STREAM INVENTORY REPORT

Big River
(Pacific Ocean to Georgia-Pacific property line)

WATERSHED OVERVIEW

Big River is a tributary to the Pacific Ocean (Figure 1). Elevations range from 0 feet at the mouth of the creek to 2,620 feet in the headwater areas. Big River's legal description at the confluence with the Pacific Ocean is T17N R17W S36. Its location is 39°17'10"N. latitude and 123°42'16"W. longitude according to the USGS Mathison Peak 7.5 minute quadrangle. Big River drains a watershed of approximately 32,234 acres. In addition to the mainstem Big River, five class one tributaries were surveyed: Laguna Creek, Little North Fork Big River, East Branch Little North Fork Big River, Two Log Creek and Hatch Gulch. The results for the tributaries of Big River are presented in separate reports.

HABITAT INVENTORY RESULTS

The habitat inventory of July 10, 1996 through July 24, 1996, was conducted by Diana Hines, Dave Wright and Dave Lundby. The portion of the mainstem surveyed includes the section at the end of the tidal zone, near the confluence of Laguna Creek, to the end of the Georgia-Pacific (G.P.) property line. The total length of surveyed stream in Big River was 108,731 feet (20.6 miles, 33 KM) (Table 1). Side channels comprised 1,837 feet of this total.

Big River consists of three reaches: F4 for the first 79,207 feet, F3 for the next 9,291 feet and a B2 for the remaining 18,396 feet.

Table 1 summarizes the Level II Riffle, Flatwater and Pool Habitat Types. By percent occurrence Riffles comprised 10%, Flatwater 45% and Pools 45% of the habitat types (Graph 1). By percent total length, Riffles comprised 4%, Flatwater 51% and Pools 45% (Graph 2).

Fifteen Level IV Habitat Types were identified and are summarized in Table 2. The most frequently occurring habitat types were Glides 26%, Runs 18% and Lateral Scour Log Pools 12% (Graph 3). The most prevalent habitat types by percent total length were Glides at 37%, Runs 13% and Mid-Channel Pools 11% (Table 2).

Table 3 summarizes Main, Scour and Backwater Pools which are Level III Pool Habitat Types. Scour pools were most often encountered at 74% occurrence and comprised 74% of the total length of pools.

Table 4 is a summary of maximum pool depths by Level IV Pool Habitat Types. Pools with depths of three feet (.91 m) or greater are considered optimal for fish habitat. In Big River, 236 of the 253 pools (93%) had a depth of three feet or greater (Graph 4).

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The depth of cobble embeddedness was estimated at pool tail-outs. Of the pool tail-outs measured, 0% had a value of 1, 6% had a value of 2, 19% had a value of 3 and 75% had a value of 4 (Graph 5).

Of the Level II Habitat Types, Pools had the highest mean shelter rating at 45 (Table 1). Of the Level III Pool Habitat Types, Main Channel Pools had a shelter rating of 55 (Table 3).

Of the 253 pools, 45% were formed by Large Woody Debris (LWD): 27% by logs and 18% by root wads (calculated from Table 4).

Table 6 summarizes dominant substrate by Level IV Habitat Types. Of the Low Gradient Riffles fully measured, 33% had gravel and 50% had small cobble as the dominant substrate (Graph 6).

Mean percent closed canopy was 33%: 20% coniferous trees and 13% deciduous trees. Mean percent open canopy was 67% (Graph 7, calculated from Table 7).

Table 7 summarizes the mean percent substrate/vegetation types found along the banks of the stream. Mean percentage right bank vegetated was 62% while mean percent left bank vegetated was 69%. Deciduous trees were the dominant bank vegetation type in 54% of the units fully measured. The dominant substrate composing the structure of the stream banks was Sand/Silt/Clay, found in 71% of the units fully measured.

DISCUSSION

The information gathered in the process of habitat typing will provide Georgia-Pacific with baseline data on the current condition of this creek and the available habitat for salmonids. These data can be used to identify components of the habitat in need of enhancement so appropriate conditions for Big River can be obtained over time.

Level II habitat types by percent occurrence and length

Flatwater habitat types comprised a high percentage of the units by both percent occurrence and length at 45% and 51% respectively (Table 1 and Graph 1). These unit types usually do not provide optimal spawning or rearing habitat for salmonids. Riffle habitat units comprised a very low percentage of the river by both percent occurrence and length at only 10% and 4% respectively. Pools, however, comprised a much higher percentage by both percent occurrence and length at 45% each. Riffles usually provide good spawning habitat while pools provide important rearing habitat. In addition, Mundie (1969) reported that invertebrate food production is maximized in riffles while pools provide an optimum feeding environment for coho. In fact, the most productive streams are those consisting of a pool to riffle ratio of approximately one to one (Ruggles 1966).

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Pool Depth

According to Flosi and Reynolds (1994), a stream with at least 50% of its total habitat composed of primary pools is generally desirable. Primary pools are at least two feet deep in first and second order streams and at least three feet deep in third order streams. The information from Graph 4 on maximum depth in pools was used to determine percentage of primary pools. Big River, a seventh order stream, is composed mainly of deep pools with 93% of the pools having a maximum depth of three feet or greater.

Instream Shelter

Instream shelter ratings are derived from two measurements: instream shelter complexity and instream shelter percent cover. The first is a value rating which provides a relative measure of the quality and composition of the shelter, and the second is a measure of the area of a habitat unit covered by shelter. The various types of instream shelter include LWD, SWD, boulders, root wads, terrestrial vegetation, aquatic vegetation, bedrock ledges and undercut banks. Of the Level II habitat types Pools had the highest shelter rating at 45. Of the Level III habitat types Main Channel Pools had the highest shelter rating at 55. These values are low as shelter values of 80 or higher are considered optimal for good rearing habitat (Flosi and Reynolds 1994).

Large Woody Debris

The presence of Large Woody Debris in streams is a significant component of fish habitat. Woody debris creates areas of low flow, providing a refuge for fish during periods of high flow (Robison and Beschta, 1990). Woody debris also provides cover for fish, lowering the risk of predation. The percent of pools formed by LWD in Big River was 45%. Whether these numbers are high or low, relative to the needs of salmonids is difficult to ascertain since the optimum amount of woody debris in streams has not been specified (Robison and Beschta 1990). However, based on data from Georgia-Pacific's 1995 Aquatic Vertebrate Study, the only coho found in the Ten Mile River Basin were in stream reaches where approximately 50% of pools were formed by large woody debris. Those reaches that did not support coho had a significantly lower percentage of pools formed by large woody debris (Ambrose et al, 1996). This suggests that a low percentage of LWD formed pools could adversely affect juvenile Coho Populations (C.S. Shirvel 1990) .

The above LWD analysis pertains only to pools formed by logs or root wads as described in Flosi and Reynolds (1994)**:** Lateral Scour Pool Log Enhanced, Lateral Scour Pool Root Wad Enhanced, Backwater Pool Log Formed and Backwater Pool Root Wad Formed. Other pools containing LWD as a component were not included in the calculation. For example, plunge pools may be formed by boulders, bedrock or LWD but are not described as such by habitat unit types. Therefore, the LWD formed pool calculation is limited to four pool types and does not quantify the total amount of LWD in Big River.

Removal of "sinker logs" was observed throughout the first few miles of river surveyed. In addition, it was observed that some logs which had recently fallen in the river, or along the river, were being removed as well. The significance of this activity is that it impacts the river by decreasing the amount of LWD available for LWD formed pools and cover. This activity, which is not sanctioned by Georgia-Pacific, occurred above the tidal influence near the Laguna Creek confluence where the survey started.

Canopy

There are two important benefits of canopy cover in coastal streams. Canopy keeps stream temperatures cool as well as providing nutrients in the form of leaf litter and organic material (Bilby 1988). This leaf litter, organic material, and their associated nutrients are utilized as a food source by benthic macroinvertebrates (aquatic insects). The macroinvertebrates, in turn, are major food sources for most fish species in forested areas (Gregory et al., 1987). Mean percent canopy cover for the Big River was only 33%. This is very low since a canopy cover of 80% or higher is considered optimum, Flosi and Reynolds (1994).

Coniferous trees occupied a larger portion of the canopy than did deciduous trees. Coniferous trees comprised 20% and deciduous trees 13% of the canopy. Wood from coniferous trees does not deteriorate as rapidly as wood from alder and most other deciduous species (Sedell, *et al*. 1988). Therefore, more LWD would be available in the future for fish cover and LWD formed pools in this river and other creeks dominated by coniferous species.

Embeddedness

High embeddedness values (silt levels), such as those found in Big River, have been associated with many negative impacts on salmonids. These negative impacts can be observed in important environmental components of salmonid habitat such as pool habitats, dissolved oxygen levels and water temperatures.

High silt levels also impact dissolved oxygen levels. They do so by reducing water circulation within the substrate, thus lowering the oxygen levels needed by salmonid eggs (Sandercock, 1991). This can hinder the survival of the eggs deposited in the redds.

Water temperature is impacted by high silt levels in several ways. Hagans et al (1986) reported the following impacts to water temperatures: 1) the loss of a reflective bottom; 2) darker sediment (as opposed to clean gravels) storing heat from direct solar radiation which is then transferred to the water column; and 3) a reduction in the flow of water through the substrate interstitial spaces thereby exposing more of the water column to direct solar radiation.

Another means by which water temperatures are increased is through the widening of stream channels: over time, high silt levels increase the substrate surface level of the creek, resulting in a wider, shallower stream channel (Flosi and Reynolds 1994). In shallow streams more surface area is exposed to the sun relative to the volume of water, leading to an increase in solar heating which in turn leads to higher water temperatures.

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Substrate embedded with silt in varying degrees were given corresponding values as follows: 0-25%= value 1, 26 - 50% = value 2, 51 - 75% = value 3 and 76 - 100% = value 4. According to Flosi and Reynolds (1994), creeks with embeddedness values of two or higher are considered to have poor quality fish habitat. In Big River, 94% of the pool tail-outs measured had embeddedness values of two or more.

It is important to consider, however, that the above embeddedness values were obtained in the summer during low flow conditions. In winter and spring, flows are usually higher due to the rainy season and the lowered evapotranspiration of the trees. This higher flow can carry some of the previously deposited silt to sites further downstream. Therefore, embeddedness values may fluctuate throughout the year along different sections of the stream.

Substrate

In Big River, 33% of the Low Gradient Riffles had gravel and 50% had small cobble as the dominant substrate. The relatively high concentration of gravel and small cobble in riffles indicates that there is a sufficient amount of substrate available as potential spawning habitat. While this river had sufficient substrate for spawning in the riffles surveyed, the overall percentage of riffles in the surveyed portions of the river was very low at only 10% (Table 1). Subsequently, there may be a lack of sufficient spawning habitat in this river. Another point to consider is that regardless of the amount of substrate or spawning habitat available, this habitat may not be suitable for salmonids if it is highly embedded.

Overall, the surveyed portions of Big River appear to have a relatively high percentage of primary and LWD formed pools. However, this river also appears to have insufficient canopy, low shelter values and high embeddedness values. In addition, while there was sufficient substrate for spawning, habitat for spawning appeared to be limited.

Georgia-Pacific recognizes that there are areas of the mainstem Big River in need of enhancement, and where feasible will attempt to restore those areas over time as part of its long term management plan. The company will also attempt to facilitate a healthy environment for salmonids in this creek through sound management practices.

RECOMMENDATIONS

1) Big River should be managed as an anadromous, natural production watershed.

2) Sources of stream bank erosion should be mapped and prioritized according to present and potential sediment yield. Identified sites should then be treated to reduce the amount of fine sediment entering the stream. In addition, sediment sources related to road systems need to be identified, mapped and treated according to their potential for sediment yield to the watershed.

3) Shelter values throughout Big River could be increased by addition of large logs and root wads, boulder clusters, log and boulder wiers and log and boulder deflectors. These need to be

placed carefully to prevent washing out in high flows. The Stream Habitat Restoration Manual, by Flosi and Reynolds, 1994, provides detailed descriptions for restoration efforts.

4) Increase the canopy in Big River by planting willow, alder, redwood and Douglas-fir along the watercourses where shade canopies are not at acceptable levels. Planting efforts need to be coordinated to follow bank stabilization or upslope erosion control projects. Since this is such a wide river planting trees may not be sufficient because of the time it will take for them to grow to adequate heights for providing canopy. A proportion of trees already present along the river should be allowed to grow and left to maintain a functional overstory canopy.

5) Log debris accumulations retaining large quantities of fine sediment should be modified if necessary, over time, to avoid excessive sediment loading in downstream reaches.

COMMENTS AND LANDMARKS

The following landmarks and possible problem sites were noted. All distances are approximate and taken from the beginning of the survey reach.

Position: (ft):	Comments:
6315	Laguna Creek enters left bank at 84'
6416	Road crossing
7852	Ninety mm salmonid observed
8052	Thirty mm steelhead (STHD)
9888	Redds (these redds and most of the others noted in this memo were probably created by lamprey)
12199	Lots of sinker mill logs, might have been old dammed area
12603	Substrate consists of large quantities of sinker mill logs
12815	Thirty mm STHD
13711	Thirty mm STHD
14492	Twenty mm STHD
15081	Mill logs
16745	STHD - 200 mm

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Position: (ft):	Comments:
18478	STHD - 50 mm
19529	Four 50 mm salmonids
19529	Four young of year (yoy)
19756	One 200 mm STHD
19986	Two 30 mm STHD
20453	Five 200 mm STHD
22510	Confluence with Railroad Gulch at 100'
22588	Three redds observed
23995	Embeddedness improving
24234	Redds
24804	Three 50 mm salmonids
25598	Nice pool, good cover; many fish observed, Woodlands swimming hole
25692	Good cover, many salmonids observed
26555	Three 35 mm salmonids observed
26665	Two redds
30877	Three redds
31090	Three redds
32274	Four redds
40431	Two redds
41541	Camp One pool
44521	Four redds
46602	Seven redds, good spawning substrate

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Position: (ft):	Comments:
47865	Picolati's Opening
50168	Tributary enters right bank at 887'
54377	Four redds
55164	Western pond turtle
58005	Four redds at tail
58402	Eight redds
59719	Two redds
62590	Redds
68691	Six redds
70481	Fourteen redds
72789	Three redds
73815	Six redds
75222	Five redds
75754	Six redds
77184	Four redds
79207	Burns Camp/Two Log crossing
79355	Channel type here, channel type changes to an F3.
79937	Five redds
80104	Two Log confluence at 167'
81604	Four redds
81756	Three redds, many salmonids

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Position: (ft):	Comments:
82654	Four redds
84626	Four redds. many salmonids
88033	Four redds
88228	Unit ends at Hatch Gulch
89560	Two redds
88584	Channel type here, channel type changes to an B2.
90846	Four redds
92312	Nice pool; good cover, root wads. 3 redds
92745	Five redds
93163	Approximately 12 redds
93229	Many juvenile STHD and frogs
94232	Approximately 15 STHD
94708	Approximately 10 redds
95107	Very nice pool
97004	Approximately 20 redds
106894	End of survey. G.P. property line

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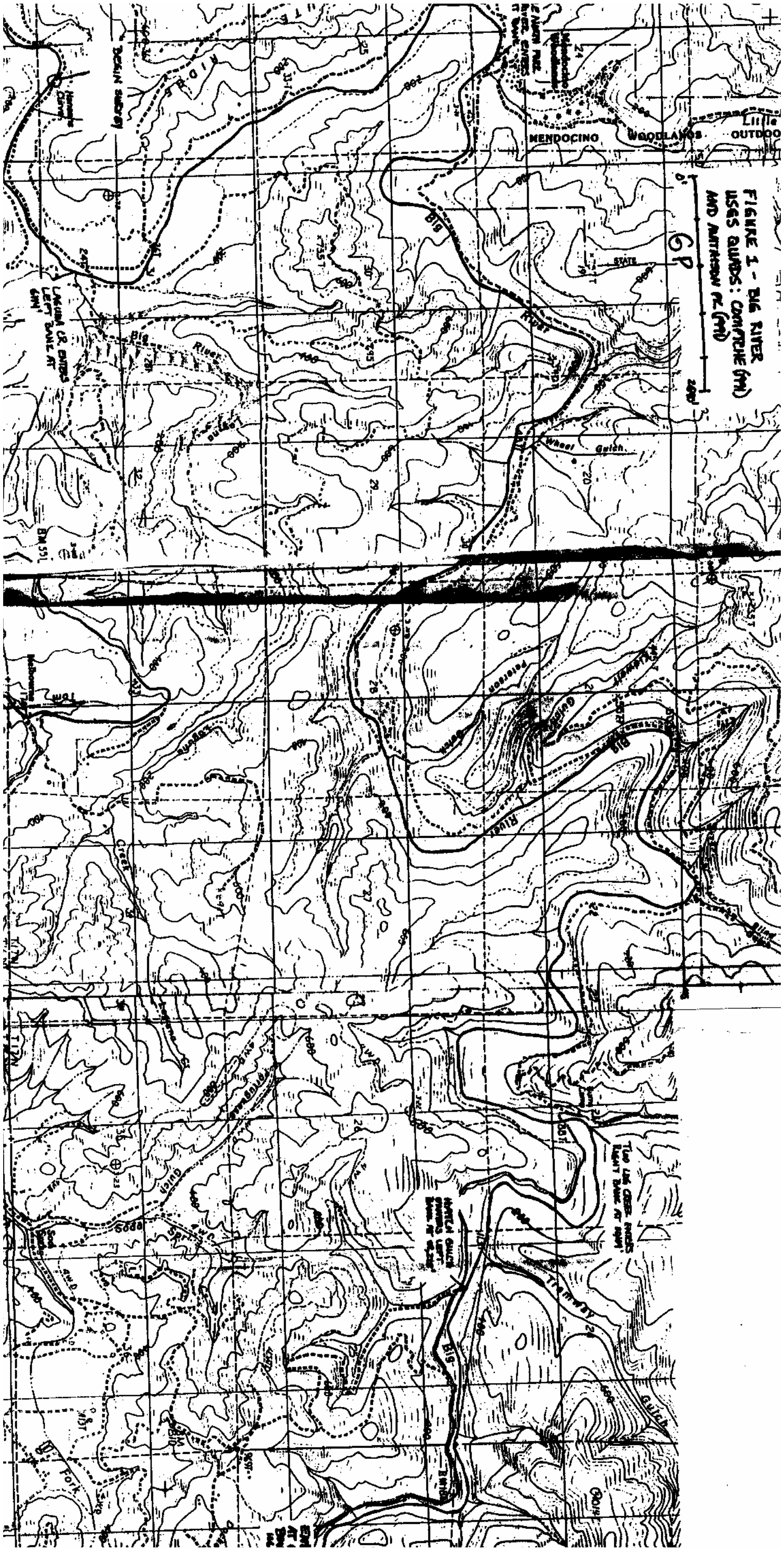

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