Chapter IV

4.0 Watershed Assessment - Results and Analysis/Quantity and Quality of Watershed Runoff

4.1 Watershed Water Budgets

4.1.1 Precipitation and Snow Pack Conditions

Rainfall and snow pack conditions were obtained from the U.S. Natural Resources Conservation Service (NRCS) Snotel Data Site at Secesh Summit (elevation 1,978 meters) located on the northern edge of the North Fork Payette River basin boundary. Monthly precipitation and the snow water equivalent (SWE) of the snowpack for water years 1994-1996 are presented in Figure 4-1 and 4-2. The SWE recorded at this site provides an estimate of the quantity of water contained in the snowpack that would be available for runoff. Water volume stored as snowpack is generally greatest in April and May at the onset of snowmelt and reflects the accumulated storage of precipitation deposited as snow during the earlier months. A comparison of the SWE with the historical trend (1961 - 1990; Figure 4-2) shows that water content of the snowpack exceeded historical averages by 15% (38.0 inches or 965 mm) and 9% (36.1 inches or 917 mm), respectively, at the onset of the snowmelt season in May of 1995 and 1996.

Rain on snow events can potentially generate episodic peak flows in runoff that exceed normal rates of snowmelt. Precipitation amounts were below normal in May (2.1 inches or 53 mm) and above normal (5.0 inches or 127 mm) in June 1995 (Figure 4-1). These conditions were reversed during the following snowmelt season with above normal precipitation in May (7.2 inches or 183 mm) and well below normal in June (1.1 inches or 30 mm). Total annual precipitation at the Secesh Summit for both water years was 1,514 mm (59.6 inches) and 1,661 mm (65.4 inches) in 1995 and 1996, respectively. These totals exceeded the annual average (1961-1990) of 1,298 mm (51.1 inches).

Local precipitation information near Big Payette Lake was obtained from the McCall Airport (elevation 5,030 feet) climate monitoring site (Figure 4-3). Total precipitation in calendar year 1995 was 824 mm (32.5 inches) and 665 mm (26.2 inches) in calendar year 1996. Daily precipitation amounts follow a distinct seasonal pattern with lower rainfall amounts occurring during the warmer summer months and increasing in the fall and winter with passage of cold fronts. These weather fronts can generate significant runoff to Big Payette Lake as rain on snow events. These events are most likely to occur in February or March when air temperatures begin fluctuating above freezing.

Figure 4-1. & Figure 4-2

Figure 4-3. McCall rainfall amounts.

4.1.2 Tributary Stream Flows and Water Budgets

Upper Payette Lake Tributaries: Hydrographs based on field flow measurements and continuous water level recorders are presented in Figures 4-4. The daily hydrograph at the N.F. Payette River above Upper Payette Lake represents the typical pattern in runoff observed in the Upper Payette Lake drainage basin. Selection of a suitable site for monitoring stream flow was limited due to backwater affects from the Upper Payette Lake and the braided stream conditions that were present upstream. Consequently, stream flows were measured from a bridge spanning a well defined channel near the stream confluence with Upper Payette Lake. The close proximity of this site to the lake and lack of slope influenced recorder sensitivity during the period July through September when the lake was normally full (5555.3 ft. msl). Effects on the discharge estimates during the remainder of the year were minimal due to regulation of water levels within the lake. Water levels are typically reduced by 0.9 m (3.0 ft) in the fall to create additional storage space for the following year snowmelt.
Peak flows in WY 1995 were observed in late May coinciding with the rise in air temperatures as recorded at the NRCS Secesh Snotel Data Site (Figure 4-4). Runoff volume declined through the remaining snowmelt period and reached a seasonal low in late September. The following year hydrograph was similar but with peak flows occurring approximately two weeks later (June) due to cooler spring temperatures.

Highest tributary stream flows were recorded from the North Fork Payette River above Upper Payette Lake. Flow estimates from this site for WY 1995 ranged from 0.8 - 522 cfs. Higher peak flows were recorded during the second week of June in WY 1996 which exceeded 810 cfs, but fewer days of high flow rates were observed in WY 1996 as compared to WY 1995.

Continuous flow measurements on Twentymile Creek were maintained for only a short period before the gauge site was damaged during the first year peak flow event. Field measurements of flow rates were obtained throughout the study whenever stream conditions permitted. Peak flows were difficult to measure due to changes in channel routing under high flow conditions. Two distinct channels are present near the confluence of this stream with Upper Payette Lake. At flow volumes below 50 cfs, runoff is typically confined to the mainstem channel (north branch). As flows increase and reach bank full stage, additional water spills into a second channel (south branch) which continues to the lake. This south channel appears to have been

formed in recent years during peak runoff events and currently has a bottom channel elevation higher than the river mainstem. The substrate in this south channel is sandy in texture and appears to be eroding downward and laterally.

The hydrograph pattern in runoff for Cougar Creek was similar to that of the North Fork Payette River flowing into Upper Payette Lake. Stream flow volumes ranged from 0.2 - 109.7 cfs in WY 1995 and from 0.1 - 131.6 cfs in WY 1996. As with the North Fork Payette river inflow, an accelerated runoff event was recorded during the second week of June and produced the highest peak flows for the water year.

Comparison of synoptic field flow measurements taken throughout the two water years confirm there is a high degree of similarity in the temporal runoff characteristics between streams draining into Upper Payette Lake (Table 4-1). Highest correlations were observed among flow measurements between the North Fork Payette River above Upper Payette Lake and other streams.

Figure 4-4. Daily Hydrographs representing a) gauged seasonal runoff from tributary streams; b) synoptic field flow measurements in the Upper Payette Lake drainage basin, and; c) average daily air temperature (degrees Celsius) at Secesh Summit Snotel Site. Trend line estimated for missing data by interpolation.

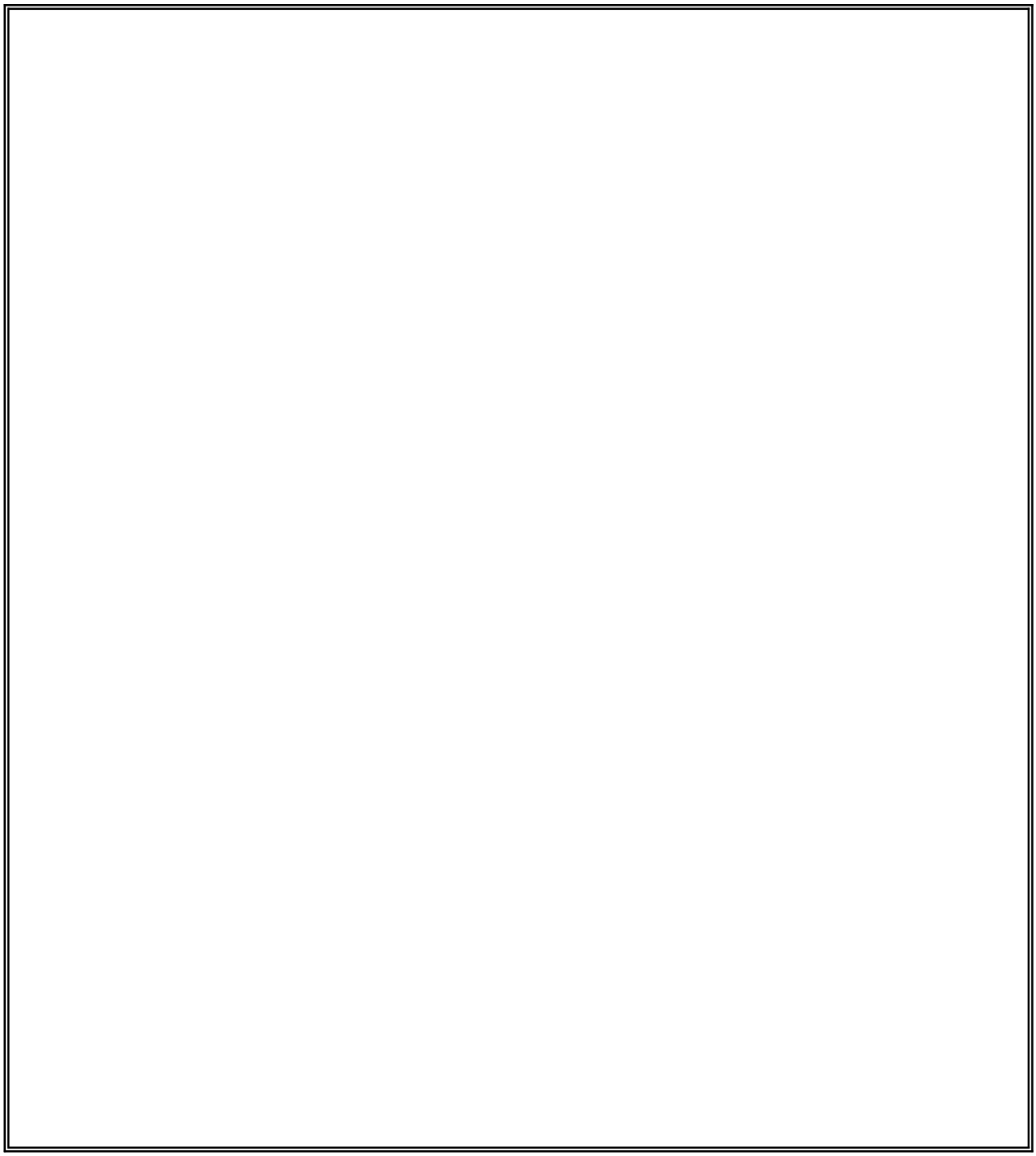

Table 4-1. Correlation matrix of synoptic stream flow measurements obtained during water

years 1995 and 1996.

Upper Basin Streams				Lower Basin Streams		
	UPL-In	Cougar	20Mile	Deep	Pearl	Fisher
Cougar	.97					
20Mile	.95	.96				
Deep	.81	.84	.85			
Pearl	.90	.83	.83	.43		
Fisher	.97	.96	.95	.70	.73	
UPL-Out	.95	.95	.95	.87	.71	.96

Upper Payette Lake Water Budget: Total inflow to Upper Payette Lake was estimated by combining runoff from the gaged and ungaged inflows (Table 4-2). Ungaged inflows to Upper Payette Lake include runoff from Camp Creek on the west side of the lake and Outlet Creek on the east side. Total water yield from these sources was estimated by computing the water yield coefficient (m^3/hectare) for Cougar Creek and applying this yield to the drainage area of the ungaged streams. Both ungaged streams are lower yield perennial streams (compared to other inflows) but drain different land types. The Camp Creek drainage is similar to Cougar Creek and characterized by a glaciated valley with steep walls and subject to short-term, intense runoff. Culverts placed in the campground road crossing this stream adjacent to Upper Payette Lake were washed-out during the 1994 snowmelt season. Outlet Creek drains a smaller basin composed of moraines and glacial outwash with low slope gradients. Accordingly, the yield coefficient for Outlet Creek was reduced by fifty percent to reflect these differences in land type and drainage conditions.

Estimated water yields from monitored streams for the Upper Payette Lake subbasins ranged from 10,500 - 15,700 m^3/ha (Table 4-2). Despite the significant loss of vegetation cover associated with wildfires in these watersheds, the estimated water yields fell within the range of estimates for unburned watersheds (see Table 4-4 and Table 4-5). Estimates of pre-burn water yield characteristics are not available. Reduction of vegetation cover by wildfires can result in increased snow depths and affect melt rates (McNabb and Swanson, 1990). Other studies on the changes in hydrology related to wildfires have reported increased water yields, higher peak flows, increased overland flow and stream baseflow (Tiedemann et al., 1979). Initial increases in the annual yield range from approximately 762 - 5,077 m^3/ha (3-20 acre-inches/acre) have been reported in the northwest (Beschta, 1990). A post fire assessment of these watersheds conducted by the forest service rated these streams as having a moderate to high risk potential for change in flow or stream channel characteristics following the fire (Payette National Forest, 1995).

Table 4-2. Monthly cumulative (cf) estimates for streams flowing into Upper Payette Lake. Streams designated as UPLIN = North Fork Payette River into Upper Payette Lake, 20Mile=Twentymile Creek, COUGAR = Cougar Creek. Cumulative flows for Camp Creek are based on water yield of Cougar Creek. Cumulative flows for Outlet Creek are based on Cougar Creek water yield at 50%.

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WY95	UPLIN	20MILE	COUGAR	CAMP	OUTLET	Total
OCT	90	68	17	14	3	192
NOV	157	118	33	27	6	341
DEC	132	100	28	23	5	287
JAN	173	264	48	39	8	533
FEB	539	1,064	225	185	37	2,049
MAR	1,058	1,107	391	321	64	2,942
APR	3,520	2,167	971	797	159	7,614
MAY	9,734	6,486	2,071	1,699	340	20,329
JUN	4,686	3,480	909	746	149	9,970
JUL	1,636	2,002	483	397	79	4,598
AUG	776	698	132	108	22	1,736
SEP	471	379	30	25	5	910
Total	22,973	17,933	5,339	4,380	876	51,501
(m3/ha)	12,377	10,597	13,429	13,429	6,714	11,698
(Acre-Ft/Acre)	4.1	3.5	4.4	4.4	2.2	3.8
WY96						
OCT	444	388	73	60	12	976
NOV	1.008	965	126	104	21	2.223
DEC	2.655	2.670	595	488	98	6.505
JAN	2.158	2.335	466	382	76	5.417
FEB	1.785	2.006	419	343	69	4.621
MAR	632	756	159	131	26	1.704
APR	2.632	2.230	571	468	94	5.994
MAY	8.450	4.983	1.476	1.211	242	16.361
JUN	7.835	7.063	1.606	1.318	264	18.085
JUL	1.152	1.388	314	257	52	3.162
AUG	172	181	41	34	7	434
SEP	289	306	24	20	4	642
Total	29.210	25.269	5.868	4.814	963	66.124
(m3/ha)	15,737	14,933	14,759	14,759	7,379	15,020
(Acre-Ft/Acre)	5.2	4.9	4.8	4.8	2.4	4.9

Figure 4.5. Comparison of total monthly inflow and outflow water volume for Upper Payette Lake.

Table 4-3. Radial gate openings and discharge volumes.

Discharge Over Spillway	
Gates Closed (Feet of Head)	cfs
1	206
2	580
3	1,070