Summers 2002-03
WRD	Development of rating curve for gaging stations	Fall 2003
WRD	Water distribution model for understanding flows through the various channels of the system under different management scenarios and with varying levels of available water	November 2002 – December 2003 *(continued on next page)*

Inter-fluve, Inc.	Fish passage assessment including CAD drawings of different passage scenarios, and cost estimates	Fall 2003

Project Objectives (*for ODFW portion of grant work completed*)

Objective 1 Evaluate the effects of channel flow manipulation on the upstream passage of adult spring chinook.

Task 1.1 Document migration timing (and estimate run size) of spring chinook in the Calapooia River basin past the Thompson's Mill facilities. Operate upstream migrant fish traps in the fishways of the dams associated with the Thompson's Mill complex from May 8 through July 31. Traps will be installed at Sodom and Shear Dam fishways and monitored initially by a combination of ODFW permanent staff and volunteers. When OWEB finds become available (anticipated to occur in late May), 2 seasonal employees (EBA's) will be hired to assume this operation. Traps will be activated at the beginning of each 5 day work week (typically on a Monday) and fished continuously into Friday of each week at which time they will be removed, thereby allowing fish to move freely upstream until the next reactivation. Traps will be checked daily and any fish encountered released upstream unharmed. Data collected specific to adult chinook will be expanded to estimate total run size into the basin as well as document migration timing.

Rationale: In 1999, the Agency trapped at the subject facilities up to the time Mill operation associated flashboard installation occurred (late June), thereby blocking all upstream passage. Adult chinook were subsequently observed to be stranded below the subject facilities and successfully captured (via seine) by Agency personnel and transported upstream. In 2001, Agency confirmed presence of significant adult chinook escapement into the upper watershed (as evidenced by summertime snorkel surveys conducted in key adult holding areas), indicating that flow manipulations implemented that year specifically to optimize adult fish passage (associated with Mill non-generation) was successful. Unfortunately, a lack of Agency resources precluded fishway trapping in 2001 and thus, a critical piece of information is lacking relative to the issue. Trapping is needed to 1) determine the proportion of the chinook run that is negatively impacted by status quo Mill operations, and 3) evaluate the effects of flow management/manipulation on the upstream passage of adult spring chinook..

Products: Written report documenting: 1) the migration timing and estimated total run size of adult spring chinook into the Calapooia river basin above the subject facilities.

Task 1.2 Document flows in Sodom Ditch and the Calapooia River. **ODFW and OWRD personnel will collaborate on the collection of stream flow data at key locations which will be used in combination with the results from adult**

trapping (Task 1.1) to assist in the determination of optimum flow management strategies within the Thompson's Mill channel complex.

Rationale: Collection of flow data during the adult migration period is essential to the development flow recommendations designed to optimize fish passage at the subject facilities.

Products: Written report characterizing flow regimes in the subject channels during the period of active adult migration (May through July).

Task 1.3 Assess adequacy of fishways at Sodom and Shear dams. ODFW engineering staff will conduct a technical assessment of the subject fishways. Additionally, any evidence of fish delay observed during implementation of Task 1.1 will be documented**.**

Rationale: Resolution of upstream fish passage issues at the subject facilities requires an assessment of other factors potentially impacting fish migration. Passage deficiencies have previously been identified at Sodom dam and its' associated fishway. Continued technical investigation/ analysis of the situation at Sodom and Shear Dam is warranted.

Products: Written report characterizing the status of the subject facilities and identifying specific improvements needed.

Objective 2 Evaluate the effects of channel flow manipulations on salmonids and other aquatic species that inhabit Sodom Dditch and the Calapooia River channel during the low flow period.

Task 2.1 Conduct physical and biological sampling within the subject channels. Habitat and biological surveys employing, where practicable, standard inventory protocols will be conducted throughout the channel complex.

Rationale: This action is requisite to providing resource managers an understanding of how fish present in the subject channels respond to manually altered flow regimes during periods of low flow. Past sampling in Sodom Ditch has shown that juvenile salmonids and lamprey are negatively impacted during periods of low flow as a result of standard flow management practices. Of particular interest is how to best allocate available water between channels when total rover flow available is insufficient to support upstream passage, and in extreme situations, certain forms of aquatic life, in all areas.

Products: Written report describing and quantifying, to the extent possible, the physical habitat and biological resources present in the subject channels during the low flow period (data collection June through October).

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Task 2.2 Document flows and temperatures in Sodom Ditch and the Calapooia River. ODFW and OWRD personnel will collaborate on the collection of stream flow and temperature data at key locations which will be used in combination with the results from physical and biological sampling (Task 2.1) to assist in the

determination of optimum low flow management strategies within the Thompson's Mill channel complex.

Rationale: Collection of flow and temperature data during the low flow period is essential to the development of flow recommendations designed to optimize fish survival in the subject channels.

Products: Written report that includes flow and temperature data collected during the low flow periods (data collection June through October).

Objective 3 Use information acquired to develop recommendations specific to flow management in the Thompson's Mill channel complex so that fish passage and survival is optimized.

Task 3.1 Synthesize the information collected in Objectives 1 and 2.

Rationale: Fish passage and survival can be improved with modified flow regimes at the subject location. Acquisition of the aforementioned information will provide the basis for improved conditions and increased fish survival.

Products: Written report detailing ODFW recommendations specific to seasonal flow management/manipulation within the subject channels.

Chapter 2: General site descriptions

The Physical Setting

The Calapooia River watershed is complex. Water flow, stream habitat, and fish populations change through the seasons and over time in the response to natural and human events. Nature events such as floods and droughts impact stream habitat, fish distributions and populations. Human-related actions such as construction of roads, water diversions, dams, and land use practices can modify stream and riparian habitat, change fish movement through the river and tributary streams, and impact fish populations (Draft Calapooia Watershed Assessment, Fish Chapter, pg 4). The Thompson's Mill is set in midst of this complexity at approximately river mile 22 (22 miles upstream from the Calapooia River's confluence with the Willamette River). *See Figure 1 – Map of the Calapooia River Basin.*

The channel gradient downstream of Thompson Mill is only 0.06%. Channel gradient at the Mill is 0.10% and at the upper end of Sodom Ditch is 0.15% (Draft Calapooia Watershed Assessment, Riparian Conditions Chapter, pg. 4). The combination of channel gradient and channel sinuosity reflects where gravel deposition occurs along the Calapooia River. The greatest density of gravel deposition occurs from the Sodom Ditch diversion to the Brownsville ditch diversion. Here, channel sinuosity increases and channel gradient decreases, thereby causing much of the river's gravel load to resist further downstream movement (Draft Calapooia Watershed Assessment, Riparian Conditions Chapter, pg. 6). Understanding this natural gravel deposition becomes important when examining future management scenarios for the Mill because of the large amounts of gravel and location of deposition, on-going maintenance of the Calapooia

Channel and Sodom Channel split is likely (conversations with landowner, and Interfluve engineer).

The riparian vegetation along the Sodom Ditch is primarily grass seed fields. These fields do not provide shade to the water during summer months. The riparian vegetation along the Calapooia Channel is much more diverse and forested and provides more shade to the water surface during summer months (Draft Calapooia Watershed Assessment Riparian Vegetation Chapter, pg. 8).

Brief Structures Descriptions

Figures 1 and 2 illustrate the channels and locations of structures at the site. The existing Sodom Ditch dam is a concrete structure built in 1957 (Photo 2 and 3). It is approximately 11-ft in height from the outlet apron to the crest of the dam. Three concrete buttresses extend from the scour apron to the crest of the dam. Including the crest and width of the existing fishway, the dam is 85-ft wide.

The existing Shear dam is a concrete structure built in 1956. It is approximately 5-ft in height from the scour apron to the crest of the dam. The crest of the dam is 7.1-ft higher than the water level in the downstream scour pool under stagnant conditions. Including the crest and width of the existing fishway, the dam is 40-ft wide. Detailed descriptions, locations, photos, and dimensions for the Sodom and Shear dams are included in the Interfluve report, Attachment B.

Figure 1. Map of the Calapooia River Basin.

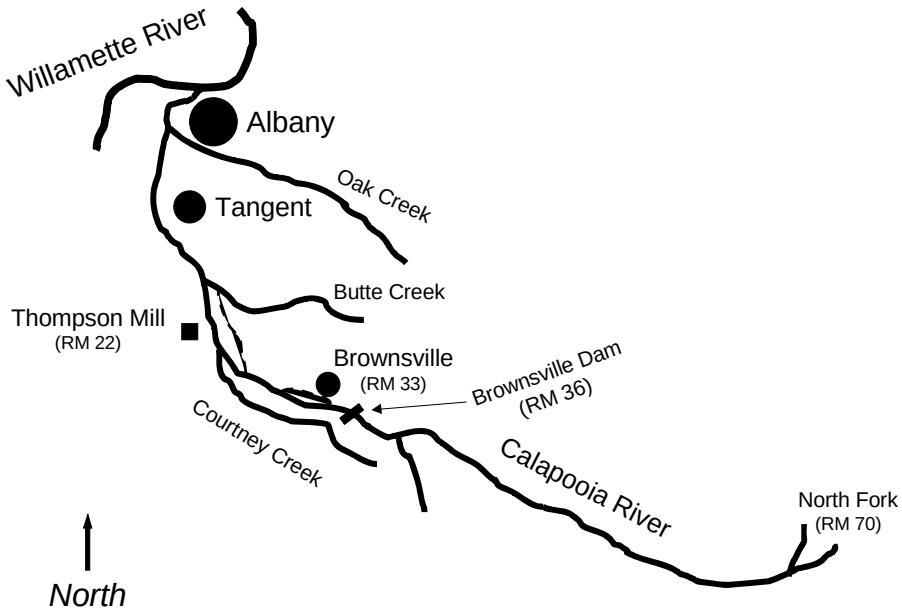


Photo 1. Shear Dam and fishway

Figure 2. Map of the Thompsons Mill complex.

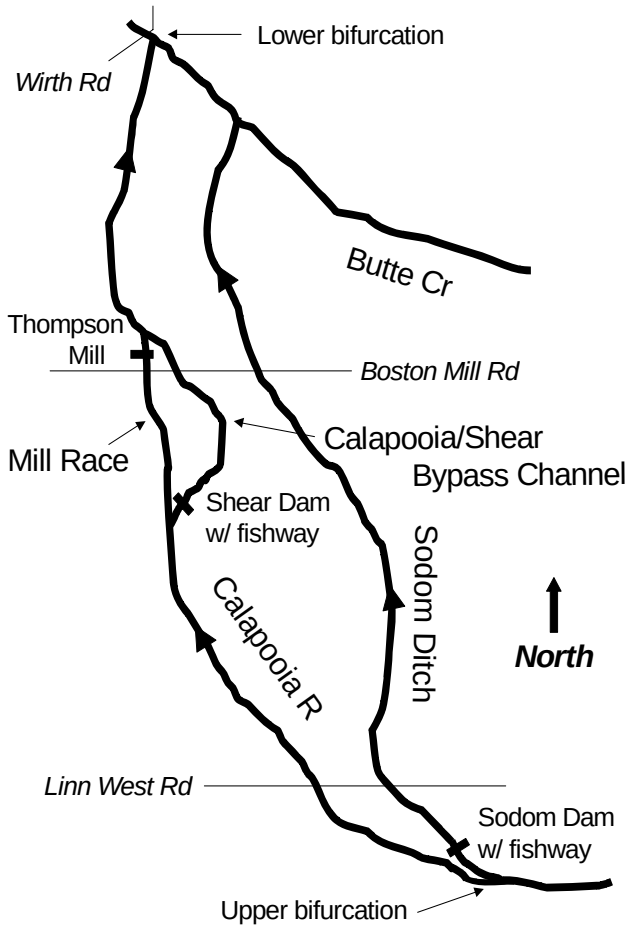


Photo 2. Sodom ditch dam. Fishway and apron are shown.

Photo 3. Sodom ditch fishway.

Chapter 3: Fish Passage

Fish Sampling Methods

Fish traps were installed in the Sodom and Shear Dam fishways on May 7 - 8, 2002, respectively, and were operated through August 1, 2002. Traps at both locations were operated, on average 4 out of 7 days per week. Their intermittent operation allowed for the unimpeded passage of fish during a significant portion of each week. While in operation, traps were checked daily and all fish processed.

Adult salmonid captures were carefully examined for the presence of fin marks (e.g. missing adipose fin) that, if present, identified them as hatchery fish. All fish captured were identified as to species and released upstream. Every effort was made to minimize stress and injury to fish that encountered the fish traps. All fish were monitored after release and any that exhibited signs of acute lethargy were closely monitored and, when necessary, revived.

Fish Sampling Results: Spring Chinook

Migration Timing and Run Size

Given the timing of adult spring chinook entry into the upper Willamette basin, as documented at Willamette Falls , it is likely that few fish would have migrated past the subject traps prior to their installation. We therefore believe that the findings described below accurately represent the temporal distribution of adult chinook migration at the subject location.

Sodom Dam

The first adult spring chinook was captured at Sodom dam on May 16, 2002. The last fish was captured on July 4, 2002. During this period a total of 15 adult chinook, all unmarked, were captured at the trap and another 31 observed on the dam's spillway apron (Figure 3). Although the number of captures was fairly well distributed from mid-May through early-July, activity at the site (captures + observations) was clearly greatest during the month of June. This observed temporal distribution is consistent with that documented in other Willamette basin tributaries that support spring chinook populations. For example, in the Santiam River spring chinook start arriving in significant numbers in early May, peak in June, and taper off dramatically in July.

In the Santiam, small numbers of fish continue to migrate upstream throughout the summer until the time spawning commences in the fall. Poor water quality (i.e., excessive water temperatures associated with very low flows) is believed to preclude this type of low-level, continuous, migration of adult chinook in the lower and middle reaches of the mainstem Calapooia River.

During the subject period (May 7 – August 1, 2002), the trap was operational 48 of the 85 (56%) total trapping days available. Passage estimates for non-trapping days are calculated by expanding data collected during those times that the trap was operational. Application of this methodology indicates that a total of 27 chinook passed through the Sodom fishway during the trapping period.

The previously described methodology for estimating total passage based on partial counts assumes that passage rates between the two periods (trap v. non-trap) are similar. Trap and

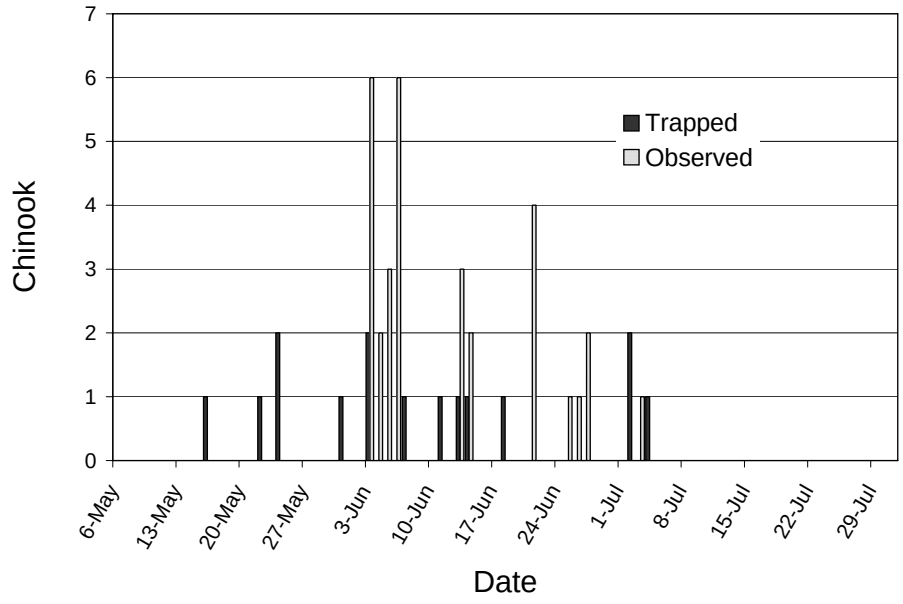
observation data collected at the Sodom fishway trap indicates that passage rates during the weekends (i.e. non-trap periods) were likely higher than those documented during times the trap was in operation and, thus, the potential for underestimating passage rates is relatively high. During the month of June, for example, every (non-trap) weekend was "bracketed" on either end (i.e. Friday and Monday of the following week) with fish being present at the site, either in the trap or observed on the dam's apron. During the trapping season, there were several occasions where weekends "bracketed" with fish coincided with significant rain events (during which fish movement often corresponds), lending further support to the assumption that passage rates were higher, possibly significantly so, during non-trap periods. Fish movement often corresponds to rain events and unfortunately for our study, the rain events during this season occurred on weekends when the trap was not operating.

Observations of fish on the dam's apron cannot be used to estimate total passage at the site since they would have been "double-counted" if they subsequently entered the trap and/or were observed on the apron at a later date(s). Their documentation, however, provides a useful indicator of relative activity levels at the site (Figure 3).

Shear Dam

Documented chinook activity at the Shear Dam fishway trap was limited to a single unmarked adult captured on June 11, 2002. Upon release, this fish was observed to pass downstream over the dam's spillway. It was not captured again although it could have re-ascended the fishway during a non-trap period. Trapping conditions at the site were considered excellent throughout the trapping season. The relative lack of activity combined with the presence of very suitable passage flows in the Shear channel indicates that most chinook access the upper Calapooia basin via Sodom Ditch.

Figure 3. Number of spring chinook salmon trapped and observed at Sodom Dam during the spring and summer of 2002.



Basin Escapement

Since 1996, ODFW staff has conducted annual snorkel surveys on a 6 mile reach of the upper Calapooia mainstem (above Holley). Adult chinook have been observed in varying numbers every year since the survey was established (Figure 4). Counts for years 1998 and 2000 potentially include hatchery adults that were released into the subject area prior to the survey being conducted and cannot be considered representative of the natural run size to the basin; the natural component of the run in these two years may have been significantly smaller than that depicted in Figure 3.

Although the data are limited, annual counts have exceeded the period (1996-2003) average since the seasonal non-generation ("non-gen") arrangement went into effect in 2001 (Figure 4). It is likely that fish passage and survival, particularly for the later migrating component of the run (late June-early July) improved significantly during the non-gen years since channel flows during these years were managed for the exclusive benefit of fish.

The relatively modest number of adults counted during summer snorkel surveys in 2002 is consistent with the similarly modest numbers of fish documented at the Sodom fishway trap earlier that season. This observation appears to weaken the aforementioned hypothesis that the basin's chinook run was significantly larger than indicated by our trapping operations alone. It is possible, however, that a significant number of fish ascended the Sodom fishway undetected (i.e., during the weekend non-trap periods) and later succumbed to some pre-spawning mortality factor (e.g., disease, predation, poaching) *prior* to the time the surveys were conducted.

Figure 4. Number of spring chinook salmon observed during annual snorkel surveys in the upper Calapooia River, 1996 through 2003.

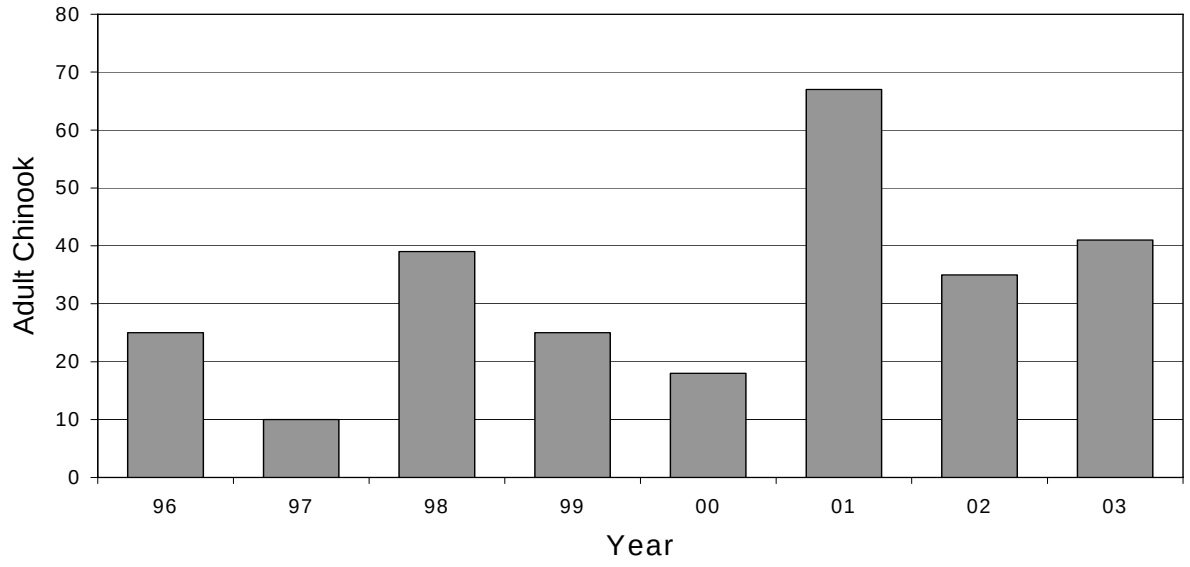


Figure 5. Spring and early summer flows (measured and estimated) in Sodom Ditch and the Shear bypass channel (2001).

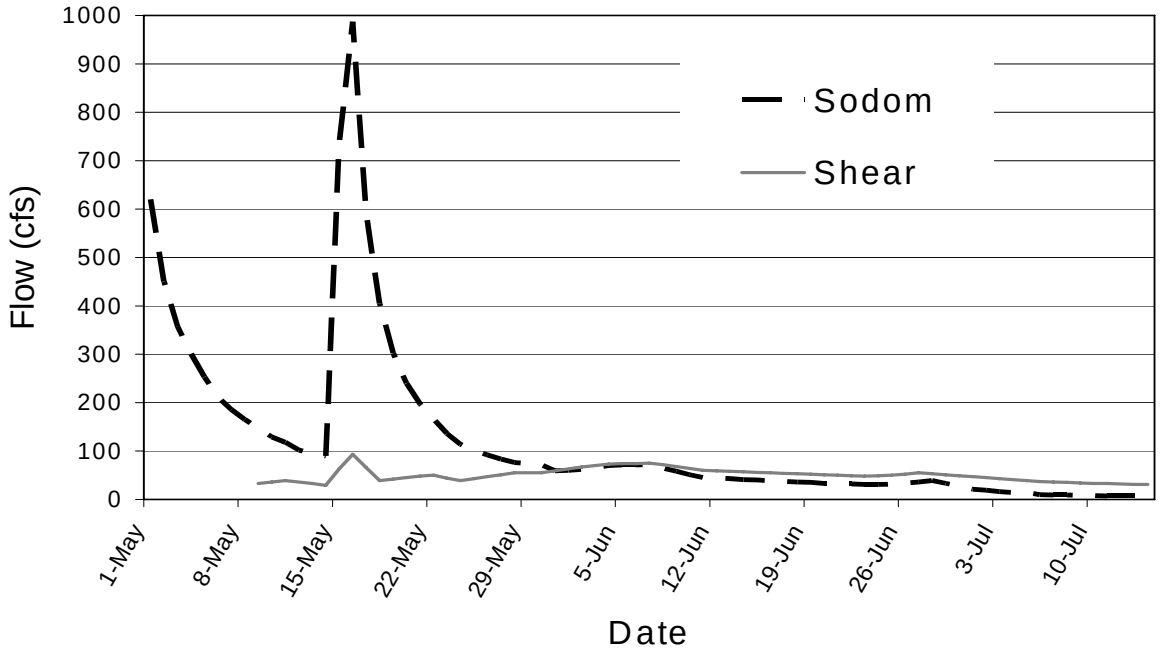
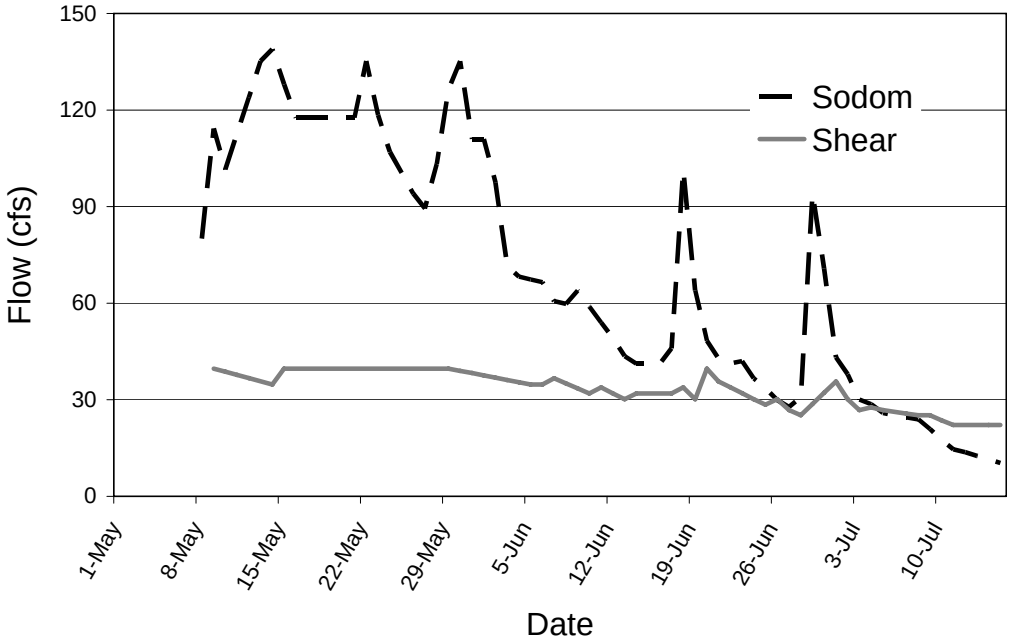


Figure 6. 2002 spring and early summer flows (measured and estimated) in Sodom Ditch and the Shear bypass channel.



Three Factors Affecting Migration and Survival of Salmonids in Thompson's Mill Complex

1. Flow and Temperature

Stream flows in Sodom Ditch and the Calapooia River below Shear dam ("Shear bypass channel") were monitored throughout the adult chinook migration period for each of the three non-gen years (Figures 5 and 6). *[note: at the time of this writing, processing of 2003 flow data is incomplete and therefore not presented graphically]*

Flows in Sodom Ditch generally reflect the annual hydrograph for the Calapooia basin. Flows are highest, and most favorable from a fish passage standpoint, early in the period (May) and drop significantly as the season progresses. By mid-June, flows have typically declined to levels considered marginal for upstream passage of adult chinook (*see "Oregon Method" discussion*).

In 2001 and 2002, flows in the Shear bypass channel remained relatively constant throughout the period at levels well in excess of that considered necessary to meet the minimum passage requirements for migrating chinook (*see "Oregon Method" discussion*). In 2003, Shear channel flows were compromised due to significant leakage at the Mill caused by deterioration of the dam's stoplogs (this was repaired in the summer of 2003). Consequently, by mid-June of 2003, flow levels in the Shear channel had declined to a point where passage standards were not being achieved.

In most years, the later-migrating segment of the Calapooia basin's spring chinook run is subjected to a potentially detrimental combination of rising water temperatures and declining stream flows characteristic of the late-spring/early-summer period. This situation can become particularly acute in Sodom Ditch due to its wide active channel, high susceptibility to solar warming, and presence of numerous gravel bars that may hinder passage at low flows.

The influence of annual variation in critical environmental parameters (e.g., flow, temperature) on fish passage and survival can be significant. Overall, environmental conditions in 2001 were superior to those in 2002 in terms of: 1) total discharge for the passage season (higher) and 2) temperature regimes during the latter part of the season (cooler).

Evidence of reduced chinook survival was documented in Sodom Ditch between Linn West Road and Sodom Dam in early July 2002. Field staff observed several adults behaving lethargically and subsequently documented evidence of fish mortalities in the form of partial remains of at least two adults. Low flows and associated early July water temperatures (low to mid 70's degrees F) almost certainly contributed to the cause of the observed behavior and/or mortalities.

2. Trapping (2002)

It is possible that operation of the fish trap at Sodom Dam contributed to reduced fish survival, particularly later in the trapping season when fish were most vulnerable to the effects of handling-induced stress/trauma (due to increased water temperatures associated with low flows), unavoidable "harassment" associated with increased human presence/activity at the site, and migration delays associated with trap operations. On July 4, 2002 field staff processed a large (estimated 40 lb.), apparently healthy, female chinook at the Sodom trap. The fish, while very lethargic at release, eventually righted itself (with some assistance from project personnel) and

proceeded slowly upstream. A week later, a chinook carcass, exactly matching the description of the aforementioned fish, was recovered immediately above the dam.

At the end of the 2002 field season, a decision was made by the Thompson's Mill Working Group to forgo future trapping of chinook at the subject facilities, largely due to the concerns and observations described above. Augmenting this decision was the belief that the season's trapping effort had amply characterized how adult chinook are most likely to interact with the Thompson's Mill channel complex in *non-gen* years.

Though inconclusive in its implications, it is interesting to note that neither stressed fish nor mortalities were observed anywhere in the channel complex during the non-gen years of 2001 and 2003 when trapping was not conducted. It seems logical to assume that later migrating individuals would be most capable of successfully negotiating the channel complex, even under relatively adverse environmental conditions, when exposure to anthropogenic stressors was minimized.

3. Channel Selection

A primary research impetus for trapping at Sodom and Shear dams was documenting which channels fish use during their migration to the upper watershed. The fact that chinook displayed a clear preference for Sodom ditch is not surprising for a number of reasons.

Sodom Ditch is the larger of the two channels and consequently experiences significantly higher flows early in the migration period (May). As fish moving upstream approach the lower bifurcation - the Sodom/Calapooia "split" - they would naturally be attracted to the larger, higher discharge, channel. As flows recede and the channels' entrances approach some semblance of flow parity, new arrivals might still be inclined to follow their predecessor's route due to the presence of lingering olfactory markers. Additionally, the hydraulics associated with the wider, shallower, and more physically complex entrance to Sodom Ditch would likely prove more attractive to actively migrating chinook than the "slough-like" entrance to the Calapooia reach. Finally, because Sodom Ditch almost certainly functions as the downstream conveyance route for the large majority of outmigrant chinook juveniles, it is probable that a measure of "imprinting" occurs which incrementally predetermines their route selection when returning as adults several years hence.

Water temperature differences between the channels could influence route selection later in the migration period (June/July). Temperatures during this period are typically several degrees cooler in the mid to lower reaches of the Calapooia reach, a phenomenon clearly attributable to the marked differences between the two channel's physical profiles and extent of vegetative overstory. Sodom Ditch is significantly wider and much more exposed to the sun's warming influence than is the Calapooia reach which is considerably narrower and well canopied throughout much of its length. The results of our trapping in 2002, however, indicate that temperature was not a primary determining factor in channel selection by chinook.

In 1999, adult chinook were documented (via fish salvage operations and visual observations) in both Sodom Ditch and the Calapooia reach. Ongoing Mill operations during the 1999 migration period may have resulted in a greater proportion of the run selecting the Calapooia reach than

would have occurred in a non-gen year. The observed differences in route selection between non-gen and gen years may be largely attributable to differences in how flows are managed between the two operational modes.

Fish Sampling Results: Winter Steelhead

Fish passage: Sodom and Shear Dam fishways

Documented upstream passage of adult winter steelhead was limited to a single unmarked adult captured on May 14, 2002 at the Shear Dam trap. In May 2002, a total of four steelhead "kelts" (i.e., adults that had recently spawned and were en route to the ocean) were collected above the upper trap panel at the Sodom trap and released downstream. Kelts were not encounterd at the Shear trap. The paucity of fish in 2002 is not indicative of run size since the majority of the winter steelhead migration in the Calapooia basin occurs prior to the time (early May) that trapping was started. Intermittent trapping at Sodom Dam in 1999, (from mid-March through late June), produced a total of 33 adult winter steelhead, only 1 of which was captured during the month of May. By April 16, eighty-five percent (28 fish) of the season total had been trapped. No steelhead were captured at the Shear Dam trap in 1999, however, high flows precluded effective trapping at this location throughout much of the spring.

Spawning and juvenile (age 0) distribution

Winter steelhead spawning in Sodom Ditch has been documented in each of the four years that monitoring has taken place (Table 3). Although suitable spawning habitat occurs throughout its length, most steelhead redds were consistently observed in the Ditch's upper reaches. Redd densities were highest in 2002, particularly in the 1.0 mile reach of stream between Sodom Dam and Linn West Road.

Steelhead fry were sampled (via seining) throughout Sodom Ditch during late spring/early summer of 2001 and 2002. Sampling failed to produce fry in 2003 despite documented spawning activity comparable to that observed in 2001.

Table 3. Results of fishery surveys (spawning and seine) conducted in Sodom Ditch.

	Winter Steelhead (StW)		Pacific Lamprey		
	Redds	Adults	Redds	Adults	Comments
1999	5	2	50	4	Both StW adults were observed on a redd
2000	---	---	---	---	---
2001	14	1	26	0	StW fry present in low densities
2002[1]	26	0	60	0	StW fry present in high densities
2003	11	1[2]	---[3]	3	StW fry not observed

[1] Steelhead and lamprey enumerated in reach from Sodom Dam to Linn West Rd only. Redds present from Linn West Rd to Wirth Rd but not enumerated.

[2] Winter steelhead mortality – appeared to have been poached.

[3] Lamprey redds abundant but not enumerated.

Fry densities were markedly highest in 2002 with the greatest concentrations of fish in the reach between Sodom Dam and Linn West Road. On June 10, 2002 large numbers of steelhead fry were visually documented along the stream's margins and in shallow riffles throughout this reach. Subsequent sampling on July 1st and 10th documented a steady decline in the abundance of fry in this reach. By July 15th, no fry could be located. Their disappearance is likely the result of steadily deteriorating environmental conditions, specifically, increasing water temperatures associated with reduced flow levels characteristic of this period. Decreasing flows would increase vulnerability of fry to predation from native and non-native fish species (e.g. northern pike minnow, bass, etc.) that inhabit Sodom Ditch in large numbers.

Winter steelhead spawning and associated juvenile production in Sodom Ditch constitutes an "outlier" for the Calapooia basin. With the exception of Sodom Ditch, all known winter steelhead spawning in the Calapooia basin takes place in the upper mainstem and selected tributaries located well above Holley (RM 46), 20 river miles above Sodom Ditch. Indeed, the vast majority of mainstem spawning occurs above RM 65.

In the summer of 2002, a remnant steelhead redd was documented on the mainstem at rm 48 by ODFW biologists conducting a snorkel survey. With the aforementioned exception (Sodom Ditch), this observation constitutes the lowermost occurrence of steelhead spawning in the basin. During the 2002 snorkel survey, biologists were also able to define the lowermost extent of steelhead fry occurrence, which, not surprisingly, terminated a short distance below the aforementioned redd. Summertime water temperatures throughout this section of the mainstem are typically marginal for salmonids, particularly age 0 juveniles (fry/fingerling) that tend to be less capable than their older counterparts of tolerating adverse conditions, including predation by other fish.

In the late spring/early summer of 2002 and 2003, ODFW biologists conducted steelhead spawning surveys on the Calapooia mainstem from Brownsville Dam (rm 36) downstream to Sodom Dam, a distance of 10 rm. No steelhead redds were observed or fry collected via seining, despite the presence of an abundance of potentially excellent spawning habitat. These efforts constituted the first attempt to document/validate long held assumptions relative to steelhead spawning activity (or lack thereof) in this portion of the mainstem.

In 1999, ODFW field staff documented evidence of adult steelhead migration delay at Sodom Dam resulting from an apparent "false attraction" condition at the dam's spillway. False attraction occurs when actively migrating fish become fixated on a specific hydraulic feature that precludes their timely passage. It is suspected that a significant portion of the aforementioned steelhead spawning activity in Sodom Ditch may be attributable to passage deficiencies at Sodom Dam.

Oregon Method

The "Oregon Method" (OM) methodology for determining the minimum flow requirements for adult fish passage was performed at eight locations throughout the Thompson's Mill channel complex in 2002-03. Sites included in the assessment were selected on the basis of their perceived potential for becoming problematic for adult chinook passage under low flows conditions characteristic of late spring-early summer.

The OM defines minimum passage flow as that which 1) meets passage criteria (i.e., 0.8 ft. minimum depth for adult chinook) over 25 % of the total stream width, and 2) meets passage criteria for a continuous section of stream representing at least 10% of the total stream width. OM minimum flow requirements for adult fish only ensure that fish have physical freedom to move throughout the stream. Flows exceeding the passage criteria facilitate passage and are therefore desirable.

OM investigations to date indicate that minimum flows of **14** and **57** cfs are necessary to meet the upstream passage requirements of spring chinook in the Shear bypass channel and Sodom Ditch, respectively. Future monitoring will be needed to insure the accuracy of these estimates.

Fish Passage Assessment

ODFW Fish Passage Program personnel visited the subject fishways on several occasions over a two year period. Their goal was to gather site-specific information to begin the process of quantitatively describing the existing passage situation from an engineering perspective. The information developed was subsequently provided to engineers from Inter-fluve, Inc. for use in their fish passage assessment

Conclusions

From a chinook survival standpoint, the Calapooia reach offers several potential advantages over Sodom Ditch as a favorable fish passage route. Throughout most of its length this channel is well removed from human habitation and relatively inaccessible. Its narrow channel and dense riparian buffer should allow fish to move upstream in relative seclusion. Temperature regimes in this channel are consistently cooler in late June and early July when environmental and other potential stressors are most likely to become problematic for later migrating fish. Conversely, potential negative aspects of this route include: 1) the abundance of woody debris accumulations that could impede passage in some situations, and 2) the close proximity of the channel to rural residential properties at several locations.

However, given the apparent propensity for upstream migrating salmon (and winter steelhead, based on '99 trapping results) to select Sodom Ditch as their upstream route of passage it makes logical sense to prioritize this channel in the spring/early summer flow management context. *[It should also be acknowledged that normal winter/spring flow regimes preclude the option of excluding steelhead and/or salmon from Sodom Ditch]* To the extent possible, flows in Sodom Ditch should be managed such that they meet, and preferably exceed, the aforementioned Oregon Method (OM) minimums for upstream passage of adult chinook salmon. Concurrently, it is also important that adequate passage flows be provided in the Calapooia reach and Shear bypass channel to accommodate fish that select this route (*see "Recommendations" section for additional flow management specifics).*

It is important to emphasize the fact that this project addresses fish passage and survival under a specific set of conditions, that of the Mill being *inoperable* ("non-gen" mode) from early May through early October. Alternative flow management scenarios significantly different from that assessed would very possibly change the way various fish species interact with the channel

complex. As discussed previously, upstream migrating fish confronting a "split-channel" situation will usually follow the higher of two discharges. Thus, in a scenario where significantly more water was present in the Calapooia "fork" due, for example, to ongoing Mill operations, channel selection by chinook might be more equally distributed between Sodom Ditch and the Calapooia reach than what was observed in 2002. Significant discharge associated with Mill operations *could* also have the effect of delaying adult salmonids below the Mill dam for varying periods of time ("false attraction") unless flows were managed to provide sufficient attraction to the Shear bypass channel (*evidence of this possible effect was observed immediately below the Mill dam in early-mid July of 1999 in the form of adult chinook salvaged and observed at this location after Shear Dam was blocked and it's flow [sans approximately 0.25 cfs which is legally required to be maintained in the channel] diverted down the millrace for hydropower generation).* Flow management scenarios involving an operational Mill will require appropriate technical investigations before their effect on fish passage and survival can be determined.

While seemingly paradoxical, winter steelhead spawning and associated juvenile production in Sodom Ditch constitutes a resource value that must be accommodated to the fullest extent possible. In this context, the previously mentioned technical assessment of fish passage at Sodom Dam is believed to represent the initial phase of the strategy offering the greatest potential for achieving this mandate. The impetus for improving steelhead passage opportunities at Sodom Dam stems from a combination of the following factors: 1) past observations of apparent adult steelhead delay at Sodom Dam (associated with "false attraction" to spill across the dam's crest), 2) the "outlier" status of steelhead spawning in Sodom Ditch and 3) the inability of Sodom Ditch (and the lower Calapooia basin) to support juvenile steelhead through the critical summer low flow period, under virtually any flow management scenario. This latter factor represents the single most compelling reason to pursue opportunities for facilitating adult steelhead passage at Sodom Dam.

Chapter 4: Fish Use During the Low Flow (Summer) Period

Field staff expended considerable effort over the summer of 2002 documenting various physical and biological parameters of the channel complex. Limited monitoring was also conducted on the mainstem Calapooia above and below the channel complex.

Fish Sampling Methods

Three primary means of gathering biological information were employed: trapping, electrofishing, and seining. Additionally, angling with hook and line proved to be an effective means of capturing salmonids in certain situations. All equipment (sans that used for angling) was provided by ODFW.

Hoop traps are cylindrical shaped cages having dimensions of 3' in diameter by 8' in length. Welded rebar forms the trap's frame which is wrapped with plastic mesh ("vexar") having a 0.25" diameter mesh size. An internal fyke situated near the units mid-point creates the trap-effect by guiding fish into an area where the possibility of their subsequent escape is very low. Traps were checked frequently throughout the course of the standard work week.

The electrofishers used in the project were: 1) a Smith Root, Inc. model 12-B POW and Coffelt BP-3. Adherence to *NOAA Fisheries Guidelines for Electrofishing* occasionally required cessation of electrofishing activity due to encounters with ESA-listed species (winter steelhead juveniles). Electrofishing methodologies used ranged from basic reconassaince level (i.e. presence-absence) surveys to standard ODFW Aquatic Inventory Project protocols.

Seines were constructed of nylon netting and varied in length and mesh size, depending on the individual habitat type being sampled. They were used extensively throughout Sodom Ditch for determining the relative abundance of winter steelhead fry. The Calapooia reach was poorly suited to seining due to the presence of large amounts of in-stream woody material.

Fish Sampling Results (Summer 2002)

Hoop traps: Calapooia reach

Since the early 1990's, hoop traps have been used successfully throughout the mid-Willamette basin to sample salmonids in small, low gradient, "valley floor" streams. With few exceptions, data on salmonid use in these locations was either very limited or altogether non-existent. This was due, in part, to the fact that the target streams were often difficult to sample with electrofishers and/or seines during the time of year (wet season) that salmonids were most likely to be present. Hoop traps, because they operate 24/7, are especially well suited to documenting salmonid occurrence in situations where their numbers are few and/or presence sporadic.

Of particular interest to project investigators was that of determining the level of salmonid presence in the Calapooia reach of the channel complex during the summer period. As noted previously, water traveling down the Calapooia arm experiences a significant decrease in temperature during the summer months. It has been hypothesized that steelhead juveniles (age 0 fry) produced in Sodom Ditch might use the Calapooia reach as a "thermal refuge" during the summer months. Additionally, although small numbers of cutthroat trout and older age class steelhead juveniles had been documented in both channels during the spring-early summer period (incidental to adult trapping and salvage operations), their summertime whereabouts were unknown. Hoop traps were viewed as a potentially effective means of documenting their presence.

Hoop traps were placed in the Calapooia reach of the channel complex at 3 locations: 1) approximately 0.1 rm below the upper bifurcation point, 2) immediately below Shear dam (on the Shear bypass channel), and 3) half-way between Thompson's Mill and the lower bifurcation point (at approximately rm 21).

Between the three locations, a total of six native (Northern Pikeminnow, Largescale Sucker, Sand Roller, Dace, Sculpin, Redside Shiner) and two non-native species (Bass, Bullhead Catfish) were represented in the catch. Northern pikeminnow, a native piscivore, dominated the catch at all locations. The trap situated below Shear Dam was considered marginal in terms of effectiveness and consequently deactivated after a relatively short period of operation.

The lowest trap in the system seemed well positioned to intercept salmonids hypothetically exiting Sodom Ditch in search of thermal refuge. The fact that none were encountered at this location would suggest that summertime utilization of the Calapooia channel by salmonid

"refugees" from other areas (e.g., Sodom Ditch, Calapooia mainstem below the complex) and/or year round Calapooia "residents" is limited. It is possible, however, that the target species (juvenile steelhead, cutthroat) were present but simply not detected by trapping at this location.

Electrofishing: Calapooia reach of the channel complex

Electrofishing was conducted in August and September at selected locations from throughout the Calapooia and Shear bypass channels in order to document fish species and life stages present. Sample sites were selected, in part, on their perceived potential for harboring ESA-listed salmonid fish species. With the exception of juvenile Pacific lamprey produced by electrofishing, species composition and age distribution of fish sampled via this method was similar to that of hoop trapping.

In late August 2002, a single winter steelhead fingerling (age 0) was captured via electrofishing in the Calapooia River immediately downstream of the complex's lower bifurcation point (above Wirth Road). It was immediately apparent to project personnel that the subject steelhead was inflicted with "black spot" disease, a condition typically associated with prolonged exposure to water of marginal quality. This site had been chosen for intensive sampling due to a combination of the following factors: 1) its close proximity to the bifurcation point (and therefore salmonids potentially seeking refuge from deteriorating water quality in Sodom Ditch), 2) water temperature regimes better suited to salmonid survival due to the cooling influence of the Calapooia reach located just upstream, and 3) the occurrence of habitat types likely to be inhabited by salmonids, if present.

Additional summer sampling specifically targeting salmonids was not conducted on the mainstem Calapooia River downstream of Wirth Road. Available information strongly suggests that, with rare exception, low flows and associated water temperature regimes preclude salmonid utilization of the lower Calapooia River mainstem during the summer.

In mid October 2002, prior to the onset of the fall rains, electrofishing conducted in the Shear bypass channel a short distance below Boston Mill Road produced a single cutthroat trout in excellent condition. This fish was captured in a small concrete fishway situated adjacent to a low profile concrete dam structure that spans the channel at this location. The capture site, a small plunge pool, was a habitat type both well suited to supporting and capturing salmonids with electrofishing equipment. The timing and location of this capture suggests that cutthroat utilize the Calapooia reach in low numbers throughout the summer months. Prior to this event, the latest date in the season that cutthroat had been documented in the Calapooia reach was July 8 (1999).

Electrofishing: Sodom Ditch

The reader is advised to refer to the "winter steelhead" section in Chapter 3 for a detailed discussion of early summer sampling efforts targeting juveniles (age 0 fry) of this species.

Electrofishing was conducted in September at selected locations from throughout the Sodom Ditch in order to document fish species and life stages present. Sodom Ditch, unlike the Calapooia/Shear channel, is well suited to electrofishing and seining throughout its length. Despite an abundance of habitat types favored by salmonids, none were sampled during the

September sampling effort. For reasons previously discussed, this finding was not at all unexpected. With the exception of sand rollers (not present), species composition in Sodom Ditch was similar to that documented via electrofishing and hoop trapping in the Calapooia channel.

The most interesting finding from our summertime sampling effort in Sodom Ditch involved Pacific lamprey. Juveniles representing multiple age classes were abundant at all locations sampled despite the presence of extremely low flows and warm water temperatures.

Habitat

Channel Hydrology

Stream flows in Sodom Ditch and the Calapooia/Shear bypass channel below Shear Dam were monitored throughout the summer period for each of the three non-gen years (Figures 7 and 8). *[note: at the time of this writing, processing of 2003 flow data is incomplete and therefore not presented graphically]*

Total flow through the system was significantly higher in the summer of 2001 than it was in 2002. In both years, for different reasons, the Calapooia reach received the majority of the available flow. In 2001, this distribution represented the "default" for flow allocation between channels. Significant uncertainty existed in 2001 relative to how available flows should be managed through the summer to benefit fish. Additionally, deviation from the "default" (e.g. divert more water down Sodom Ditch) would have required some form of potentially problematic physical intervention at the upper bifurcation point. Consequently, a decision was made to not attempt proactive flow manipulation and instead monitor (to the limited extent possible) various physical and biological parameters in both channels. Physical and biological monitoring conducted throughout the channel complex in 2001 provided compelling evidence that the aforementioned default flow allocation constituted the optimum flow management strategy for fish. Thus, the 2002 summer hydrograph *generally* represents what project investigators felt was appropriate in terms of flow distribution between channels (*note: Sodom flows < 5 cfs from late July through September are considered inadequate; however, until a viable means of manipulating flows between the channels is developed, this scenario is likely to persist*).

Temperature

Temperatures were monitored at selected locations throughout the summer period for each of the three non-gen years (Tables 4-6). In general, temperature regimes in Sodom Ditch closely mimic those in the Calapooia River above Sodom Dam (i.e. above the upper bifurcation point). A similar phenomenon is apparent between the Calapooia at Thompson's Mill and below Sodom Ditch (i.e. below the lower bifurcation point). As discussed previously in this report, water traveling down the Calapooia reach of the complex experiences a significant cooling effect. Given the character of the Sodom Ditch channel, it is believed that flow increases in this channel, however substantial, would have minimal influence on water temperature. It seems apparent that under virtually any flow management scenario, water temperatures in Sodom Ditch would be problematic for salmonids, particularly later in the season when total river flow above the complex reaches its seasonal low.

Physical Habitat Surveys

Habitat surveying was conducted at selected locations on Sodom Ditch and the Calapooia reach/Shear bypass channels in the summer of 2002. Methodologies employed ranged from basic reconnaissance-level surveys to ODFW's *Aquatic Habitat Inventory Project (AHIP)* "*intermediate level surveys*" involving detailed measurements of various physical parameters. The information obtained in 2002 augments that collected during reconnaissance-level surveys conducted on Sodom Ditch in 1999and 2001. Following is a brief summary of surveys conducted and salient information obtained.

Calapooia reach/Shear bypass channel

A combination of the aforementioned survey types was conducted throughout significant portions of the subject channel. Complete coverage, however, was precluded by a number of factors. The stream reach between Linn West Road and Shear Dam was limited to *AHIP* surveys conducted between RM 23-25 due to access restrictions involving private property. The Shear bypass channel survey was limited to occasional spot-checks due in part to the extraordinary and inherently dangerous effort required to negotiate a channel choked with woody debris and overhanging vegetation and surrounded on both sides by a nearly impenetrable vegetative buffer. This condition was documented by ODFW biologists in 2001 during an unsuccessful attempt to survey the channel using kayaks. Uncertainty regarding the ability of this channel to accommodate upstream passage of salmon and steelhead was the primary impetus for the originally planned 2002 survey (neither adult salmon nor steelhead were captured at this location in 1999). However, the capture of both spring chinook and winter steelhead adults at the Shear Dam trap in the spring of 2002 resolved this uncertainty and, under the circumstances, significantly weakened the justification for expending significant project resources on acquisition of a comprehensive survey at this location.

The Calapooia River above and below its respective bifurcation points with Sodom Ditch is dramatically different in physical character and riparian influence than the reach spanning these points. This difference can be directly attributed to the fact that the majority of the river's flow (and hydraulic energy) passes through Sodom Ditch during the seasonal high flow period (winter/spring). Consequently, the Calapooia reach of the channel complex is dominated by a silt substrate throughout its length rendering it largely unsuitable for spawning by salmonids and Pacific lamprey. Patches of gravel substrate observed were relatively few in number, small in surface area, and usually heavily impacted with a combination of silts and fine organic materials. Particle size of available gravels was smaller than that preferred by large salmonids for spawning but well suited for cutthroat trout. The dominant habitat type consists of scour pools and glides with large amounts of woody material of all size classes being present. Six large debris jams were documented between the upper bifurcation point and Interstate 5. It is possible that the upstream migration of adult salmonids is periodically constrained and/or disrupted by the presence of these types of transient channel features. Predominant land use is agricultural with a minor rural residential component. The riparian area, while relatively narrow in width, is dominated by mature deciduous trees that provide a relatively high degree of shading throughout the summer period.

Sodom Ditch

AHIP surveys were conducted on Sodom Ditch at the following four locations in August and September of 2002: Sodom Dam to Linn West Road, at the Interstate 5 crossing, at the Boston Mill Road crossing, and upstream of the lower bifurcation point (above Wirth Road). Reconnaissance-level surveys were also completed during this period.

The channel lacks significant meander throughout most of its length, presumably due to its artificial origins. Riffles, glides and scour pools comprise the dominant habitat types. Though infrequent, pools exceeding six feet in depth were observed in all reaches. Gravel comprises the dominant substrate type and excellent quality spawning habitat for large salmonids and/or Pacific lamprey is abundant, particulary in the channel's upper reaches. Below Interstate-5, the quality of potential spawning gravels appears to have been comprised by an increased occurrence of fine sediments. Extensive areas of "hard-pan" clay substrate were also observed throughout the channel. In-channel woody material is present but only in modest abundance. Adjacent land use is exclusively agriculture. Though dominated by mature deciduous tree species (oak, cottonwood, maple) throughout significant portions of its length, the relatively narrow riparian area appears to be limited in its ability to influence/control water temperatures.

Conclusions

In its present condition, Sodom Ditch is incapable of supporting significant numbers of salmonids throughout the summer period. *[Note: past documentation (summer/fall 2001) of several steelhead parr in the Sodom fishway is considered an anomaly attributable to a set of exceptional rearing conditions unique to the fishway]* Monitoring results strongly indicate that the situation would improve only marginally if the entire Calapooia flow were diverted down Sodom Ditch. It is unknown to what extent the situation for salmonids could be improved if the riparian area were "optimized". That would depend on the degree of influence that the improved riparian area was able to exert on summertime water temperature regimes. Given that only marginal summer temperature regimes for salmonids have been documented in the relatively well insulated Calapooia reach, it seems that, in the absence of large scale habitat changes *throughout the basin*, Sodom Ditch's future potential to support salmonids will continue to be severely limited.

Sodom Ditch, even in its compromised flow state, supports an apparently robust population of juvenile Pacific lamprey throughout the summer period. Lamprey appeared to be present in Sodom Ditch in much higher densities than those observed in the Calapooia reach. It is probable that lamprey production is significantly greater in Sodom Ditch due to the abundance of spawning habitat present.

Physical and biological information obtained to date on the Calapooia reach suggests that salmonids (cutthroat trout and perhaps winter steelhead parr), may be present in this channel, albeit in low numbers, throughout the summer. This channel's cooling influence on mainstem river temperatures (below the lower bifurcation point) may also provide salmonids with additional rearing options; indications are, however, that these opportunities would be fairly limited.

For the reasons mentioned above, current non-gen summer flow allocation strategies emphasize the Calapooia/Shear channel (see "Recommendations" section for details). It is expected that these strategies will be modified as acquisition of new information warrants.

Figure 7. 2001 summer and early fall flows measured and estimated in Sodom Ditch and the Calapooia reach.

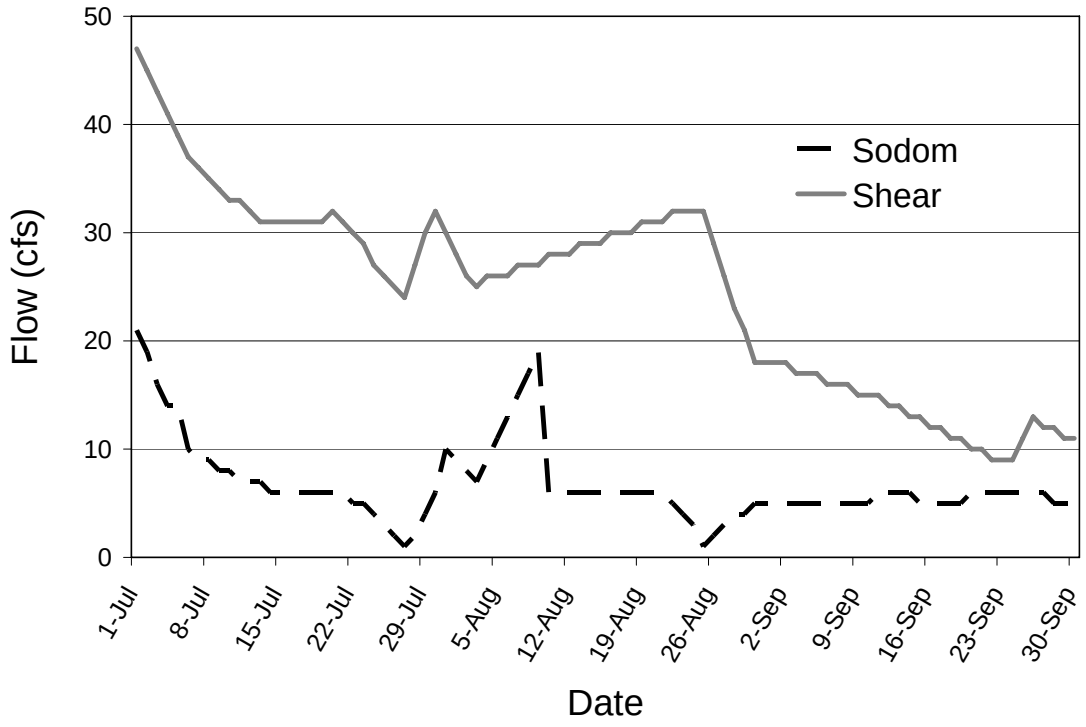


Figure 8. 2002 summer and early fall flows measured and estimated in Sodom Ditch and the Calapooia reach.

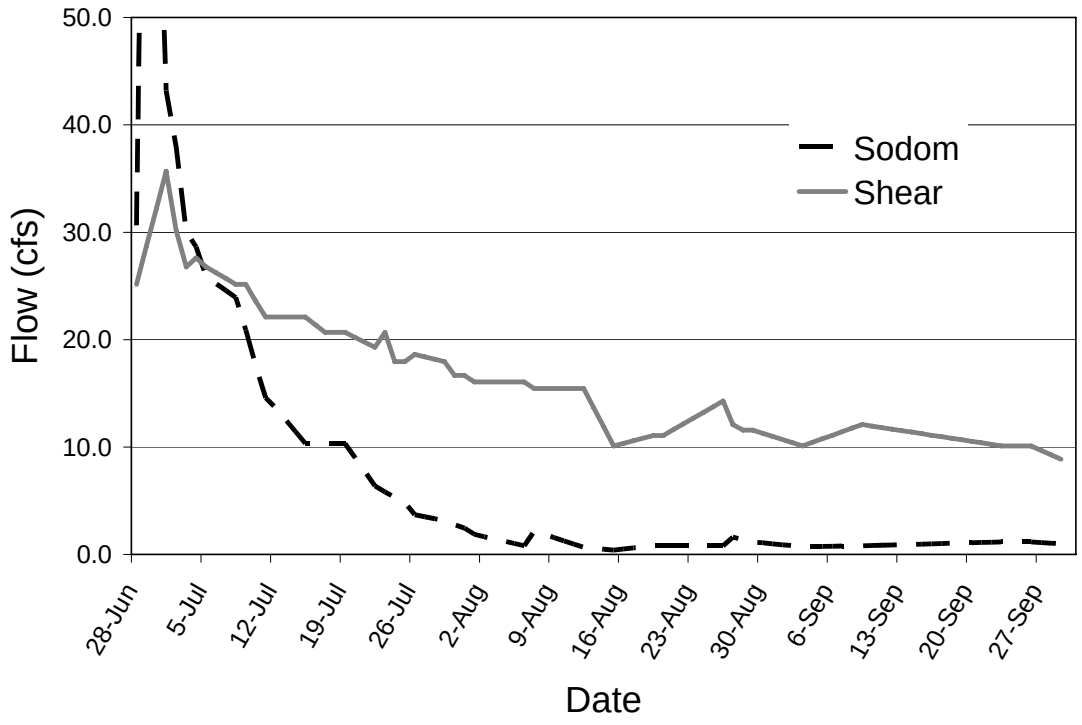


Table 4. Water temperatures (in °F) measured at four locations in the Thompson Mill complex during the summer of 2001.

		Calapooia above Sodom Dam	Sodom Ditch at Boston Mill Rd	Calapooia River at Thompson Mill	Calapooia River Below Sodom Ditch
June	Max	77.4	75.3	73.2	73.9
	Min	54.6	55.3	58.0	57.4
July	Max	81.6	80.9	75.3	73.9
	Min	60.8	61.5	62.2	60.8
Aug	Max	83.0	81.6	73.2	73.2
	Min	62.8	60.8	62.8	62.2
Sept	Max	76.0	78.1	70.4	69.7
	Min	56.0	53.9	56.7	56.0

Table 5. Water temperatures (in °F) measured at four locations in the Thompson Mill complex during the summer of 2002.

		Calapooia above Sodom Dam	Sodom Ditch at Boston Mill Rd	Calapooia River at Thompson Mill	Calapooia River Below Sodom Ditch
June	Max	80.2	78.8	73.2	75.3
	Min	54.6	56.8	60.8	57.4
July	Max	83.0	81.7	75.2	77.4
	Min	67.0	65.0	67.0	66.3
Aug	Max	82.3	81.6	73.9	75.3
	Min	63.5	60.1	62.8	62.8
Sept	Max	77.4	75.4	68.3	69.7
	Min	58.5	55.9	57.4	59.4

Table 6. Water temperatures (in °F) measured at four locations in the Thompson Mill complex during the summer of 2003.

		Calapooia above Sodom Dam	Sodom Ditch at Boston Mill Rd	Calapooia River at Thompson Mill	Calapooia River Below Sodom Ditch
June	Max	----	79.5	73.2	76.7
	Min	----	61.5	62.8	60.8
July	Max	83.7	82.3	----	78.1
	Min	67.7	65.6	----	67.7
Aug [1]	Max	78.8	78.1	----	76.7
	Min	65.6	62.8	----	64.2
Sept	Max	79.5	76.7	----	71.1
	Min	60.8	59.4	----	60.8

[1] Temperature data not collected from 8/12/03 through 8/20/03.

Chapter 5: Flow Management Recommendations

Background

The Technical Committee, (hereafter "Committee") under the direction of the Thompson's Mill Working Group, developed a flow management operation plan to accomplish the following:

- Identify and meet anadromous fish passage requirements;
- Allow for continued though sometimes limited operation of the Mill, identifying when it could operate, at what levels and with what likelihood;
- Incorporate the potential to convert a portion of the Mill's early priority water right to an instream water right for the benefit of natural systems: while not alienating the current water using community.

The Committee relied extensively on a flow management model developed by the Oregon Water Resources Department (WRD) specifically for this project. The model is based on statistical flow records from US Geological Survey (USGS) historic gaging stations for the Calapooia River near Holley and Albany. The data have been modified to reflect stream flows available at the project site, including the anticipated inflow into the raceway by Spoon and Courtney Creeks.

To run the model, one must first:

- Identify all of the competing demands and their flow needs;
- Identify where in the stream, canal and channel system the needs occur; and
- Prioritize the identified uses.

Once this is accomplished, the model can be used to evaluate when lower priority uses are limited or eliminated under varying streamflow conditions.

Using this methodology, the Committee has developed the flow allocation and priority ranking shown in Table 7. Using Table 7 in the water distribution model results in water allocations with the expected periods of use based on 50, 80 and 95% streamflow probabilities as show on Tables 8, 9 and 10. These tables are all derived using 12 cfs as the instream water right.

A 50% exceedance probability implies that the depicted flow will be available one out of two years and represents an average year. An 80% exceedance probability implies that the listed flows will be available eight out of ten years and represents dryer than usual conditions. A 95% exceedance probability is indicative of drought conditions. We have included the 95% analysis because stream flows during the past two irrigation seasons (2002, 2003) have approached these conditions.

Calapooia Water Demands and Priority Rankings

The Committee identified 10 demands on the stream system. Three of the demands have multiple priority dates and are recognized twice each in the model resulting in 13 demands total. They are described (in pages 36-38 of this document) in order of priority.

1. **Mill Race Leakage:** Leakage through the Mill turbines when they are not operating. Cutting this back to less than 1.5 cfs would take extraordinary measures. This leakage only recognized during low flow periods and is incorporated into Mill's use when Mill is operating.

2. **The New Instream Water Right**. There are two instream water rights (IWR) for flows to be maintained in the Calapooia River (hereafter River) and its tributaries above two specific sites, one in Albany, and the other near Holley. The Albany IWR protects not more than 20 cfs and the Holley IWR protects not more than 30 cfs. These IWRs have the same priority date, June 22, 1964. In normal years (50% exceedance probability), these instream water rights are met year round. In dry years (80% exceedance probability), the IWRs are not met in August and September. When the IWR is not met, the Water Resources Department (WRD) regulates water users junior to June 22, 1964, to protect instream flows. 41 cfs of consumptive water rights exist above the Mill, 24 cfs are senior to the 1964 IWRs. Many of these rights go unused for years at a time.

Recent investigations indicated that up to 10 to 13 cfs[1] of water rights are exercised annually. Should more of the senior water rights ever be exercised, they could theoretically dry up the River. Flows in the River above the Mill have been measured as low as 10.4 cfs and 11.2 cfs in August 2002 and 2003. There is nothing that precludes existing pre-1964 consumptive water rights from drawing down the river. The new IWR would set a new floor below which the river would not be depleted. It would be created out of a portion of the Mill's oldest hydromechanical water right (35 cfs with a priority of 1858). Once established, it would be the River's senior IWR. The level the IWR is set at is crucial to the irrigation community. So far, they will not oppose the establishment of this new IWR so long as it does not upset the status quo water use. The Committee reached consensus to recommend **12 or 13** cfs to protect with a new IWR. This level will not affect junior irrigators because they are regulated when the river drops below 20 cfs. It may affect senior users in extremely dry years or if more senior users come back into production.

3. **Irrigation Senior Rights**. The irrigation rights predating 1964 are lumped into this category for a total of 24 cfs. It is estimated that 10 cfs of these rights are exercised. This is based on a 2002 windshield survey of irrigated lands and is supported by the agreement between the Calapooia Irrigation District and the Mill. The Committee's intention is to hold the current senior users harmless in this process. However, in extremely dry years, or should more of these old rights come back into regular use additional regulation of pre-1964 irrigation rights may take place.

4. **Municipal Senior Rights**. The City of Brownsville has municipal water rights for up to 1.17 cfs of surface and shallow ground water which are senior to the 1964 IWR. (A 1962 Surface Water Right for 0.67 cfs and a 1921 Ground Water Registration for 0.50 cfs). According to the Water Resources Department's Water Use Reporting web page, during August, September and

[1] 2002 "windshield" survey indicated up to 13 cfs of total irrigation use above the Mill, 10 cfs senior to 1964, 3 junior. July 29, 2003, one day series of measurements suggested 7.0 cfs of consumptive use on that day above the Mill, 0.41 of which was used along Brush Creek.

October, in the years 1989 through 2001, the City exceeded its surface water right of 0.67 six times.

In an extremely dry year, a new 12 or 13 cfs IWR with an 1858 priority date could become an issue for the City if it were relying on its 1962 surface water right. *It is time to get the city involved in these talks. Perhaps the 1921 Ground Water Registration can be relied on should that occur.*

5. **Calapooia River Above Sodom**. This a 1964 instream water right for flows in the Calapooia River, with a measuring site in South Albany. Investigations in 2003 indicate the flow above the Sodom Ditch is near 14 cfs when the flow at Albany drops below 20 cfs. In 2003, 8 water rights and one illegal use totaling 5.9 cfs were regulated off to protect this flow. Because one of the rights is largely non-consumptive and because not all of the rights were exercised at the same time, the estimated stream flow increase is approximately 3 cfs. The status of this right does not change as a result of these discussions.

6. **Irrigation Junior Rights.** These are the post June 22, 1964, irrigation rights above the Mill and total 17 cfs. They are commonly regulated off during low flow years. Their status will not change as a result of these discussions. Based largely on pre and post regulations during the 2002 field season, the junior irrigation right consumptive demand is estimated at 3 cfs.

7. **Municipal Junior Rights.** These are the City of Brownsville water rights junior to the 1964 IWR with a total of 1.83 cfs. Water use reporting records of the WRD indicate that the City does not use these during low flow periods. *Again, it is time to bring the City into the loop.*

8. **Municipal Aesthetic Rights.** The City of Brownsville holds a 1994 right for 2.232 cfs (1,000 gallons per minute) for aesthetic use in the old mill canal which runs through town. There are also seven irrigation rights along the canal with a total of 0.26 cfs (118 gallons per minute). (2.49 cfs total.) The canal has been regulated off in 2002 and 2003 during August and September (*though water continues to leak around the headgate foundation*).

9. **Sodom Ditch; and**
10. **Calapooia River Below Shearer.**
These two uses (Sodom Ditch and Calapooia River below Shearer) are the combination of flows necessary for fish passage through the channels during the passage season, ecological maintenance flows during the summer months, and transition flows ramping up to the passage season.

Period: May 1 through July 15
Primary objective: Maximize upstream passage opportunities for adult spring chinook

Minimum flow needs (*estimates preliminary*):
Sodom Ditch: 57 cfs
Calapooia River below Shearer Dam: 14 cfs

Minimum flow requirements for adult fish (as determined by the *Oregon Method*) only ensure that fish have physical freedom to move throughout the stream. Flows exceeding the passage

criteria will facilitate passage and should therefore be provided to the extent possible. Ideally, excess flows should be allocated between the channels in levels proportionate to their prescribed minimums.

At lower flow regimes, emphasis will be placed on maintaining the minimum flow target in Sodom Ditch as the vast majority of adult chinook use this channel during their upstream migration. Consequently, the Calapooia spring flow target *may* be incrementally compromised in certain years.

Period: July 16 through September 30
Primary objective: Provide "ecological maintenance" flows in Sodom Ditch and the Calapooia River.

Flow allocation emphasizes the Calapooia reach of the channel complex.
Flows in Sodom Ditch should not drop below 5 cfs.

******So long as the 1964 IWR provides 14 cfs to this reach, there would be 9 in the Calapooia below Shearer Dam. When only 12 is available, generally, the flows will be proportionally reduced.

This approach acknowledges: 1) the extremely limited potential for sustaining salmonids in Sodom Ditch during the subject period through flow manipulation, and 2) that flow allocation emphasizing the Calapooia reach results in decreased water temperatures which may provide a net benefit to the fish resources of the area.

Period: October 1 through November 30
Primary objective: Provide transition flows from "ecological maintenance" to "fish passage" for cutthroat trout and winter steelhead. ******As streamflows increase, a minimum target in the Sodom Ditch and the River below Sodom Dam would be 57 and 14 cfs respectively.

Period: December 1 through April 30
Primary objective: Maximize upstream passage opportunities for adult winter steelhead.

In the context of flow availability, steelhead passage should not be an issue during this time of the year, provided sufficient flow is maintained in all channels potentially used for passage. An allocation strategy similar to that employed for adult chinook represents a logical approach to flow allocation during this period.

****** During this period, flows are rarely an issue. The typical split between the Sodom Ditch and the Calapooia River below Sodom Dam is two thirds down the Sodom and one third down the River. It is anticipated that this regime will continue.