Section 2 - Hydrology of the Fifteenmile Creek Watershed

General

Stream flows for Fifteenmile Creek between the headwaters and a diversion point upstream of the City of Dufur, Oregon, are summarized and evaluated in this section to identify the potential amount of water that could be authorized for diversion and storage on the basis of 50 percent exceedance flows and desired minimum ecological flows. A diversion point, the existing diversion for the Orchard Ridge Ditch, approximately 7.5 miles upstream of the Ramsey Creek confluence, at river mile (RM) 43.5, was identified as the best location to remove water from Fifteenmile Creek for storage while still being able to return water to the creek upstream of the City of Dufur. This diversion point location in the watershed would provide for an off-channel gravity flow storage and release system. The existing stream flow data provided for this Study were prepared and evaluated by the Oregon Water Resources Department (OWRD).

This evaluation uses historical mean daily flow (MDF) data at the Fifteenmile Creek gauge that was located at Rice (No. 14104500). The recording of flow data at the Rice gauging station began in October 1946, and data were last collected in September 1984. During the 38 years that this gauging station was in operation, there were 17 complete water years recorded, 21 peak flow records recorded, and 19 low flow records collected. Flow data from this station were adjusted to account for tributary inputs, in-stream water rights, and water right diversions for irrigation in order to determine an estimated flow for the upstream proposed point of diversion (POD) location. The location of the gauging station and POD are shown on Figure 2-1.

Existing Stream Flows

The stream flow data indicate that Fifteenmile Creek typically experiences the highest flows in January and February. The peak flows were taken from the data from the Rice location adjusted for the upstream location above Ramsey Creek. Figure 2-2 shows the low and high flow years of record, the average flow for the 17 years of complete flow data, the 2013 water year flow at Station 14103996 above the confluence of Ramsey Creek and Fifteenmile Creek, and the 2-year recurrence interval naturally occurring high flow (calculated to be approximately 425 cubic feet per second [cfs]). It should be noted that the flow at Station 14103996 for the 2014 water year stays mostly between the plotted high flow year and the low flow year on the figure.

The 2-year recurrence interval was calculated by taking the peak flow from the 21 years of data where the peak flow was recorded and ranking the flows in order from the lowest to the highest, with the low flow being ranked number 21 and the highest flow being ranked as number 1. An exceedance probability was then calculated by dividing the rank of the flow by the number of years of data collected plus one. Dividing the number 1 by the exceedance probability percentage gives the return period for the recorded flow. In Fifteenmile Creek, the 2-year peak return flow is 425 cfs.

Fifty percent exceedance natural stream flows from the Rice gauging station were used as the basis for estimating the maximum amount of water that would be available for off-channel storage from Fifteenmile Creek without any limitations on the capacity of diversion or conveyance systems. The flow

data were adjusted by OWRD to determine the flow that is estimated to be available for storage after consumptive use (the amount of water used for irrigation) and in-stream water rights are removed from the natural stream flow.

Ecological Flows

Flow data were also used to evaluate ecological flows. The Oregon Department of Fish and Wildlife (ODFW) provided the information used in this Study for the Ecological and Seasonally Varying Flow (SVF) requirements (see Appendix A). These flows were evaluated using the following parameters as defined in *White Paper: Peak and Ecological Flow; a Scientific Framework for Implementing Oregon HB 3369* (Peak and Ecological Flow Technical Advisory Committee, 2010).

1. Base Flow Functions - "Base flow functions such as subsistence and minimum or optimum habitat flows. These represent the low flow functions of a stream that provide minimal direct habitat for fish and other aquatic organisms. They can also represent minimal flows that are sufficient in quantity to overcome the potential for threats to aquatic life from harmful pollutants or stream heating"

2. Biological Triggering Flows - "Biological triggering flows represent elevated stream flows that may trigger a behavior in an aquatic organism that is essential for its survival such as migration or spawning."

3. Channel Maintenance Flows - "Channel habitat maintenance flows are elevated stream flows (often flood or peak flows) that rework the channel or its streambed rejuvenating or cleaning gravel, reforming habitat features, replenishing/rejuvenating riparian vegetation, and/or re-establishing connectivity with off-channel habitats."

These three types of flows are further described as follows:

Base Flows

Base flows provide minimal to optimum habitat for basic life cycle needs of the target aquatic species and connectivity between a main stream and its tributaries. Base flows can be set at the in-stream water right (ISWR) level for the reach, per the ODFW Basin Investigation Report's (BIR) minimum flow requirements or flow studies based on computer modeling analysis. For this Study, ISWR exist that are reflective of a Fisheries Stream Flow Requirements Study by ODFW. The ISWR are used for the minimum base flows. The BIR has also identified an optimum base flow that is a little higher than the ISWR. The optimum flow does not always exist in the stream due to annual variations in the flow. For this reason, OWRD also evaluated the estimated median flow. The ISWR, optimum base flow, and OWRD estimated median flow are shown on Table 2-1 and Figure 2-3. The target flow is equal to the BIR optimum flow or the OWRD estimated median flow, whichever is less. The base flow has been taken into account in the water storage calculations. A discussion of the effects these flows will have on the amount of water to be stored is found later in this section.

TABLE 2-1
ODFW BASE FLOW TARGETS FOR FIFTEENMILE CREEK ABOVE EIGHTMILE CREEK

Month	BIR Minimum Flow (ISWR) (cfs)	BIR Optimum Flow (cfs)	OWRD Estimated Median Flow (cfs)	Target Flow (cfs)
January	4	13	65.7	13.0
February	4	13	102.0	13.0
March	13	20	97.5	20.0
April	20	34	66.9	34.0
May	20	34	65.6	34.0
June	20	34	49.8	34.0
July	13	20	12.8	12.8
August	13	20	5.9	5.9
September	4	13	6.1	6.1
October	4	13	7.9	7.9
November	4	13	11.3	11.3
December	4	13	24.7	13.0

ODFW suggests that two compliance points (water measuring stations) will be needed to ensure base flows are met in Fifteenmile Creek during the storage season. The upstream compliance point should be between the POD (approximate RM 43.5 and Ramsey Creek (approximate RM 36). The target flow at these two locations is the ISWR. These two compliance points will also be needed during the irrigation season to ensure that water dedicated in stream remains in stream. The specific location of the compliance points will be determined at some time in the future in consultation with ODFW.

Biological Triggering Flows

Elevated flows in streams are needed to flush young fish downstream, initiate upstream migration of adults, and complete life cycle dynamics of aquatic insects and other organisms. Elevated flows for triggering stream health and migration are site specific. ODFW provided the timing and amount of flow needed to maintain the biological triggering flows for this system and have indicated that the period of concern for these flows is March 1 through April 14 and that all flows should be left in stream during this period.

Channel Maintenance Flows

Channel maintenance flows are needed to create or maintain stream morphology and habitat and require movement of the streambed. The volume of flow required for channel maintenance is directly related to the size of the streambed substrate. Streambed movement allows for cleaning of fines from gravels, and the elevated channel maintenance flows provide scouring and filling, which controls encroaching riparian vegetation, retains bed configurations, and replenishes streamside vegetation. Therefore, channel maintenance flows are in the range of bank-full flows. For the purposes of this Study, channel maintenance flows are considered the naturally occurring 2-year recurrence high flow. The channel maintenance flow is calculated at approximately 425 cfs. ODFW recommends that when the flow at the above-mentioned compliance point reaches the channel maintenance level, diversion should stop. The flow range at which diversion should stop, and the duration of the stoppage, needs to be evaluated in consultation with ODFW and OWRD. Additional

information regarding channel maintenance flows can be found in the September 2007 ODFW guidance document titled "Calculating Channel Maintenance/Elevated In-stream Flows When Evaluating Water Right Applications for Out of Stream and Storage Rights." The maximum storage diversion rate is proposed to be a maximum of 30 cfs or less than 8 percent of the channel maintenance flow. Due to the variable nature of live flows and the low percentage of maintenance flow being proposed for diversion, channel maintenance flows are not expected to be adversely impacted even during periods of maximum diversion.

Storage Period

The storage period is the time, depending on availability, water could be stored for later release during water recovery periods. The possible available storage period is generally between November 1 and April 15. The off-channel storage method would limit the amount of peak flows that could be stored to the maximum amount of flow that could be diverted and transported to the storage site. A suggested maximum diversion rate of 30 cfs is used in this Study. Diverting 30 cfs would require enlarging the Orchard Ridge Ditch or installing a pipeline that would carry 30 cfs to the storage site.

Stored Water Quantities

Water Availability Method

Several factors affect the amount of water that may be diverted for storage. The largest amount of water estimated to be available is calculated using OWRD water availability data, which uses the 50 percentile flow numbers and uses the amount of water available above the in-stream water right (ISWR) and consumptive use (CU) or irrigation water rights. Using this method of determining available water for storage results in 4,274 acre-feet being available for storage. Table 2-2 shows the water available for storage in each month as calculated by OWRD. With 25 percent of the stored water assumed to be available for in-stream use during low flow periods, approximately 1,070 acre-feet would be available for in-stream exchange.

TABLE 2-2
USING BIR MINIMUM FLOW (ISWR)

Month	ISWR (cfs)	Storage Season	Storage Amount (acre-feet)	Storage Rate (cfs)	Irrigation Water Rights (CU) (cfs)
January	4	Yes	1,419	23.1	0
February	4	Yes	1,609	29.0	0
March	13	Yes	576	9.4	0.7
April	20	Yes	132	2.2	5.03
May	20	No	0	0.0	13.57
June	20	No	0	0.0	11.27
July	13	No	0	0.0	3.33
August	13	No	0	0.0	1.53
September	4	No	0	0.0	1.58
October	4	No	0	0.0	0.46
November	4	Yes	11	0.2	0
December	4	Yes	528	8.6	0
Total			**4,274**		

15 Percent Method

Senate Bill 839 (SB 839) continuously appropriates funds to OWRD to make loans and grants for qualifying projects and for the cost of administering the loan and grant program. SB 839 establishes the criteria for projects to qualify for grants and loans.

The taskforce for SB 839 suggested that 15 percent of the MDF could be removed from the stream without any ecological harm to the stream. Using this criterion for water removal, the average amount of water that could be stored would be 1,526 acre-feet. This amount is similar to the SVF method shown below, so the feasibility analysis in the remainder of this Study will not evaluate the 15 percent method amount further.

Seasonally Varying Flow Method

SVF includes leaving base flows for basic physical habitat needs, as well as higher flows for channel maintenance, habitat connectivity, upstream and downstream migration, and other functions. ODFW considers SVF needs only between November 1 and April 15 because of the natural hydrograph and storage season and the Oregon Administrative Rules 690 Division 33 restrictions for water withdrawals without mitigation between April 15 and September 30. ODFW also recommends that no water be diverted from the stream from March 1 through April 14 since March is the peak period for adult steelhead upstream migration and April is an important month for juvenile steelhead outmigration. Using the ODFW recommended storage season months of November through February, the amount of water available for storage is estimated to be 1,921 acre-feet. Table 2-3 shows the water available for storage each month using this method to calculate water availability. With 25 percent of the stored water assumed to be available to be left in the stream during low flow periods, approximately 480 acre-feet would be available to improve stream flow.

TABLE 2-3
USING BIR TARGET FLOW (CFS)
NO STORAGE IN MARCH OR APRIL

Month	BIR (cfs)	Storage Season	Storage Amount (acre-feet)	Storage Rate (cfs)	Irrigation Water Rights (CU) (cfs)
January	13	Yes	865	14.1	0
February	13	Yes	1,056	19.0	0
March	20	No	0	0.0	0.7
April	34	No	0	0.0	5.03
May	34	No	0	0.0	13.57
June	34	No	0	0.0	11.27
July	13	No	0	0.0	3.33
August	6	No	0	0.0	1.53
September	6	No	0	0.0	1.58
October	8	No	0	0.0	0.46
November	11	Yes	0	0.0	0
December	13	Yes	0	0.0	0
Total			**1,921**		

Larch Creek Water Storage

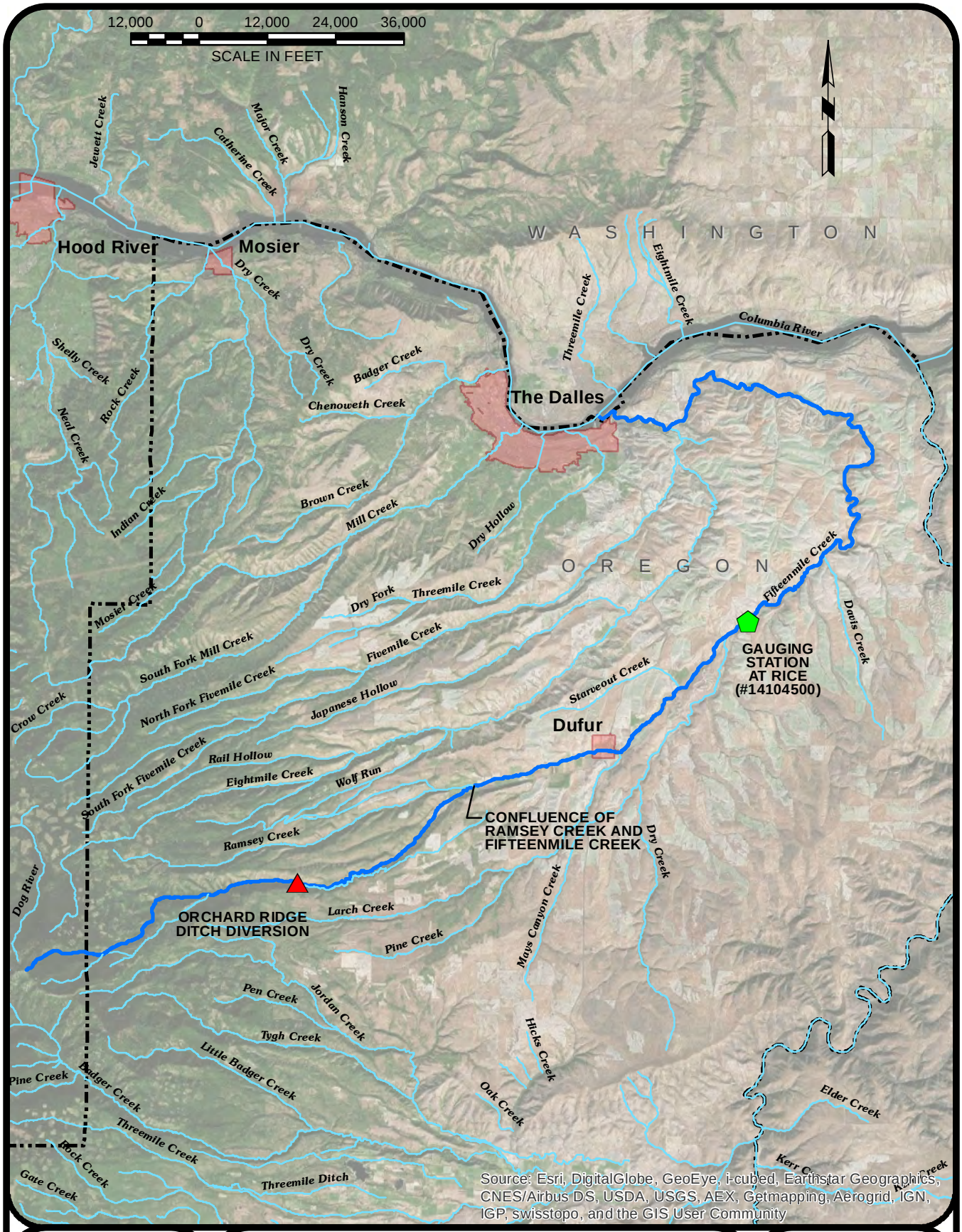
One of the sites being considered for off-channel storage is in the Larch Creek Basin. Larch Creek flows intermittently during wetter years, so consideration was given to including possible intermittent flows from Larch Creek for this site. Using the water availability method for calculating storage volumes, estimated additional storage amounts in Larch Creek range from 1,300 to 2,100 acre-feet. This volume of water could add to the total amount for the Larch Creek site, but it would not affect the feasibility evaluation results. If the Larch Creek site is determined to be feasible, then the additional water from this drainage should be considered.

Release Period

The release period is a window of time, June 1 through October 31, when stream flows are the lowest, irrigation demands exist, and/or stream temperatures may be critically high, making stream flow enhancement critical. Section 4, Temperature Evaluation, of this Study discusses the effects of different amounts of water being introduced into the stream during low flow periods.

Summary

The amount of water that could be available for flow augmentation from a reservoir was determined by using data provided by the OWRD. According to the information received from OWRD, the estimated surface water available for storage from Fifteenmile Creek would be 4,274 acre-feet. The 4,274 acre-feet is the estimated amount of water that could be available for storage using the MDF and the water availability basis. The availability numbers are based on the 50 percent exceedance flows in Fifteenmile Creek. When considering ecological flows, the total storage amount is estimated to be reduced to 1,921 acre-feet. In the future, consideration for possible impacts associated with climate change may need to be given. At that time, more flow data may be available for analysis.



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FIFTEENMILE CREEK WATERSHED ABOVEGROUND STORAGE FEASIBILITY STUDY

POINT OF DIVERSION AND GAUGING STATION LOCATIONS

FIGURE

2-1

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Fifteenmile Creek Flow Chart

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WASCO COUNTY SOIL AND WATER CONSERVATION DISTRICT

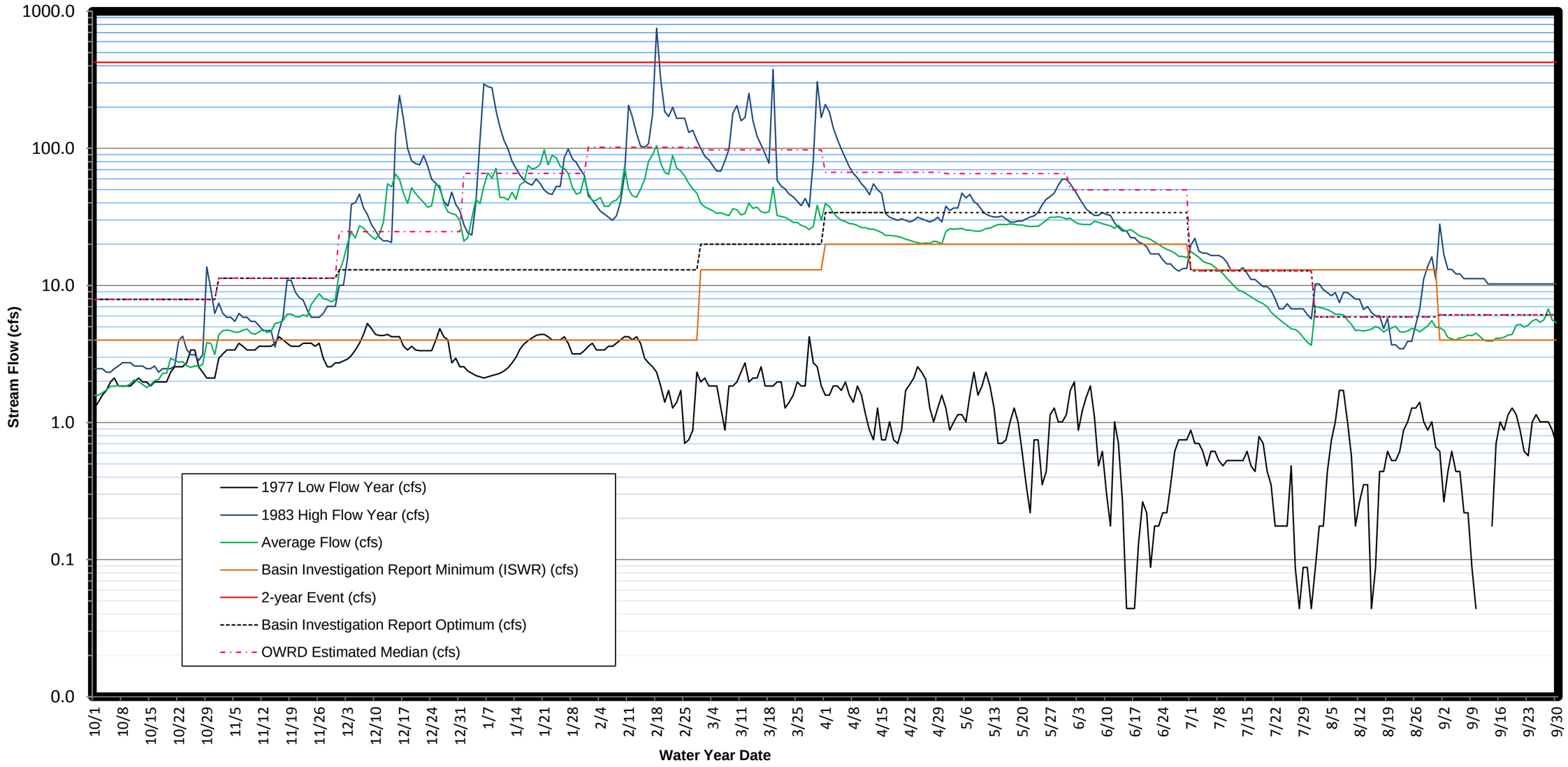
FIFTEENMILE CREEK WATERSHED ABOVEGROUND STORAGE FEASIBILITY STUDY

FIFTEENMILE CREEK FLOW CHART

FIGURE

2-2

Fifteenmile Creek Ecological Flow Chart



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FIFTEENMILE CREEK WATERSHED ABOVEGROUND STORAGE FEASIBILITY STUDY

FIFTEENMILE CREEK ECOLOGICAL FLOW CHART

FIGURE 2-3