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2011 Walla Walla Basin Seasonal Seepage Assessments Report

Walla Walla River, Mill Creek, Touchet River, and Yellowhawk Creek

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In Cooperation with:

Washington Department of FISH and WILDLIFE

STATE OF OREGON WATER RESOURCES DEPARTMENT WRD

OWEB Oregon Watershed Enhancement Board

WASHINGTON STATE DEPARTMENT OF ECOLOGY

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Overview:

The Walla Walla River watershed is a bi-state watershed that originates in Oregon and passes through the state of Washington on route to its confluence with the Columbia River. (Figure 1) As in many watersheds in the Western United States, the Walla Walla River basin's water quality and endangered species issues are heavily influenced by the timing, availability, quality and quantity of water originating from both surface and ground sources. The more obvious, seasonal variation in supply (winter-spring = higher flows, summer-fall = lower flows) is well documented in readily available annual hydrographs and continuous flow data. Historically, there's been a lack of understanding of how the Walla Walla River and its tributaries stream discharge vary spatially relative to: water use, groundwater inputs, evaporation, irrigation returns, and tributary inputs. From the near-pristine headwaters of the Walla Walla River, Mill Creek, and Touchet River in the Blue Mountains to near the confluence with the Columbia (Nine Mile Bridge) variations in environmental conditions help shape the various flow profiles within the watershed.

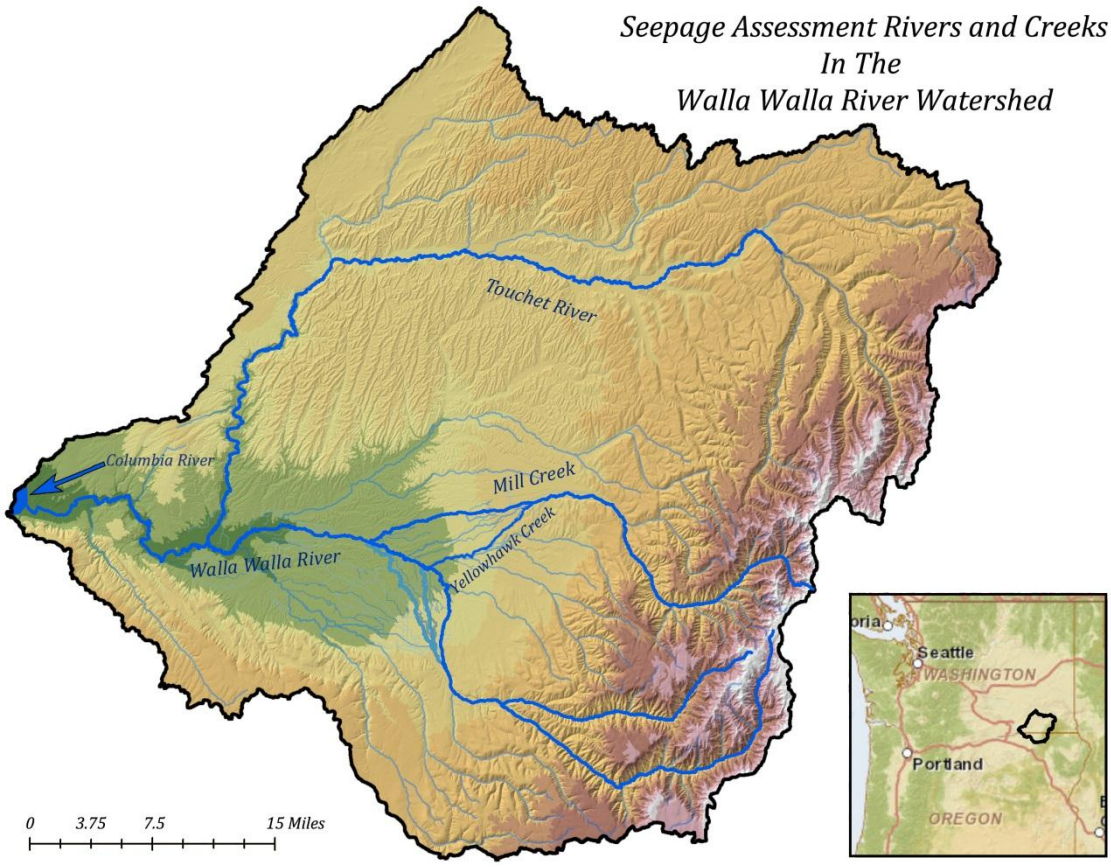

Figure 1: Map of the Walla Walla Watershed showing the Walla Walla River, Touchet River, Mill Creek, and Yellowhawk Creek.

Starting in 2002, WWBWC staff, state and federal agency personnel, and volunteers from Washington and Oregon began conducting seasonal instream flow, diversion inventories, and tributary flow surveys termed "seepage assessments" as a primary first step toward quantifying the spatial variation in water volume for the Walla Walla River. Since 2002 the WWBWC has conducted 14 assessments on the Walla Walla River, 5 assessments on Mill Creek and the Touchet River, 2 assessments on the East and West Little Walla Walla Rivers, and 2 assessments on Yellowhawk Creek. Seepage assessments, at first, were conducted in two primary seasons of concern; June when ESA-listed fish species are moving from the lower to upper watershed to either spawn or rear for the summer

months and August when Clean Water Act water quality issues and low flow volumes are at their most critical levels. This report shares the data collected from these bi-state cooperative seepage assessments. The focus of the analysis presented in this report is to quantify the channel bed gains and losses for the Walla Walla River, Touchet River, Mill Creek, and Yellowhawk Creek.

Methodology:

Data collection and quality

Seepage runs were typically completed over a 48-hour period with most of the measurements taken during the first 24-hour period. The QAPP (Quality Assurance Project Plan) for the Watershed Management Initiative Hydrology, Fisheries and Aquifer Recharge Monitoring-Modeling Project outlines the protocols for cross-sectional measurements used by the WWBWC to collect the instream flow data.[1]

Data was recorded using a variety of flow methods including hand and spreadsheet calculations. Diversion measurements were made using a variety of methods including: "weir stick" (used in conjunction with a particular weir's rating table), flow-rate meters on pumps or diversions, estimate of rate of diversion using sprinkler-head-counting method and on the larger diversions continuous flow recorders. Most diversion sites were recorded by direct measurement using weirs, meters and/or flow meters. Tributary inputs were calculated using instream flow measurements or data from the gauge station closest to the confluence of the tributary and the Walla Walla River. At each gauge the average daily flow was used to represent flow for the site.

WWBWC personel conducting a discharge measurement

While not directly relevant to the analysis shared in this report, each field team also collected parameters such as (1) channel and riparian photographs, (2) temperature (F), (3) specific conductivity (uS) (4) cross-sectional channel profile (wetted width and depths in feet). This information is available through the Walla Walla Basin Watershed Council's website[2]. Data collected by all project partners was individually compiled by each of the collection agencies and then organized and analyzed by the WWBWC.

The data for all of the seepage assessments for the Walla Walla River, Touchet River, Mill Creek, and Yellowhawk Creek can be found in *Attachments A and B*. Data sets include site identification or name, the digitized river mile[3] and instream flow, diversion and tributary quantities. The analysis and discussion sections of this report will review the data and identify areas of net gains and losses and discuss general trends. However the main objective of this report is to present this dataset for use by our numerous project and policy-planning partners to better manage and monitor instream flows in the Walla Walla Watershed.

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[1] The WWBWC, 2008. *Watershed Management Initiative Hydrology, Fisheries and Aquifer Recharge Monitoring-Modeling Project*, Walla Walla Basin Watershed Council And the WMI Technical Review Team

[2] www.wwbwc.org

[3] ESRI ArcGIS software was used to determine the river mile through digitizing the streams from the 2006 basin satellite imagery.

Spatial Flow Model

In order to assess the longitudinal profile for each system, a spatially-oriented model was needed. The National Agriculture Imagery Program (NAIP) 2006 imagery for Walla Walla County, Columbia County, and the Umatilla County was used as a base layer to digitize the project streams. The thalweg for each system was digitized using ESRI ArcMap. The digitized linear feature provided the ability to break down each system into "GIS river miles". The diversions, tributaries, and instream flow measuring sites were located by hand held GPS or by identifying the location using the NAIP imagery in ArcMap. Water managers from both Oregon and Washington worked with WWBWC staff to locate all diversions, tributaries and instream flow sites.

Reach Analysis:

Analysis was conducted using a simple mass-balance approach assessing water balance values on a reach-by-reach basis. Reaches were defined by the closest upstream and downstream instream flow measurement. All water budget calculations were performed from a given instream flow site upriver to the next nearest instream flow site. The equations for net tributary inputs and diversion withdraws are mass balance of all values in a defined reach. The basic equations for water budget analysis were[4]:

(1) Net Channel Gains and Losses $(N_{GL}) = (\sum (T_R) - \sum (D_R)) + (Q_{DN} - Q_{UP})$

Where: $\sum (T_R)$ = Sum of all Tributary Inputs for given reach

$\sum (D_R)$ = Sum of all Diversion withdraws for a given reach

Q_{DN} = Flow value at reach's downstream site

Q_{UP} = Flow value at reach's upstream site

Units: cubic-feet-per-second/reach

(2) Net Rate of Channel Bed Gains and Losses $(N_{GL-R}) = (N_{GL}) / (RM_{DN} - RM_{UP})$

Where: (N_{GL}) = Net Channel Gains and Losses for a given reach

RM_{DN} = River Mile at downstream flow site

RM_{UP} = River Mile at upstream flow site

Units: cubic-feet-per-second/mile/reach

Analysis Assumptions:

In order to correctly identify possible gaining or losing trends, general assumptions must be made to identify and quantify immeasurable components of the model. The assumptions that were made as the data was analyzed are listed below.

[4] *Bower, R.J. 2005. Walla Walla River Surface Water Budget Assessment: 2002 to 2004. Walla Walla Basin Watershed Council, www.wwbwc.org*

- Instream, diversion, and tributary flow data are representative of actual conditions for a particular season: Spring, summer, and fall datasets used in conjunction provide a reasonable and representative flow profile for the river for the corresponding season of measurement.

- Spatial model data node (e.g. diversion, instream flow, and tributary) locations are +/- 25 meters of where they were originally. This assumption is likely to have remained true for the majority of the sites through the entire field seasons of data collected on the Walla Walla River. In Washington, points of diversion (PODs) can be moved short distances without a formal permitting process while in Oregon moving a POD location is not allowed without proper POD transfer authorization. In Washington, if a particular POD was known to vary by year, a mid-point was chosen on the respective reach to represent that POD. Because reach analysis based on upstream and downstream instream-measurements, this method seemed applicable.

- Total Instream Net Gains (Total N_{GL}) can only be attributed to accretional[5] sum of the following sources: groundwater, hyphoreic[6] inflow, surface irrigation returns or "tail water," and any unmeasured springs and tributaries. Due to the inability to quantify these various sources via direct measurement N_{GL} is assumed to be a compilation of these various processes.

- Total Instream Net Losses (Total N_R) can only be attributed to the sum of the following losses: a) direct surface evaporation from sun and wind, b) evapotranspiration through riparian plant transpiration, and c) channel bed infiltration or net loss to the underlying alluvial aquifer system. Due to the inability to quantify these various sources via direct measurement they are assumed to be implicit to the sum of Net Losses. Net Losses is used here as relative to surface water, it is understood that in a high connective aquifer-surface system, water is not truly "lost" and may show up further down gradient as net gains to the river.

- All surface diversions are accounted for in the diversion inventory[7]. The amount of gains and losses relative to the volume of instream flow measurements were assumed to be equal. Generally a rule of thumb for instream flow measurements is that accuracy is within (+/-) 10% of the true flow value. This would mean that a 100 cfs measurement would have a confidence range of +/- 10 cfs while a 10 measurement would be +/- 1 cfs. This crude confidence range assumption helps as we analyze and discuss the qualification of river reaches where net gains and losses are apparent as a trend.

[5] *In science, accretion is a process in which the size of something gradually increases by steady addition of smaller parts*

[6] *beneath the bed of a stream, where water percolates through interstices between the rocks*

[7] *The assistant watermaster for the Milton-Freewater area along with the former watermaster for the Walla Walla Valley assisted in the accounting of all diversions on each of the assessed river, stream, or creek.*

Results and Discussion

The Walla Walla River seepage assessments have been conducted over the past 10 years through various conditions and seasons. The WWBWC and its agency partners and volunteers began conducting seepage assessments on the Touchet River and Mill Creek systems in the fall of 2008. 2011 was the first year that assessments were conducted on Yellowhawk Creek.

Walla Walla River Seepage Assessment

Data was first tabulated into a spreadsheet model and processed for all seepage runs utilizing the water budget analysis equations (*Attachments A)*. Analysis for each reach is applied from the downstream instream flow measurement on that particular line to the next, upriver instream flow site. Each instream location was assigned a Walla Walla River Reach ID and the application of analysis results can be deduced from the designated "Defined Reach Data" column (*Table 1)*. Only field-verified data was used for analysis.

Walla Walla River Seepage Assessment, July 21, 2011

Flow Measurement Location (Reach Locations)	Actual River Mile (GIS)	Rate Per Mile (cfs)	Net Gain/Loss (cfs)	Gross Instream Gain/Loss Change (cfs)	2011 Net Diversion Total (cfs)	2011 Net Tributary Inputs Total (cfs)	2011 Flow (cfs)	Gaining/Losing
RV Park to Byerly Bdg	5.68	-2.90	-20.91	-21.85	-0.94	0.00	91.86	Losing
Byerly Bdg to USGS Touchet Gauge	12.88	-4.72	-15.29	-15.29	0.00	0.00	113.71	Losing
USGS Touchet Gauge to MacDonald Rd Bdg	16.12	3.77	53.90	119.93	-6.23	72.26	129.00	Gaining
Lowden Rd Bdg	28.24							
MacDonald Rd Bdg to Detour Rd Bdg	30.41	-0.64	-2.29	-28.23	-25.94	0.00	9.07	Losing
Detour Rd Bdg to Swegle Rd Bdg	33.97	0.10	0.11	8.24	-0.08	8.21	37.30	Gaining
Swegle Rd Bdg to Last Chance Rd Bdg	35.04	2.80	4.13	4.13	0.00	0.00	29.06	Gaining
Last Chance Rd Bdg to Beet Rd Bdg	36.52	-1.12	-2.02	-2.97	-1.56	0.61	24.93	Losing
Beet Rd Bdg to WWR WDFW #5 Site	38.32	-9.51	-4.91	-36.91	-32.00	0.00	27.90	Losing
WWR WDFW #5 Site to Old Milton Hwy Bdg	38.84	4.58	6.29	45.80	0.00	39.50	64.81	Gaining
Old Milton Hwy Bdg to Hwy 125 Bdg	40.21	0.14	0.10	0.10	0.00	0.00	19.01	Gaining
Hwy 125 Bdg to Pepper Bdg	40.94	-0.20	-0.19	-0.19	0.00	0.00	18.91	Losing
Pepper Bdg to M-10	41.90	3.55	3.69	4.40	0.00	0.71	19.10	Gaining
M-10 to Mauer Lane (M9a)	42.94	2.99	2.46	2.46	0.00	0.00	14.70	Gaining
Mauer Lane (M9a) to Tum-A-Lum Bdg (M8)	43.76	1.67	1.11	1.11	0.00	0.00	12.24	Gaining
Tum-A-Lum Bdg (M8) to M7	44.43	-5.73	-2.53	-2.53	0.00	0.00	11.13	Losing
M7 to M5	44.87	-10.77	-11.77	-11.77	0.00	0.00	13.66	Losing
M-5 to Nursery Bdg M-4	45.96	-7.61	-5.03	-4.61	0.00	0.42	25.43	Losing
Nursery Bdg M-4 to M3	46.62	-18.23	-11.72	-8.15	3.57	0.00	30.04	Losing
M3 to M2	47.26	4.47	1.96	1.96	0.00	0.00	38.19	Gaining
M2 to M1a Grove School Bdg	47.70	4.04	3.58	-112.99	-116.57	0.00	36.23	Gaining
M1a Grove School Bdg to Couse Creek Rd Bdg	48.59	-3.98	-4.24	-3.89	-0.08	0.43	149.22	Losing
Couse Creek Rd Bdg to Day Road	49.66	-0.07	-0.07	-2.44	-2.37	0.00	153.11	Losing
Day Road to Joe West Bdg	50.59	20.91	20.46	20.46	0.00	0.00	155.55	Gaining
Joe West Bdg to South Fork Bdg	51.57	-10.24	-16.87	-10.18	-3.37	10.06	135.09	Losing
South Fork Bdg to CTUIR Hatchery	53.22	1.68	8.75	3.35	-5.40	0.00	145.26	Gaining
CTUIR Hatchery to Keating	58.44	8.39	13.70	13.50	-0.20	0.00	141.91	Gaining
Keating to SF Walla Walla BLM Trailhead	60.07	-10.94	-19.44	-19.60	-0.16	0.00	128.41	Losing
SF Walla Walla BLM Trailhead	61.85	x	x	x	x	x	148.01	

Table 1: MS Excel model data table for the July Walla Walla River seepage run.

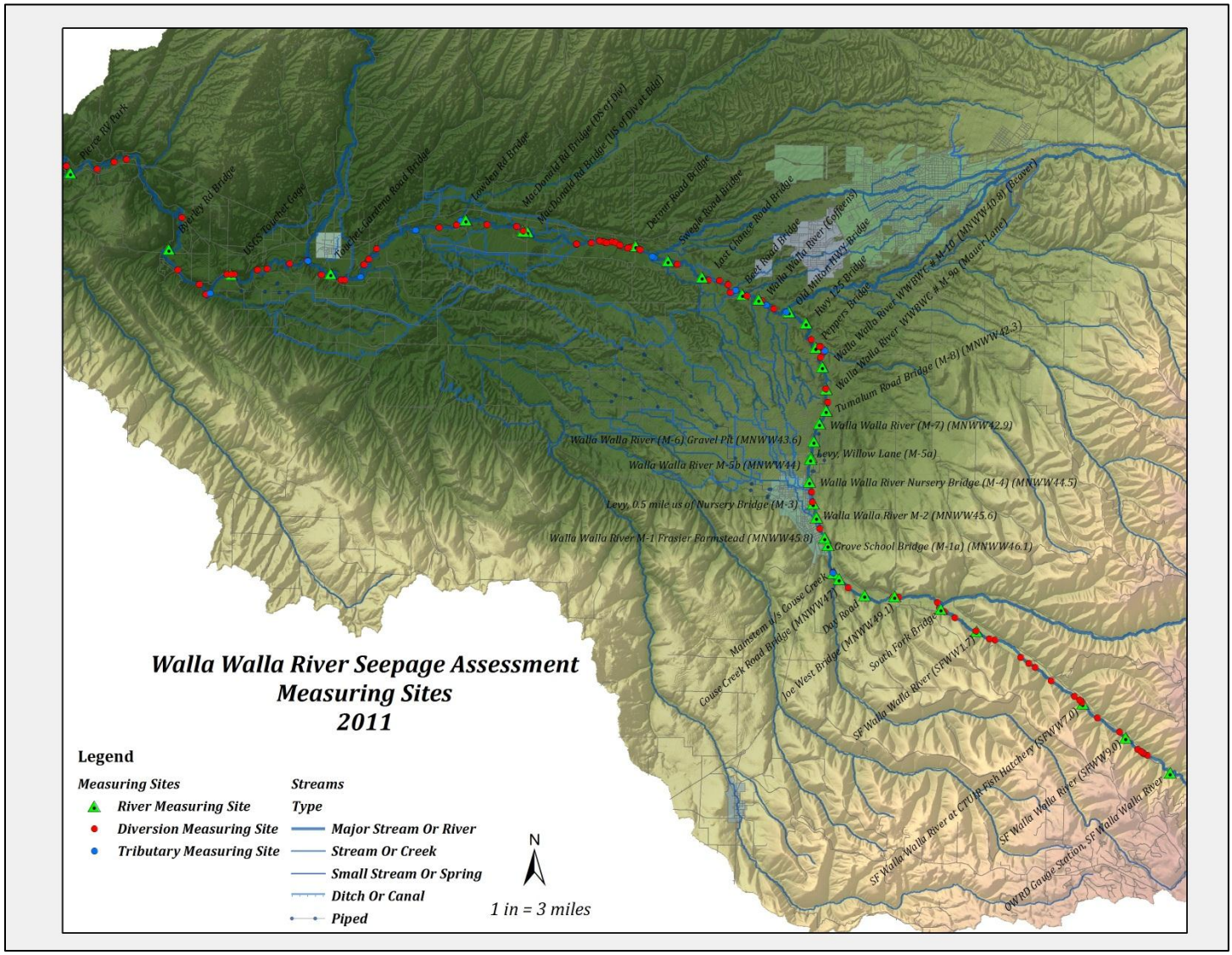
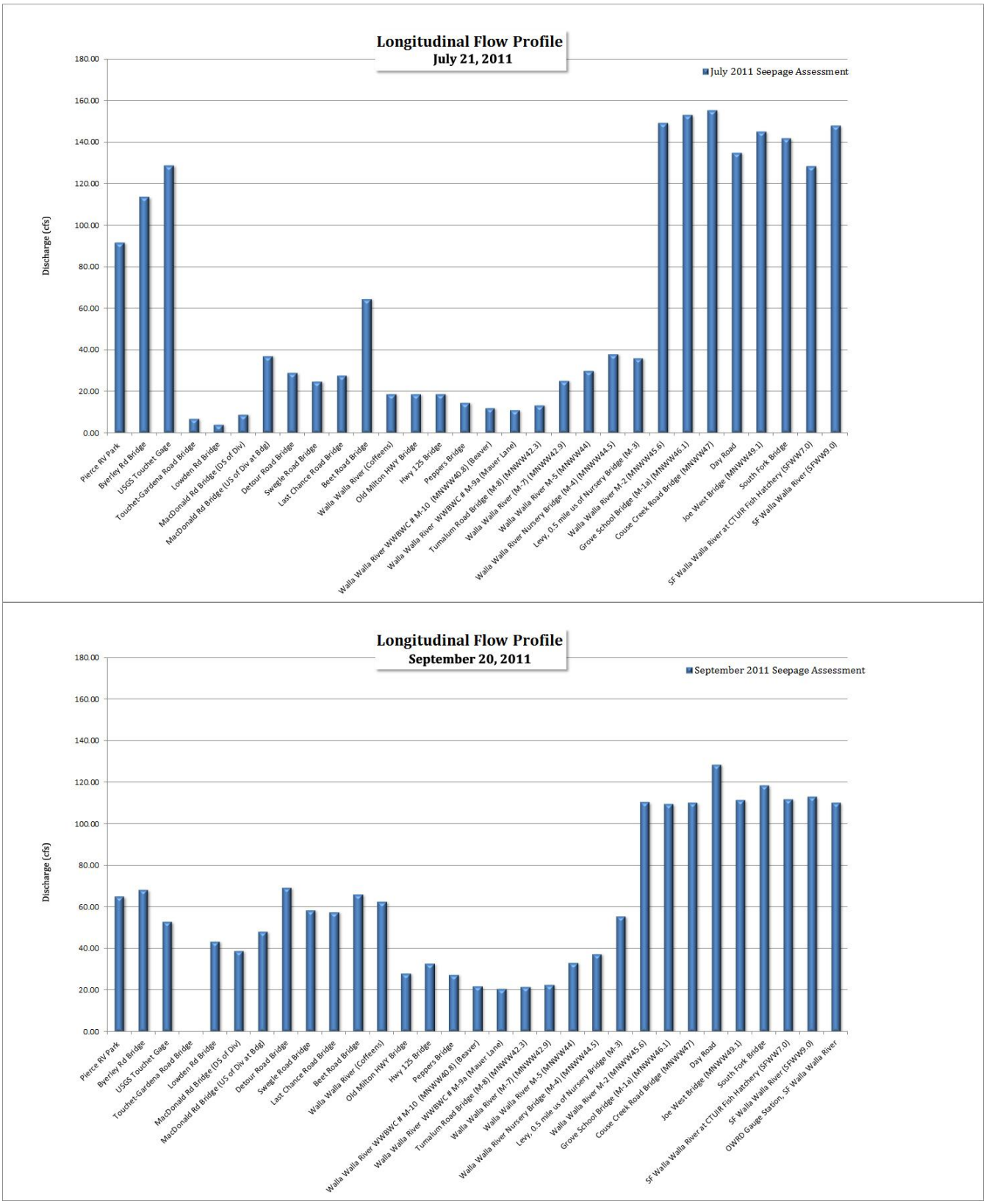


Figure 2: Walla Walla River Seepage Assessment Measuring Sites 2011

Water Year Comparison of Datasets

Longitudinal flow profiles *(Figures 3 and 4)* provide a general overview of the seasonal flow rate on the Walla Walla River. The flow profiles are based upon seasonal differences in the Walla Walla River and years of similar conditions were compiled together in each profile. A longitudinal flow profile based on spatial locations of the measurements taken during the September 20, 2011 seepage assessment can be seen in figure 5.



Figures 3 and 4: Walla Walla River Seasonal Flow Profiles 2011

The longitudinal flow profile provides insight of where water is available and/or being used on the Walla Walla River based upon river mile. The most noticeable amount of flow being diverted into the Little Walla Walla River between mile 45 and 50.

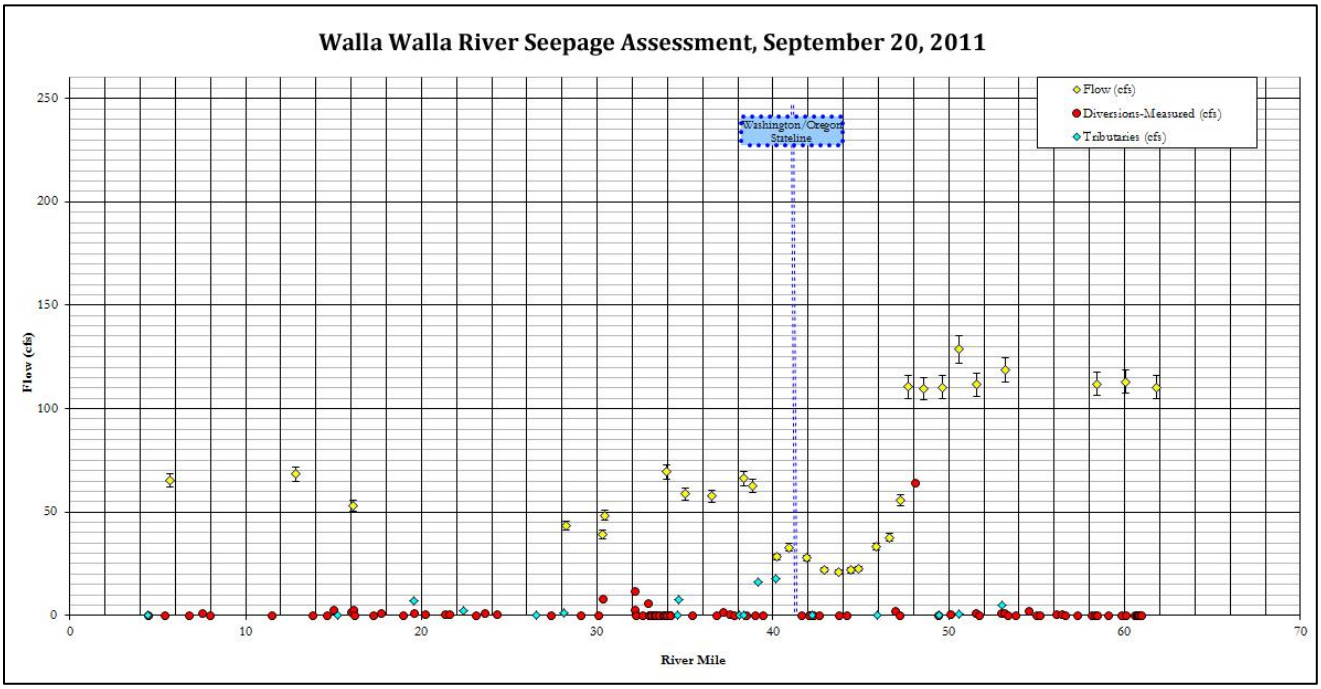


Figure 5: September 20, 2011 Walla Walla River Flow Profile

The results from the 2011 July and September net channel gains and losses (N_{GL}) are documented in figure 6 and figure 7. The 2010-2011 cool wet winter and spring resulted in a higher than normal snow pack which melted off at a slow rate throughout the early spring. The added runoff in the Walla Walla Basin contributed to higher than normal flows in the Walla Walla River. The flow profiles for the two seepage assessments for the Walla Walla River show less variability between the early summer and late summer/early fall than in previous years of conducting seepage runs.

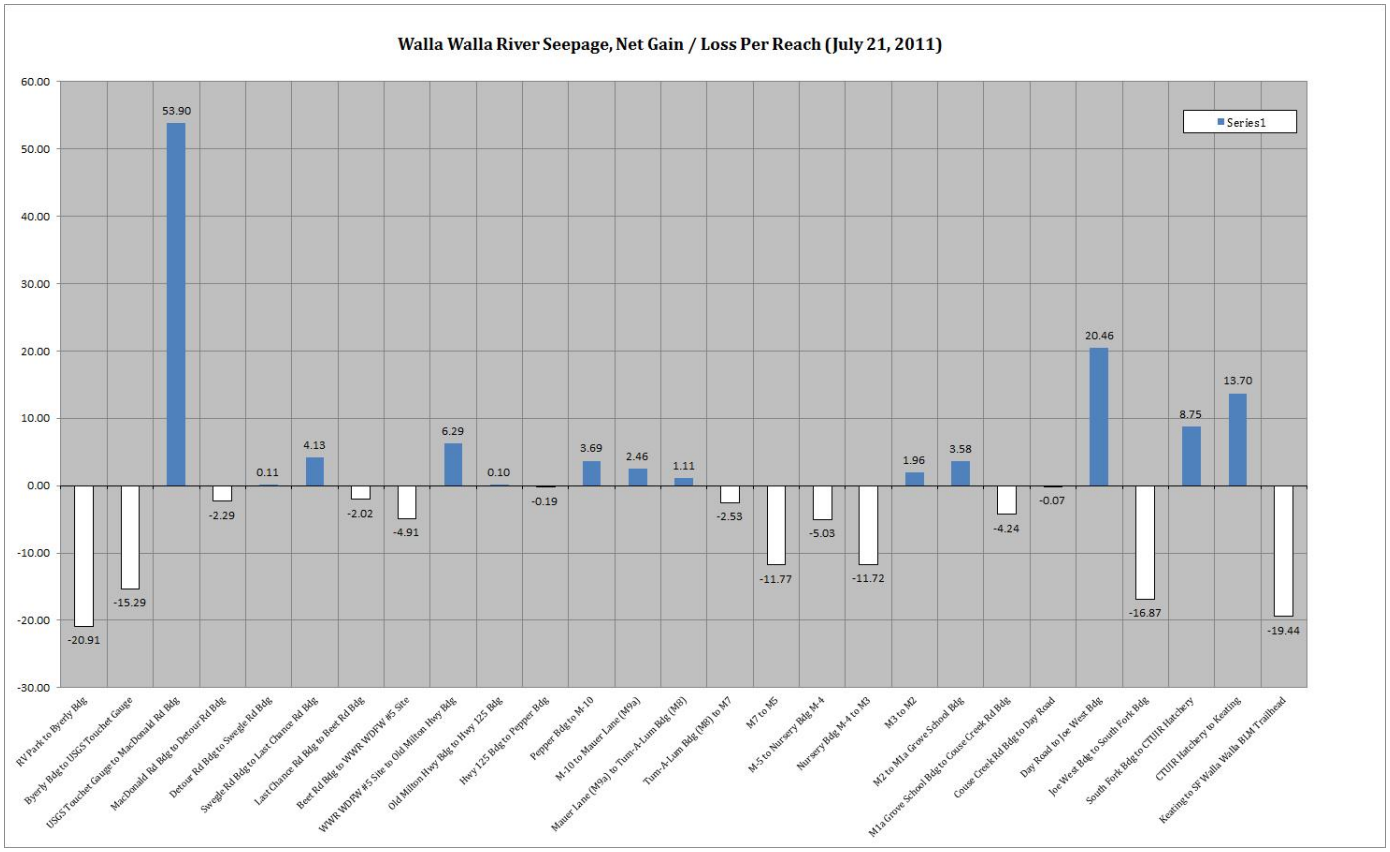


Figure 6: Walla Walla River Net Gain or Loss per Reach, July 2011

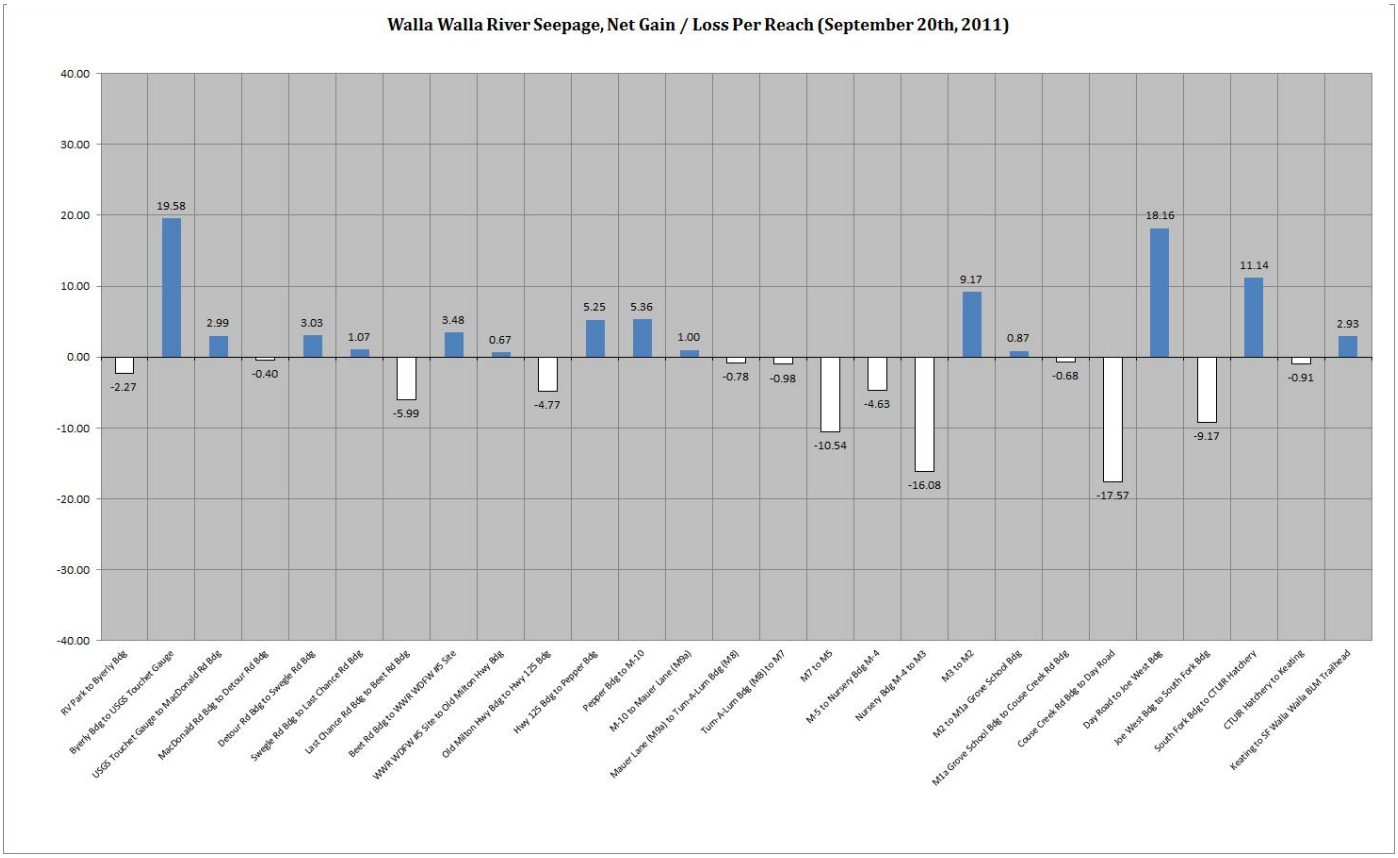


Figure 7: Walla Walla River Net Gain or Loss per Reach, September 2011

Another useful product from this analysis is the net tributary and diversion values associated with each reach of the river. This provides a useful visual tool to assess, relative to instream flow values, the location and magnitude of mainstem flow contributions and identifying the high withdrawal reaches. (Figure 8) Additional Net Reach Analysis graphs for all assessed streams and creeks can be found in Attachment C.

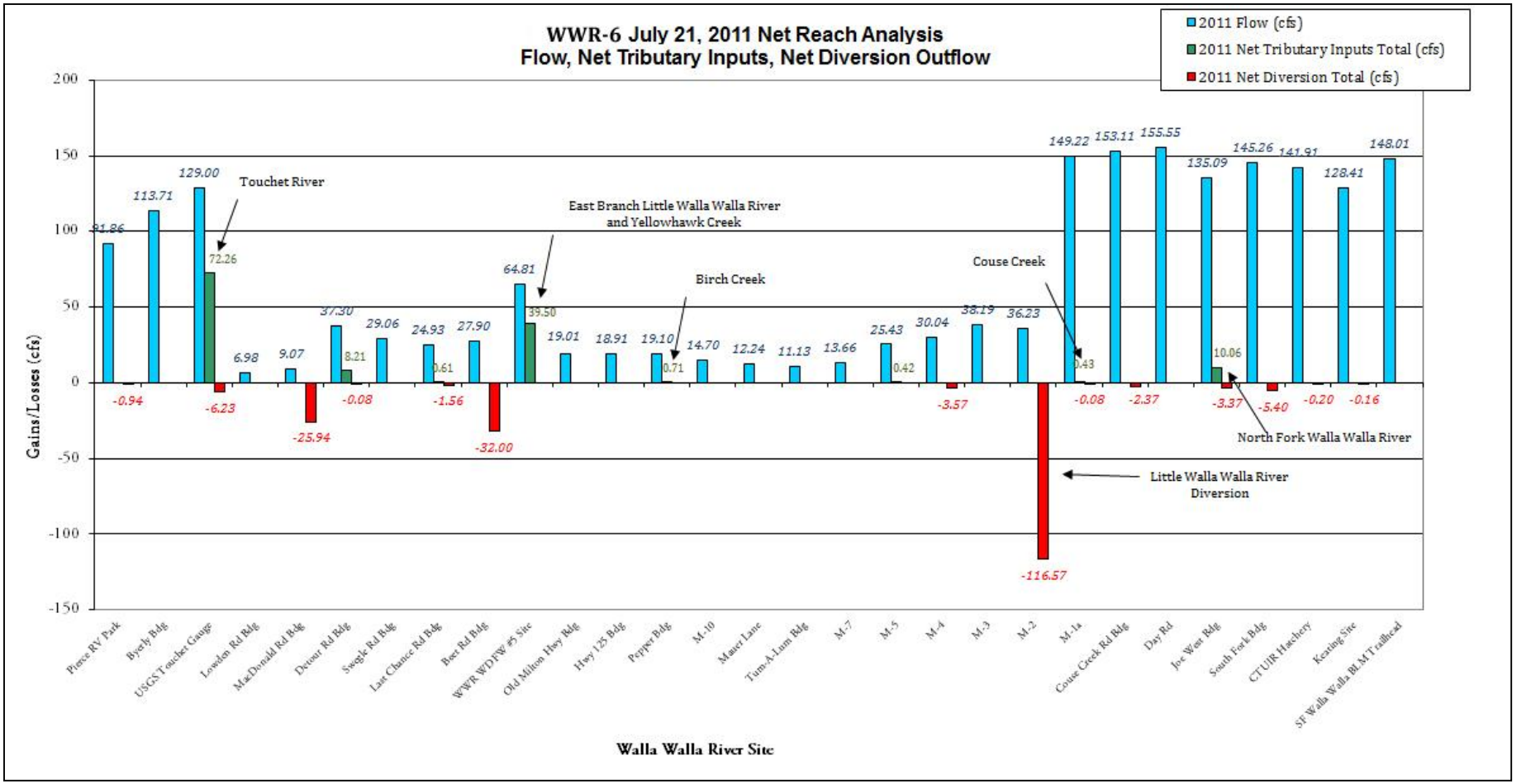


Figure 8: Walla Walla River Net Reach Analysis, June 21, 2011.

Within the Oregon portion of the basin on the Walla Walla River, two upriver sites and the Little Walla Walla River diversion in Milton-Freewater comprise the most visually apparent diversions.

The Little Walla Walla River diversion is in the proximity of where the Walla Walla River historically braided into multiple channels consisting primarily of three main distributaries. (Figure 9) The Tum-A-Lum Branch (now called the mainstem), the East Little Walla Walla River (now named the Crockett Ditch and East Prong of the Little Walla Walla River) and the West Little Walla Walla River (now named the Ford Ditches and West Prong of the Little Walla Walla River).

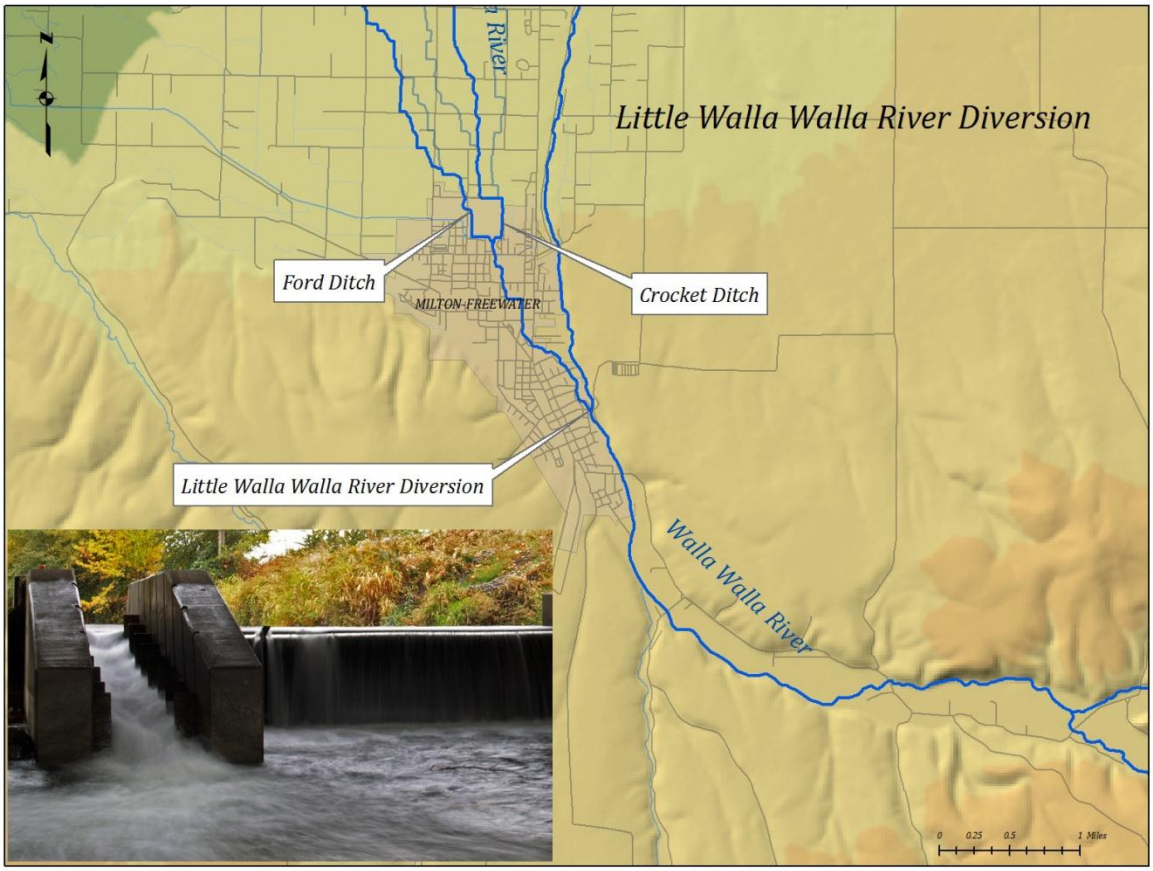


Figure 9: Little Walla Walla Diversion at Milton-Freewater

Other distributaries to the west such as Mud, Dry, and Pine Creeks were most likely tied into this distributary system. Many of the historical distributaries west of the mainstem (Tum-A-Lum Branch) were converted into irrigation conveyance systems for hundreds of farms. Because the Little Walla Walla system is currently used mostly for irrigation purposes, it was treated as a diversion for purposes of analysis for the Walla Walla River. It should be noted also that it is generally believed that water lost in this portion of the basin can return to the mainstem Walla Walla River as groundwater and springs (e.g. Big Spring and East Little Walla Walla River flow, and at certain times of year as West Little Walla Walla River flow).

In the Washington section of the river (Pepper Bridge to the confluence with the Columbia) major tributary contributions from both the East Branch (Prong)[8] of the Little Walla Walla River and Yellowhawk Creek help to approximately double or triple the instream flow volumes (Old Milton Highway Bridge (19.01 cfs) to Walla Walla River (WDFW #5) 64.81 cfs (July, 2011). The major diversions in Washington in August appear to be located in the lower section of the river (From the Beet Rd Bdg to MacDonald Road Bridge). Due to the large scale for flow (y-axis) in this graph, the smaller point diversions are difficult, if not impossible, to see. A review of the data (*Attachments A-1 through A-12*) does show numerous diversions along most segments of the river.

Water Budget Analysis and Mapping: Channel Bed Gains and Losses

The primary purpose of calculating both the rate and total volumes for net channel gains and losses is to better understand which areas of the river may have groundwater inputs (gains) or channel bed infiltration (losses). This type of information is particularly applicable for the numerous other modeling and research efforts currently underway in the Walla Walla River system. For salmon and bull trout recovery research, the collected data provides spatial reference to potential areas for rearing habitat (groundwater gains provided cool water by volume to gaining reaches while losing reach may indicate thermal or flow barriers). Currently the WWBWC and its partners are studying the relationships between the inflow of groundwater into the Walla Walla River, temperature changes, and fish movements. It also provides valuable information with regard to where ground water from the Little Walla Walla River may reemerge in the Walla Walla River mainstem aside from the more obvious surface tributary sources which are directly applicable to the Habitat Conservation Plan and USACE Feasibility study modeling effort.

[8] *The source of this tributary water is generally thought to be from springs (primarily from the Big Springs branches and East Prong Little Walla Walla area) located in the Little Walla Walla system that convey ground water returns from the channel bed losses in Oregon's Levee section: Tum-A-Lum Bridge to Grove School Bridge.*

Utilizing the simple mass balance equation (*Total Volume of Water Budget = Total Net Gains and Losses + Total Tributary Gains + Total Diversion Losses)* and the total of water exchanged in the designated modeled area from the July 2011 dataset and the 2011 September dataset were further quantified using percent distribution. The percentages of the total volume of water movement in the modeled area relative to distribution are displayed in *figures 10 and 11*. July 2011 results show that Walla Walla River flows from the OWRD gauge on the upper South Fork to Nine Mile Bridge decline from 148.01 cfs to 91.86 cfs. Diversions (59%, 191.3 cfs) make up the majority of the water budget while the tributary inputs (40%, 132.2 cfs) and the potential groundwater returns (1%, 3.0 cfs) are less significant.

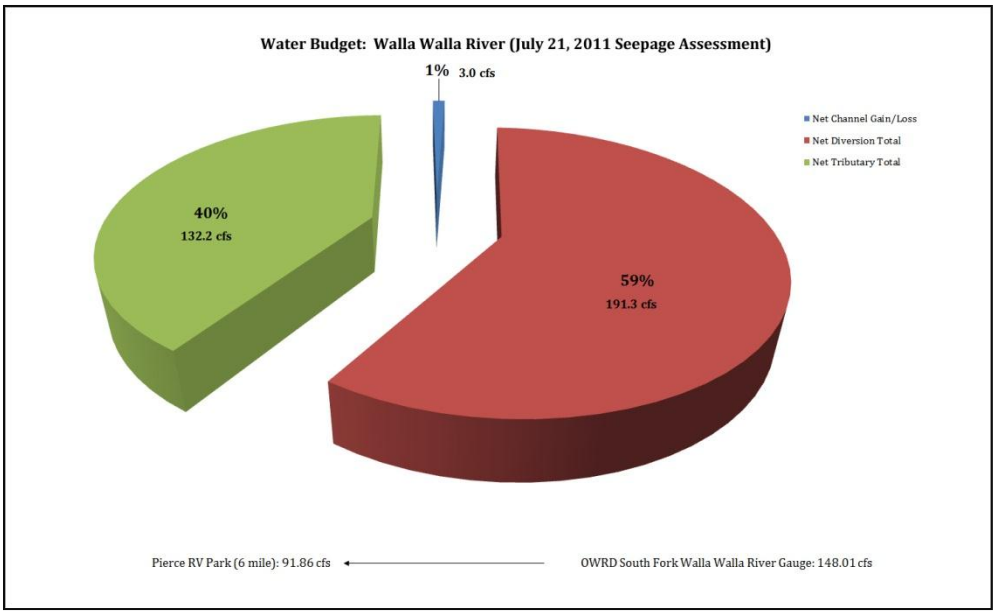


Figure 10: Water Budget July 2011

In September there is a decrease in tributary inputs (32%, 58.4 cfs) and a relative increase in groundwater returns (5%, 9.5 cfs) which combine to make up 37% of the total budget. However, the net diversion total of 113.03 which is a increase of 63% percent of the water budget.

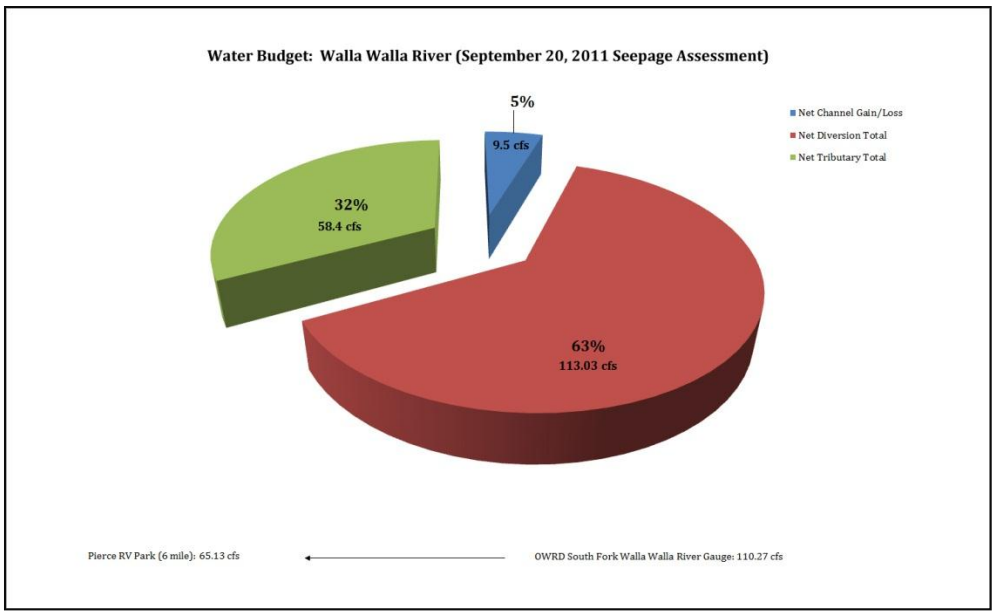


Figure 11: Water Budget Sept. 2011

Mill Creek Seepage Assessment

The seepage assessments on Mill Creek were conducted on July 7th and September 6th of 2011. The WWBWC followed the same procedures discussed in the methodology section. The assessment area begins upstream of the USGS Real-time Gauge Station at the Oregon/Washington Stateline and continues downstream to the confluence with the Walla Walla River (Figure 12). Ten reaches were defined based upon access, proximity to the next reach, and the geomorphology of the system. The thalweg was digitized using ArcMap 9.2 and the digitized layer was transformed into a linear route to break the feature into 25-meter segments. From the 2011 results, Mill Creek has

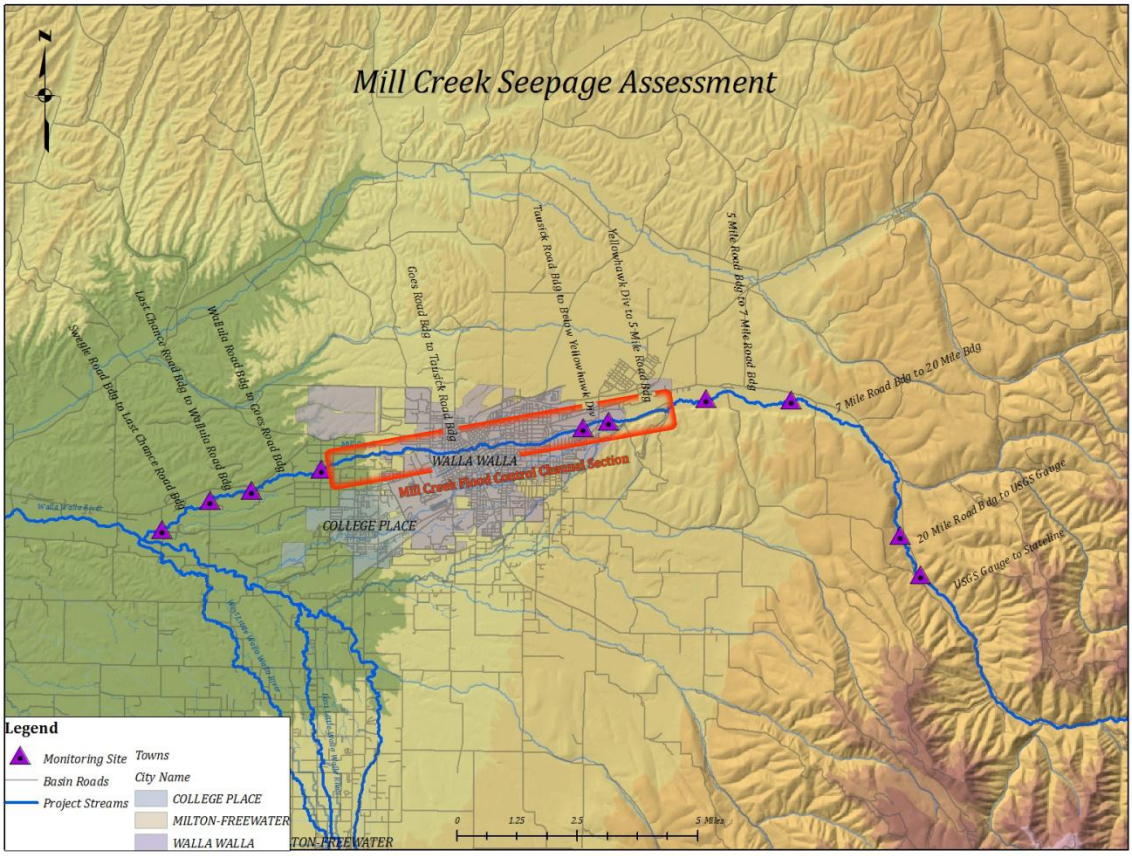


Figure 12: Mill Creek designated project reaches, 2011

a channel bed loss before it enters the concrete section, possibly from the weirs located downstream from the USGS gauge site at the Mill Creek Division which slows the water before it enters into the concrete section. The concrete section continues through the city of Walla Walla then exits back into a natural channel just downstream of Gose Street Bridge. Immediately downstream of the concrete flow control section there is a noticeable channel bed gain from possible return of recharge above the concrete section (Figures 13 and 14).

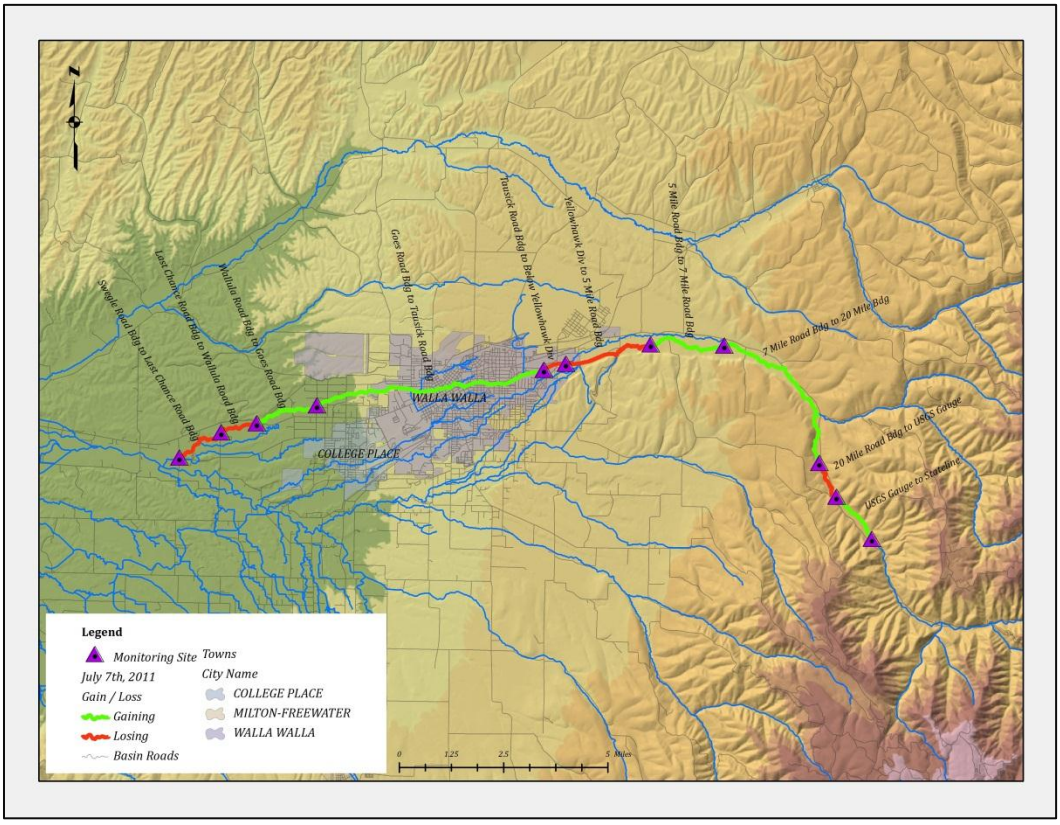


Figure 13: July 7, 2011 Mill Creek Seepage Assessment depicting the gaining and losing reaches within the assessment area

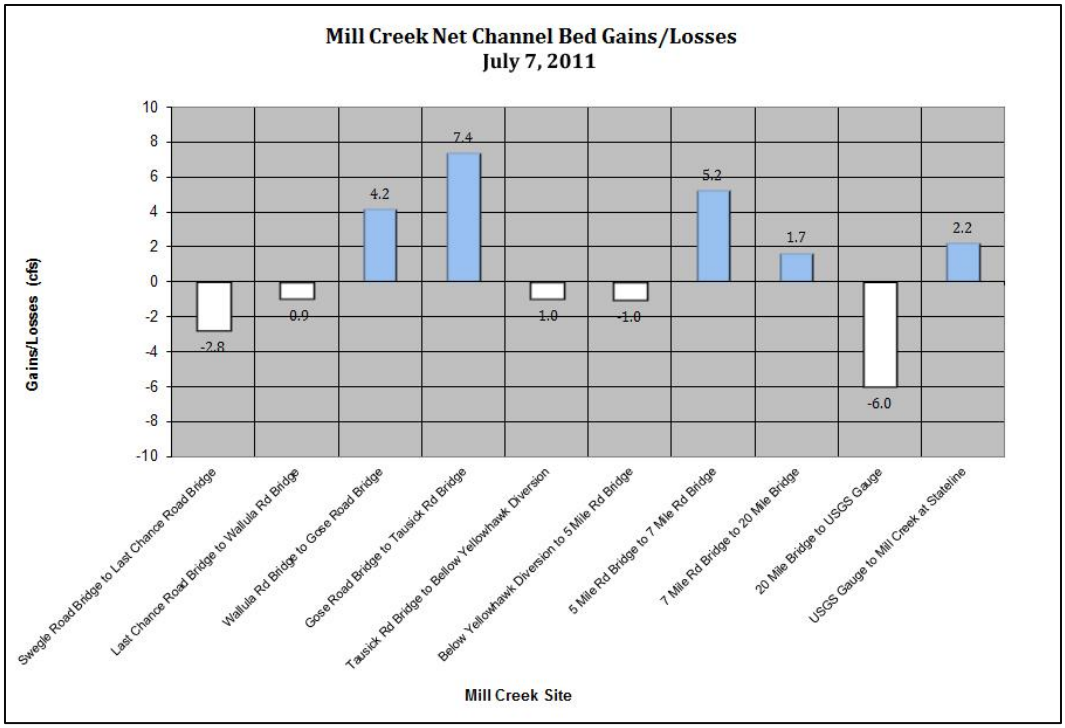


Figure 14: July 7, 2011 Seepage Assessment Net Gains and Losses per Reach

The sites measured above the city of Walla Walla City flood control section showed the most variability in the 2011 seepage assessments. Sites in the July assessment documented as gaining reaches in the upper reaches inversely were losing reaches in the late summer/early fall seepage assessment. A seasonal decline in the water table could potentially be the cause in the upriver changes from gaining to losing reaches. Additional investigations into the relationship between the upriver groundwater levels and channel bed gains and losses needs to occur in order to fully understand the seasonal fluctuations.

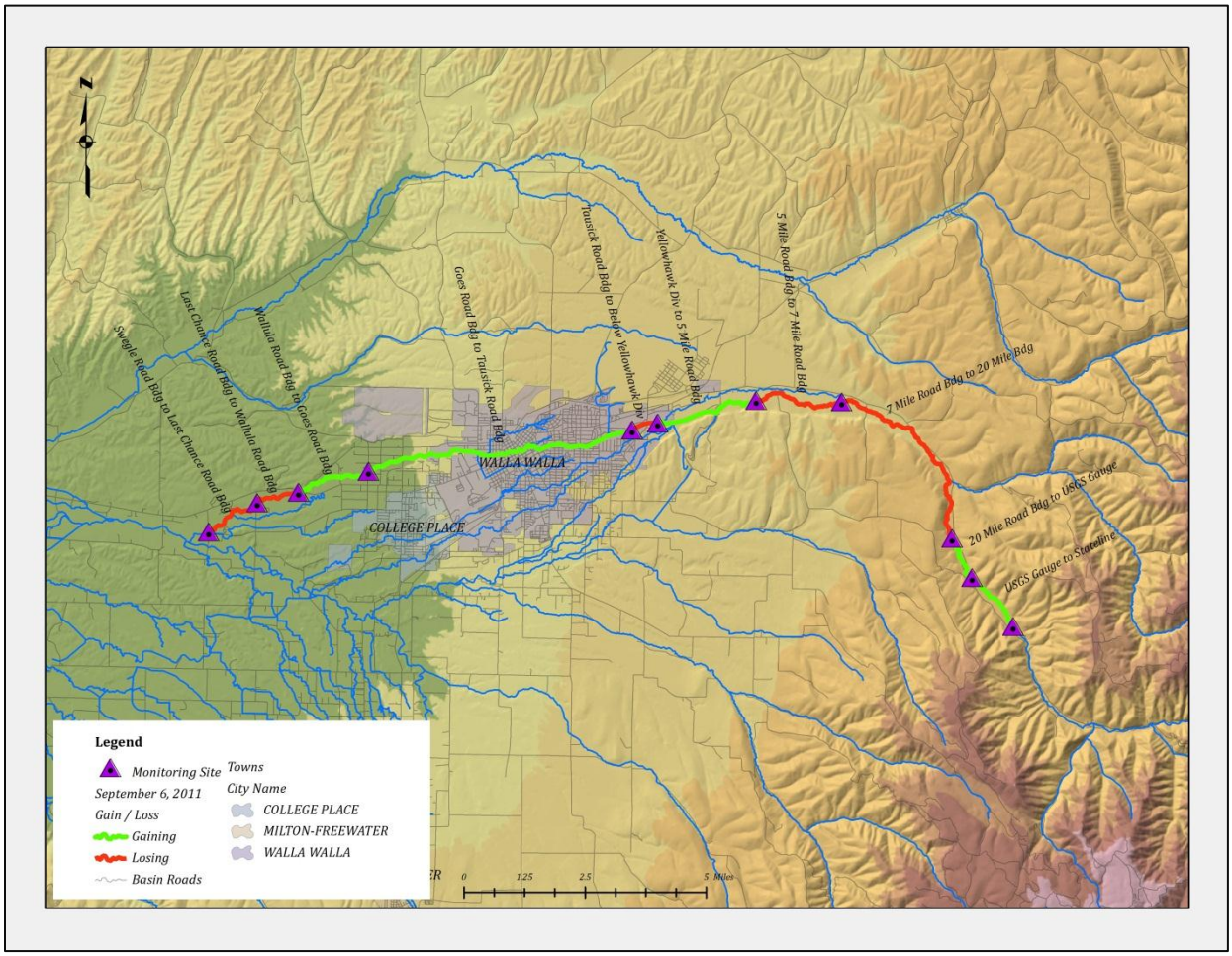


Figure 15: September 6, 2011 Mill Creek Gains / Losses per Reach

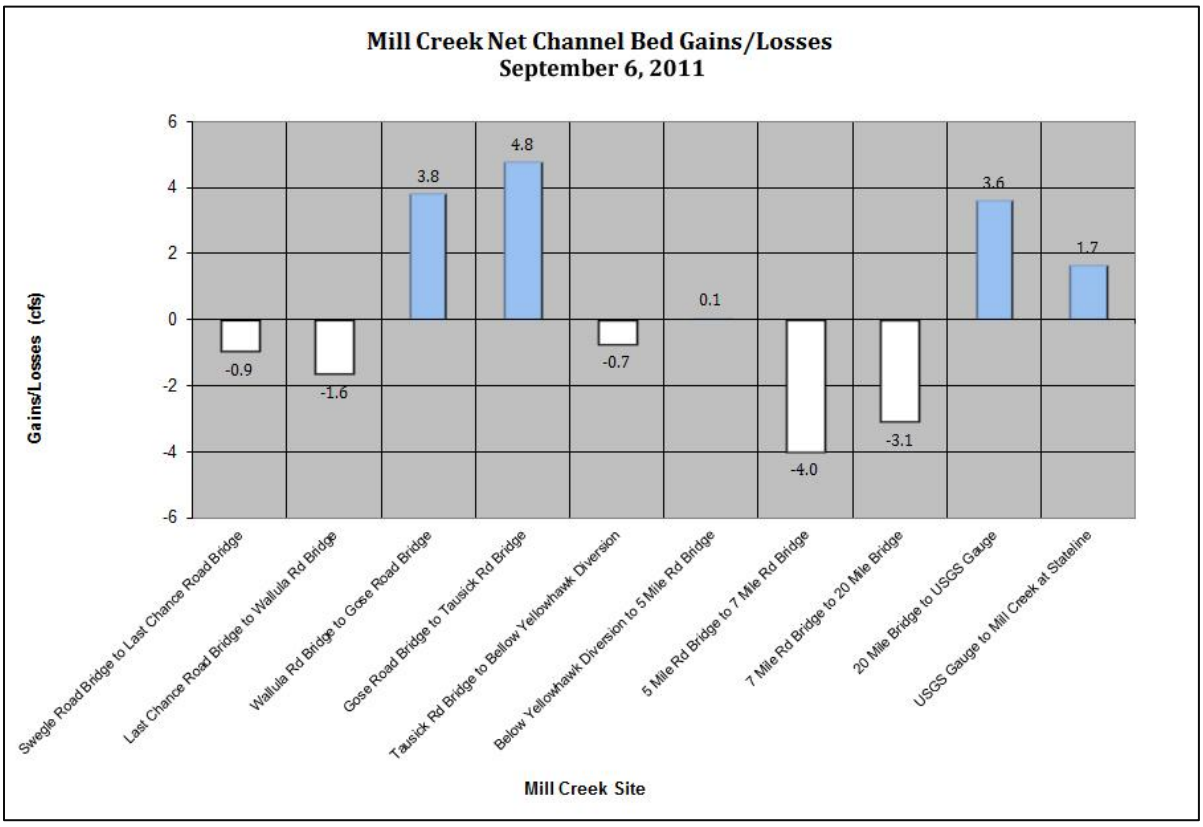


Figure 16: September 6, 2011 Net Gains and Losses Per Reach

The datasheets for the two Mill Creek seepage assessments can be found in Attachment B-1.

Utilizing the simple mass balance equation and the total of water exchanged in the designated modeled area from the July 7, 2011 dataset and the September 6, 2011 dataset were further quantified using percent distribution. The percentages of the total volume of water movement in the modeled area relative to distribution are displayed in *figure 17 and figure 18*. July 2011 results show that Mill Creek flows from the Oregon-Washington state line to the confluence with the Walla Walla River decline from 46.6 cfs to 18.1 cfs. Diversions (75%, 42.52 cfs) make up the majority of the water budget while the tributary inputs (9%, 5.0 cfs) and groundwater returns (16% 9.0 cfs) are less significant.

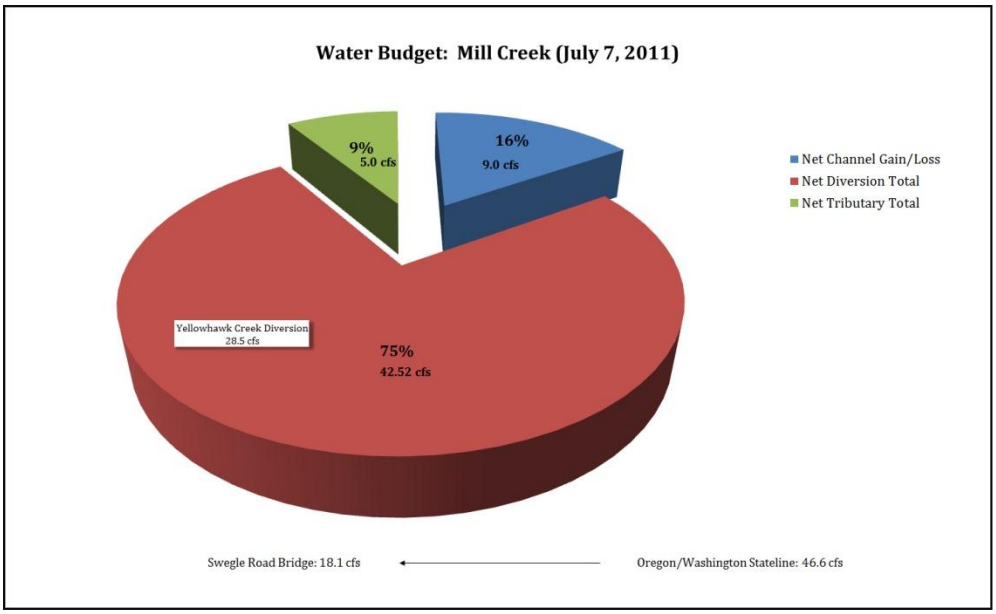


Figure 17: Water Budget July 7, 2011

In September although there's a decrease in volume the percentages are similar. Tributary inputs (10%, 3.5 cfs) and groundwater returns (10%, 3.5 cfs) combine to make up 21% of the total budget while diversions make up the remaining 79% (26.9 cfs).

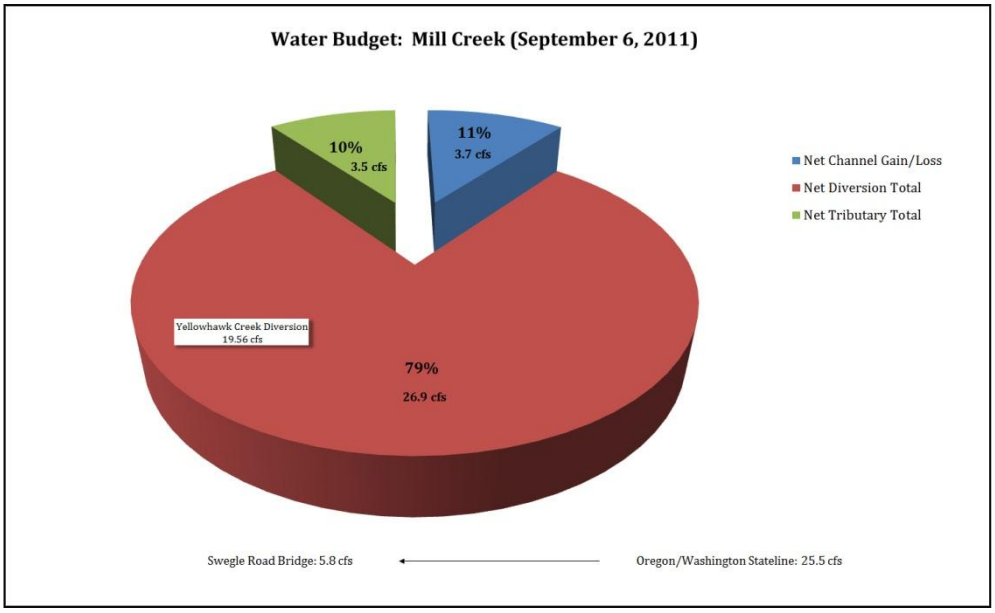


Figure 18: Water Budget Sept.6, 2011

Touchet River Seepage Assessment

The Touchet River is the largest tributary of the Walla Walla River in southeastern Washington. The river drains an area of approximately 740 square miles and is approximately 66 miles in length from the North and South Fork Touchet River confluence to the Walla Walla River.

The seepage assessments on the Touchet River were conducted on July 13, 2011 and in September 12, 2011. The WWBWC followed the same procedures discussed in the methodology section. The assessment area begins along the Dayton Levee just downstream of the North and South Forks of the Touchet River downstream to the Walla Walla River close to the town of Touchet. Eleven reaches were defined (Figure 19) based upon access, proximity to the next reach, and the geomorphology of the system. The thalweg was digitized using ArcMap 9.2 then the digitized layer was transformed into a linear route to allow for the ability to break the feature into uniform segments.

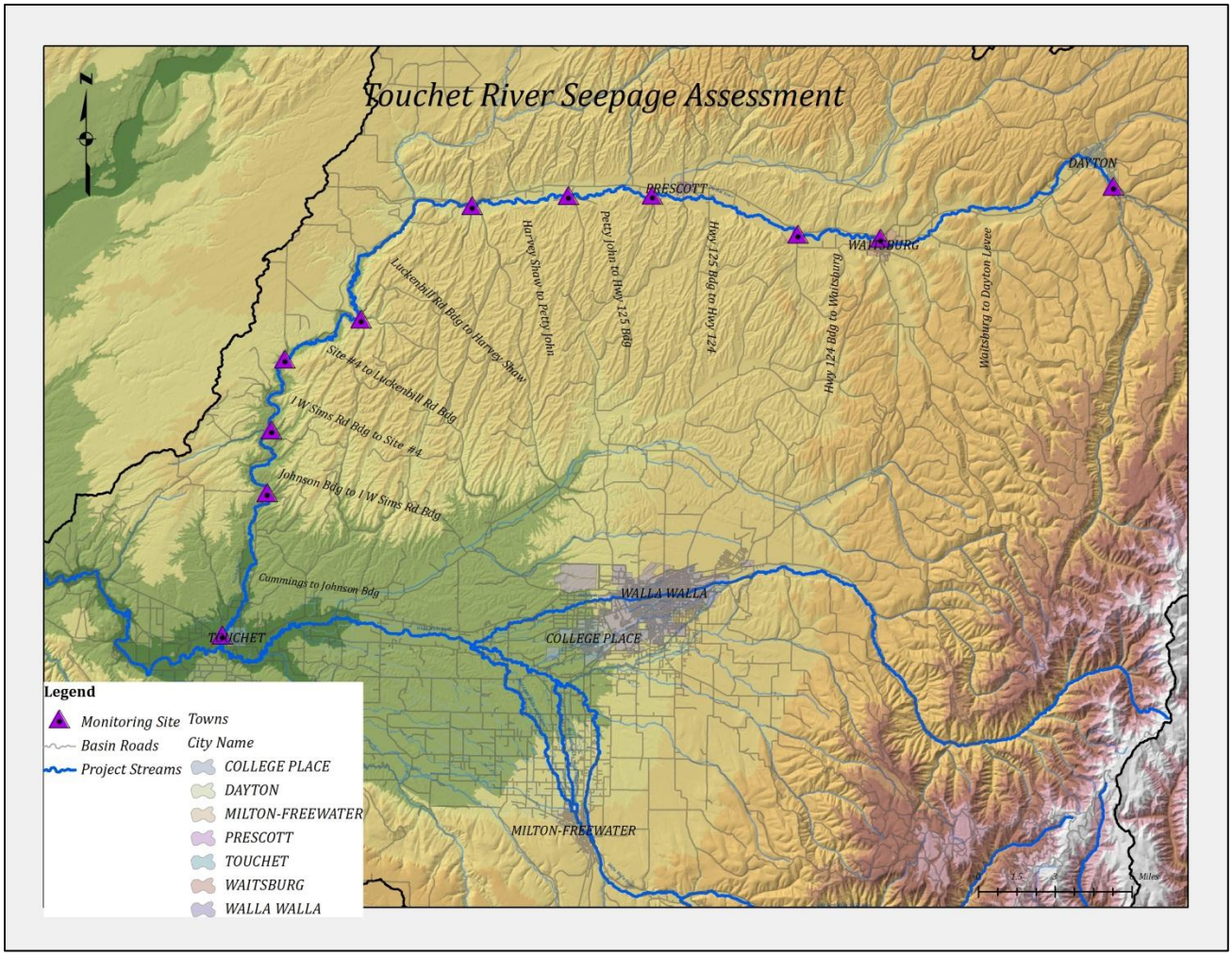


Figure 19: Touchet River Seepage Assessment Sampling Locations and Reaches

The first seepage assessment of 2011 was conducted on July 13th. From the initial 2011 assessment five reaches were defined as gaining while six reaches were defined as losing. Two of the gaining reaches were located in the "lower" part of the river downstream of Hoffman Road sampling site. *(Figures 20 and 21)*

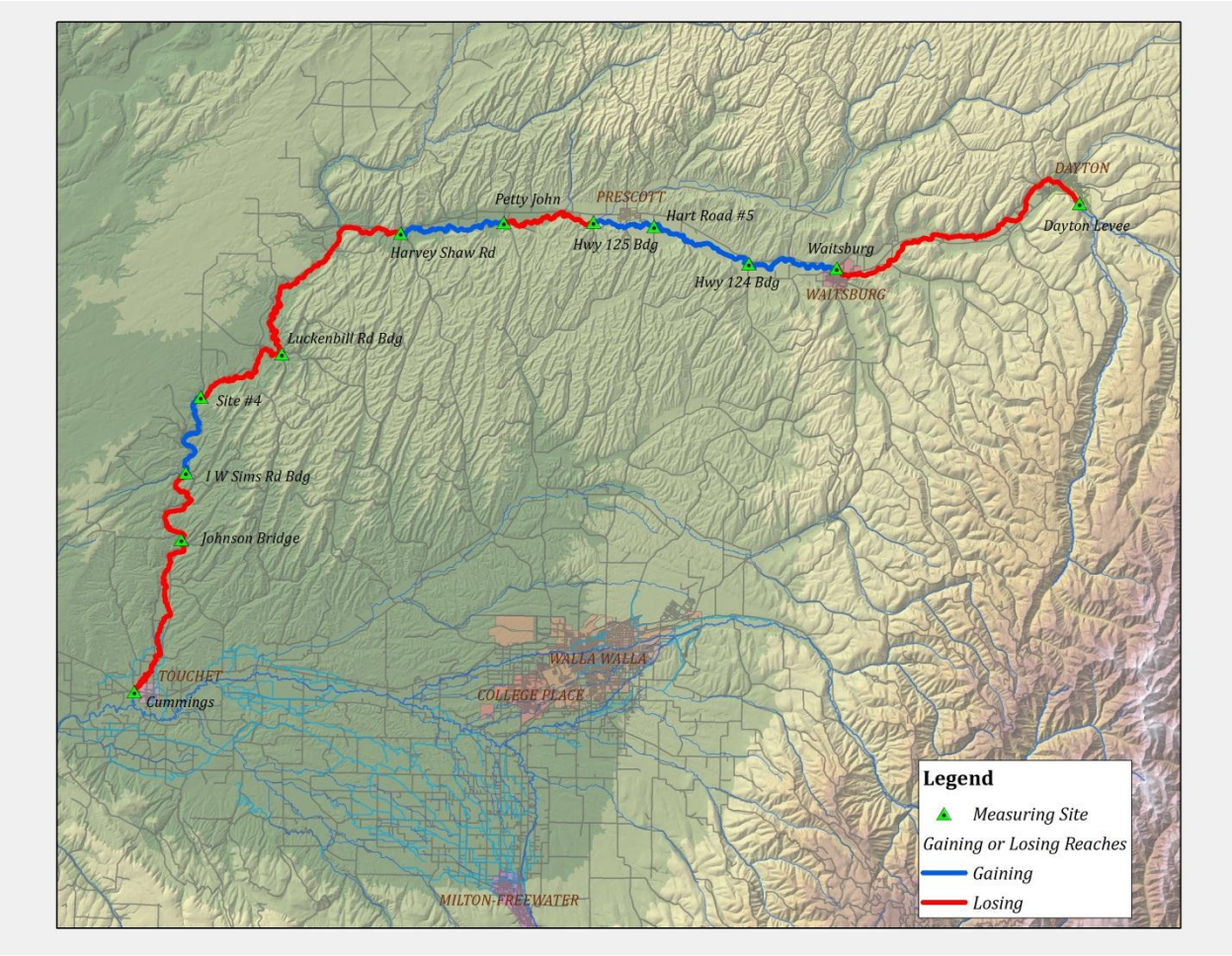


Figure 20: Touchet River Seepage Assessment July 13, 2011 Gains and Losses per Reach

Hart Road Bridge measuring site

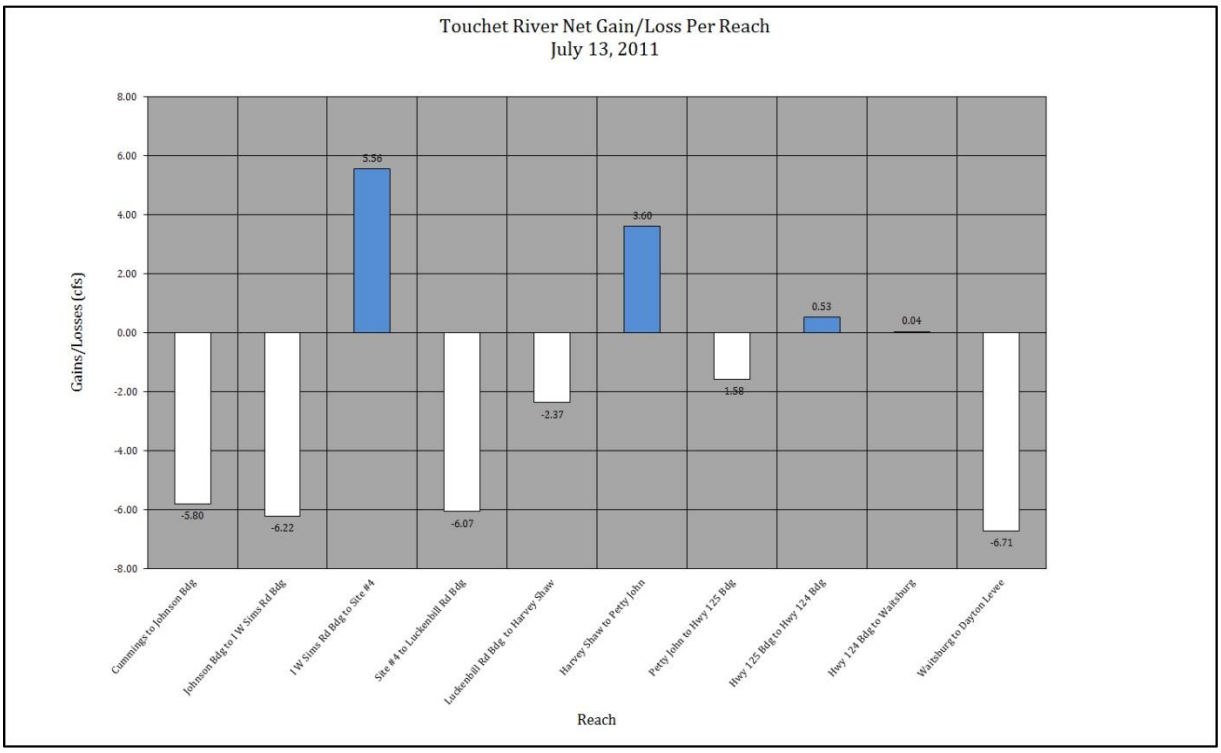


Figure 21 July 13, 2011 Net Gains and Losses per Reach

The second seepage assessment of 2011 on the Touchet River was conducted in September. In the late summer assessment four of the eleven reaches were identified as gaining reaches while seven were identified as losing reaches. *(Figures 22 and 23)* The two upper reaches from the town of Waitsburg to the Dayton Levee in July were identified as losing reaches were documented as gaining reaches in the September assessment.

Touchet River below the Hwy 125 Bridge, September 12, 2011

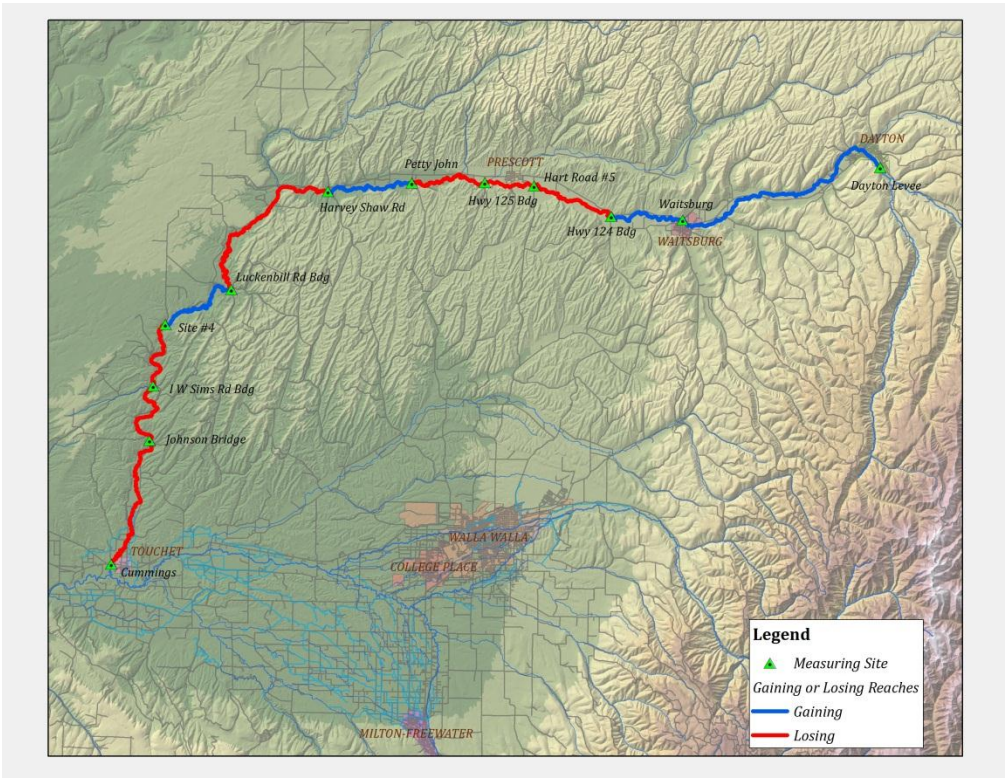


Figure 22: Touchet River Seepage Assessment September 12, 2011 Gains and Losses per Reach

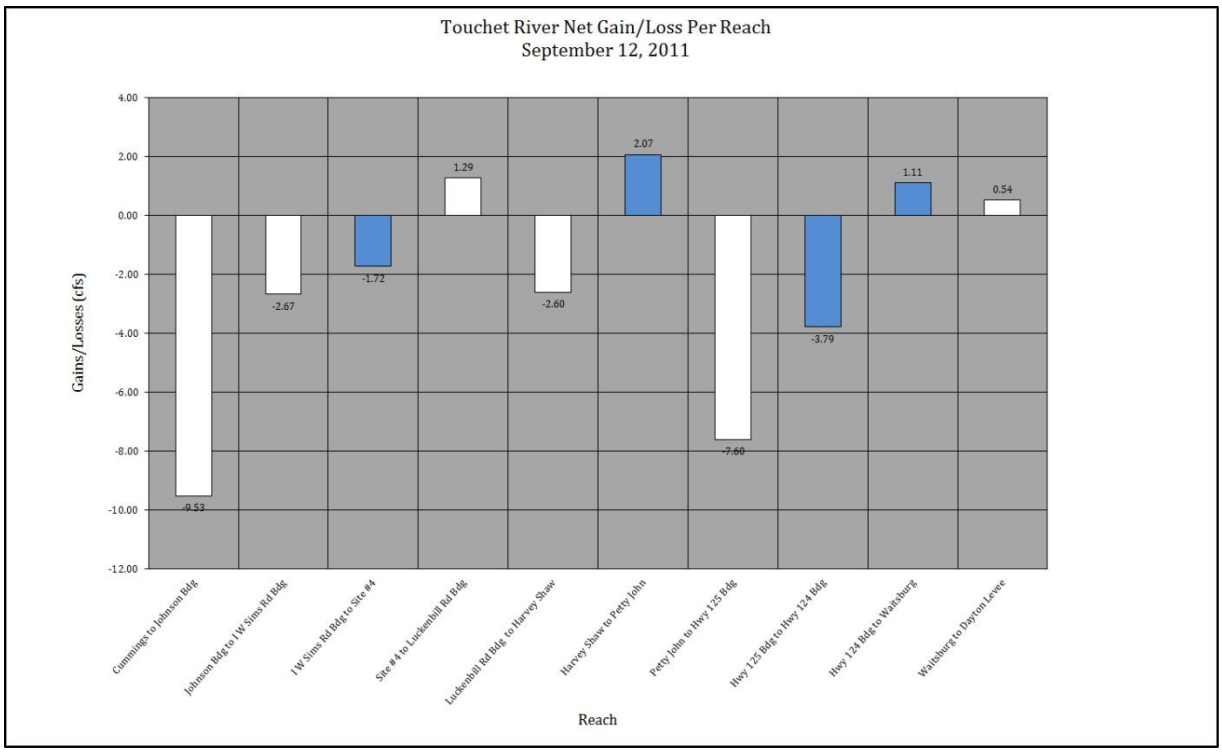


Figure 23: September 12, 2011 Net Gains and Losses per Reach

Utilizing the simple mass balance and the total of water exchanged in the designated modeled area from the July 2011 dataset and the 2011 September dataset were further quantified using percent distribution. The percentages of the total volume of water movement in the modeled area relative to distribution are displayed in *figures 24 and 25*. July 2011 results show that the Touchet River flows from above Dayton to the confluence with the Walla Walla River decline from 87.57 cfs to 57.04 cfs. Diversions (44%, 25.9 cfs) take up less than half of the water budget while the tributary inputs (24%, 14.2 cfs) and groundwater returns (32% -19 cfs) total 56% of the total budget.

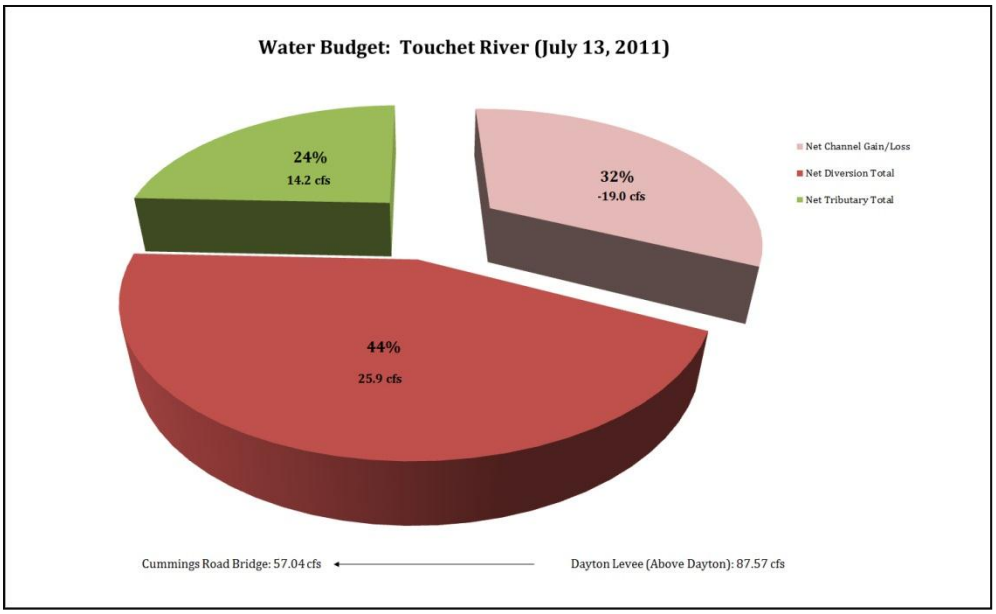


Figure 24: Water Budget July 13,

In September although there's a decrease in volume the percentages are similar. Tributary inputs (18%, 11.9 cfs) and groundwater losses (37%, -24.1 cfs) combine to make up 55% of the total budget while diversions make up the remaining 45% (24.1 cfs). The noticeable difference from the three other systems examined, the Touchet River is a net losing river system.

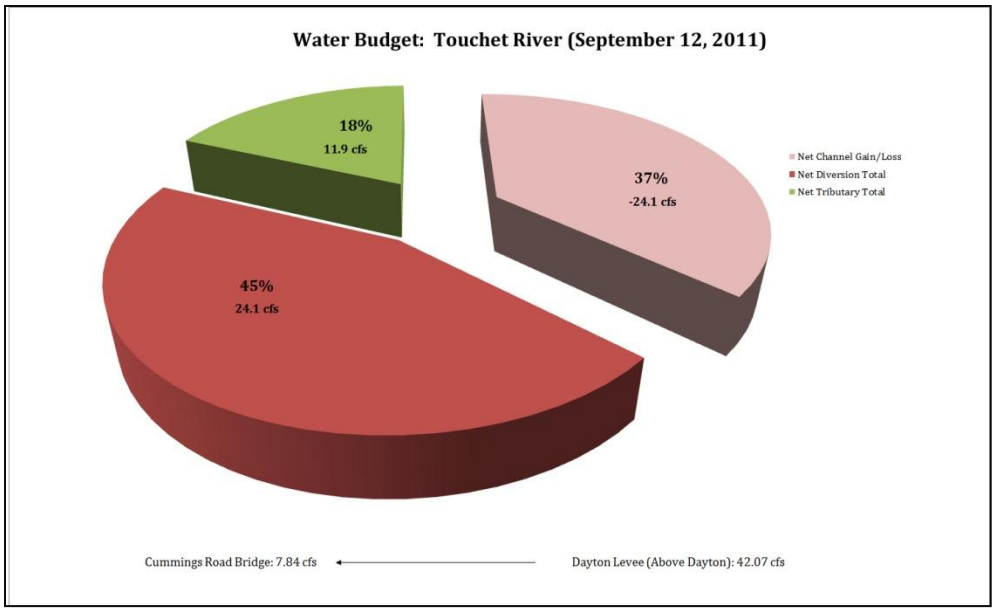


Figure 25: Water Budget Sept. 12. 2011

Yellowhawk Creek Seepage Assessment

Yellowhawk Creek is designated as a priority stream for preservation and restoration in the Snake River Salmon Recovery Plan, the WRIA 32 Watershed Plan and the Walla Walla Sub-Basin Plan. The stream is a critical fish passage stream during low flows from late June to mid-October. A distributary to Mill Creek from the Walla Walla River, Yellowhawk Creek flows are maintained by the US Army Corps of Engineers as mitigation for extremely low flows and high temperatures in the concrete Mill Creek flood control channel through downtown Walla Walla.[9]

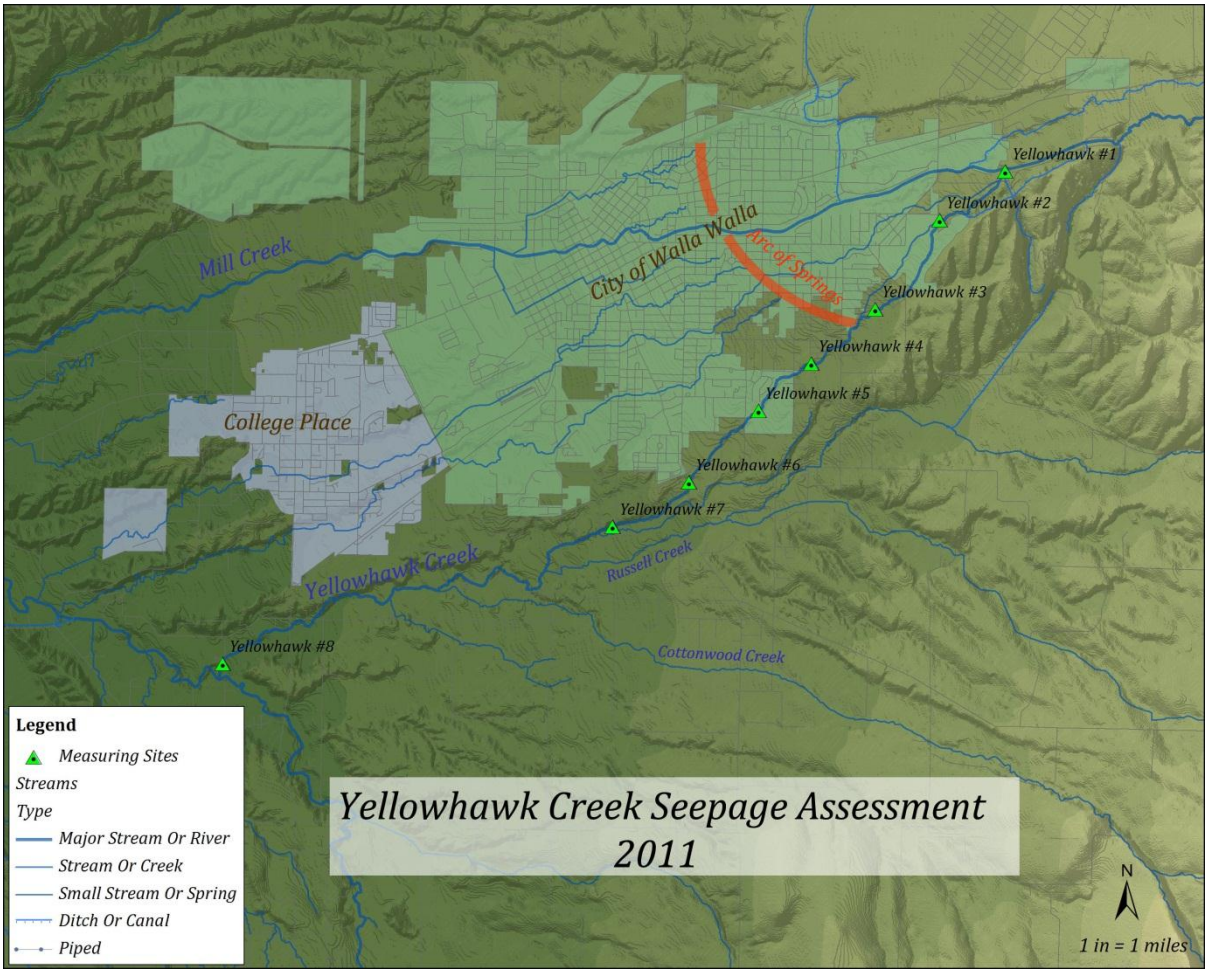


Figure 26: Yellowhawk Creek measuring sites, 2011

The seepage assessments on Yellowhawk Creek were conducted in the early summer and the late summer of 2011. The WWBWC followed the same procedures discussed in the methodology section. In June of 2011 the WWBWC, agency partners, and volunteers conducted seepage assessments from the beginning of Yellowhawk Creek at the diversion location on Mill Creek to its confluence with the Walla Walla River (Figure 26). Yellowhawk Creek is unique in that its flow is controlled on an annual basis which presents a system which has less variability in discharge than the other measured natural systems. Even with the controlled flow diverted off of Mill Creek feeding Yellowhawk Creek there is a variation of flow entering into the creek from the tributaries flowing into the lower reaches.

[9] *Yellowhawk Creek Urban Riparian Restoration Project, Kooskooskie Commons, Judith S. Johnson*

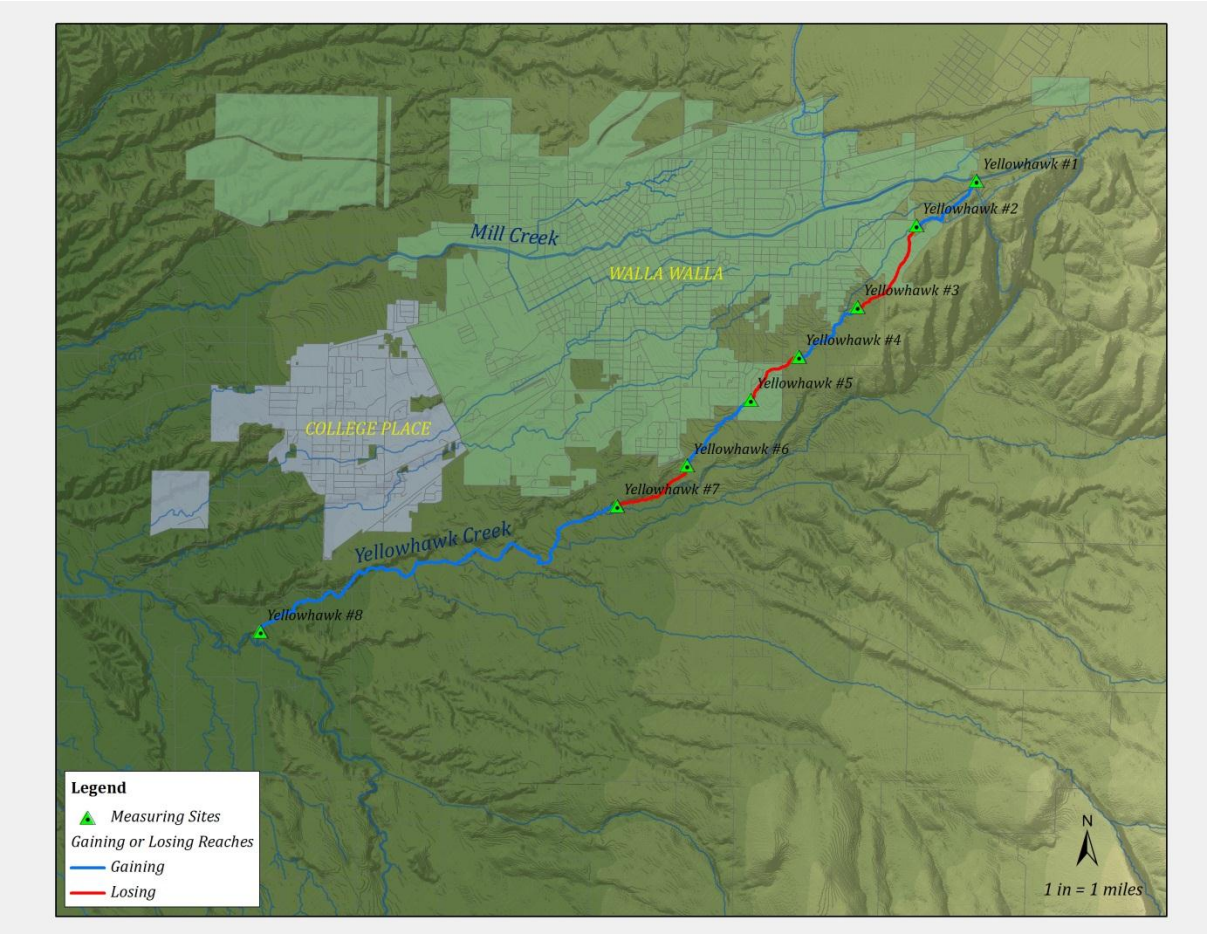


Figure 27: Net Gaining / Losing Reaches, June1, 2011

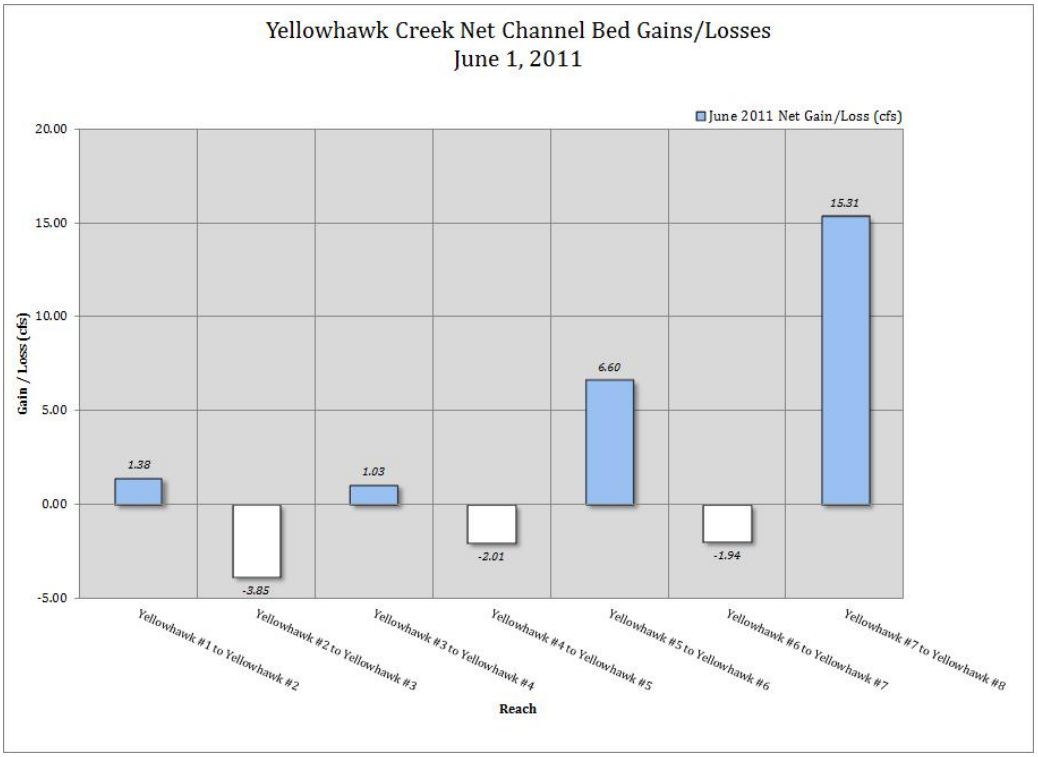


Figure 28: June1, 2011 Yellowhawk Gains and Losses per Reach

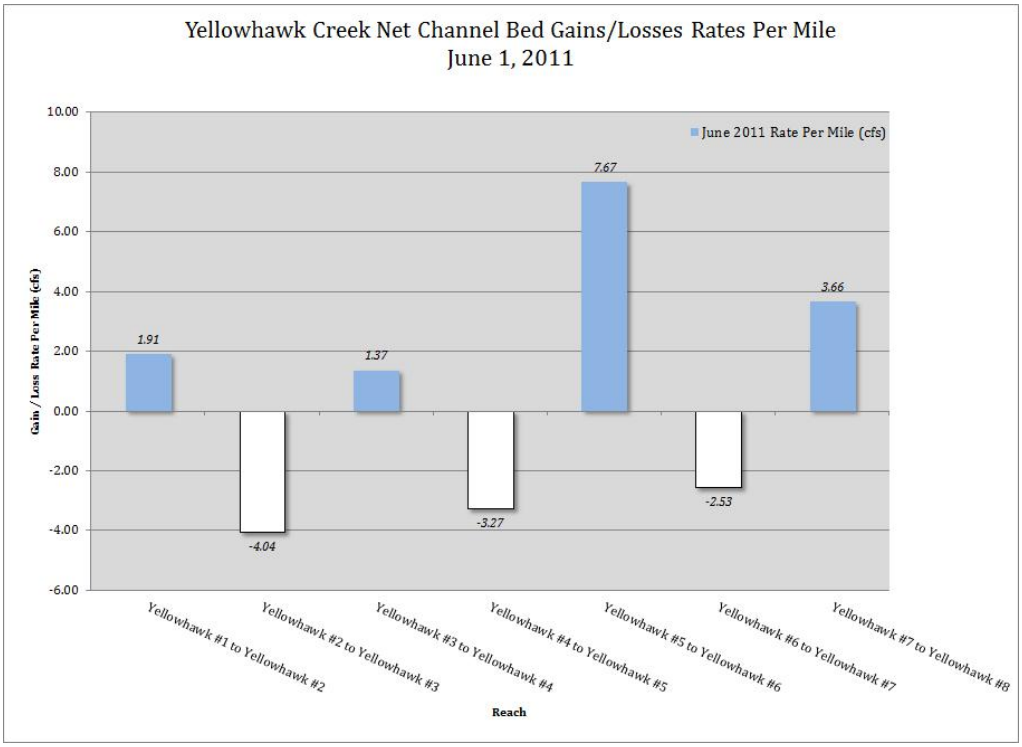


Figure 29: Yellowhawk Creek Net Channel Bed Gains/Losses (Rates per Mile) June 1, 2011

The late summer assessment on Yellowhawk Creek covered the same reaches as the spring assessment from the diversion off of Mill Creek to the Walla Walla River. The thalweg of both systems were digitized using ArcView 9.2 then the digitized layers were transformed into linear routes to allow for the ability to break the features into uniform segments. From the initial assessment of Yellowhawk Creek it appears that the gaining reaches correspond to the tributary inflows (Lower reaches are highly influenced by Russell and Cottonwood Creek inflows.) and the "arc" of springs located between reaches 4 and 5.

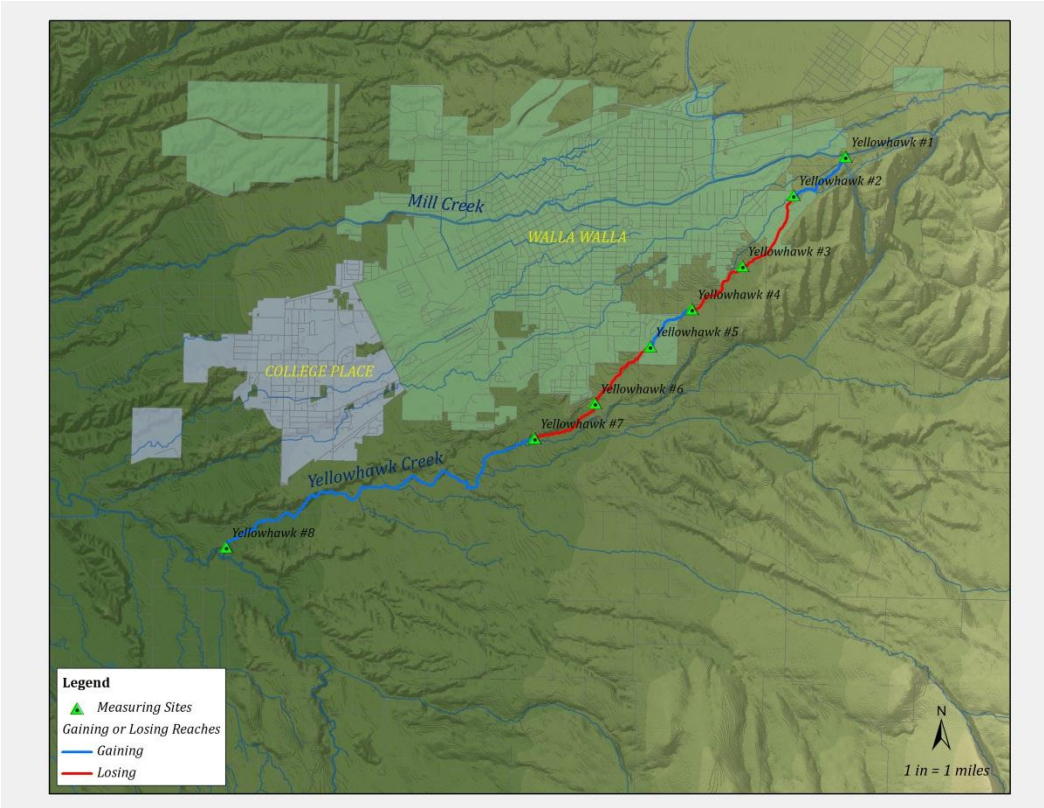


Figure 30: September 8, 2011 Yellowhawk Seepage Assessment Gaining and Losing Reaches and Rates Per Mile.

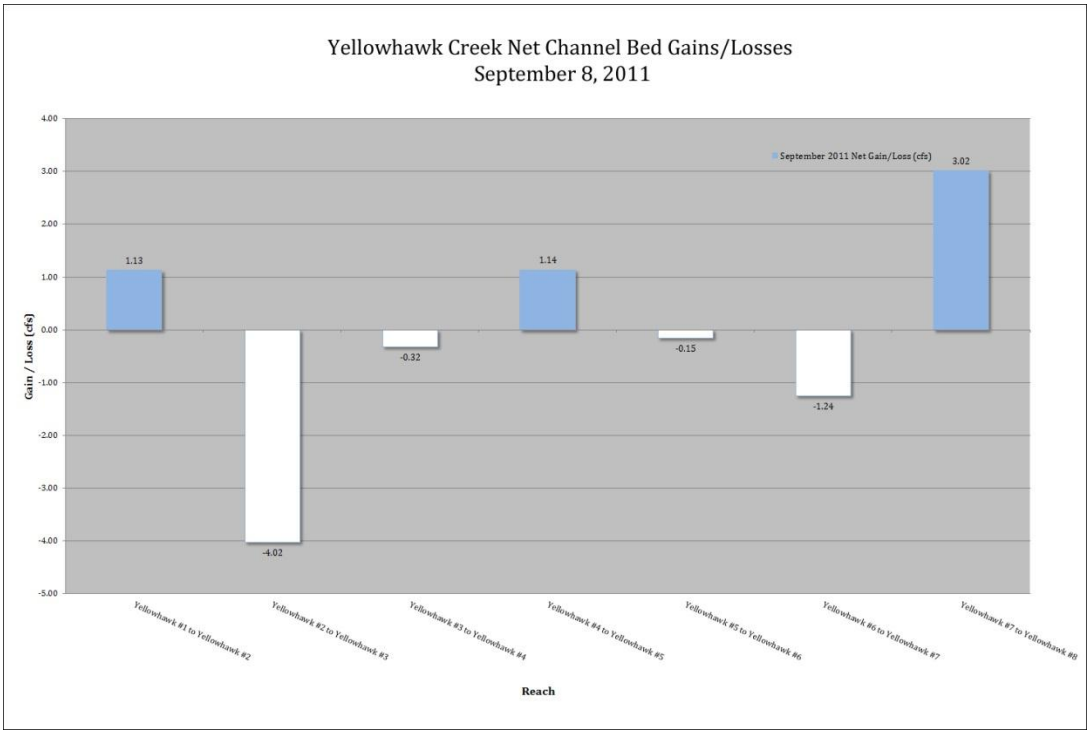


Figure 31: Yellowhawk Creek Net Channel Bed Gain/Loss September 8, 2011

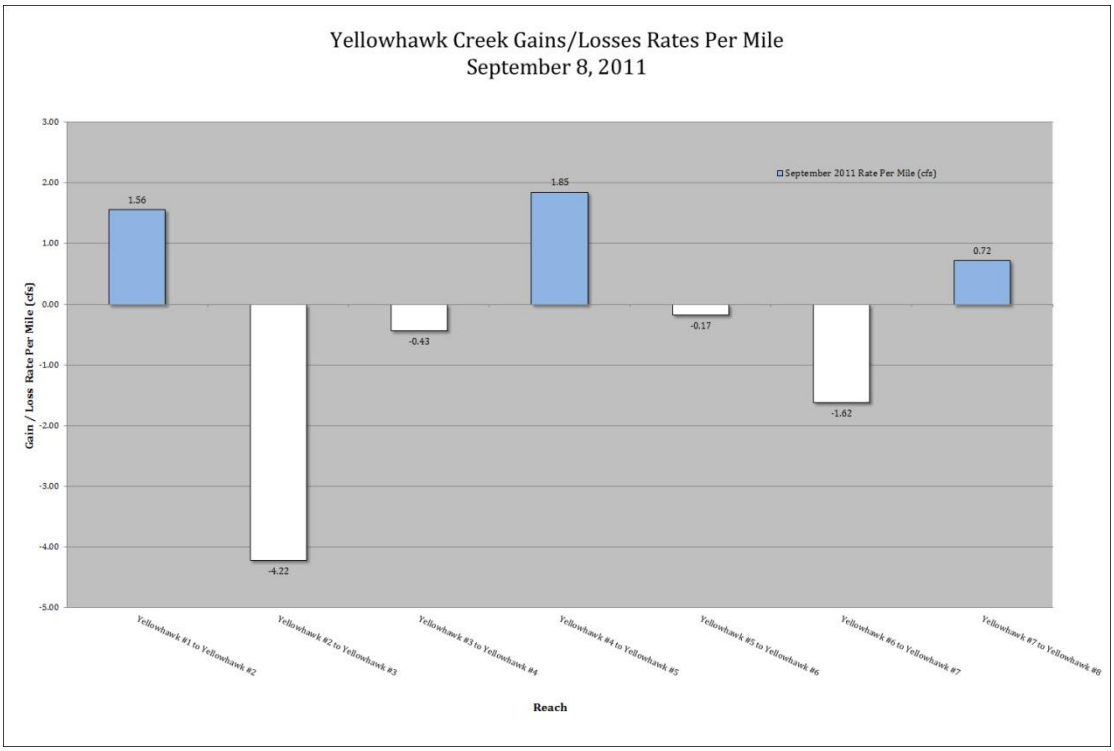


Figure 32: Net Gaining / Losing Reaches and Rate per Mile

Utilizing the simple mass balance equation and the total of water exchanged in the designated modeled area from the June 2011 dataset and the September 2011 dataset were further quantified using percent distribution. The percentages of the total volume of water movement in the modeled area relative to distribution are displayed in *figures 33 and 34*. June 2011 results show that Yellowhawk Creek flows from the diversion off of Mill Creek to the confluence with the Walla Walla River increases from 27.26 cfs to 79.54 cfs. Diversions (12%, 42.52 cfs) make up less than a third of the water budget while the tributary inputs (44%, 9.0 cfs) and groundwater returns (44% 48.8 cfs) combine to make up the majority of the water budget.

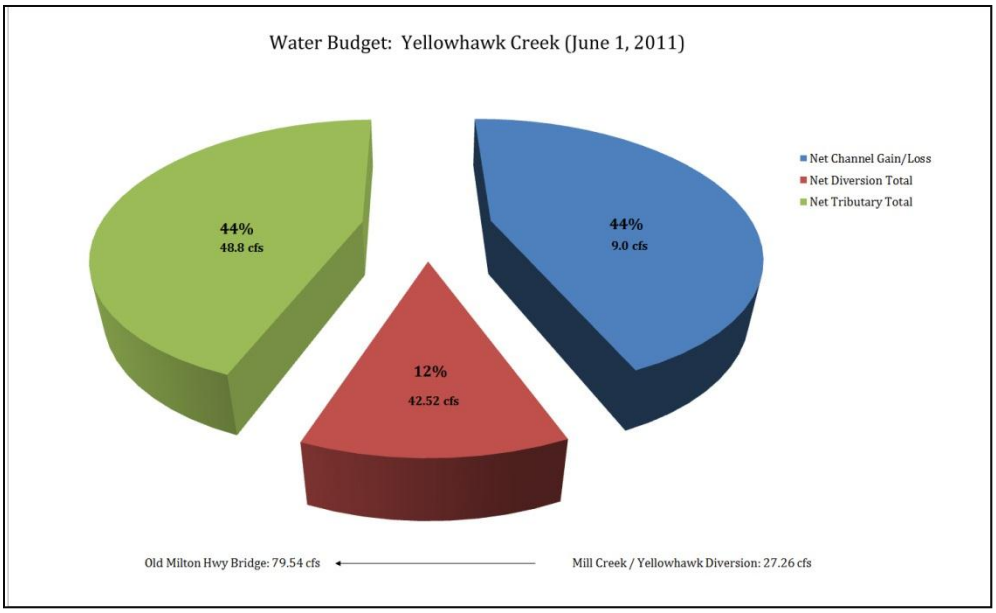


Figure 33: Water Budget June 1, 2011

In September there's a significant change in the water budget for Yellowhawk Creek. Tributary inputs (35%, 4.1 cfs) and groundwater losses (4%, -.4 cfs) combine to make up 39% of the total budget while diversions make up the remaining 61% (7.11 cfs).

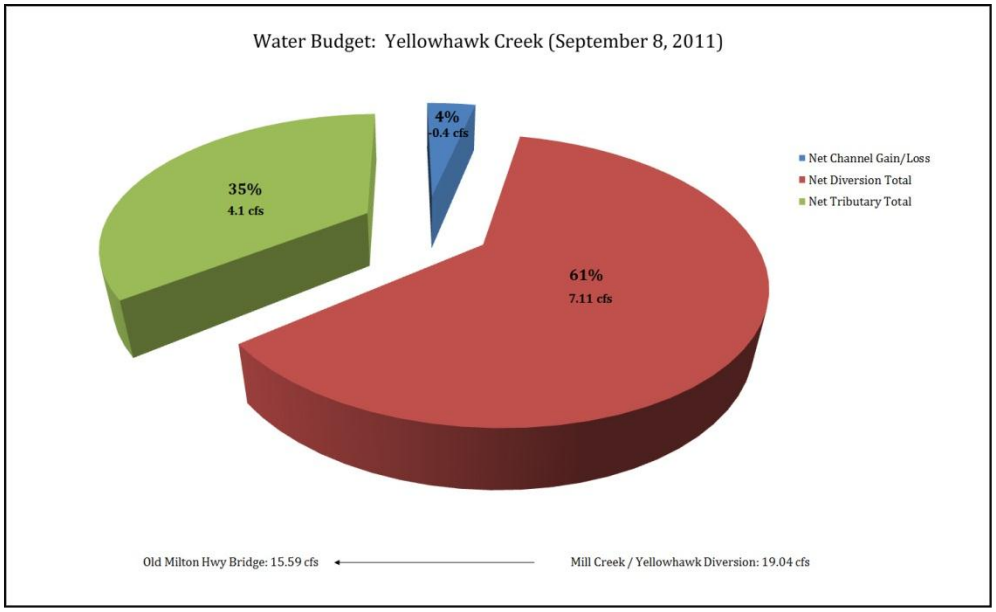


Figure 34: Water Budget Sept. 6, 2011

The datasheets for the two Yellowhawk Creek seepage assessments can be found in Attachment B-3.

Summary:

The water budget analysis and data sets discussed in this report provide water managers and researchers in the Walla Walla basin a more refined tool by which to look at seasonal and spatial flow distribution in the Walla Walla River, Touchet River, Mill Creek, and Yellowhawk Creek systems. While these values represent 'snap shots' in time, the information can be coupled with the numerous continuous gauges sites to help piece together the transient nature of each of the flow systems. Rates of net gains and losses provide an estimate of the magnitude of channel bed flux relative to three important irrigation related seasons in the Walla Walla basin.

The analysis tends to support the current theories about where each system shows groundwater gains and losses with several exceptions. Areas such as the Walla Walla River in Oregon at the levee segment that have been shown through other studies to be areas of high loss are confirmed using this data collection and analysis approach.

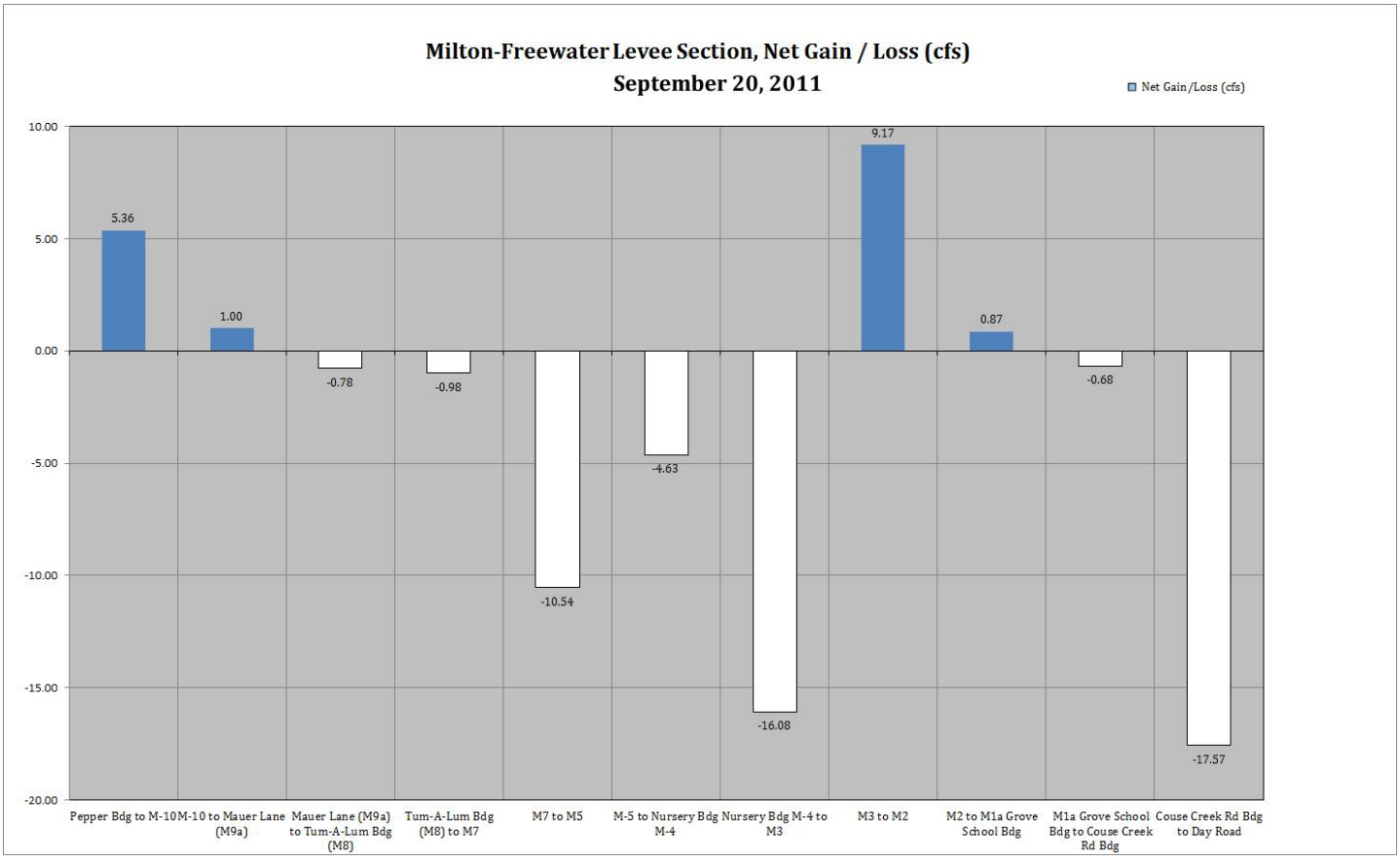


Figure 35: Milton Freewater Levee Section, Walla Walla River, September 20, 2011

With additional basin wide efficiency projects being proposed the data sets collected for the assessed systems will help provide information on how each system may be affected. Further seepage assessments should be conducted to confirm these results with particular focus being spent on areas where analysis was either inconclusive or contradictory to commonly-held theories about each of the assessed systems.

Collaborators:

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Water Right Solutions, Walla Walla, Washington. Bill Neve, PO Box 551, Walla Walla, WA 99362

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Attachment A

Attachment A-1 June 2002 Seepage Data Set

Flow Measurement Location	Actual River Mile	Rate Per Mile	Net Gain/Loss	Gross Gain/Loss Change (Instream)	Net Diversion Total	Net Trib Total	Flow (cfs)
Peppers Bridge Location (WDFW/WDOE Gauge station)	41.07	15.85	19.50	19.50	0.00	0.00	118.00
Walla Walla River WWBWC # M-10 (MNWW40.8)	42.30	9.20	6.90	6.90	0.00	0.00	98.50
Walla Walla River WWBWC # M-9a (Mauer Lane)	43.05	-1.69	-1.00	-1.00	0.00	0.00	91.60
Tumalum Road Bridge (M-8) (MNWW42.3)	43.64	0.35	0.20	0.20	0.00	0.00	92.60
Walla Walla River (M-7) (MNWW42.9)	44.21	-31.52	-35.30	-35.30	0.00	0.00	92.40
Walla Walla River M-5b (MNWW44)	45.33	14.83	8.60	15.60	0.00	7.00	127.70
Walla Walla River Nursery Bridge (M-4) (MNWW44.5)	45.91	-23.29	-18.40	-18.40	0.00	0.00	112.10
Levy, 0.5 mile us of Nursery Bridge (M-3)	46.70	-25.52	-29.60	-147.20	-117.60	0.00	130.50
Grove School Bridge (M-1a) (MNWW46.1)	47.86	18.26	37.80	32.20	-5.60	0.00	277.70
Day Road	49.93	-33.93	-30.20	-30.20	0.00	0.00	245.50
Joe West Bridge (MNWW49.1)	50.82	19.82	32.50	72.20	-2.10	41.80	275.70
South Fork Bridge	52.46	0.21	1.10	-2.90	-4.00	0.00	203.50
SF Walla Walla River at CTUIR Fish Hatchery (SFWW7.0)	57.63	-12.47	-20.20	-20.20	0.00	0.00	206.40
SF Walla Walla River (SFWW9.0)	59.25	-5.13	-9.40	-9.40	0.00	0.00	226.60
OWRD Gauge Station, SF Walla Walla River	61.08						236.00

Flow data applies to River flow at Location ID

Rate/Net gain-loss/Gross/Net Div and Trib data applies from Location ID to next UPSTREAM site.

Attachment A-2	August 2002 Seepage Data Set						
Flow Measurement Location	**Actual River Mile**	**Rate Per Mile**	**Net Gain/Loss**	**Gross Gain/Loss Change (Instream)**	**Net Diversion Total**	**Net Trib Total**	**Flow (cfs)**
Peppers Bridge Location (WDFW/WDOE Gauge station)	41.07	-0.82	-0.40	-0.10	0.00	0.30	12.40
Oregon/WA stateline (WDFW Gauge station 2001-2)	41.56	1.49	1.10	1.10	0.00	0.00	12.50
Walla Walla River WWBWC # M-10 (MNWW40.8)	42.30	4.53	3.40	3.40	0.00	0.00	11.40
Walla Walla River WWBWC # M-9a (Mauer Lane)	43.05	-7.46	-4.40	-4.40	0.00	0.00	8.00
Tumalum Road Bridge (M-8) (MNWW42.3)	43.64	-1.23	-0.70	-0.70	0.00	0.00	12.40
Walla Walla River (M-7) (MNWW42.9)	44.21	-13.85	-5.40	-5.40	0.00	0.00	13.10
Walla Walla River (M-6) Gravel Pit (MNWW43.6)	44.60	-21.10	-15.40	-15.40	0.00	0.00	18.50
Walla Walla River M-5b (MNWW44)	45.33	0.00	0.00	7.40	0.00	7.40	33.90
Levy, Willow Lane (M-5a)	45.38	-9.81	-5.20	-5.20	0.00	0.00	26.50
Walla Walla River Nursery Bridge (M-4) (MNWW44.5)	45.91	-10.51	-8.30	-12.90	-4.60	0.00	31.70
Levy, 0.5 mile us of Nursery Bridge (M-3)	46.70	-3.88	-4.50	-54.30	-49.80	0.00	44.60
Grove School Bridge (M-1a) (MNWW46.1)	47.86	6.51	7.10	2.90	-4.20	0.00	98.90
Couse Creek Road Bridge (MNWW47)	48.95	-3.47	-3.40	-6.80	-3.40	0.00	96.00
Day Road	49.93	2.02	1.80	1.80	0.00	0.00	102.80
Joe West Bridge (MNWW49.1)	50.82	3.96	6.50	4.20	-7.80	5.50	101.00
South Fork Bridge	52.46	1.31	1.80	-3.20	-5.00	0.00	96.80
SF Walla Walla River (SFWW1.7)	53.83	1.74	6.60	-0.90	-7.50	0.00	100.00
SF Walla Walla River at CTUIR Fish Hatchery (SFWW7.0)	57.63	5.37	8.70	8.70	0.00	0.00	100.90
SF Walla Walla River (SFWW9.0)	59.25	-4.21	-7.70	-7.80	-0.10	0.00	92.20
OWRD Gauge Station, SF Walla Walla River	61.08	x	x	x	x	x	100.00

Flow data applies to River flow at Location ID

Rate/Net gain-loss/Gross/Net Div and Trib data applies from Location ID to next UPSTREAM site.

Attachment A-3 June 2003 Seepage Data Set

Flow Measurement Location	Actual River Mile	Rate Per Mile	Net Gain/Loss	Gross Gain/Loss Change (Instream)	Net Diversion Total	Net Trib Total	Flow (cfs)
Oregon/WA stateline (WDFW Gauge station 2001-2)	41.56	7.16	5.30	4.90	-0.40	0.00	11.90
Walla Walla River WWBWC # M-10 (MNWW40.8)	42.30	2.13	1.60	1.60	0.00	0.00	7.00
Walla Walla River WWBWC # M-9a (Mauer Lane)	43.05	-11.02	-6.50	-6.50	0.00	0.00	5.40
Tumalum Road Bridge (M-8) (MNWW42.3)	43.64	3.16	1.80	1.80	0.00	0.00	11.90
Walla Walla River (M-7) (MNWW42.9)	44.21	-17.95	-7.00	-7.00	0.00	0.00	10.10
Walla Walla River (M-6) Gravel Pit (MNWW43.6)	44.60	-11.51	-8.40	-8.40	0.00	0.00	17.10
Walla Walla River M-5b (MNWW44)	45.33	-14.72	-8.54	-7.90	0.00	0.64	25.50
Walla Walla River Nursery Bridge (M-4) (MNWW44.5)	45.91	2.28	1.80	-3.40	-5.20	0.00	33.40
Levy, 0.5 mile us of Nursery Bridge (M-3)	46.70	-2.84	-3.30	-80.80	-77.50	0.00	36.80
Grove School Bridge (M-1a) (MNWW46.1)	47.86	8.81	9.60	5.60	-4.00	0.00	117.60
Couse Creek Road Bridge (MNWW47)	48.95	0.20	0.20	-3.10	-3.30	0.00	112.00
Day Road	49.93	3.48	3.10	3.00	-0.10	0.00	115.10
Joe West Bridge (MNWW49.1)	50.82	-8.09	-13.26	-7.00	-4.60	10.86	112.10
South Fork Bridge	52.46	2.96	15.30	6.80	-8.50	0.00	119.10
SF Walla Walla River at CTUIR Fish Hatchery (SFWW7.0)	57.63	-5.00	-8.10	-8.10	0.00	0.00	112.30
SF Walla Walla River (SFWW9.0)	59.25	5.96	10.90	10.70	-0.20	0.00	120.40
OWRD Gauge Station, SF Walla Walla River	61.08						109.70

Flow data applies to River flow at Location ID

Rate/Net gain-loss/Gross/Net Div and Trib data applies from Location ID to next UPSTREAM site.

Attachment A-4

August 2003 Data Set

Flow Measurement Location	Actual River Mile	Rate Per Mile	Net Gain/Loss	Gross Gain/Loss Change (Instream)	Net Diversion Total	Net Trib Total	Flow (cfs)
Highway 12 Bridge (Mouth of Walla Walla River)	0.00						
Nine Mile Bridge	8.54	-1.81	-13.32	-13.32	0.00	0.00	3.64
USGS Touchet Gage	15.91	-2.04	-23.97	-21.24	0.00	2.73	16.96
Lowden Rd Bridge	27.64	13.10	26.59	23.80	-2.79	0.00	38.20
MacDonald Rd Bridge	29.67	-1.71	-6.20	-28.00	-21.80	0.00	14.40
Detour Road	33.29	2.97	3.24	2.24	-1.20	0.20	42.40
Swegle Road Bridge	34.38	-0.46	-0.67	-0.67	0.00	0.00	40.16
Last Chance Road Bridge	35.84	-3.26	-5.47	-7.67	-2.40	0.20	40.83
Beet Road Bridge	37.52	-9.49	-5.60	-5.60	0.00	0.00	42.90
Walla Walla River (WDFW #5 Site)	38.11	0.89	1.20	25.70	-0.80	25.30	48.50
Old Milton HWY Bridge	39.46	2.42	3.90	3.90	0.00	0.00	22.80
Peppers Bridge Location (WDFW/WDOE Gauge station)	41.07	6.37	3.12	3.20	-0.22	0.30	18.90
Oregon/WA stateline (WDFW Gauge station 2001-2)	41.56	0.95	0.70	0.70	0.00	0.00	15.70
Walla Walla River WWBWC # M-10 (MNWW40.8)	42.30	-1.07	-0.80	-0.90	-0.10	0.00	15.00
Walla Walla River WWBWC # M-9a (Mauer Lane)	43.05	-1.69	-1.00	-1.00	0.00	0.00	15.90
Tumalum Road Bridge (M-8) (MNWW42.3)	43.64	-4.56	-2.60	-2.60	0.00	0.00	16.90
Walla Walla River (M-7) (MNWW42.9)	44.21	-12.82	-5.00	-5.00	0.00	0.00	19.50
Walla Walla River (M-6) Gravel Pit (MNWW43.6)	44.60	-21.54	-16.80	-14.20	0.00	2.60	24.50
Levy, Willow Lane (M-5a)	45.38	0.94	0.50	0.50	0.00	0.00	38.70
Walla Walla River Nursery Bridge (M-4) (MNWW44.5)	45.91	-7.09	-5.60	-10.60	-5.00	0.00	38.20
Levy, 0.5 mile us of Nursery Bridge (M-3)	46.70	-3.71	-4.30	-47.80	-43.50	0.00	48.80
Grove School Bridge (M-1a) (MNWW46.1)	47.86	4.22	4.60	-0.70	-5.30	0.00	96.60
Couse Creek Road Bridge (MNWW47)	48.95	6.24	6.12	3.10	-3.02	0.00	97.30
Day Road	49.93	0.56	0.50	0.40	-0.10	0.00	94.20
Joe West Bridge (MNWW49.1)	50.82	3.84	6.30	2.80	-5.40	1.90	93.80
South Fork Bridge	52.46	2.10	2.88	-5.40	-8.28	0.00	91.00
SF Walla Walla River (SFWW1.7)	53.83	2.78	10.56	6.90	-3.66	0.00	103.30
SF Walla Walla River at CTUIR Fish Hatchery (SFWW7.0)	57.63	2.10	3.40	3.40	0.00	0.00	96.40
SF Walla Walla River (SFWW9.0)	59.25	-7.65	-14.00	-14.00	0.00	0.00	93.00
OWRD Gauge Station, SF Walla Walla River	61.08	-4.08	-24.36	0.00	0.00	24.36	107.00
Walla Walla River 47 feet upstream of Burnt Cabin (Find location)	67.05	-1.55	-1.70	1.80	0.00	3.50	89.50
Walla Walla River 71 feet us Table Creek	68.15	8.37	16.23	27.70	0.00	11.47	87.70
SF Walla Walla River (upstream of Skiphorton)	70.09	2.85	10.52	16.60	0.00	6.08	60.00
Upper South Fork Walla Walla River (Reser Creek)	73.78						43.40

Flow data applies to River flow at Location ID

Rate/Net gain-loss/Gross/Net Div and Trib data applies from Location ID to next UPSTREAM site.

Attachment A-5 June 2004 Data Set

Flow Measurement Location	Actual River Mile (GIS)	Rate Per Mile	Net Gain/Loss	Gross Gain/Loss Change (Instream)	Net Diversion Total	Net Trib Total	Flow (cfs)
Highway 12 Bridge (Mouth of Walla Walla River)	0.00	x	x	x	x	x	x
Nine Mile Bridge	8.54	-0.02	-0.08	-0.08	0.00	0.00	184.54
Cummings Bridge	12.71	-16.53	-52.89	-47.97	0.00	4.92	184.62
USGS Touchet Gage	15.91	16.55	75.62	172.20	-3.86	100.44	232.59
Lowden Rd Bridge	27.64	2.33	4.73	1.94	-2.79	0.00	60.39
MacDonald Rd Bridge	29.67	-2.03	-7.36	-32.91	-25.55	0.00	58.45
Detour Road	33.29	2.25	2.45	35.26	0.00	32.82	91.36
Swegle Road Bridge	34.38	2.53	3.70	3.70	0.00	0.00	56.09
Last Chance Road Bridge	35.84	-1.30	-2.96	-40.23	-40.94	3.67	52.39
Walla Walla River (WDFW #5 Site)	38.11	-9.82	-13.26	49.37	0.00	62.63	92.62
Old Milton HWY Bridge	39.46	1.35	2.17	2.17	0.00	0.00	43.24
Peppers Bridge Location (WDFW/WDOE Gauge station)	41.07	-7.91	-9.73	-7.57	0.00	2.16	41.07
Walla Walla River WWBWC # M-10 (MNWW40.8)	42.30	11.96	16.02	16.02	0.00	0.00	48.64
Tumalum Road Bridge (M-8) (MNWW42.3)	43.64	3.70	2.11	2.11	0.00	0.00	32.62
Walla Walla River (M-7) (MNWW42.9)	44.21	0.18	0.07	0.07	0.00	0.00	30.51
Walla Walla River (M-6) Gravel Pit (MNWW43.6)	44.60	-19.15	-25.09	-23.09	0.00	2.00	30.44
Walla Walla River Nursery Bridge (M-4) (MNWW44.5)	45.91	0.45	0.88	-158.54	-159.42	0.00	53.53
Grove School Bridge (M-1a) (MNWW46.1)	47.86	35.06	30.15	31.84	-1.87	3.56	212.07
Mainstem u/s Couse Creek	48.72	42.62	8.95	8.95	0.00	0.00	180.23
Couse Creek Road Bridge (MNWW47)	48.95	-17.76	-17.41	-19.64	-2.23	0.00	171.28
Day Road	49.93	27.21	24.22	24.17	-0.05	0.00	190.92
Joe West Bridge (MNWW49.1)	50.82	-10.90	-17.90	4.00	-5.40	27.30	166.75
South Fork Bridge	52.46	-1.70	-8.90	-12.90	-4.00	0.00	162.80
SF Walla Walla River (SFWW9.0)	59.25	8.60	29.70	24.30	-5.50	0.00	175.70
OWRD Gauge Station, SF Walla Walla River	61.08	x	x	x	x	x	151.40

Flow data applies to River flow at Location ID

Rate/Net gain-loss/Gross/Net Div and Trib data applies from Location ID to next UPSTREAM site.

Attachment A-6

August 2004 Data Set

Flow Measurement Location (Reach Locations)	Actual River Mile (GIS)	Rate Per Mile (cfs)	Net Gain/Loss (cfs)	Gross Instream Gain/Loss Change (cfs)	Net Diversion Total (cfs)	Net Tributary Inputs Total (cfs)	Measured Instream Flow (cfs)
Highway 12 Bridge (Mouth of Walla Walla River)	0.00	x	x	x	x	x	x
Cummings Bridge	12.71	-1.48	-4.74	-6.30	-1.56	0.00	16.70
USGS Touchet Gage	15.91	0.57	2.60	2.52	-1.54	1.46	23.00
Touchet-Gardena Road Bridge	20.48	1.70	12.14	9.01	-3.59	0.46	20.48
Lowden Rd Bridge	27.64	-0.02	-0.05	-8.19	-8.14	0.00	11.47
MacDonald Rd Bridge	29.67	0.96	4.51	-11.08	-17.71	2.12	19.66
Swegle Road Bridge	34.38	-3.71	-5.42	-5.42	0.00	0.00	30.74
Last Chance Road Bridge	35.84	1.39	2.34	0.79	-2.00	0.45	36.16
Beet Road Bridge	37.52	-2.63	-1.55	-1.55	0.00	0.00	35.37
Walla Walla River (WDFW #5 Site)	38.11	-2.12	-2.86	23.44	-0.29	26.59	36.92
Old Milton HWY Bridge	39.46	1.83	2.96	2.96	0.00	0.00	13.48
Peppers Bridge Location (WDFW/WDOE Gauge station)	41.07	1.14	1.40	1.50	-0.28	0.38	10.52
Walla Walla River WWBWC # M-10 (MNWW40.8) (Beaver)	42.30	1.92	1.44	1.44	0.00	0.00	9.02
Walla Walla River WWBWC # M-9a (Mauer Lane)	43.05	0.41	0.24	0.24	0.00	0.00	7.58
Tumalum Road Bridge (M-8) (MNWW42.3)	43.64	2.00	1.14	1.14	0.00	0.00	7.34
Walla Walla River (M-7) (MNWW42.9)	44.21	-9.97	-3.89	-3.89	0.00	0.00	6.20
Walla Walla River (M-6) Gravel Pit (MNWW43.6)	44.60	-15.79	-12.32	-10.32	0.00	2.00	10.09
Levy, Willow Lane (M-5a)	45.38	-1.75	-0.93	-0.93	0.00	0.00	20.41
Walla Walla River Nursery Bridge (M-4) (MNWW44.5)	45.91	-3.61	-7.07	-77.44	-70.37	0.00	21.34
Grove School Bridge (M-1a) (MNWW46.1)	47.86	8.09	8.82	8.82	0.00	0.00	98.78
Couse Creek Road Bridge (MNWW47)	48.95	-3.29	-3.22	-3.22	0.00	0.00	89.96
Day Road	49.93	-12.24	-10.89	-10.95	-0.06	0.00	93.18
Joe West Bridge (MNWW49.1)	50.82	11.11	18.33	11.57	-6.76	0.00	104.13
South Fork Bridge	52.46	0.49	2.51	-3.90	-6.41	0.00	92.56
SF Walla Walla River at CTUIR Fish Hatchery (SFWW7.0)	57.63	4.09	6.63	6.63	0.00	0.00	96.46
SF Walla Walla River (SFWW9.0)	59.25	-7.65	-14.00	-14.17	-0.17	0.00	89.83
OWRD Gauge Station, SF Walla Walla River	61.08	x	x	x	x	x	104.00

Flow data applies to River flow at Location ID

Rate/Net gain-loss/Gross/Net Div and Trib data applies from Location ID to next UPSTREAM site.

Attachment A-7 **2007 August Data Set**

Flow Measurement Location (Reach Locations)	Actual River Mile (GIS)	Rate Per Mile (cfs)	Net Gain/Loss (cfs)	Gross Instream Gain/Loss Change	2007 Net Diversion Total (cfs)	2004 Net Tributary Inputs Total (cfs)	2004 Flow (cfs)
Nine Mile Bridge	8.50	-0.57	-2.40	-5.58	-3.18	0.00	5.70
Cummings Bridge	12.71	0.32	1.02	-0.70	-1.72	0.00	11.30
USGS Touchet Gage	15.91	0.86	3.94	-0.20	-6.96	2.82	12.00
Lowden Rd Bridge	27.64	1.10	2.24	-6.20	-8.44	0.00	12.20
MacDonald Rd Bridge	29.67	0.70	2.53	-12.20	-14.73	0.00	18.40
Detour Road	33.29	-1.91	-2.08	1.10	0.00	3.18	30.60
Swegle Road Bridge	34.38	0.12	0.18	0.09	-0.09	0.00	29.50
Last Chance Road Bridge	35.84	0.37	0.62	-1.38	-2.00	0.00	29.41
Beet Road Bridge	37.52	3.22	1.90	1.90	0.00	0.00	30.79
Walla Walla River (WDFW #5 Site)	38.11	-2.26	-3.06	14.73	0.00	17.79	28.89
Old Milton HWY Bridge	39.46	0.60	0.97	0.97	0.00	0.00	14.16
Peppers Bridge Location (WDFW/WDOE Gauge station)	41.07	2.88	3.54	3.54	0.00	0.00	13.19
Walla Walla River WWBWC # M-10 (MNWW40.8) (Beaver)	42.30	1.23	0.92	0.92	0.00	0.00	9.65
Walla Walla River WWBWC # M-9a (Mauer Lane)	43.05	-2.90	-1.71	-2.00	-0.29	0.00	8.73
Tumalum Road Bridge (M-8) (MNWW42.3)	43.64	-1.67	-0.96	-0.96	0.00	0.00	10.73
Walla Walla River (M-7) (MNWW42.9)	44.21	-18.44	-7.16	-7.16	0.00	0.00	11.69
Walla Walla River (M-6) Gravel Pit (MNWW43.6)	44.60	-1.26	-0.92	-0.92	0.00	0.00	18.85
Walla Walla River M-5b (MNWW44)	45.33	-1.63	-0.94	-0.94	0.00	0.00	19.77
Levy, Willow Lane (M-5a)	45.38						
Walla Walla River Nursery Bridge (M-4) (MNWW44.5)	45.91	-1.56	-1.69	-4.79	-3.10	0.00	20.71
Walla Walla River M-2 (MNWW45.6)	46.99	-4.56	-4.00	-73.00	-69.00	0.00	25.50
Grove School Bridge (M-1a) (MNWW46.1)	47.86	10.41	11.32	11.32	0.00	0.00	98.50
Couse Creek Road Bridge (MNWW47)	48.95	-2.84	-2.78	-5.52	-2.74	0.00	87.18
Day Road	49.93	0.43	0.38	0.34	-0.04	0.00	92.7
Joe West Bridge (MNWW49.1)	50.82	-0.89	-1.46	-3.26	-6.00	4.20	92.36
South Fork Bridge	52.46	0.38	1.95	-4.78	-6.73	0.00	95.62
SF Walla Walla River at CTUIR Fish Hatchery (SFWW7.0)	57.63	4.59	7.41	7.30	-0.11	0.00	100.4
SF Walla Walla River (SFWW9.0)	59.25	-7.03	-12.89	-12.89	0.00	0.00	93.1
OWRD Gauge Station, SF Walla Walla River	61.08	x	x	x	x	x	105.99

Flow data applies to River flow at Location ID

Rate/Net gain-loss/Gross/Net Div and Trib data applies from Location ID to next UPSTREAM site.

Attachment A-8	2007 October Data Set						
Flow Measurement Location (Reach Locations)	**Actual River Mile (GIS)**	**Rate Per Mile (cfs)**	**Net Gain/Loss (cfs)**	**Gross Instream Gain/Loss Change**	**2007 Net Diversion Total (cfs)**	**2007 Net Tributary Inputs Total (cfs)**	**2007 Flow (cfs)**
Nine Mile Bridge	8.50	-3.04	-12.80	-16.60	-3.80	0.00	54.34
Cummings Bridge	12.71	1.71	35.14	36.24	-57.40	58.50	70.94
Detour Road	33.29	4.31	4.69	14.09	0.00	9.40	34.70
Swegle Road Bridge	34.38	-0.84	-1.22	-1.31	-0.09	0.00	20.61
Last Chance Road Bridge	35.84	0.80	1.34	0.53	-2.00	1.19	21.92
Beet Road Bridge	37.52	3.35	1.98	-15.31	-17.29	0.00	21.39
Walla Walla River (WDFW #5 Site)	38.11	-1.49	-2.01	20.29	0.00	22.30	36.70
Old Milton HWY Bridge	39.46	-0.64	-1.04	-1.04	0.00	0.00	16.41
Peppers Bridge Location (WDFW/WDOE Gauge station)	41.07	3.22	3.95	3.95	0.00	0.00	17.45
Walla Walla River WWBWC # M-10 (MNWW40.8) (Beaver)	42.30	-1.52	-2.03	-2.03	0.00	0.00	13.50
Tumalum Road Bridge (M-8) (MNWW42.3)	43.64	1.57	0.90	0.90	0.00	0.00	15.53
Walla Walla River (M-7) (MNWW42.9)	44.21	-11.23	-4.36	-4.36	0.00	0.00	14.63
Walla Walla River (M-6) Gravel Pit (MNWW43.6)	44.60	-1.80	-1.40	-1.40	0.00	0.00	18.99
Levy, Willow Lane (M-5a)	45.38	-11.25	-5.94	-5.94	0.00	0.00	20.39
Walla Walla River Nursery Bridge (M-4) (MNWW44.5)	45.91	0.70	0.76	0.76	0.00	0.00	26.33
Walla Walla River M-2 (MNWW45.6)	46.99	-0.91	-0.80	-87.50	-86.70	0.00	25.57
Grove School Bridge (M-1a) (MNWW46.1)	47.86	13.31	14.47	14.47	0.00	0.00	113.07
Couse Creek Road Bridge (MNWW47)	48.95	-1.80	-1.76	-4.50	-2.74	0.00	98.60
Day Road	49.93	6.15	5.44	5.40	-0.05	0.00	103.10
Joe West Bridge (MNWW49.1)	50.82	0.70	1.15	1.15	0.00	0.00	97.70
South Fork Bridge	52.46	2.28	11.77	9.17	-2.60	0.00	96.55
SF Walla Walla River at CTUIR Fish Hatchery (SFWW7.0)	57.63	-3.76	-6.08	-6.08	0.00	0.00	87.38
SF Walla Walla River (SFWW9.0)	59.25	-7.93	-14.54	-14.54	0.00	0.00	93.46
OWRD Gauge Station, SF Walla Walla River	61.08	x	x	x	x	x	108.00
Flow data applies to River flow at Location ID							
Rate/Net gain-loss/Gross/Net Div and Trib data applies from Location ID to next UPSTREAM site.							

Attachment A-9	2008 July Data Set						
Flow Measurement Location (Reach Locations)	**Actual River Mile (GIS)**	**Rate Per Mile (cfs)**	**Net Gain/Loss (cfs)**	**Gross Instream Gain/Loss Change**	**2007 Net Diversion Total (cfs)**	**2007 Net Tributary Inputs Total (cfs)**	**2007 Flow (cfs)**
Nine Mile Bridge	8.5	-0.2	-0.7	-0.7	0.0	0.0	58.3
Cummings Bridge	12.7	0.7	2.4	4.0	1.7	0.0	59.0
USGS Touchet Gage	15.9	-2.5	-11.3	38.3	-1.1	50.7	55.0
Touchet-Gardena Road Bridge	20.5	0.8	6.0	4.3	-3.3	1.6	16.7
Lowden Rd Bridge	27.6	6.7	13.5	-4.5	-18.1	0.0	12.4
MacDonald Rd Bridge	29.7	-7.2	-26.0	-37.4	-11.3	0.0	16.9
Detour Road	33.3	14.2	15.4	21.4	-0.2	6.2	54.3
Swegle Road Bridge	34.4	-1.2	-1.8	-1.8	0.0	0.0	32.9
Last Chance Road Bridge	35.8	-7.4	-12.5	-14.2	-1.8	0.0	34.7
Beet Road Bridge	37.5	25.2	14.9	14.9	0.0	0.0	48.9
Walla Walla River (WDFW #5 Site)	38.1	-1.0	-1.3	15.4	-1.0	17.6	34.0
Old Milton HWY Bridge	39.5	-3.1	-5.0	-5.0	0.0	0.0	18.7
Peppers Bridge Location (WDFW/WDOE Gauge station)	41.1	-0.1	5.9	5.5	-0.4	0.0	23.6
Walla Walla River WWBWC # M-10 (MNWW40.8) (Beaver)	42.3	3.0	2.2	2.2	0.0	0.0	18.1
Walla Walla River WWBWC # M-9a (Mauer Lane)	43.0	-7.4	-4.4	-4.4	0.0	0.0	15.9
Tumalum Road Bridge (M-8) (MNWW42.3)	43.6	-0.8	-0.5	-0.5	0.0	0.0	20.3
Walla Walla River (M-7) (MNWW42.9)	44.2	-5.6	-2.2	-2.2	0.0	0.0	20.8
Walla Walla River (M-6) Gravel Pit (MNWW43.6)	44.6	-8.2	-6.0	-6.0	0.0	0.0	22.9
Walla Walla River M-5b (MNWW44)	45.3	-184.9	-8.7	-8.7	0.0	0.0	28.9
Levy, Willow Lane (M-5a)	45.4	1.9	1.0	1.0	0.0	0.0	37.6
Walla Walla River Nursery Bridge (M-4) (MNWW44.5)	45.9	-10.5	-11.4	-11.4	0.0	0.0	36.6
Walla Walla River M-2 (MNWW45.6)	47.0	9.1	8.0	-78.7	-86.7	0.0	47.9
Grove School Bridge (M-1a) (MNWW46.1)	47.9	-0.2	10.0	10.0	0.0	0.0	126.6
Couse Creek Road Bridge (MNWW47)	49.0	-0.5	-0.5	-3.3	-2.7	0.0	116.6
Day Road	49.9	-5.9	-5.2	-5.3	-0.1	0.0	119.9
Joe West Bridge (MNWW49.1)	50.8	17.9	29.5	35.5	-4.7	10.8	125.1
South Fork Bridge	52.5	0.4	-21.7	-24.3	-2.6	0.0	89.6
SF Walla Walla River at CTUIR Fish Hatchery (SFWW7.0)	57.6	-2.6	-4.2	-4.2	0.0	0.0	113.8
SF Walla Walla River (SFWW9.0)	59.3	5.5	10.0	10.0	0.0	0.0	118.0
OWRD Gauge Station, SF Walla Walla River	61.1	x	x	x	x	x	108.0
Flow data applies to River flow at Location ID							
Rate/Net gain-loss/Gross/Net Div and Trib data applies from Location ID to next UPSTREAM site.							

Attachment A-10 **2008 November Data Set**

Flow Measurement Location (Reach Locations)	Actual River Mile (GIS)	Rate Per Mile (cfs)	Net Gain/Loss (cfs)	Gross Instream Gain/Loss Change (cfs)	2009 Net Diversion Total (cfs)	2009 Net Tributary Inputs Total (cfs)	2009 Flow (cfs)
Nine Mile Bridge	8.54	-2.82	-11.73	-15.29	-3.56	0.00	52.04
Cummings Bridge	12.71	-1.11	-3.54	-10.67	-7.13	0.00	67.33
USGS Touchet Gauge	15.91	9.39	42.90	62.20	-8.90	28.20	78.00
Touchet-Gardena Bdg	20.48	0.30	2.14	4.94	-0.89	3.69	15.80
Lowden Rd Bdg	27.64	-1.51	-3.08	-11.48	-8.40	0.00	10.86
MacDonald Rd Bridge	29.67	-0.47	-2.22	-0.17	-18.45	20.50	22.34
Swegle Rd Bdg	34.38	2.45	3.58	3.58	0.00	0.00	22.51
Last Chance Rd Bdg	35.84	-0.34	-0.57	-0.57	0.00	0.00	18.93
Beet Rd Bdg	37.52	-5.13	-3.03	-36.63	-33.60	0.00	19.50
WWR WDFW #5 Site	38.11	0.92	1.25	27.95	0.00	26.70	56.13
Old Milton Hwy Bdg	39.46	5.06	3.46	3.46	0.00	0.00	28.18
Hwy 125 Bdg	40.14	-0.84	-0.78	-0.78	0.00	0.00	24.72
Pepper Bridge	41.07	1.08	1.32	1.50	0.00	0.18	25.50
M-10	42.30	4.96	3.62	3.62	0.00	0.00	24.00
M9a (Mauer Lane)	43.03	-0.79	-0.48	-0.48	0.00	0.00	20.38
Tum-A-Lum Bdg	43.64	-5.42	-9.43	-9.43	0.00	0.00	20.86
M-5	45.38	1.12	0.59	0.59	0.00	0.00	30.29
Nursery Bdg M-4	45.91	3.84	7.52	-81.78	-89.30	0.00	29.70
M1a Grove School Bdg	47.86	13.55	14.74	14.74	0.00	0.00	111.48
Couse Creek Rd Bdg	48.95	-5.46	-5.34	-8.56	-3.22	0.00	96.74
Day Road	49.93	5.51	4.88	2.68	-2.20	0.00	105.30
Joe West Bdg	50.82	0.18	0.29	0.85	-0.25	0.81	102.62
South Fork Bdg	52.46	1.68	8.71	4.45	-4.26	0.00	101.77
CTUIR Hatchery	57.63	-3.25	-5.25	-5.25	0.00	0.00	97.32
Keating	59.25	1.19	2.01	2.01	0.00	0.00	102.57
SF Walla Walla BLM Trailhead Bdg	60.94	x	x	x	x	x	100.56

Rate/Net gain-loss/Gross/Net Div and Trib data applies from Location ID to next UPSTREAM site.

Attachment A-11

Walla Walla River Seepage Assessment, July 2011

Flow Measurement Location (Reach Locations)	Actual River Mile (GIS)	Rate Per Mile (cfs)	Net Gain/Loss (cfs)	Gross Instream Gain/Loss Change (cfs)	2011 Net Diversion Total (cfs)	2011 Net Tributary Inputs Total (cfs)	2011 Flow (cfs)	Gaining/Losing
RV Park to Byerly Bdg	5.68	-2.90	-20.91	-21.85	-0.94	0.00	91.86	Losing
Byerly Bdg to USGS Touchet Gauge	12.88	-4.72	-15.29	-15.29	0.00	0.00	113.71	Losing
USGS Touchet Gauge to MacDonald Rd Bdg	16.12	3.77	53.90	119.93	-6.23	72.26	129.00	Gaining
Lowden Rd Bdg	28.24						6.98	Losing
MacDonald Rd Bdg to Detour Rd Bdg	30.41	-0.64	-2.29	-28.23	-25.94	0.00	9.07	Losing
Detour Rd Bdg to Swegle Rd Bdg	33.97	0.10	0.11	8.24	-0.08	8.21	37.30	Gaining
Swegle Rd Bdg to Last Chance Rd Bdg	35.04	2.80	4.13	4.13	0.00	0.00	29.06	Gaining
Last Chance Rd Bdg to Beet Rd Bdg	36.52	-1.12	-2.02	-2.97	-1.56	0.61	24.93	Losing
Beet Rd Bdg to WWR WDFW #5 Site	38.32	-9.51	-4.91	-36.91	-32.00	0.00	27.90	Losing
WWR WDFW #5 Site to Old Milton Hwy Bdg	38.84	4.58	6.29	45.80	0.00	39.50	64.81	Gaining
Old Milton Hwy Bdg to Hwy 125 Bdg	40.21	0.14	0.10	0.10	0.00	0.00	19.01	Gaining
Hwy 125 Bdg to Pepper Bdg	40.94	-0.20	-0.19	-0.19	0.00	0.00	18.91	Losing
Pepper Bdg to M-10	41.90	3.55	3.69	4.40	0.00	0.71	19.10	Gaining
M-10 to Mauer Lane (M9a)	42.94	2.99	2.46	2.46	0.00	0.00	14.70	Gaining
Mauer Lane (M9a) to Tum-A-Lum Bdg (M8)	43.76	1.67	1.11	1.11	0.00	0.00	12.24	Gaining
Tum-A-Lum Bdg (M8) to M7	44.43	-5.73	-2.53	-2.53	0.00	0.00	11.13	Losing
M7 to M5	44.87	-10.77	-11.77	-11.77	0.00	0.00	13.66	Losing
M-5 to Nursery Bdg M-4	45.96	-7.61	-5.03	-4.61	0.00	0.42	25.43	Losing
Nursery Bdg M-4 to M3	46.62	-18.23	-11.72	-8.15	3.57	0.00	30.04	Losing
M3 to M2	47.26	4.47	1.96	1.96	0.00	0.00	38.19	Gaining
M2 to M1a Grove School Bdg	47.70	4.04	3.58	-112.99	-116.57	0.00	36.23	Gaining
M1a Grove School Bdg to Couse Creek Rd Bdg	48.59	-3.98	-4.24	-3.89	-0.08	0.43	149.22	Losing
Couse Creek Rd Bdg to Day Road	49.66	-0.07	-0.07	-2.44	-2.37	0.00	153.11	Losing
Day Road to Joe West Bdg	50.59	20.91	20.46	20.46	0.00	0.00	155.55	Gaining
Joe West Bdg to South Fork Bdg	51.57	-10.24	-16.87	-10.18	-3.37	10.06	135.09	Losing
South Fork Bdg to CTUIR Hatchery	53.22	1.68	8.75	3.35	-5.40	0.00	145.26	Gaining
CTUIR Hatchery to Keating	58.44	8.39	13.70	13.50	-0.20	0.00	141.91	Gaining
Keating to SF Walla Walla BLM Trailhead	60.07	-10.94	-19.44	-19.60	-0.16	0.00	128.41	Losing
SF Walla Walla BLM Trailhead	61.85	x	x	x	x	x	148.01	

Attachment A-12

Walla Walla River Seepage Assessment, September 2011								
Flow Measurement Location (Reach Locations)	Actual River Mile (GIS)	Rate Per Mile (cfs)	Net Gain/Loss (cfs)	Gross Instream Gain/Loss Change (cfs)	2011 Net Diversion Total (cfs)	2011 Net Tributary Inputs Total (cfs)	2011 Flow (cfs)	Gaining/Losing
RV Park to Byerly Bdg	5.68	-0.31	-2.27	-3.22	-0.95	0.00	65.13	Losing
Byerly Bdg to USGS Touchet Gauge	12.88	6.04	19.58	15.35	-4.23	0.00	68.35	Gaining
USGS Touchet Gauge to MacDonald Rd Bdg	16.12	0.21	2.99	4.71	-8.75	10.48	53.00	Gaining
Lowden Rd Bdg	28.24						43.60	Losing
MacDonald Rd Bdg to Detour Rd Bdg	30.41	-0.11	-0.40	-21.22	-20.82	0.00	48.29	Losing
Detour Rd Bdg to Swegle Rd Bdg	33.97	2.82	3.03	10.80	0.00	7.77	69.51	Gaining
Swegle Rd Bdg to Last Chance Rd Bdg	35.04	0.72	1.07	0.96	-0.11	0.00	58.71	Gaining
Last Chance Rd Bdg to Beet Rd Bdg	36.52	-3.32	-5.99	-8.44	-2.45	0.00	57.75	Losing
Beet Rd Bdg to WWR WDFW #5 Site	38.32	6.75	3.48	3.48	0.00	0.00	66.19	Gaining
WWR WDFW #5 Site to Old Milton Hwy Bdg	38.84	0.48	0.67	34.52	-0.33	34.19	62.71	Gaining
Old Milton Hwy Bdg to Hwy 125 Bdg	40.21	-6.62	-4.77	-4.77	0.00	0.00	28.19	Losing
Hwy 125 Bdg to Pepper Bdg	40.94	5.44	5.25	5.25	0.00	0.00	32.96	Gaining
Pepper Bdg to M-10	41.90	5.15	5.36	5.72	0.00	0.36	27.71	Gaining
M-10 to Mauer Lane (M9a)	42.94	1.21	1.00	1.00	0.00	0.00	21.99	Gaining
Mauer Lane (M9a) to Tum-A-Lum Bdg (M8)	43.76	-1.18	-0.78	-0.78	0.00	0.00	20.99	Losing
Tum-A-Lum Bdg (M8) to M7	44.43	-2.22	-0.98	-0.98	0.00	0.00	21.77	Losing
M7 to M5	44.87	-9.65	-10.54	-10.54	0.00	0.00	22.75	Losing
M-5 to Nursery Bdg M-4	45.96	-7.01	-4.63	-4.32	0.00	0.31	33.29	Losing
Nursery Bdg M-4 to M3	46.62	-25.00	-16.08	-18.08	-2.01	0.00	37.61	Losing
M3 to M2	47.26	20.92	9.17	-54.83	-64.00	0.00	55.69	Gaining
M2 to M1a Grove School Bdg	47.70	0.98	0.87	0.87	0.00	0.00	110.52	Gaining
M1a Grove School Bdg to Couse Creek Rd Bdg	48.59	-0.64	-0.68	-0.68	0.00	0.00	109.65	Losing
Couse Creek Rd Bdg to Day Road	49.66	-19.26	-17.99	-18.26	-0.69	0.42	110.33	Losing
Day Road to Joe West Bdg	50.59	18.56	18.16	16.96	-1.20	0.00	128.59	Gaining
Joe West Bdg to South Fork Bdg	51.57	-5.57	-9.17	-6.99	-2.68	4.86	111.63	Losing
South Fork Bdg to CTUIR Hatchery	53.22	2.13	11.14	6.64	-4.50	0.00	118.62	Gaining
CTUIR Hatchery to Keating	58.44	-0.56	-0.91	-1.11	-0.20	0.00	111.98	Losing
Keating to SF Walla Walla BLM Trailhead	60.07	1.65	2.93	2.82	-0.11	0.00	113.09	Gaining
SF Walla Walla BLM Trailhead	61.85	x	x	x	x	x	110.27	

Attachment B-1

Mill Creek Seepage Assessments

October, 2008

Flow Measurement Location (Reach Locations)	Actual River Mile (GIS)	Rate Per Mile (cfs)	Net Gain/Loss (cfs)	Gross Instream Gain/Loss Change (cfs)	2009 Net Diversion Total (cfs)	2009 Net Tributary Inputs Total (cfs)	2009 Flow (cfs)
Swegle Road Bridge	0.5	0.7	1.1	2.3	0.0	1.2	10.5
Last Chance Road Bridge	1.9	-0.4	-0.4	-0.4	0.0	0.0	8.2
Wallula Rd Bridge	2.9	4.7	8.2	7.5	-0.8	0.0	8.6
Goes Bridge	4.7	0.2	1.4	-1.2	-2.6	0.0	1.1
Tausick Rd Bridge	10.6	-5.4	-3.0	-1.5	0.0	1.5	2.3
Below Yellowhawk Diversion	11.1	0.1	0.2	-23.3	-23.4	0.0	3.8
5 Mile Rd Bridge	13.5	1.4	3.0	-1.4	-4.3	0.0	27.1
7 Mile Rd Bridge	15.6	-2.8	-12.6	-11.7	0.0	0.8	28.5
20 Mile Bridge	20.2	7.8	8.2	8.2	0.0	0.0	40.2
USGS Gauge	21.2	-1.7	-2.4	-2.4	0.0	0.0	32.0
Mill Creek At Stateline	22.6	x	x	x	x	x	34.4

June, 2009

Flow Measurement Location (Reach Locations)	Actual River Mile (GIS)	Rate Per Mile (cfs)	Net Gain/Loss (cfs)	Gross Instream Gain/Loss Change (cfs)	2009 Net Diversion Total (cfs)	2009 Net Tributary Inputs Total (cfs)	2009 Flow (cfs)
Swegle Road Bridge	0.5	0.2	0.3	2.1	0.0	1.8	16.1
Last Chance Road Bridge	1.9	-0.2	-0.2	-0.2	0.0	0.0	14.0
Wallula Rd Bridge	2.9	1.8	3.2	2.1	-1.1	0.0	14.2
Goes Bridge	4.7	0.1	0.7	-1.4	-2.1	0.0	12.1
Tausick Rd Bridge	10.6	-6.8	-3.8	-1.7	0.0	2.1	13.5
Below Yellowhawk Diversion	11.1	-0.6	-1.5	-33.0	-31.5	0.0	15.2
5 Mile Rd Bridge	13.5	2.0	4.2	-0.9	-5.1	0.0	48.2
7 Mile Rd Bridge	15.6	-1.7	-7.6	-6.1	0.0	1.5	49.1
20 Mile Bridge	20.2	4.6	4.8	4.8	0.0	0.0	55.2
USGS Gauge	21.2	-1.5	-2.1	-2.1	0.0	0.0	50.4
Mill Creek At Stateline	22.6	x	x	x	x	x	52.5

July, 2010

Flow Measurement Location (Reach Locations)	Actual River Mile (GIS)	Rate Per Mile (cfs)	Net Gain/Loss (cfs)	Gross Instream Gain/Loss Change (cfs)	2009 Net Diversion Total (cfs)	2009 Net Tributary Inputs Total (cfs)	2009 Flow (cfs)
Swegle Road Bridge	0.5	-0.2	-0.3	0.7	0.0	1.0	13.9
Last Chance Road Bridge	1.9	-1.2	-1.2	-1.2	0.0	0.0	13.2
Wallula Rd Bridge	2.9	2.7	4.7	4.2	-0.5	0.0	14.4
Goes Bridge	4.7	1.0	5.9	6.0	-0.9	1.0	10.2
Tausick Rd Bridge	10.6	0.8	0.4	0.4	0.0	0.0	4.2
Below Yellowhawk Diversion	11.1	-3.4	-8.0	-32.6	-24.6	0.0	3.8
5 Mile Rd Bridge	13.5	2.5	5.2	-1.7	-6.9	0.0	36.4
7 Mile Rd Bridge	15.6	-0.1	-0.7	0.3	-0.3	1.2	38.1
20 Mile Bridge	20.2	5.0	5.3	5.3	0.0	0.0	37.8
USGS Gauge	21.2	-2.6	-3.7	-4.3	-0.6	0.0	32.5
Mill Creek At Stateline	22.6	x	x	x	x	x	36.8

July, 2011

Flow Measurement Location (Reach Locations)	Actual River Mile (GIS)	Rate Per Mile (cfs)	Net Gain/Loss (cfs)	Gross Instream Gain/Loss Change (cfs)	2009 Net Diversion Total (cfs)	2009 Net Tributary Inputs Total (cfs)	2009 Flow (cfs)
Swegle Road Bridge	0.5	-2.0	-2.8	-1.1	0.0	1.7	18.1
Last Chance Road Bridge	1.9	-0.9	-0.9	-1.0	-0.1	0.0	19.2
Wallula Rd Bridge	2.9	2.4	4.2	3.5	-0.7	0.0	20.2
Goes Bridge	4.7	1.3	7.4	2.2	-5.2	0.0	16.7
Tausick Rd Bridge	10.6	-1.7	-1.0	0.5	0.0	1.5	14.5
Below Yellowhawk Diversion	11.1	-0.4	-1.0	-29.5	-28.5	0.0	14.0
5 Mile Rd Bridge	13.5	2.5	5.2	-2.7	-8.0	0.0	43.5
7 Mile Rd Bridge	15.6	0.4	1.7	3.2	-0.3	1.9	46.3
20 Mile Bridge	20.2	-5.7	-6.0	-6.0	0.0	0.0	43.1
USGS Gauge	21.2	1.6	2.2	2.4	0.2	0.0	49.0
Mill Creek At Stateline	22.6	x	x	x	x	x	46.6

September, 2011

Flow Measurement Location (Reach Locations)	Actual River Mile (GIS)	Rate Per Mile (cfs)	Net Gain/Loss (cfs)	Gross Instream Gain/Loss Change (cfs)	2009 Net Diversion Total (cfs)	2009 Net Tributary Inputs Total (cfs)	2009 Flow (cfs)
Swegle Road Bridge	0.5	-0.6	-0.9	0.1	0.0	1.0	5.8
Last Chance Road Bridge	1.9	-1.6	-1.6	-1.6	0.0	0.0	5.7
Wallula Rd Bridge	2.9	2.2	3.8	3.8	-0.1	0.0	7.4
Goes Bridge	4.7	0.8	4.8	-0.7	-5.5	0.0	3.6
Tausick Rd Bridge	10.6	-1.3	-0.7	0.9	0.0	1.7	4.3
Below Yellowhawk Diversion	11.1	0.0	0.1	-21.0	-21.1	0.0	3.4
5 Mile Rd Bridge	13.5	-1.9	-4.0	-4.0	0.0	0.0	24.4
7 Mile Rd Bridge	15.6	-0.7	-3.1	-2.3	0.0	0.8	28.3
20 Mile Bridge	20.2	3.4	3.6	3.6	0.0	0.0	30.6
USGS Gauge	21.2	1.2	1.7	1.5	-0.2	0.0	27.0
Mill Creek At Stateline	22.6	x	x	x	x	x	25.5

Attachment B-2

Touchet River Seepage Assessments

Composite Seepage Data Set 2009 — June 2009 Data Set

Flow Measurement Location (Reach Locations)	Actual River Mile (GIS)	Rate Per Mile (cfs)	Net Gain/Loss (cfs)	Gross Instream Gain/Loss Change (cfs)	Net Diversion Total (cfs)	Net Tributary Inputs Total (cfs)	Measured Instream Flow (cfs)
Cummings	0.86	0.14	1.79	-16.21	-18.00	0.00	106.95
Johnson Bridge	8.80	0.42	10.55	10.55	0.00	0.00	123.16
I W Sims Rd Bdg	13.18	-0.31	-12.85	-12.85	0.00	0.00	112.61
Site #4	17.18	1.38	3.49	1.26	-2.23	0.00	125.46
Luckenbill Rd Bdg	21.99	0.49	6.35	6.35	0.00	0.00	124.20
Hoffman Rd	25.09	-0.60	-11.97	-11.97	0.00	0.00	117.85
Harvey Shaw Rd	32.23	1.06	4.69	4.69	0.00	0.00	129.82
Petty John	37.20	-4.28	-1.01	-1.01	0.00	0.00	125.13
Hwy 125 Bdg	41.53	-0.48	-5.56	-5.69	-0.13	0.00	126.14
Hart Road #5	44.19	-0.62	-7.39	-7.14	-0.91	1.16	131.83
Hwy 124 Bdg	48.79	0.21	19.38	23.08	0.00	3.70	138.97
Waitsburg	52.92	-1.17	-10.27	-8.77	-8.93	10.43	115.89
Dayton Levee	64.97	x	x	x	x	x	124.66

Composite Seepage Data Set 2009 — September 2009 Data Set

Flow Measurement Location (Reach Locations)	Actual River Mile (GIS)	Rate Per Mile (cfs)	Net Gain/Loss (cfs)	Gross Instream Gain/Loss Change (cfs)	Net Diversion Total (cfs)	Net Tributary Inputs Total (cfs)	Measured Instream Flow (cfs)
Cummings	0.86	-0.23	-1.80	-21.86	-20.06	0.00	11.88
Johnson Bridge	8.80	-0.07	-0.31	-0.31	0.00	0.00	33.74
I W Sims Rd Bdg	13.18	-1.36	-5.43	-5.43	0.00	0.00	34.05
Site # 4	17.18	0.97	4.67	4.67	0.00	0.00	39.48
Luckenbill Rd Bdg	21.99	-0.12	-1.25	-1.25	0.00	0.00	34.81
Harvey Shaw Rd	32.23	0.41	2.03	2.03	0.00	0.00	36.06
Petty John	37.20	-0.61	-2.62	-2.62	0.00	0.00	34.03
Hwy 125 Bdg	41.53	-0.38	-2.75	-2.36	0.00	0.39	36.65
Hwy 124 Bdg	48.79	-2.61	-10.79	-10.59	0.00	0.20	39.01
Waitsburg	52.92	0.13	1.53	0.06	-8.00	6.53	49.60
Dayton Levee	64.97	x	x	x	x	x	49.54

Composite Seepage Data Set 2010 — July 2010 Data Set

Flow Measurement Location (Reach Locations)	Actual River Mile (GIS)	July 2010 Rate Per Mile (cfs)	July 2010 Net Gain/Loss (cfs)	Gross Instream Gain/Loss Change (cfs)	Net Diversion Total (cfs)	Net Tributary Inputs Total (cfs)	Measured Instream Flow (cfs)
Cummings	0.86	1.58	12.56	19.50	-6.94	0.00	53.51
Johnson Bridge	8.80	0.55	2.39	2.39	0.00	0.00	73.01
I W Sims Rd Bdg	13.18	0.07	0.27	1.05	-0.78	0.00	75.40
Site # 4	17.18	-0.90	-4.35	-2.86	-1.49	0.00	76.45
Luckenbill Rd Bdg	21.99	0.35	3.63	3.63	0.00	0.00	73.59
Harvey Shaw Rd	32.23	-2.57	-12.80	-12.80	0.00	0.00	77.22
Petty John	37.20	2.16	9.33	9.33	0.00	0.00	64.42
Hwy 125 Bdg	41.53	1.67	12.10	11.76	0.00	0.34	73.75
Hwy 124 Bdg	48.79	-0.49	-2.04	-3.04	0.00	1.00	85.51
Waitsburg	52.92	-0.04	-0.50	-0.23	-9.22	8.95	82.47
Dayton Levee	64.97	x	x	x	x	x	82.24

Composite Seepage Data Set 2011 July 2011 Data Set

Flow Measurement Location (Reach Locations)	Actual River Mile (GIS)	July 2011 Rate Per Mile (cfs)	July 2011 Net Gain/Loss (cfs)	Gross Instream Gain/Loss Change (cfs)	Net Diversion Total (cfs)	Net Tributary Inputs Total (cfs)	Measured Instream Flow (cfs)
Cummings	0.86	0.73	5.80	17.58	-11.78	0.00	57.04
Johnson Bridge	8.80	1.42	6.22	6.22	0.00	0.00	74.62
I W Sims Rd Bdg	13.18	-1.39	-5.56	-5.56	0.00	0.00	80.84
Site # 4	17.18	1.26	6.07	6.85	-0.78	0.00	75.28
Luckenbill Rd Bdg	21.99	0.23	2.37	2.37	0.00	0.00	82.13
Harvey Shaw Rd	32.23	-0.72	-3.60	-3.60	0.00	0.00	84.50
Petty John	37.20	0.37	1.58	1.58	0.00	0.00	80.90
Hwy 125 Bdg	41.53	-0.07	-0.53	1.07	-1.86	0.26	82.48
Hwy 124 Bdg	48.79	-0.01	-0.04	-2.24	0.00	2.20	83.55
Waitsburg	52.92	0.56	6.71	6.26	-11.27	11.72	81.31
Dayton Levee	64.97	x	x	x	x	x	87.57

Composite Seepage Data Set 2011 September 2011 Data Set

Flow Measurement Location (Reach Locations)	Actual River Mile (GIS)	September 2011 Rate Per Mile (cfs)	September 2011 Net Gain/Loss (cfs)	Gross Instream Gain/Loss Change (cfs)	Net Diversion Total (cfs)	Net Tributary Inputs Total (cfs)	Measured Instream Flow (cfs)
Cummings	0.86	-1.20	-9.53	-19.55	-10.02	0.00	7.84
Johnson Bridge	8.80	-0.61	-2.67	-2.67	0.00	0.00	27.39
I W Sims Rd Bridge	13.18	-0.43	-1.72	-2.30	-0.58	0.00	30.06
Site #4	17.18	0.27	1.29	1.29	0.00	0.00	32.36
Luckenbill Rd Bridge	21.99	-0.25	-2.60	-2.60	0.00	0.00	31.07
Harvey Shaw Rd	32.23	0.42	2.07	2.07	0.00	0.00	33.67
Petty John	37.20	-1.76	-7.60	-7.60	0.00	0.00	31.60
Hwy 125 Bdg	41.53	-0.52	-3.79	-4.66	-1.01	0.14	39.20
Hwy 124 Bdg	48.79	0.27	1.11	1.79	-0.07	0.75	43.86
Waitsburg	52.92	0.04	0.54	-7.06	-18.63	11.03	42.07
Dayton Levee	64.97	x	x	x	x	x	49.13

Attachment B-3

Yellowhawk Seepage Assessment

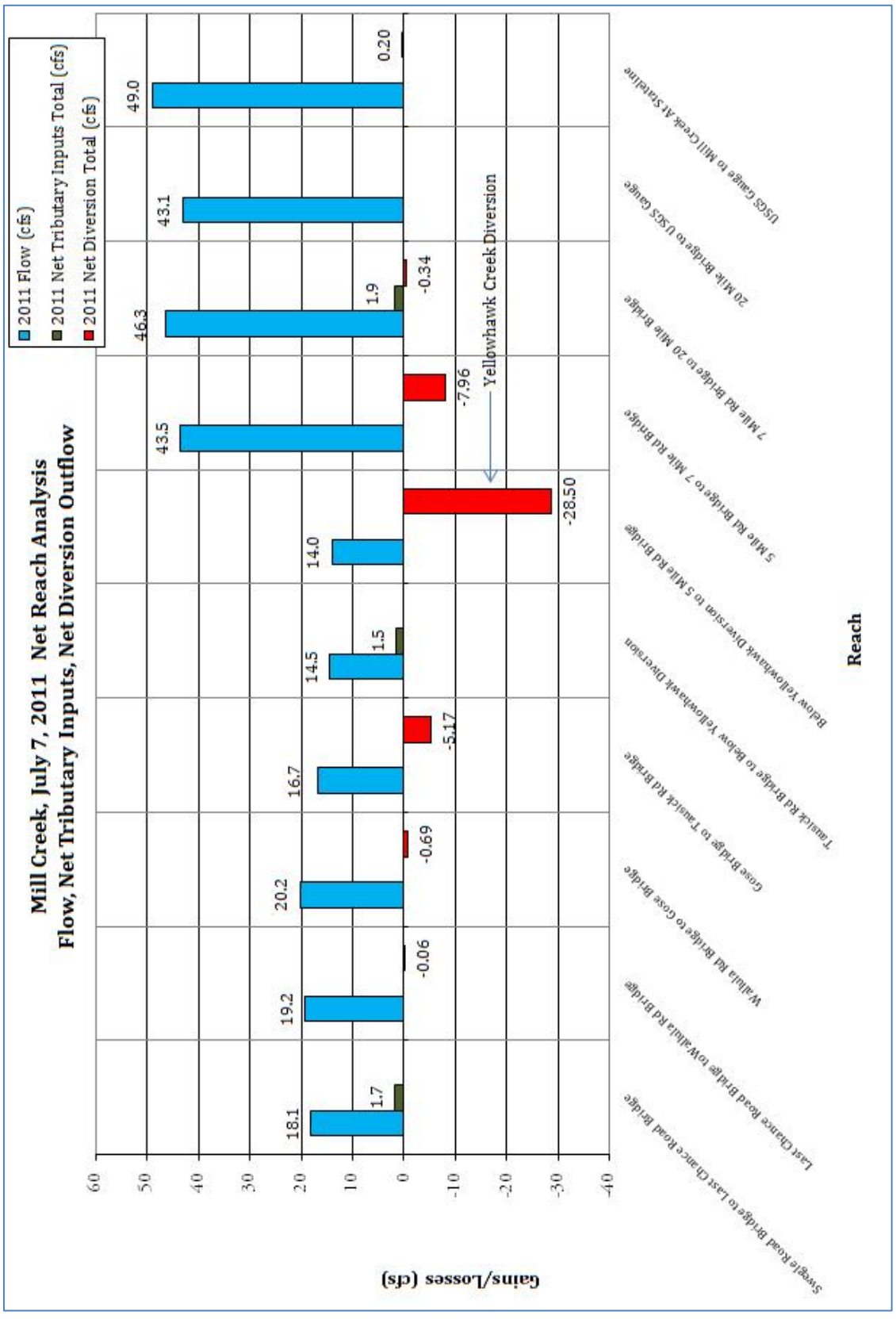
June 2011 Seepage Assessment

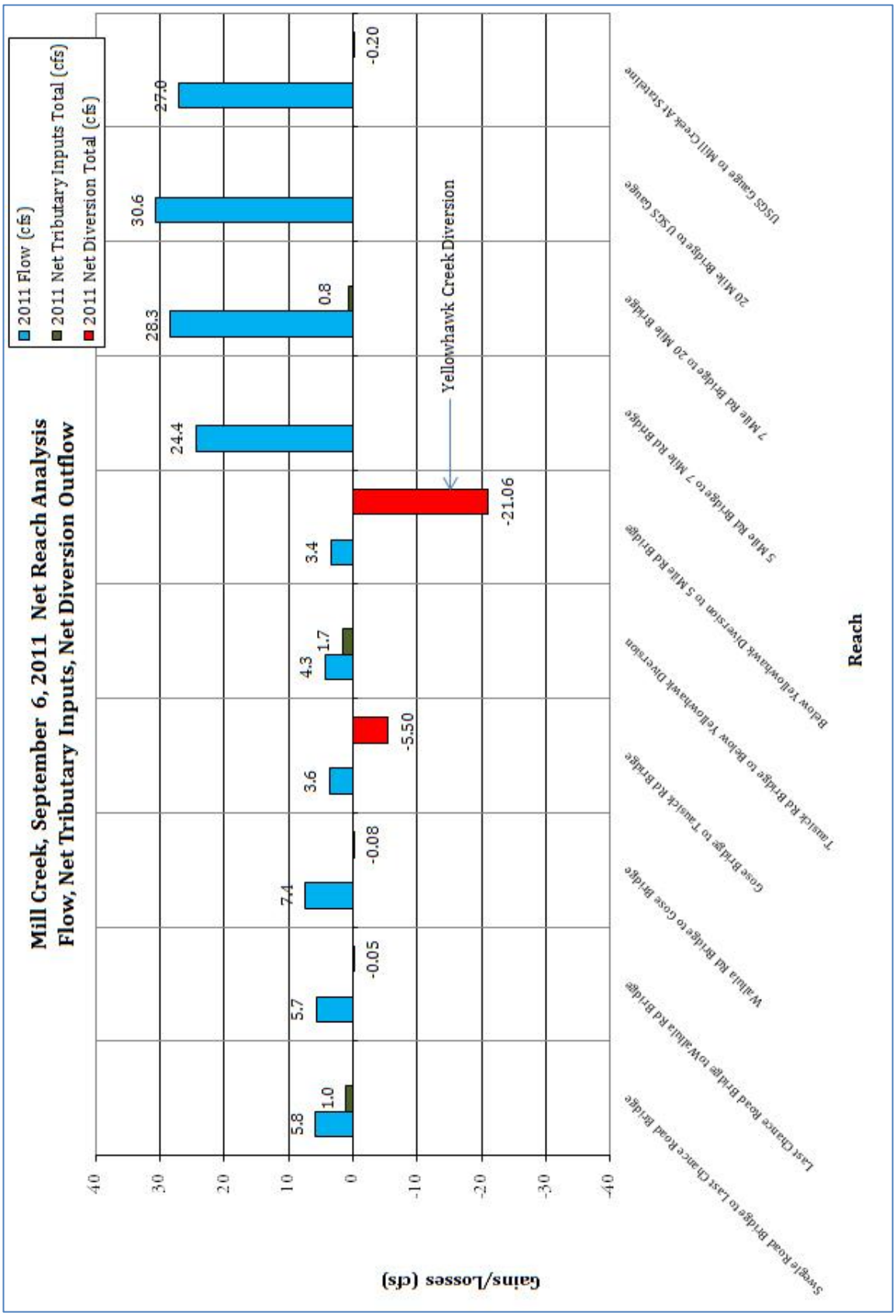
Flow Measurement Location (Reach Locations)	Actual River Mile (GIS)	Rate Per Mile (cfs)	Net Gain/Loss (cfs)	Gross Instream Gain/Loss Change (cfs)	2011 Net Diversion Total (cfs)	2011 Net Tributary Inputs Total (cfs)	2011 Flow (cfs)	Gaining/Losing
Yellowhawk #1 to Yellowhawk #2	0.02	1.91	1.38	-2.24	-3.62	0.00	27.26	Gaining
Yellowhawk #2 to Yellowhawk #3	0.74	-4.04	-3.85	-12.41	-8.56	0.00	25.02	Losing
Yellowhawk #3 to Yellowhawk #4	1.70	1.37	1.03	5.38	0.00	4.35	12.61	Gaining
Yellowhawk #4 to Yellowhawk #5	2.45	-3.27	-2.01	-2.41	-0.40	0.00	17.99	Losing
Yellowhawk #5 to Yellowhawk #6	3.06	7.67	6.60	6.60	0.00	0.00	15.58	Gaining
Yellowhawk #6 to Yellowhawk #7	3.92	-2.53	-1.94	-1.94	0.00	0.00	22.18	Losing
Yellowhawk #7 to Yellowhawk #8	4.69	3.66	15.31	59.30	-0.50	44.49	20.24	Gaining
Yellowhawk #8 -	8.87	x	x	x	x	x	79.54	Gaining

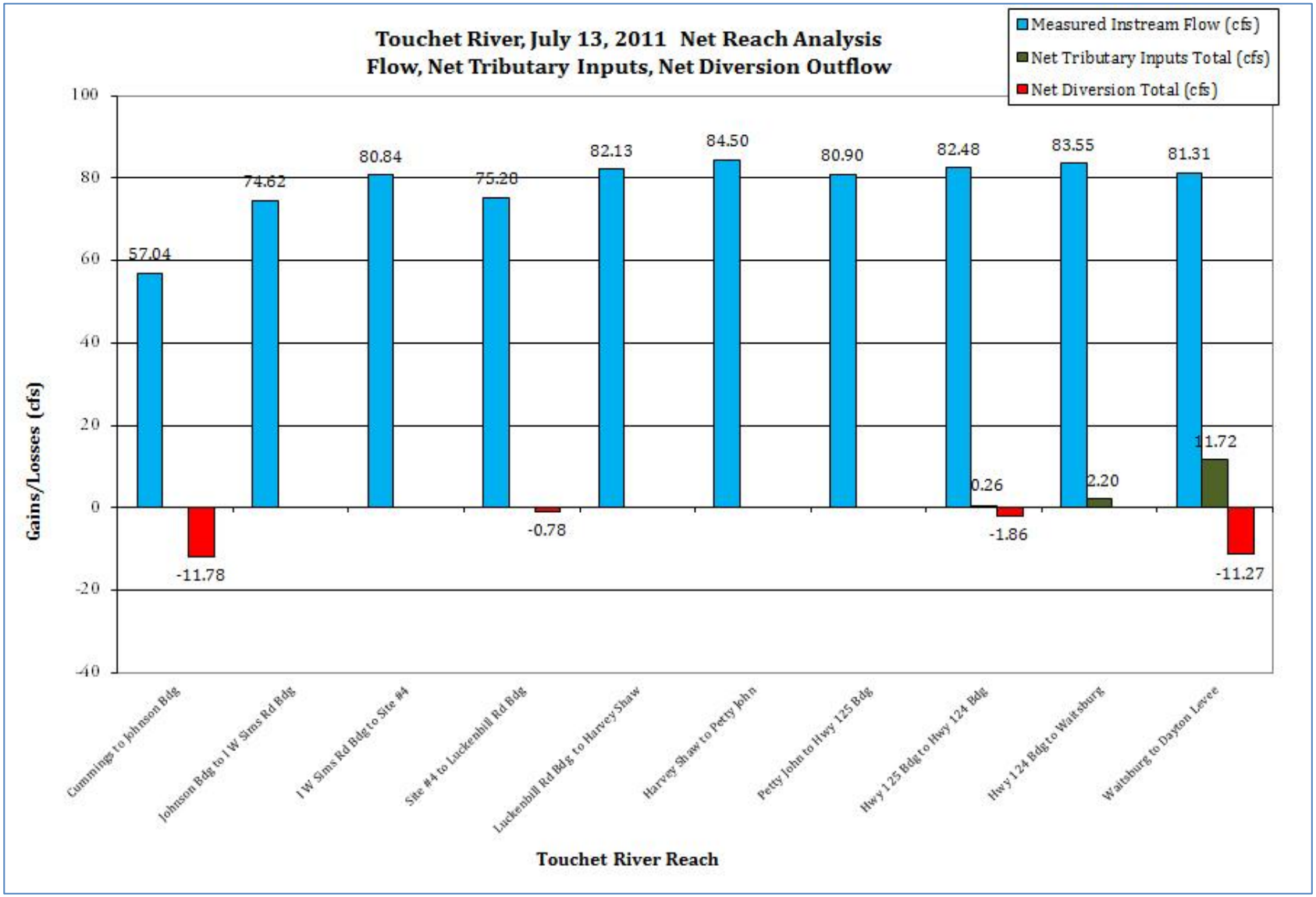
September 2011 Seepage Assessment

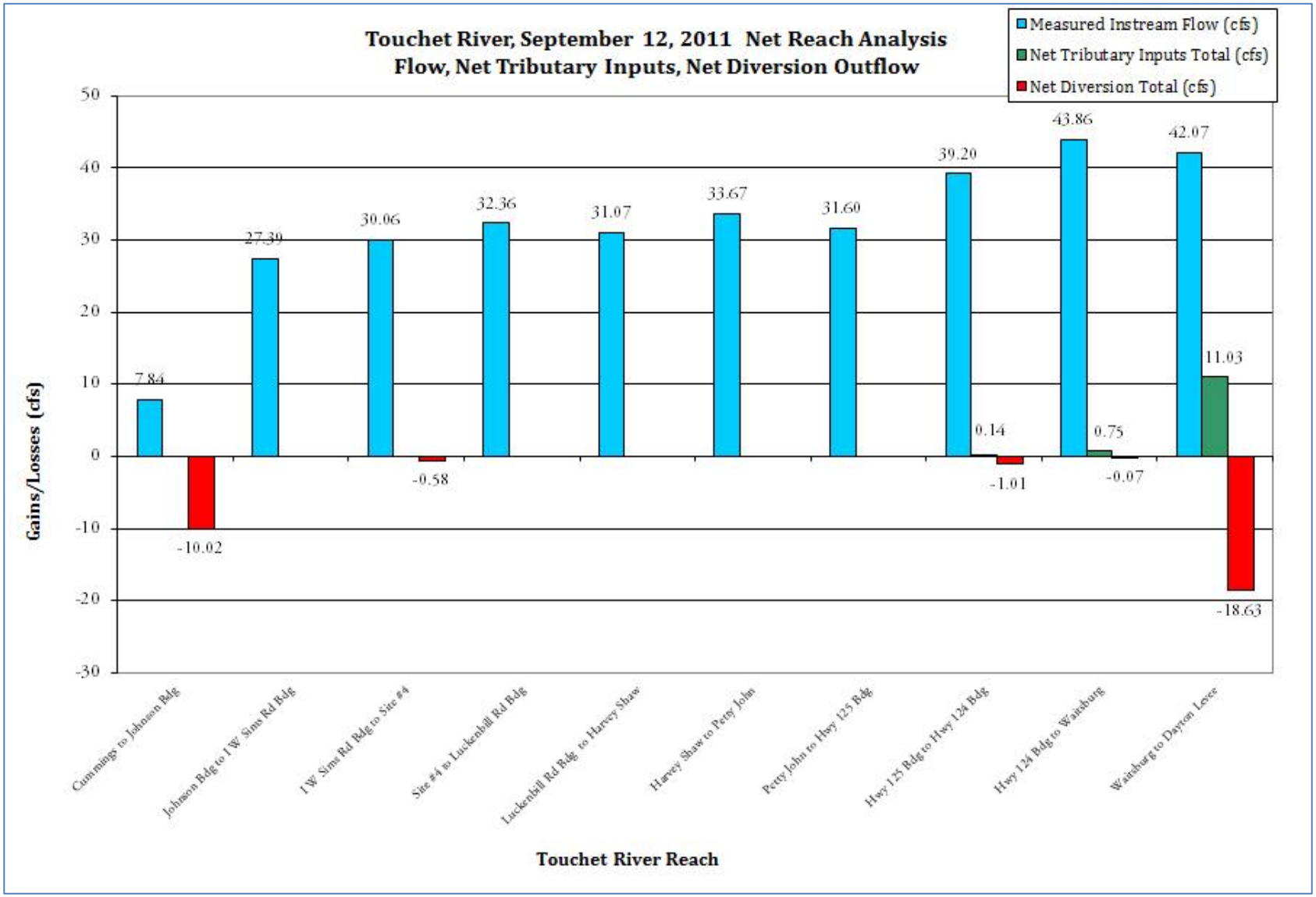
Flow Measurement Location (Reach Locations)	Actual River Mile (GIS)	Rate Per Mile (cfs)	Net Gain/Loss (cfs)	Gross Instream Gain/Loss Change (cfs)	2011 Net Diversion Total (cfs)	2011 Net Tributary Inputs Total (cfs)	2011 Flow (cfs)	Gaining/Losing
Yellowhawk #1 to Yellowhawk #2	0.02	1.56	1.13	-0.68	-1.81	0.00	19.04	Gaining
Yellowhawk #2 to Yellowhawk #3	0.74	-4.22	-4.02	-6.69	-2.67	0.00	18.36	Losing
Yellowhawk #3 to Yellowhawk #4	1.70	-0.43	-0.32	3.26	0.00	3.58	11.67	Losing
Yellowhawk #4 to Yellowhawk #5	2.45	1.85	1.14	1.14	0.00	0.00	14.93	Gaining
Yellowhawk #5 to Yellowhawk #6	3.06	-0.17	-0.15	-0.15	0.00	0.00	16.07	Losing
Yellowhawk #6 to Yellowhawk #7	3.92	-1.62	-1.24	-1.24	0.00	0.00	15.92	Losing
Yellowhawk #7 to Yellowhawk #8	4.69	0.72	3.02	0.91	-2.63	0.52	14.68	Gaining
Yellowhawk #8 -	8.87	x	x	x	x	x	15.59	Gaining

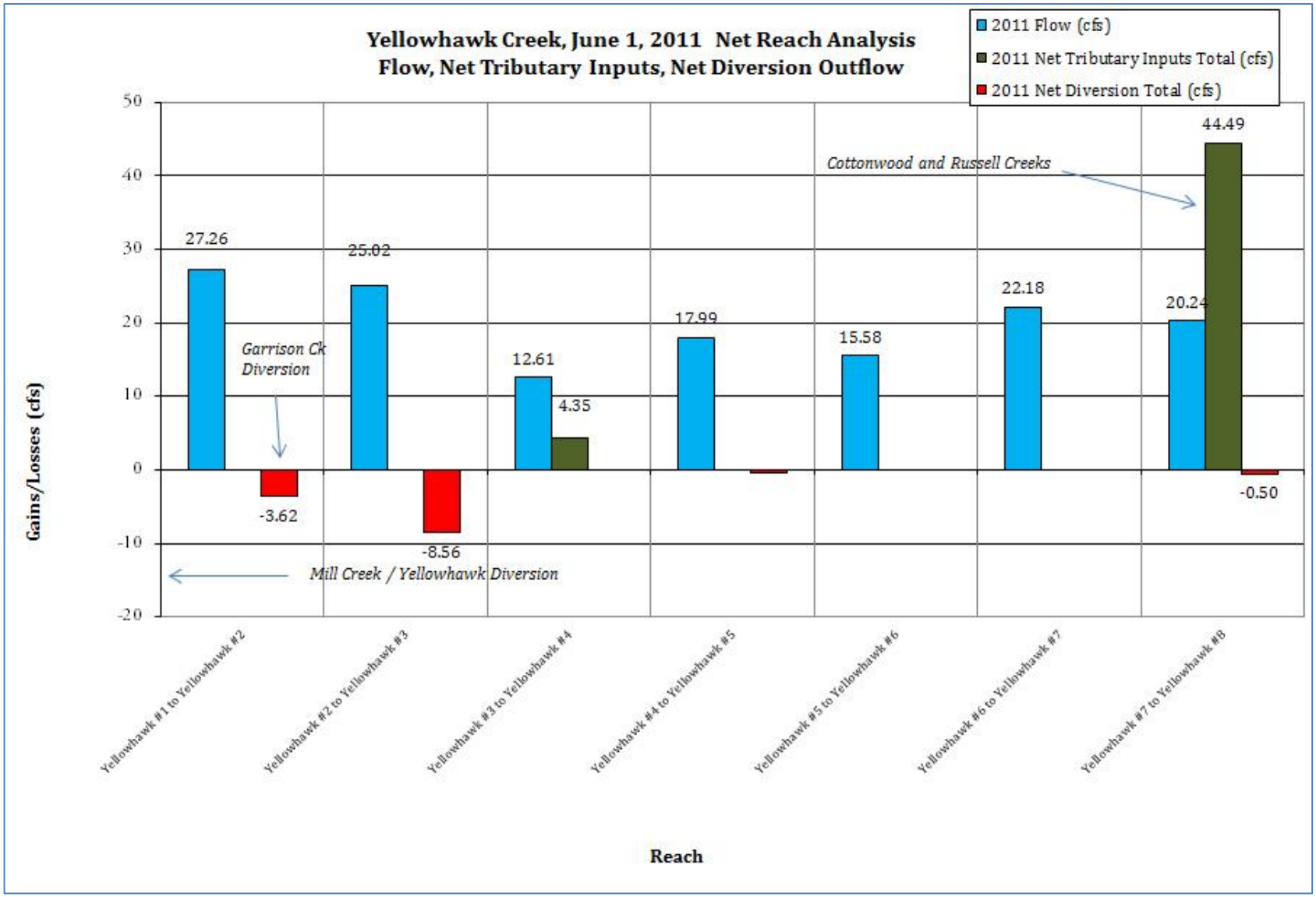
Attachment C

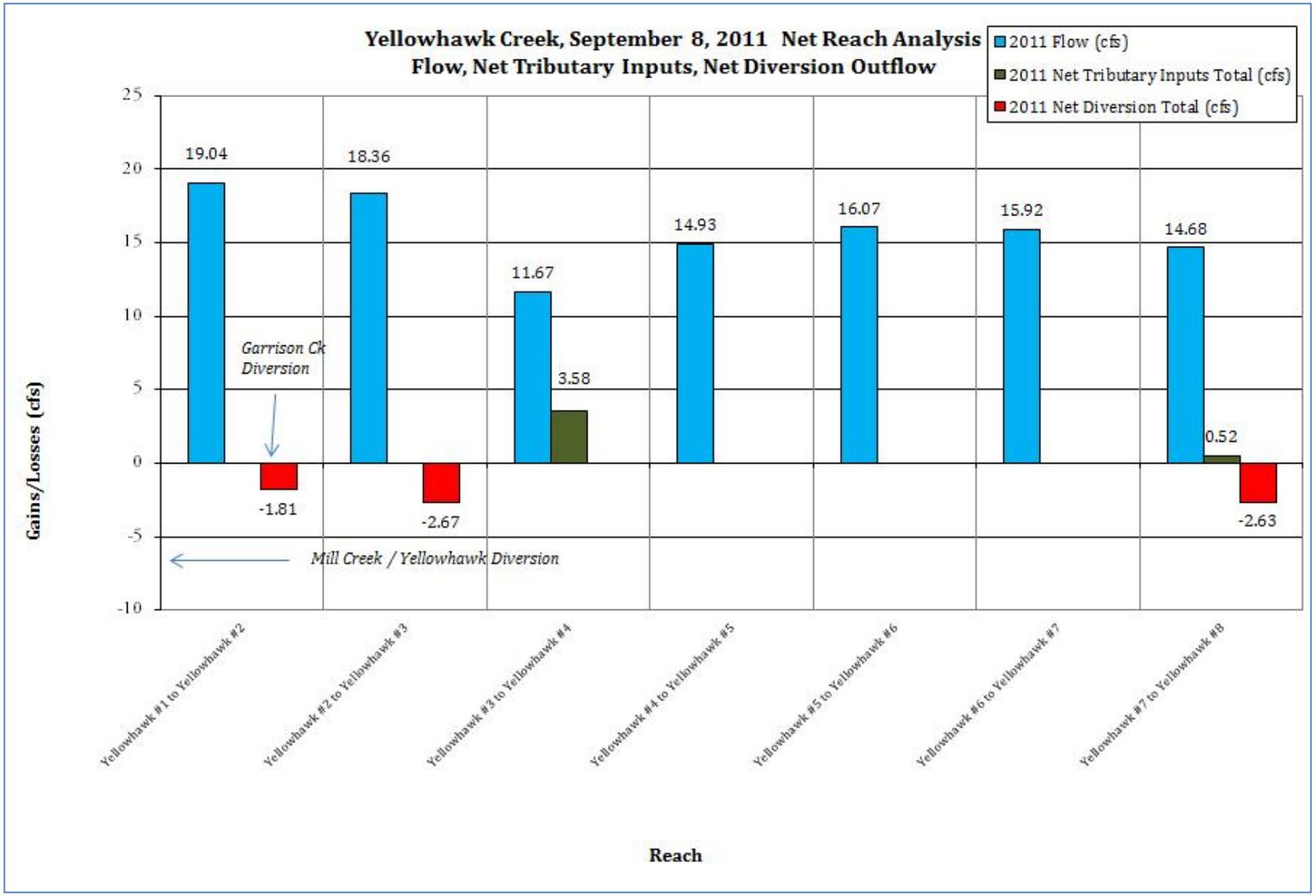



Mill Creek, September 6, 2011 Net Reach Analysis
Flow, Net Tributary Inputs, Net Diversion Outflow
2011 Flow (cfs)
2011 Net Tributary Inputs Total (cfs)
2011 Net Diversion Total (cfs)
Yellowhawk Creek Diversion
Gains/Losses (cfs)
Reach
Sweetie Road Bridge to Last Chance Road Bridge
Last Chance Road Bridge to Walula Rd Bridge
Walula Rd Bridge to Goose Bridge
Goose Bridge to Tausick Rd Bridge
Tausick Rd Bridge to below Yellowhawk Diversion
Below Yellowhawk Diversion to S Mile Rd Bridge
S Mile Rd Bridge to 7 Mile Rd Bridge
7 Mile Rd Bridge to 20 Mile Bridge
20 Mile Bridge to USGS Gauge
USGS Gauge to Mill Creek Alt Stateline
5.8
1.0
5.7
-0.05
7.4
-0.08
3.6
-5.50
4.3
1.7
3.4
-21.06
24.4
28.3
0.8
30.6
27.0
-0.20


Touchet River, July 13, 2011 Net Reach Analysis
Flow, Net Tributary Inputs, Net Diversion Outflow
Measured Instream Flow (cfs)
Net Tributary Inputs Total (cfs)
Net Diversion Total (cfs)
Gains/Losses (cfs)
100
80
60
40
20
0
-20
-40
57.04
-11.78
74.62
80.84
75.28
-0.78
82.13
84.50
80.90
82.48
0.26
-1.86
83.55
2.20
81.31
11.72
-11.27
Cummings to Johnson Bdg
Johnson Bdg to I W Sims Rd Bdg
I W Sims Rd Bdg to Site #4
Site #4 to Luckenbill Rd Bdg
Luckenbill Rd Bdg to Harvey Shaw
Harvey Shaw to Petty John
Petty John to Hwy 125 Bdg
Hwy 125 Bdg to Hwy 124 Bdg
Hwy 124 Bdg to Waitsburg
Waitsburg to Dayton Levee
Touchet River Reach


Touchet River, September 12, 2011 Net Reach Analysis
Flow, Net Tributary Inputs, Net Diversion Outflow
Measured Instream Flow (cfs)
Net Tributary Inputs Total (cfs)
Net Diversion Total (cfs)
Gains/Losses (cfs)
50
40
30
20
10
0
-10
-20
-30
7.84
-10.02
27.39
30.06
-0.58
32.36
31.07
33.67
31.60
39.20
0.14
-1.01
43.86
0.75
-0.07
42.07
11.03
-18.63
Cummings to Johnson Bdg
Johnson Bdg to I W Sims Rd Bdg
I W Sims Rd Bdg to Site #4
Site #4 to Luckenbill Rd Bdg
Luckenbill Rd Bdg. to Harvey Shaw
Harvey Shaw to Petty John
Petty John to Hwy 125 Bdg
Hwy 125 Bdg to Hwy 124 Bdg
Hwy 124 Bdg to Waitsburg
Waitsburg to Dayton Levee
Touchet River Reach


Yellowhawk Creek, June 1, 2011 Net Reach Analysis
Flow, Net Tributary Inputs, Net Diversion Outflow
2011 Flow (cfs)
2011 Net Tributary Inputs Total (cfs)
2011 Net Diversion Total (cfs)
Gains/Losses (cfs)
50
40
30
20
10
0
-10
-20
27.26
-3.62
25.02
-8.56
12.61
4.35
17.99
15.58
22.18
20.24
44.49
-0.50
Garrison Ck Diversion
Cottonwood and Russell Creeks
Mill Creek / Yellowhawk Diversion
Yellowhawk #1 to Yellowhawk #2
Yellowhawk #2 to Yellowhawk #3
Yellowhawk #3 to Yellowhawk #4
Yellowhawk #4 to Yellowhawk #5
Yellowhawk #5 to Yellowhawk #6
Yellowhawk #6 to Yellowhawk #7
Yellowhawk #7 to Yellowhawk #8
Reach


Yellowhawk Creek, September 8, 2011 Net Reach Analysis
Flow, Net Tributary Inputs, Net Diversion Outflow
2011 Flow (cfs)
2011 Net Tributary Inputs Total (cfs)
2011 Net Diversion Total (cfs)
Gains/Losses (cfs)
25
20
15
10
5
0
-5
-10
19.04
18.36
11.67
14.93
16.07
15.92
14.68
3.58
0.52
-1.81
-2.67
-2.63
Garrison Ck Diversion
Mill Creek / Yellowhawk Diversion
Yellowhawk #1 to Yellowhawk #2
Yellowhawk #2 to Yellowhawk #3
Yellowhawk #3 to Yellowhawk #4
Yellowhawk #4 to Yellowhawk #5
Yellowhawk #5 to Yellowhawk #6
Yellowhawk #6 to Yellowhawk #7
Yellowhawk #7 to Yellowhawk #8
Reach