COLUMBIA BASIN WATER TRANSACTIONS PROGRAM FLOW RESTORATION ACCOUNTING FRAMEWORK

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Version 2.0

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Terms and Definitions

Baseflow – Streamflow contributed solely from shallow groundwater in the absence of significant precipitation, runoff events, or supplemental release from storage.

Discharge – The rate of streamflow or the volume of water flowing past a specific location within a specified time interval, often expressed as cubic feet per second.

Diversion – A withdrawal from a body of water by means of a ditch, damn, pump or other engineered structure.

Ecological Flows – The flows and water levels in a water body to sustain the ecological function of the flora and fauna, and habitat processes within that water body and its margins.

Environmental Flows – The quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend upon these ecosystems.

Flow Target – Is a determined and typically measured streamflow recommendation (i.e. flow rate expressed in ft^3/s or cubic feet per second) for a regulated stream system that is dewatered and experiencing flow regime deficits due to over-appropriation of water rights and out of stream water-use demands. These determinations are usually minimum flow targets and optimum flow targets, based upon restoring a natural hydrograph to support specific biological, hydrological or water quality functions.

Limiting Factors – A condition that impacts the health and productivity of habitats and species.

Natural Flow – The flow regime of a stream as it would occur under completely unregulated conditions; that is, not subjected to regulation by reservoirs, diversions, or other human works.

Natural Hydrograph – A graph showing the variation in discharge that would exist in the absence of any human alteration, over a specific time period.

Period of Ecological Significance – The period of ecological significance is unique for each stream reach where a transaction is completed and refers to the time frame during which streamflow is a limiting factor for the targeted fish population(s). This period is determined from expert knowledge of stream conditions and habitat needs for the targeted fish population(s) and will be documented in the transaction check-list and supporting documents submitted to NFWF.

Point of Diversion (POD) – The POD is a location where surface flows are diverted from a stream for off-stream uses. The POD defines the upstream boundary of the Protected Stream Reach in which flow is enhanced through a water transaction.

Protected Stream Reach – The legal and technical definitions of a protected stream reach vary significantly by state. For the purposes of this document, protected stream reach refers to a defined stream reach from a POD to a downstream point of diversion or confluence in which instream flows are augmented and secured through one or more flow transactions.

Instream Flows – The amount of water in a stream to adequately provide for instream uses within the stream channel (i.e., aquatic organisms and riverine processes).

Qualified Local Entity (QLE) – QLEs are local and state program partners who work with irrigation districts, landowners, producers, and other organizations on projects to enhance streamflows. QLEs are eligible to submit proposals to the Columbia Basin Water Transactions Program (CBWTP) for transaction funding.

Streamflow Discharge – The quantity of water that passes a given point in a measured unit of time, such as cubic meters per second or cubic feet per second.

Water Transaction – A water transaction acquires water for instream flows through a willing seller-buyer agreement (or set of related agreements). The agreement details a change in a water use and/or water right leading to legal or de facto protection of additional water in a waterway or water body.[1]

[1] Definition adapted from: Steven Malloch, Liquid Assets: Protecting and Restoring the West's Rivers and Wetlands through Environmental Water Transactions (Arlington, VA: Trout Unlimited, 2005).

Organizational and Program Acronyms

Bonneville Environmental Foundation[2] (BEF) – BEF is an environmental nonprofit established in 1998. BEF is organized around three integrated focus areas: 1) renewable energy, 2) watersheds, and 3) climate business. BEF is primarily involved with flow work through their Model Watershed Program and Water Restoration Certificates, which allows for entities to compensate for their water use and consumption by returning flows to the environment.

Bonneville Power Administration[3] (BPA) – BPA is a public service organization with a mission to create and deliver the best value for customers and constituents to assure the Pacific Northwest:

- an adequate, efficient, economical, and reliable power supply;
- a transmission system that is adequate to the task of integrating and transmitting power from federal and non-federal generating units, providing service to BPA's customers, providing interregional interconnections, and maintaining electrical reliability and stability; and
- mitigation of the Federal Columbia River Power System's impacts on fish and wildlife.

In addition, "BPA funds and manages one of the largest fish and wildlife protection programs in the nation, and invests hundreds of millions of dollars a year to make dams safer for fish, restore damaged habitat, protect threatened lands, and more. The fish and wildlife program is guided by on-the-ground partnerships with conservation agencies, states and Tribes, and is responsive to regional and federal environmental protecting regulations."[4] BPA founded the CBWTP and issued cooperative agreements starting in 2003 with NFWF and ten qualified local entities (QLEs) to develop and implement effective and innovative ways to increase tributary flows. The CBWTP is a primary mechanism for instream water transactions in the Columbia Basin.

Columbia Habitat Monitoring Program[5] (**CHaMP)** – CHaMP is designed as a Columbia River basin-wide habitat status and trends monitoring program built around a single protocol with a programmatic approach to data collection and management. The goal of CHaMP is to generate and implement a standard set of fish habitat monitoring (status and trend) methods in up to 26 watersheds across the Columbia River basin.

Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp) – The BiOp for the FCRPS was enacted under the Endangered Species Act (ESA) mandate that states that a federal entity, in this case BPA, must consult the opinion of the Fish and Wildlife Service (FWS) or National Oceanic and Atmospheric Administration (NOAA) if they have the potential to impact an ESA-listed species. In response, the FWS or NOAA issued a BiOp to ensure that the potential threatening action does not impede species recovery and survival.[6] In the 2008 FCRPS BiOp, restoring flow to tributaries is explicitly referenced under the Reasonable and Prudent

[2] More information available at: www.b-e-f.org
[3] Modified from BPA's mission statement on the website: www.bpa.gov.
[4] BPA Fact Sheet, January 2010. Available at: http://www.bpa.gov/corporate/pubs/fact_sheets/10fs/BPA-invests-in-fish-and-wildlife.pdf
[5] Modified from the CHaMP website: www.champmonitoring.org.
[6] Reference the Federal Caucus Salmon Recovery website for additional information on the BiOps: www.salmonrecovery.gov/BiologicalOpinions.aspx

Alternative (RPA) 35 – *Tributary Habitat Implementation 2010–2018.* This RPA addresses habitat by protecting and improving tributaries, stating:

> *"The Action Agencies will identify additional habitat projects for implementation based on the population specific overall habitat quality improvement... Projects will identify location, treatment of limiting factor, targeted population or populations, appropriate reporting metrics, and estimated biological benefits based on achieving those metrics. Pertinent new information on climate change and potential effects of that information on limiting factors will be considered."*[7]

Integrated Status and Effectiveness Monitoring Program (ISEMP) – ISEMP is a monitoring program implemented by NOAA that applies new and innovative monitoring techniques, designs, and management in the Pacific Northwest.

Intensively Monitored Watershed[8] (IMW) – An IMW is a coordinated large-scale monitored effort to capture the effects of restoration activities on a watershed level and is implemented by ISEMP. There are four watersheds currently being monitored: Bridge Creek in the John Day basin, the Lemhi and Salmon Rivers in the Salmon River basin, and the Entiat River in Washington.

Modeled Watershed Program – The Modeled Watershed Program is a long-term community-based restoration and monitoring program supported by the Bonneville Environmental Foundation (BEF) based on adaptive management techniques.

National Fish and Wildlife Foundation[9] **(NFWF)** – NFWF sustains, restores, and enhances the nation's fish, wildlife, plants, and habitats. Through leadership conservation investment with public and private partners, the Foundation is dedicated to achieving maximum conservation impact by developing and applying best practices and innovative methods for measurable outcomes.

Northwest Power and Conservation Council[10] **(NWPCC)** – The NWPCC was authorized in the Northwest Power Act of 1980 and approved by the legislature of all four Columbia Basin states (Idaho, Montana, Oregon, and Washington). The council develops and maintains a regional power plan and a fish and wildlife program to balance the Northwest's environment and energy needs. The NWPCC's three tasks include:

- developing a 20-year electric power plan that will guarantee adequate and reliable energy at the lowest economic and environmental cost to the Northwest,
- developing a program to protect and rebuild fish and wildlife populations affected by hydropower development in the Columbia River Basin, and

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[7] The full RPA is available at: http://www.cbfish.org/Reports/ReportViewer.aspx?RptName=2008FCRPSBiOpDetail&rs:Format=PDF&piBiologicalOpinionActionNumber=35

[8] Additional information available at: www.nwfsc.noaa.gov/research/divisions/cbd/mathbio/isemp/projects_watersheds.cfm

[9] Additional information on NFWF is available at: www.nfwf.org.

[10] Modified from the NWPCC's mission statement on its website: www.nwcouncil.org.

- educating and involving the public in the NWPCC's decision-making processes.

The plans, policies, and programs the NWPCC develops and approves are implemented by many agencies including the Bonneville Power Administration, the U.S. Army Corps of Engineers, the Bureau of Reclamation, and the Federal Energy Regulatory Commission.[11]

[11] http://www.nwcouncil.org/about/background.htm. The NWPCC's *Briefing Book*, which captures the background and current direction of the council, is available at: http://www.nwcouncil.org/library/2010/2010-13.pdf

List of Acronyms and Abbreviations

BiOP – Biological Opinion

BEF – Bonneville Environmental Foundation

BPA – Bonneville Power Administration

CBWTP – Columbia Basin Water Transactions Program

CHaMP – Columbia Habitat Monitoring Program

EE – Ecosystem Economics

ESA – Endangered Species Act

ESU – Evolutionarily Significant Unit

FCRPS – Federal Columbia River Power System

FWS – U.S. Fish and Wildlife Service

IDFG – Idaho Department of Fish and Game

IMW – Intensely Monitored Watershed

ISEMP - Integrated Status and Effectiveness Monitoring Program

ISRP – Independent Scientific Review Panel

IWRB – Idaho Water Resources Board

NFWF – National Fish and Wildlife Foundation

NOAA – National Oceanic and Atmospheric Administration

NWPCC – Northwest Power and Conservation Council

OWRD – Oregon Department of Water Resources

PHABSIM – Physical Habitat Simulation System

PNAMP – Pacific Northwest Aquatic Monitoring Partnership

POD – Point of Diversion

QLE – Qualified Local Entity

RPA 35 – Reasonable and Prudent Alternative 35

TFT – The Freshwater Trust

USFS – United States Forest Service

USGS – United States Geological Survey

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Executive Summary

The Columbia Basin Water Transactions Program (CBWTP) Flow Restoration Accounting Framework was developed in response to four programmatic requirements:

i. External Evaluation of CBWTP by Hardner and Gullison Associates (2007)
ii. Northwest Power and Conservation Council's Independent Scientific Review Panel Funding Qualification (2010)
iii. Federal Columbia River Power System Biological Opinion (2008 & 2010)
iv. Columbia River Basin Fish and Wildlife Program (2009)

In response to these requirements, the overarching goal of the framework is to create and implement an accounting methodology that uses well-defined measures of progress to track the effectiveness of flow restoration as a tool to improve aquatic habitat conditions for targeted fish populations.

To support this goal, the framework follows a discrete logic path that tracks the four sequential steps of a flow transaction. Monitoring requirements within each subsequent tier increase in both complexity and effort, providing a progressively greater amount of data and information on the outcomes of instream flow transactions. The tiers are sequenced to support general inferences between each level and to produce a complete suite of metrics that can capture outcomes without monitoring each transaction.

All active transactions completed within the CBWTP will be subject to the new monitoring requirements outlined under this framework. Each transaction, per active fiscal year, will be placed within one of the four monitoring tiers by the relevant qualified local entities (QLEs), using a defined set of criteria based on the level of investment, the scale of focus, and stream dynamics (Figure 1). All transactions completed with the CBWTP will be required to confirm compliance with the terms of the contract under Tier 1. Depending on the type of transaction, compliance may be confirmed at the start of the transaction or be required on an annual basis. Beyond Tier 1, however, the level of impact and investment of the transaction will guide the subsequent amount of monitoring required, with progressively fewer transactions placed in ensuing tiers.

Tier 1 - Contractual Compliance – Requirements for Tier 1 ensure that the legal terms of the contract between the QLE and water user are fulfilled. All transactions are included within Tier 1 and must fulfill reporting requirements as defined by the transaction type (e.g., lease, purchase, split-season). Each type of deal has a specified set of monitoring criteria, and depending on the type of transaction, may require demonstration of compliance once (at implementation) or annually (if more consistent tracking and monitoring is necessary). Tier 1 can also account for flow added to the protected stream reach at the POD for transactions that rely upon flow as part of the contract, as is the case for minimum flow agreements. In this case, flow is monitored in order to implement the transaction. However, flow monitoring in this tier is not intended to track the degree to which flow targets or goals are reached. That type of flow monitoring is part of Tier 2 and does not focus on the evaluation of whether the terms of the contract were sufficiently met.

Tier 2 – Flow Accounting – Tier 2 accounts for the flow added to the protected stream reach from the POD along the specified length of the protected reach before, during, and after the

period of ecological significance, as defined by the objective of the transaction in addressing the key limiting factor of flow for identified and targeted species. Monitoring under Tier 2 can also be used to track progress towards flow goals and/or targets (and to help confirm minimum flow transactions have been satisfied).

Tier 3 - Aquatic Habitat Response – Transactions that fall within this tier must track changes in flow-related limiting factors by accounting for aquatic habitat metrics along a specified section of the protected reach during the period of ecological significance. This period is defined by the objective of the transaction in addressing key limiting factors that are unique to the location and purpose of the transaction. A monitoring and accounting strategy will be required for each transaction placed within this tier.

Tier 4 – Ecological Function – This tier integrates transaction and flow-specific monitoring data gathered in Tiers 1, 2, and 3 with broader monitoring efforts in priority regions throughout the Columbia Basin. Monitoring efforts in this tier will be structured in specific basins where CBWTP transaction and other local monitoring efforts overlap to evaluate changes in flow-related habitat characteristics that are examined within the context of broader-scale biological conditions and, where possible, fish population dynamics.

Monitoring requirements under this framework took effect beginning in 2014, and all active transactions will be required to follow the guidelines and timelines set forth within this framework. Importantly, while the QLEs themselves may rely on partner organizations/agencies to gather some or all of the monitoring data, each QLE will be responsible for compiling the data and submitting synthesized reporting forms to the CBWTP at the close of each monitoring season. The data will then be compiled, analyzed, communicated, and archived in compliance with BPA reporting requirements and will be used to provide necessary guidance for the next monitoring season.

This framework is designed to meet the programmatic requirements of the CBWTP, as well as to contribute and build upon the broad network of monitoring and evaluation efforts in the Columbia Basin. While the CBWTP is supported by BPA and NFWF, this framework was made possible through additional support from the Bonneville Environmental Foundation and collaboration with local partners, state agencies, and basin-specific monitoring efforts.

1. Introduction

1.1 CBWTP Program Background

The Columbia Basin Water Transactions Program (CBWTP) was developed in 2002 to address a chronic regional challenge of diminished streamflows in tributaries of the Columbia River that are critical to the survival, resilience, and persistence of anadromous and resident fish species. The CBWTP is managed by the National Fish and Wildlife Foundation (NFWF) in partnership with the Bonneville Power Administration (BPA) and the Northwest Power and Conservation Council (NWPCC).

As a result of legal water withdrawals during the peak growing season, stretches of many streams and rivers in the Columbia Basin run low—and sometimes dry—in summer and early fall, with significant consequences for imperiled salmonid species. Subbasin and other habitat assessment plans[12] throughout the Columbia Basin cite inadequate streamflows as a key factor limiting the productivity of both anadromous and resident fish species. Often, the inadequate streamflows are the result of competing out-of-stream water uses, primarily crop irrigation. Voluntary market-based water transactions provide an effective and fair response to balance the competing out-of-stream uses of water with the need to address this critical limiting factor.

The CBWTP works through qualified local entities (QLEs)[13] to acquire water rights to enhance instream flow for the benefit of threatened and endangered anadromous and resident fish species. Using temporary and permanent acquisitions of water rights and other incentive-based approaches, the CBWTP supports program partners in Oregon, Washington, Idaho, and Montana to assist landowners who wish to voluntarily restore flows to key fish habitat (Figure 1.1). QLEs secure interests in water rights through a variety of mechanisms including:

[12] In 2005, the NWPCC led a BPA-funded effort to develop subbasin plans for 58 tributary watersheds or mainstem segments of the Columbia River. The plans were developed in collaboration with state and federal fish and wildlife agencies, Indian tribes, local planning groups, fish recovery boards, and Canadian entities (where plans included transboundary rivers). Subbasin plans identified priority restoration and protection strategies for habitat and fish and wildlife populations in the U.S. portion of the Columbia River system and included identification of critical limiting factors to populations of listed anadromous fish species. The subbasin plans also integrated strategies and actions funded and pursued under the Endangered Species Act and Clean Water Act. The plans guided the future implementation of the NWPCC's Columbia River Basin Fish and Wildlife Program, which directs more than $200 million per year of BPA electricity revenues to protect, mitigate, and enhance fish and wildlife affected by hydropower dams. Subbasin plans supply this guidance by providing the context in which proposed projects are reviewed for funding through the NWPCC's program. More information on subbasin planning is available at: http://www.nwcouncil.org/fw/subbasinplanning/admin/overview.htm

[13] QLEs are local and state program partners who work with irrigation districts, landowners, producers, and other organizations on projects to enhance streamflows. QLEs are eligible to submit proposals to the CBWTP for transaction funding. QLEs include the following four state water agencies, six nonprofit organizations, and one watershed-based local entity: Clark Fork Coalition, Deschutes River Conservancy, The Freshwater Trust, Idaho Water Resources Board, Montana Department of Natural Resources and Conservation-Water Resources Division, Oregon Department of Water Resources, Trout Unlimited: Montana Water Project, Trout Unlimited: Washington Water Project, Walla Walla Watershed Management Partnership, Washington Department of Ecology, and the Washington Water Trust.

- water efficiency mechanisms on agricultural lands (e.g., crop conversion to lower water use crops or improvements in the method of irrigation that results in water savings);
- water transactions including source switches, minimum flow agreements, and transfer of rights;
- conversion of agricultural lands to alternative land uses; and
- acquisition of land or interests in land for riparian restoration.

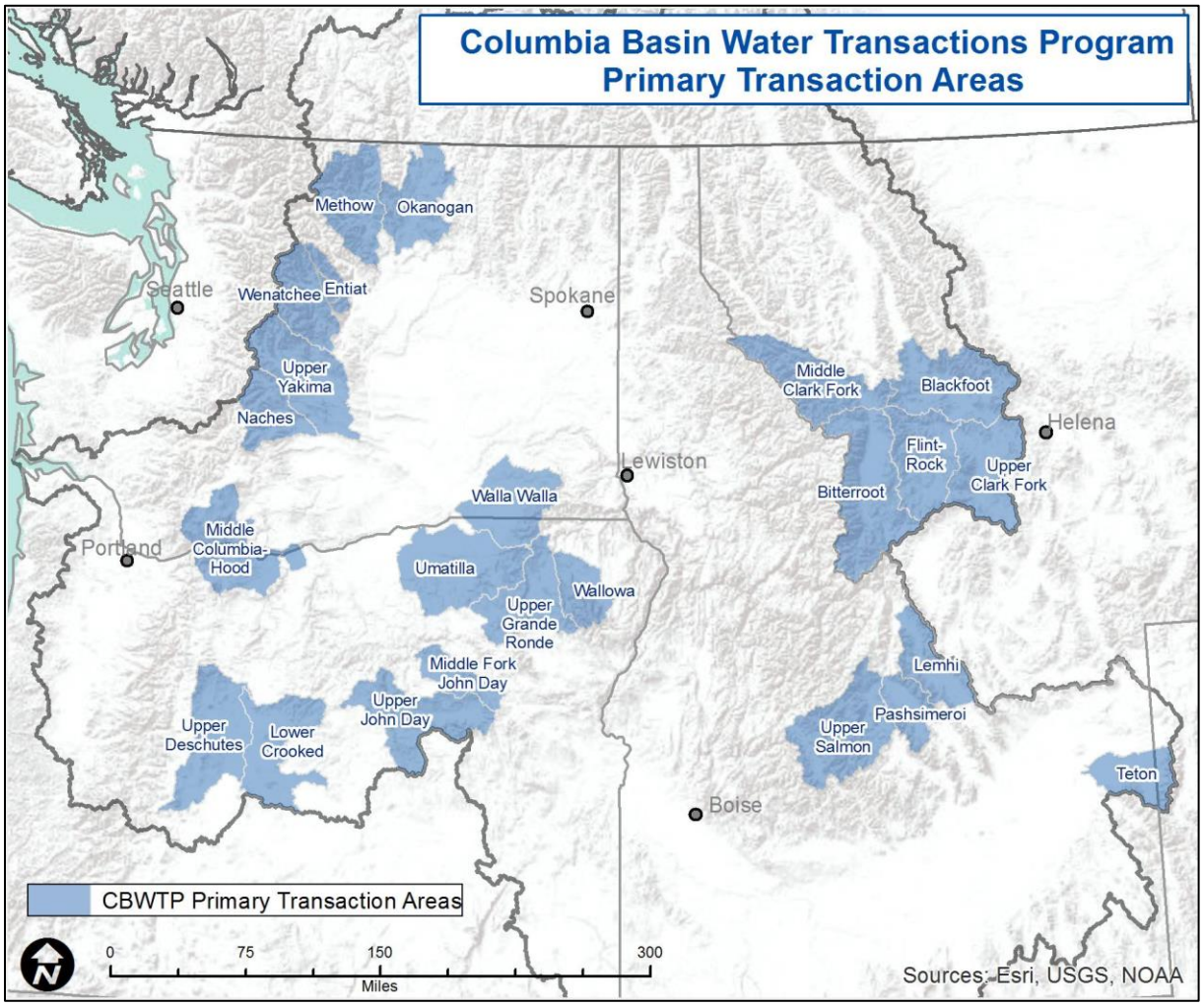

Figure 1.1 CBWTP primary subbasin areas for water transactions.

QLEs work on the ground in local communities to identify, develop, negotiate, and implement water transactions[14] that restore flow to streams.[15] They then submit the proposals to the CBWTP for funding consideration and evaluation. Using criteria approved by the NWPCC's Independent

[14] A water transaction acquires water for instream flows through a willing seller-buyer agreement (or set of related agreements). The agreement details a change in a water use and/or water right leading to legal or de facto protection of additional water in a waterway or water body. (Definition adapted from: Steven Malloch, *Liquid Assets: Protecting and Restoring the West's Rivers and Wetlands through Environmental Water Transactions* (Arlington, VA: Trout Unlimited, 2005).

[15] Summary of transaction types and deal terms are outlined in Appendix A.

Scientific Review Panel (ISRP), the CBWTP reviews and ranks each transaction proposal to ensure it provides benefits to streamflow (criteria are included in Appendix A). The CBWTP makes funding recommendations to BPA and, before funding transactions, obtains BPA approval and fund disbursement. This process also ensures effective implementation of funded projects and compliance with the National Environmental Policy Act through agreements with the local entities participating in the program. In addition to processing and funding transactions, the CBWTP provides transactional and capacity-building support to the QLEs' water transaction efforts. This programmatic investment includes direct financial support to cover the costs of bringing a transaction to fruition, as well as capacity-building resources.[16]

In recent years, the program has expanded its partnerships to include BPA Accord parties[17], such as the Confederated Tribes of the Colville Reservation, the Confederated Tribes of the Umatilla Indian Reservation, the Yakama Nation, and the State of Idaho, to ensure that water transactions financed with Accord funds have the same level of review as other CBWTP-funded water transactions. The CBWTP and the QLEs provide outreach and support to Accord parties in developing successful water transactions. Increasingly, QLEs also provide support and review to project partners working with other BPA-funded conservation projects to ensure that these projects will secure and protect the saved water for the benefit of streamflows.

Since 2002, the QLEs—in cooperation with NFWF, BPA, and additional program partners and cost share sources—have completed more than 400 water rights transactions that have restored 1,133,598, acre-feet to date (through 2014), with an additional 6.24 million acre-feet of flow protected for use over the next 100 years, watering over 1500 tributary stream miles within the Columbia Basin (Figure 1.2). These transactions have used a number of innovative methods, including short-term, long-term, and split-season leases; source switches; diversion reduction agreements; and permanent purchases.

[16] Capacity building includes providing training and workshops to QLE project management staff in all aspects of water transactions such as the following: prioritizing work areas, developing partnerships, providing transactional support on how to value and evaluate water rights, developing monitoring protocols, etc.

[17] The Columbia Basin Fish Accords are agreements among five Northwest tribes, Oregon, Washington, and Idaho for activities designed to supplement the FCSRP BiOp and the Northwest Power and Conservation Council's Fish and Wildlife Program. The Accords were implemented in 2008 and extend through 2018.

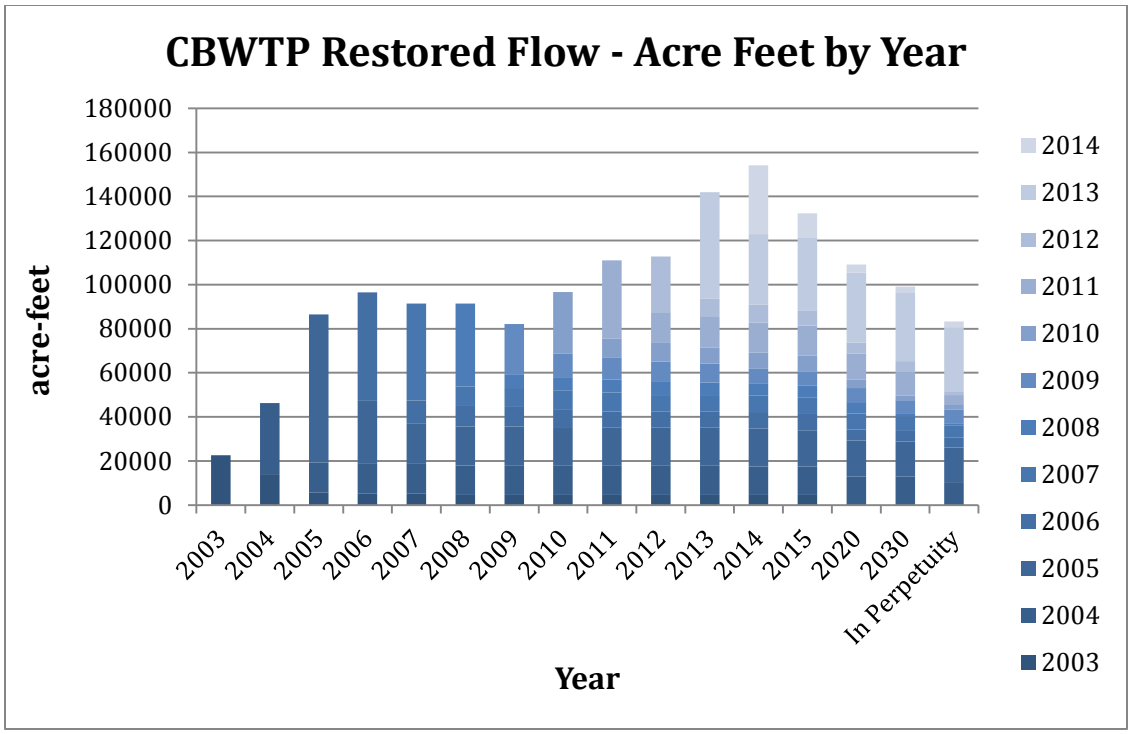

Figure 1.2 Restored flows to key tributary streams in the Columbia Basin from CBWTP transactions (2003-2014).[18]

1.2 CBWTP Monitoring Imperatives

There are four main factors that provide both the motivation and the ISRP criteria[19] for the development and implementation of this Flow Restoration Accounting Framework:

i. External Evaluation of CBWTP by Hardner and Gullison Associate s (2007)
ii. Northwest Power and Conservation Council Funding Qualification's Independent Scientific Review Panel (2010)
iii. Federal Columbia River Power System Biological Opinion (2008 & 2010)
iv. Columbia River Basin Fish and Wildlife Program (2009)

1.2.1 Hardner and Gullison External Evaluation (2007)

The CBWTP began developing a monitoring framework upon the completion of the 2007 third-party program evaluation.[20] The final evaluation report commended the CBWTP for developing a monitoring effort focused on transaction compliance and flow accounting, but recommended that the CBWTP also work to develop guidelines or standards for habitat monitoring:

[18] Acre-feet metrics are queried from the transactions proposals, which are derived from QLE's estimated maximum volume of water transacted. The water in the out years of 2015, 2020, 2030, and In Perpetuity reflect longer-term transactions that secure flow instream each year throughout the term of the transaction. The long term and perpetuity values will increase as additional CBWTP water transactions are implemented that extend into future years.
[19] http://www.cbwtp.org/partners/Criteria_02_12_04.htm
[20] Hardner & Gullison Associates, Independent External Evaluation of The Columbia Basin Water Transactions Program, 2003–2006 (Amherst, NH: author, 2007). Available at: http://cbwtp.org/jsp/cbwtp/library/documents/CBWTP%20Eval%20Report%2010-7%20FINAL.pdf

> *Recommendation #3 – Develop Guidelines or Standards for Habitat Monitoring: As CBWTP becomes more integrated with other efforts to restore fish habitat, it will also need to become better integrated with efforts to monitor the performance of habitat restoration. CBWPT should request from the Northwest Power and Conservation Council and BPA either guidelines for monitoring, or direct assistance in monitoring, to ensure that the information generated is consistent across restoration programs in the Columbia River Basin.*[21]

This recommendation provided the initial impetus to construct the first formal monitoring protocol to provide basic assurance that the terms of the transactions were met and to track hydrologic, ecological, biological changes in priority streams. The full version of the Flow Restoration Accounting Framework was developed in 2011/2012 and implementation began in 2013.

1.2.2 NWPCC Funding Qualification (2010)

During the FY 2012–2014 BPA and NWPCC funding solicitation process, the CBWTP was reviewed under the Research Monitoring and Evaluation solicitation group to provide a greater level of scrutiny of monitoring activities than in previous years. The NWPCC recommended funding the CBWTP with a specific qualification to develop a more rigorous monitoring program within the CBWTP:

> *Qualification 1: "The Water Transaction Program should complete the development of compliance, implementation, and effectiveness monitoring protocols as soon as possible. Given the lead entity is the National Fish and Wildlife Foundation, the proponents should be able to develop their monitoring program fairly quickly."*

The CBWTP was given until the spring of FY 2012 to provide a response to the above qualification. The Flow Restoration Accounting Framework outlined in this report serves as the program's response and contains the structure, activities, and reporting documents that are required to address the qualification.

1.2.3 Federal Columbia River Power System 2008 and 2010 Biological Opinion

The 2008 and 2010 Biological Opinions (BiOp)[22] issued by NOAA Fisheries to the U.S. Army Corps of Engineers, BPA, and the U.S. Bureau of Reclamation under Section 7 of the Endangered Species Act (ESA) require that the Federal Columbia River Power System (FCRPS) be operated in a manner that "is not likely to jeopardize the continued existence" of any species listed under the ESA. On August 2, 2011, Judge Redden with the U.S. District Court in Portland, Oregon, ruled that the current BiOp will remain in place through the end of 2013 and that NOAA must produce a new or supplemental BiOp that "relies only on identified mitigation measures.[23]

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[21] Hardner and Gullison offered a total of six recommendations for continued improvement and programmatic growth. These recommendations can be found within the above referenced report, pages 40–44.

[22] http://www.salmonrecovery.gov/Home.aspx

[23] The full text of Judge Redden's decision is available at: http://www.salmonrecovery.gov/Files/2011.MSJ%20Opinion%20and%20Order.FCRPS.PDF

However, since this period Judge Michael H. Simon replaced a retiring Judge Redden, while NOAA released its 2014 BiOp to replace the 2008 and 2010 supplemental BiOp covering the 13 species of Columbia and Snake River salmon and steelhead listed under the ESA. This 2014 BiOp was immediately challenged remains in effect pending Judge Simon's ruling on the current FCRPS BiOp.The CBWTP implements water transactions that help improve water quantity and water quality limiting factors in the Columbia Basin as part of RPA 35 mitigation actions.

1.2.4 Columbia River Basin Fish and Wildlife Program (2009)

To complement the BiOp, NWPCC enacted the 2009 Columbia River Basin Fish and Wildlife Program, which references, in Section D.2.a, land and water acquisitions as an appropriate method to mitigate for fish and wildlife impacts.[24] The document explicitly notes the following:

> *"Bonneville established a water transactions program in response to the 2000 Columbia River Basin Fish and Wildlife Program and the 2000 FCRPS Biological Opinion. Bonneville shall fund the continuation of the water transaction program to pursue water right acquisitions in subbasins where water quantity has been identified in a subbasin plan as a limiting factor. The water transaction program will continue to use both temporary and permanent transaction for instream flow restoration."*

Both the RPA 35 and NWPCC's Fish and Wildlife Program provide support to the CBWTP to implement water acquisitions in support of habitat restoration goals. Data gathered under this Flow Restoration Accounting Framework will help the CBWTP provide consistent information to BPA on the outputs of these investments.

1.2.5 Columbia Basin Integration

This framework is designed to meet the programmatic requirements of the CBWTP and to contribute and build upon the broad network of monitoring and evaluation efforts in the Columbia Basin. While the CBWTP is supported by BPA and NFWF, this framework is made possible through additional support from BEF and collaboration with local monitoring entities.

1.3 Broader NFWF Context

The CBWTP is a component of NFWF's Western Water Program. The foundation of the Western Water Program includes two water transaction programs: the CBWTP developed with BPA and the Desert Terminal Lakes Restoration Program. NFWF is also actively exploring the feasibility of establishing other water transactions programs throughout the West. Through implementation of established and emerging water transaction programs, NFWF hopes to assist communities in balancing agricultural, community, and ecological needs for water through economic incentives and other support; improve governance of and policy for flow restoration initiatives; develop and manage funding sources; build capacity of flow restoration practitioners; and serve as a neutral convener of flow restoration professionals.

[24] This text can be found in Section VII.I Implementation Provisions, D. Project Funding Priorities, 2. Land Water Acquisition Funds and accessed at: http://www.nwcouncil.org/library/2009/2009-09/Default.asp

1.4 NFWF – Bonneville Environmental Foundation Partnership

NFWF and BEF developed a partnership in 2011 to apply NFWF's Flow Restoration Accounting Framework in several basins key for both organizations. A joint CBWTP-BEF long-term goal is to use this effort as an example to demonstrate the ecological effectiveness of water transactions throughout the Columbia Basin. The CBWTP will use this opportunity to integrate the Flow Restoration Accounting Framework with broader basin-wide initiatives, and implement a targeted Tier 3 monitoring effort to produce monitoring data that may be relevant to other restoration and monitoring programs such as CHaMP and the Pacific Northwest Aquatic Monitoring Partnership's (PNAMP) Intensively Monitored Watersheds Project. BEF will apply monitoring data and results to their Model Watershed Programs and provide an ecological foundation for their Water Restoration Certificates.

2. Flow Restoration Accounting Framework

2.1 Theoretical Foundation

There is a growing worldwide recognition that restoration and conservation of functioning freshwater systems is essential to human livelihoods and quality of life. Quantifying and securing environmental flows[25] in support of freshwater biodiversity is an evolving field of study and practice, and includes more than 200 methodologies[26] ranging from widely implemented physical habitat models[27] to more recently developed "presumptive flow standards" based on natural or historic flow variability.[28] Parallel to the evolving field of flow quantification, there is a growing body of scientific literature exploring the general relationship between flow alteration and ecological responses.[29] Despite this proliferation of flow methodologies and research, critical knowledge gaps remain around the relationships among flow restoration, ecological responses, and biological communities.[30] More specifically, documenting direct relationships between flow alteration and targeted biota is challenging, with recent research suggesting that community and process-based physical and biological indicators do not respond to changes in the flow regime in predictable ways.[31]

These knowledge gaps persist in the Columbia Basin and drive current investments in restoration, research, and monitoring efforts for anadromous fish, which are affected by multiple aquatic, terrestrial, and oceanic variables throughout their life cycles. In 2008, NOAA Fisheries released a Biological Opinion (BiOp)[32] that identified mitigation requirements for the recovery of endangered chinook salmon and steelhead. To fulfill the BiOp mandates, BPA, NOAA, and several other regional agencies are implementing restoration and monitoring projects across the Columbia Basin. Because restoration activities are applied at a wide range of spatial scales, tracking the ecological responses to restoration actions in terms that are meaningful at both the site scale and to basin-wide fish recovery is a well-documented challenge.[33]

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[25] Environmental flows are described as "the quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend upon these ecosystems" (Brisbane Declaration, 2007).

[26] R.E. Tharme, "A Global Perspective on Environmental Flow Assessment: Emerging Trends in the Development and Application of Environmental Flow Methodologies for Rivers," *River Research and Applications* 19 (2003):397–441.

[27] G.E. Petts, "Instream Flow Science for Sustainable River Management," *Journal of the American Water Resources Association* 45 (2009):1–16.

[28] B.D. Richter et al., "A Presumptive Standard for Environmental Flow Protection," *Research And Applications*, online advanced version (2011). doi: 10.1002/rra.1511.

[29] I.C. Overton et al. (eds). (2009). *Ecological Outcomes of Flow Regimes in the Murray-Darling Basin* (Canberra, Australia: CSIRO, 2009).

[30] A.H. Arthington et al., "Preserving the biodiversity and ecological services of rivers: new challenges and research opportunities," *Freshwater Biology* 55 (2010):1-16.

[31] N.L. Poff and J.K.H Zimmerman, "Ecological responses to altered flow regimes: a literature review to inform the science and management of environmental flows," *Freshwater Biology* 55 (2010):194-205.

[32] The BiOp and any supplemental information can be accessed at: https://pcts.nmfs.noaa.gov/pls/pcts-pub/sxn7.pcts_upload.download?p_file=F25013/201002096_FCRPS%20Supplemental_2010_05-20.pdf

[33] K. Barnas and S.L. Katz, "The Challenge of Tracking Habitat Restoration at Various Spatial Scales," *Fisheries* 35, no. 5 (2010): 232.

In acknowledgement of this challenge to quantify the ecological benefits of flow restoration, the CBWTP Flow Restoration Accounting Framework has identified an overarching need to document the effectiveness of flow transactions as a restoration tool to improve flow-related limiting factors and aquatic habitat conditions that support fish populations in multiple life stages.

2.2 Logic Path

The design of the Flow Restoration Accounting Framework is constructed upon two specific logic paths that provide both the foundation for the components of the framework and the sequence and organization of the monitoring requirements within it.

The foundational logic path is premised upon a general process to assess the quality of monitoring programs at the project or reach scale that was developed for the PNAMP Project Effectiveness Monitoring Workgroup.[34] This process articulated a clear Effectiveness Monitoring Logic Path that sets forth specific steps for evaluating Columbia Basin monitoring programs. The PNAMP logic path is used as a guide for the development of this framework and a longer-term tool for evaluating the viability, durability, and success of the framework itself. The remainder of Section 2 describes the Flow Restoration Accounting Framework through the lens of each of the logic path steps (Figure 2.1).

With a focus specifically on water transactions, the Flow Restoration Accounting Framework is designed around a discrete logic path that tracks four anticipated outcomes of a flow transaction. These steps comprise the four nested tiers of monitoring investments:

Project Compliance: Ensure compliance with the terms of the transaction.

Flow Accounting: Account for the flow added to the protected stream reach at the POD before, during, and after the time period of the water transaction.

Aquatic Habitat Response: Account for changes physical aquatic habitat and flow-related limiting factors along a specified section of the protected reach during the period of ecological significance.

Ecological Function: Evaluate changes in flow-related habitat characteristics that may track with changes in broader-scale biological conditions and fish population dynamics.

2.3 Ecological Assumptions

The Flow Restoration Accounting Framework is premised upon two key ecological assumptions that strengthen the development of water transactions as a tool for aquatic habitat restoration.

1. Transacted water can be accounted for within a protected stream reach.

[34] T.W. Hillman and J. O'Neal, *Draft V3.0: Evaluation of Effectiveness Monitoring Projects* Prepared for PNAMP Project Effectiveness Monitoring Workgroup by BioAnalysts, Inc (Hillman) and TetraTech EC Inc. (O'Neal). Unpublished Report.

2. Flow is a limiting factor to ESA-listed Evolutionarily Significant Units (ESUs) and other at-risk species of concern.[35]

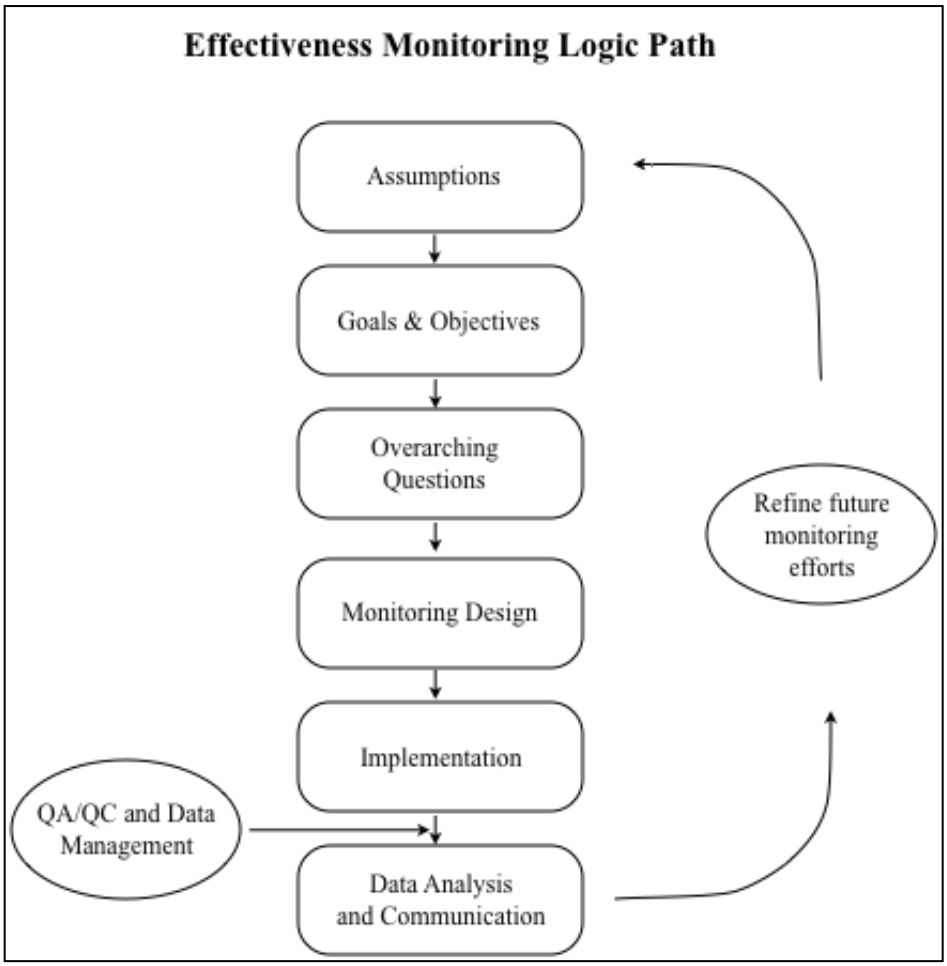

Figure 2.1 Effectiveness monitoring logic path.[36]

2.4 Goals and Objectives

The goal of the CBWTP Flow Restoration Accounting Framework is to create and implement an accounting methodology that uses well-defined measures of progress to track the effectiveness of flow restoration as a tool to improve aquatic habitat conditions for targeted fish populations.

The structure of the tiers is designed to take a sequenced approach to tracking transactions from initial implementation to impacts on aquatic stream habitat. The framework is not designed to monitor or track fish populations. However, hydrologic and aquatic physical habitat monitoring

[35] M.J. Ford, ed., *Status Review Update for Pacific Salmon and Steelhead Listed under the Endangered Species Act: Northwest* (Draft U.S. Department of Commerce, NOAA Technical Memorandum NOAA-TM-NWFSC-XXX, 2010).
[36] This figure is adapted from and informed by Hillman & O'Neal, "Draft V3.0."

data gathered under this framework will be integrated with broader biological and fish population research and monitoring where possible to best characterize and understand stream system status in CBWTP basins.

This Flow Restoration Accounting Framework is designed to meet the current needs of the program in FY 2015 and the immediate future. The Framework has an adaptive management component and will be revisited on a regular basis as the CBWTP develops.

Five objectives provide guidance to the implementation of the Flow Restoration Accounting Framework.

1. Produce structured and meaningful guidance to QLEs and partner organizations on programmatic and ecological monitoring requirements
2. Work within known programmatic capacity and budget constraints
3. Utilize monitoring data to demonstrate seasonal, yearly, and multiyear impacts of flow restoration within the Columbia Basin
4. Comply with CBWTP and BPA program requirements
5. Integrate monitoring data with other ongoing habitat and biological monitoring and research efforts

2.5 Overarching Questions

The CBWTP Flow Restoration Accounting Framework seeks to answer four questions:

a. *Project Compliance* – Are the terms of the contractual agreement for each transaction satisfied to CBWTP standards?
b. *Flow Accounting* – Can the flow added to a stream reach through a single water transaction be accounted for immediately downstream of the POD during the seasonal time frame defined by the transactional agreement?
c. *Aquatic Habitat Response* – Can the flow added to the stream through a single or multiple water transaction(s) be accounted for along a specified length of the protected reach to address limiting factors and increased aquatic habitat, during the seasonal time frame defined by the transactional agreement?
d. *Ecological Function* – What changes in flow-related habitat characteristics and aquatic species dynamics can be tracked and identified in protected stream reaches?

2.6 Monitoring Design

The CBWTP Flow Restoration Accounting Framework is built upon four nested tiers as described below and illustrated in Figure 2.2. The tiers are differentiated by four factors:

a. *Level of Investment* – The Contractual Compliance Tier (Tier 1) requires the least amount of monitoring effort, while the Aquatic Habitat Tier would generally require the highest level of expertise, time, coordination, and resource investment. Additionally, the Aquatic Habitat Tier also tends to be implemented by federally and state managed monitoring programs in partnerships with various agencies, tribes, non-governmental organizations and universities over many years or decades.
b. *Scale of Focus* – The Contractual Compliance (Tier 1) and Flow Accounting (Tier 2) tiers are focused on individual (or cumulative) transactions, the Limiting Factors Tier (Tier 3)

focuses at the Reach level, and the Aquatic Habitat Tier (Tier 4) focuses on the watershed scale.

c. *Selection Criteria* – Transactions and stream reaches will be sorted into tiers according to well-defined selection criteria (see Figure 2.3). All transactions will require monitoring under the Contractual Compliance Tier 1, with progressively fewer transactions and stream reaches falling into the subsequent tiers due to more stringent qualifying parameters.
d. *Aquatic Dynamics* – Monitoring indicators are selected to produce data that correspond to variable rates of change in aquatic responses to flow alteration. Sampling for these indicators will occur at a frequency that reflects the expected rate of change. For example, multiple data points will be gathered over the course of each season to reflect short-term changes in flow. Data gathered under the Aquatic Habitat tier will contribute to an understanding of longer-term physical habitat changes and will generally require a temporal monitoring timeframe of 5-20 years.

The four nested monitoring tiers are (Figure 2.2):

Tier 1 - Contractual Compliance – Requirements for Tier 1 ensure that the legal terms of the contract between the QLE and water user are fulfilled and met accurately. All transactions are included within Tier 1 and must fulfill reporting requirements as defined by the transaction type (e.g., lease, purchase, split-season). Each type of transaction has a specified set of monitoring criteria, and depending on the type of deal, requires demonstration of compliance annually. Tier 1 can also account for flow added to the protected stream reach at the POD for transactions that rely upon flow as part of the contract, as is the case for minimum flow agreements. In this case, flow is monitored in order to implement the transaction. However, flow monitoring in this tier is not intended to track the degree to which flow targets or goals are reached. That type of effectiveness monitoring is part of Tier 2 and does not focus on the evaluation of whether the terms of the contract were sufficiently met.

Tier 2 – Flow Accounting – Tier 2 accounts for the flow added to the protected stream reach from the POD along the specified length of the protected reach before, during, and after the period of ecological significance, as defined by the objective of the transaction in addressing the key limiting factor of flow for identified and targeted species. Monitoring under Tier 2 can also be used to track progress towards flow goals and/or targets.

Tier 3 - Aquatic Habitat Response – Transactions that fall within this tier must track changes in flow-related limiting factors by accounting for aquatic habitat metrics along a specified section of the protected reach during the period of ecological significance. This period is defined by the objective of the transaction in addressing key limiting factors that are unique to the location and purpose of the transaction. A monitoring and accounting strategy will be required for each transaction placed within this tier.

Tier 4 – Ecological Function – This tier integrates transaction and flow-specific monitoring data gathered in Tiers 1, 2, and 3 with broader monitoring efforts in priority regions throughout the Columbia Basin. Monitoring efforts in this tier will be structured in specific basins where CBWTP transaction and other local monitoring efforts overlap to evaluate changes in flow-related habitat characteristics that are examined within the context of broader-scale biological conditions and, where possible, fish population dynamics.

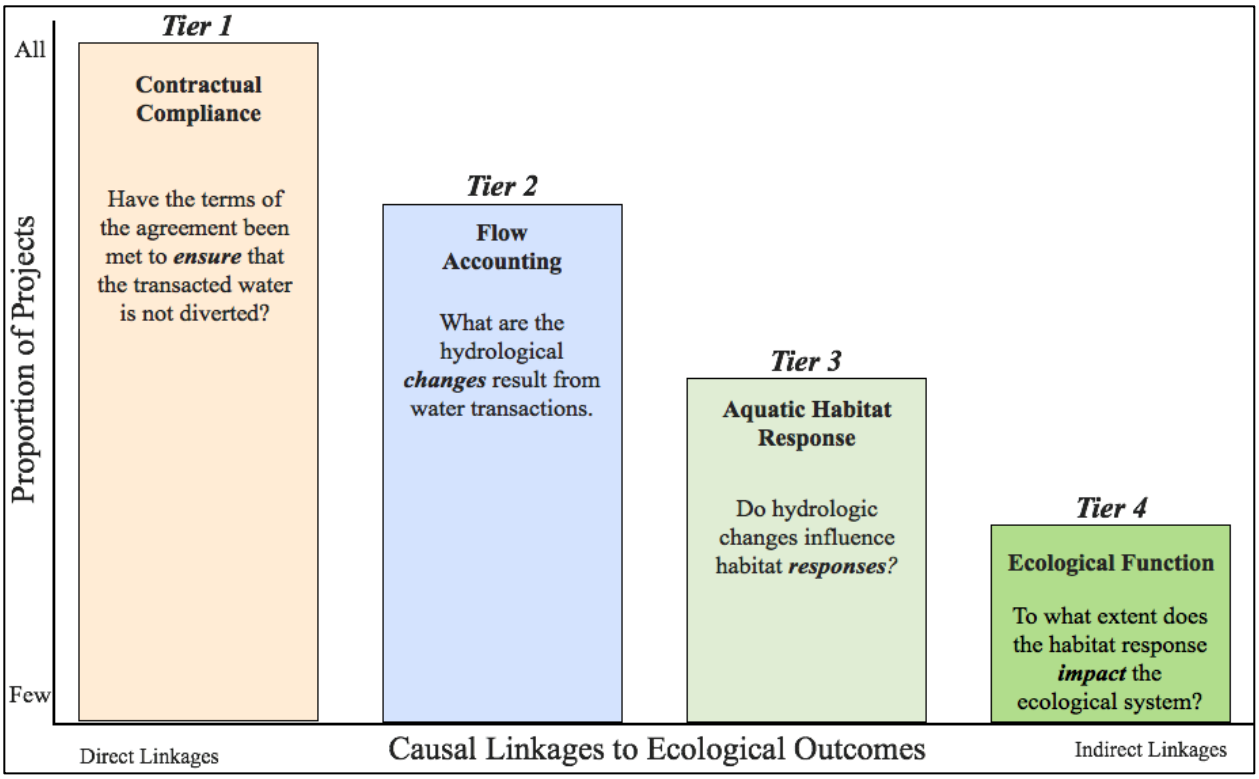

Figure 2.2 CBWTP four-tiered water transactions of the Flow Restoration Accounting Framework.

2.7 Tier Placement

Every transaction completed through the CBWTP will require some level of monitoring as determined by: i) the level of investment (both financial and time/effort), ii) the ecological impact, and iii) the ability to account for impact/change. A set of criteria for Tiers 1, 2, and 3 provide general guidance for the QLEs to determine which level of monitoring would be most appropriate for each completed transaction. Once a transaction is placed in a tier, the QLE can accept or challenge the placement and reporting requirements by following one of three options.

1. Based on the defined criteria summarized in Figure 2.3, the QLE identifies which monitoring tier is most suitable for tracking contractual obligations and the intended outcomes of the transaction.
2. When a project cannot meet the requirements of the most suitable tier as determined by the defined criteria, the QLE submits a written description to the CBWTP explaining why a specific transaction does not fit within the expected tier and suggests what level of monitoring would be appropriate.[37]
3. When monitoring data above and beyond the tier requirements is available, the QLE is only required to present the CBWTP with the required metrics but may include any other information than it deems to be useful and/or appropriate to tracking the outcomes of a transaction.

[37] This will be included in the CBWTP revised proposal checklist, which will be completed in 2015.

Monitoring requirements include those activities specified for the assigned tier as well as for the preceding tiers. For example, a transaction that is placed in Tier 1 (Contractual Compliance) would only fulfill Tier 1 requirements. However, a transaction that is placed within Tier 3 (Limiting Factors) would also be required to fulfill requirements for Tier 2 (Flow Accounting) and Tier 1 (Contractual Compliance). While the QLEs may rely on partner organizations and agencies to gather some or all of the monitoring data, the QLEs will be responsible for compiling data and submitting monitoring reporting forms to CBWTP following the close of each monitoring season.

Tier 1 – Compliance: All transactions are required to fulfill Tier 1 monitoring and transactions that do not meet the qualifications for Tiers 2 or 3 are only required to fulfill Tier 1. Exceptions may be allowed by CBWTP upon written request from the QLEs.

Tier 2 – Flow Accounting: A transaction would fall under the requirements for Tier 2 when both the transacted water flow rate is greater than 1 cfs ***and*** when these transacted flows are equal to or greater than 25 percent of median daily low flows of the targeted reach, for the prior decade for the period of ecological significance. A transaction would also qualify if the total monetary investment made were greater than $500,000, which is the cost point threshold that triggers an economic valuation for the CBWTP.

Tier 3 – Aquatic Habitat Response: Tier 3 is designed to capture the influence of cumulative flow transactions on limiting factors within a specific river reach. Tier 3 projects are located in geographies with BPA funded monitoring efforts in priority watersheds that have been identified in subbasin planning efforts and NOAA recovery plans. Three general conditions guide the selection of Tier 3 monitoring efforts:

1) If the transacted flows are equal to or greater than 50 percent of median daily low flows of the targeted reach, for the period of ecological significance during the prior decade and the term of the transaction is greater than or equal to 10 years.

2) If transacted flows provide the water to meet an established flow target and the term of the transaction is equal to or greater than 10 years.

3) The stream reach includes monitoring efforts by partner agencies and has been identified as a priority stream reach for monitoring in management and regional or local planning documents.

Tier 4 – Ecological Function: Tier 4 projects are selected at a programmatic CBWTP level to include a broad range of streamflow characteristics, transaction types, and expected ecological outcomes. Selection is typically driven by other regional effective monitoring efforts, Biological Opinion priorities, as well as agencies and stakeholder collaboration.

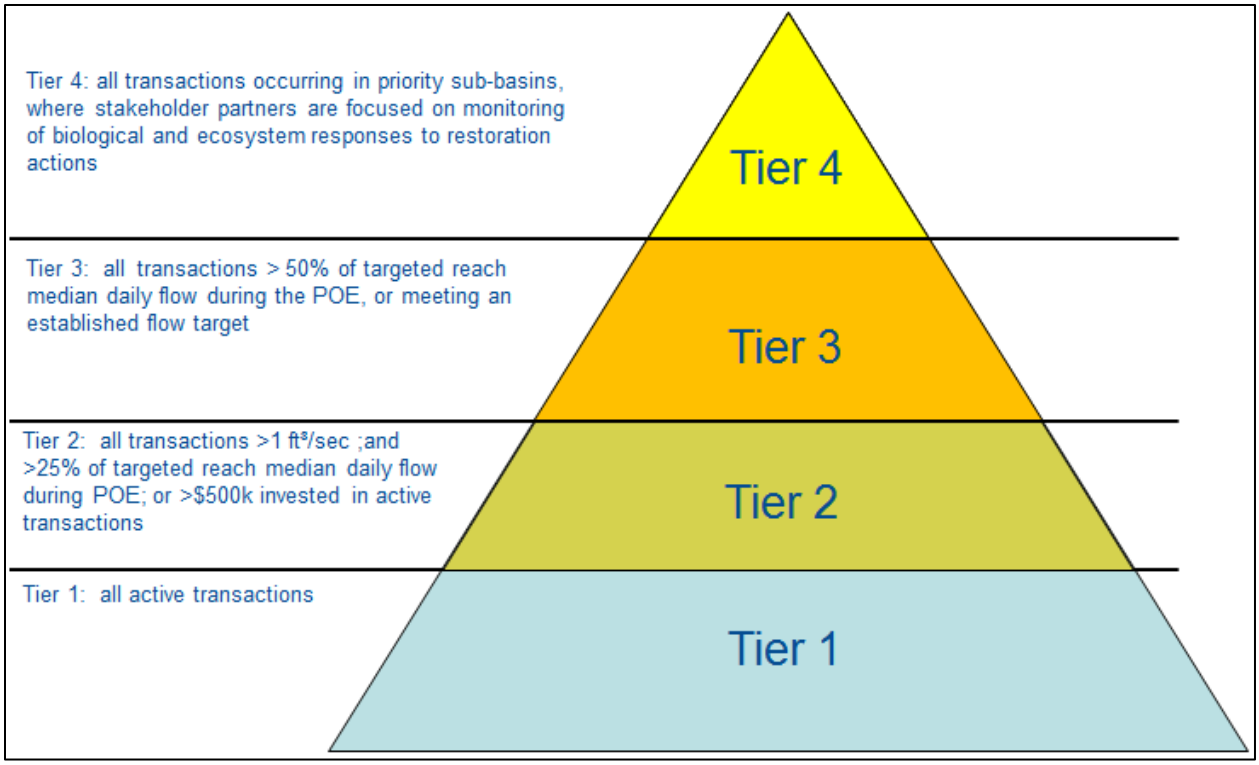

Figure 2.3 CBWTP Monitoring Program Tier Classification Requirements

2.8 Reporting

QLEs must submit reporting forms associated with the Flow Restoration Accounting Framework annually to the CBWTP. CBWTP will provide each QLE with a list of their active transactions that require reporting by April 15th of each year. An active transaction is defined as a current agreement that results in water instream during the fiscal year. Compliance monitoring data and reports will be due by December 1st in the year of monitoring an active transaction. Flow and habitat monitoring data for the remaining tiers will be due the following spring on April 1st.

The QLE is responsible for capturing metrics and reporting on the requirements outlined for the specified tier. In some instances, the QLE might partner with state or local agencies to complete monitoring activities; in these cases, the QLE is still responsible for synthesizing and reporting that data to the CBWTP. In cases where the partnering entity is unable to use the CBWTP's monitoring compliance forms, the QLE is responsible for transferring all applicable data to the compliance monitoring form and submitting the form to the CBWTP. If the partnering entities do not collect the necessary information, it becomes the QLE's responsibility to acquire that information.

3. Tier 1: Contractual Compliance

3.1 Intent of Tier 1 Contractual Compliance

The goal of the Contractual Compliance Tier is to ensure that the legal terms of each transaction are met while establishing clear and standardized reporting requirements for each transaction. The focus of monitoring can therefore be limited to the original place of use and diversion; monitoring of other downstream diversions in the protected reach or stream-discharge is not required.

3.2 Description of Tier 1 Contractual Compliance

Tier 1 establishes the foundation for each of the subsequent three tiers and therefore applies to all transactions completed under the CBWTP. Compliance monitoring focuses on the unique terms of each transaction type and structure. Specific questions have been developed to gauge the degree of transaction compliance within three categories of transactions:[38]

- Leases, transfers and/or forbearance agreements
- Diversion reduction agreements, source switches, conserved water projects, and other transactions where the irrigator is shutting off or reducing their diversion
- Minimum flow agreements

Each transaction will be assigned a Compliance Status following the completion of annual compliance monitoring requirements. The Compliance Status categories are intended to provide a snapshot of the level of compliance achieved for the monitoring season. There are four categories, defined as:

Purple – Monitoring was not performed because of two possible conditions:

a. The transaction provides a flow rate that is too small or is immeasurable to detection.
b. The transaction is deemed exempt from monitoring obligations by CBWTP. This can occur if, prior to the irrigation season, the QLE prepares sound and compelling reasons why the transaction does not warrant monitoring.

Dark Green – There were no issues complying with the terms of the transaction.

Light Green – Monitoring revealed some issues, but they were addressed and posed no further impediment to fully and completely implementing the transaction.

Yellow – Monitoring revealed issues that were addressed but were not fully resolved. So the transaction was not fully implemented according to the terms of the contract.

Red – Monitoring revealed issues that were not or could not be addressed, so the transaction was not accurately or sufficiently implemented as intended.

[38] Transaction types are described in Appendix A.

3.3 Reporting Requirements for Tier 1 Contractual Compliance

3.3.1 Reporting Forms for Tier 1 Contractual Compliance

CBWTP will send the compliance monitoring forms to the QLEs by April 15th of each year prior to the summer monitoring season. The QLEs will then have 30 days to provide CBWTP with written request for projects that could be modified or exempted from Tier placement. The CBWTP will then respond within 30 days to this request with a final determination. Following the irrigation season, all compliance monitoring forms will be due to back to the CBWTP by December 1st of that year (Figure 3.1).

Action	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Tier 1 and 2 Monitoring Forms distributed to QLEs												
QLEs and NFWF discuss revisions to monitoring plans												
End of monitoring season												
Compliance monitoring forms due to NFWF												
Previous year's flow and habitat monitoring forms due to NFWF												

Figure 3.1 Annual monitoring timeline

The monitoring workbook includes distinct spreadsheets that are intended to guide QLEs through the required field monitoring data and assists the QLEs in rolling the data into one summary sheet in order to assign a monitoring status (dark green, light green, yellow, red, or purple). Appendix C provides a table of the data requests within the workbook.

3.3.2 Photo Point Reporting for Tier 1

Photo point monitoring should be incorporated during compliance monitoring, when necessary to demonstrate any issues detected in complying with the terms of the contract. Photos used to document the presence or absence of contractual water use should capture either the ground, in context with surroundings, or the diversion in context with the river to note the absences of flow. The time, date, picture number, stream location, GPS coordinates, and any other relevant information should be recorded and submitted in Tab #3 of the CBWTP Monitoring Workbook. Any information on issues with the contract is necessary to present for third-party review of compliance monitoring. Photos and photo point monitoring forms are due to the CBWTP by Dec 1st of the year following the monitoring season.

3.3.3 Tier 1 Minimum Monitoring Requirements

The minimum annual requirements for a project placed in the Tier 1 Contractual compliance monitoring, includes one of the following:

- At least one annual site visit per project by the QLE or representative during the period of ecological significance, accompanied with photos and/or spot flow measurements assisting verification that the deal was in full compliance at the time of visit.
- A signed affidavit from partner Agency representatives, QLE representative, Water Commissioner, Ditch Rider, or another responsible water delivery system Water Manager responsible for water administration, verifying the transactional water right and associated lands are in compliance (i.e. dry fields/POU or shut headgate/POD).
- Verification of Transactional Water instream via a continuous stream stage recorder, data logger or real-time USGS stream-discharge gage.
- Verification of POU compliance utilizing Remotely Sensed imagery during the term of the Agreement (i.e. Landsat data, Digital Globe or Drone Imagery).

4. Tier 2: Flow Accounting

4.1 Intent of Tier 2 Flow Accounting

The goal of the Flow Accounting Tier is to determine the degree to which transacted water can be accounted for instream throughout the entire irrigation season, along a specified length of the protected reach.[39] The objective is to track changes in discharge during the period of ecological significance, as defined by the objective of the transaction in addressing the key limiting factor of flow for identified and targeted species. There are three conditions for data gathered under Tier 2:

1. Transacted water can most reliably be detected when the transacted water flow rate is greater than 1 cfs ***and*** when these transacted flows are equal to or greater than 25 percent of median daily low flows of the targeted reach, for the prior decade for the period of ecological significance. A transaction would also qualify if the total monetary investment made were greater than $500,000, which is the cost point threshold that triggers an economic valuation for the CBWTP

2. There is not an expectation that the full volume of transacted water will be detectable throughout the protected reach over the course of the monitoring season due to climatic variables, hydrologic conditions, downstream uses, and/or water management factors. Therefore, while QLEs are responsible for ensuring that transacted water is added to the stream, they are not responsible for ensuring that the full volume of transacted flows remains instream for the full length of the protected reach. It should be noted that the degree to which flows are present in the stream relative to flow targets, goals, or expectations have no bearing on the compliance status of the deal, unless such aspects are specific provisions for compliance with the water transaction.

3. Similarly, data produced under this tier will be publically available and can inform other flow-related monitoring actions and needs.

NOTE: If a QLE or project partner identifies any contractual or water right non-compliance issues during the monitoring season:

1. They should adequately document the infraction, if necessary.

2. Notify the water right holder of issues and place a call for water if necessary.

3. Notify the CBWTP as soon as reasonably possible.

4. Notify their respective state water agencies if issues persist beyond 24 hour period and file a formal request for action.

[39] The intent of Tier 2 monitoring is to understand instream flow dynamics. Flow monitoring data is not intended to provide information on flow for enforcement purposes.

4.2 Suggested Monitoring Methodology for Tier Flow Accounting

Streamflow monitoring is the hydrologic foundation of the flow transaction. Streamflow, or discharge, is the volume of water moving past a designated stream cross-section over a fixed period of time. Discharge is most typically represented in cubic feet per second (cfs). Flow monitoring tracks the degree to which changes in discharge can be accounted for along a specified length of the protected reach as a result of a water transaction.

4.2.1 Site Selection for Tier 2 Flow Accounting

Discharge measurements should be taken at site locations where hydraulic conditions are as uniform and straight as possible and are free of obstacles that may alter or influence stream velocity. In addition, staff gaging sites during low flow periods should be selected with a downstream stage control. Staff gaging locations should be marked with stakes, flagging, and/or GPS coordinates from a surveyed benchmark.

4.2.2 Sampling Procedure for Tier 2 Flow Accounting

Flow accounting of a water right transferred instream will require continuous stream-discharge monitoring (using a continuous stage recorder) at or near the POD location, which is where the project water right is legally administered. In addition, a second downstream continuous stream-discharge monitoring location at the end of the protected reach can be useful (pending available resources and a sensible strategy). Please note that the downstream continuous stage recorder site would offer the most value primarily after the acquired water right has gone through the administrative "change of beneficial use" at the state level in order to monitor the biological objective of the water transaction (i.e. passage or over-summering/rearing).

Stream-discharge measurements will be taken at an established channel cross-section nearest the continuous stage recorder location, either immediately upstream and/or downstream of the POD (dependent upon site conditions), with cumulative monitoring of the diversion withdrawals when required, to fully quantify flows. Stage height and corresponding stream-discharge measurement, and the time of the measurement are required for each site visit. This data will be used, along with time series stage recorded data, to develop stream discharge-rating curve that will be used to develop time series flow records or a modeled hydrograph.

Monitoring data collected near the POD location and at the end of the protected reach may be collected via one of three options:

- USGS real-time streamflow gage and/or a State Agency managed real-time streamflow gage
- Continuous stage recorders and staff gages deployed by a QLE, State Agency or partner
- Staff gages and Manual flow measurements conducted by QLE or project partners

4.2.3 Tier 2 Minimum Monitoring Requirements

Monitoring under Tier 2 focuses on tracking transacted flows along a specified length of the protected reach. In addition to monitoring the leased or project irrigation diversion withdrawals, stream-discharge measurements and continuous stage recording are required instream at the POD, so that cumulative stream-discharge may be summed as necessary. In addition to full POD monitoring, stream discharge measurements are recommended at the end of the specified length

of the protected reach to enable better understanding of ecological response and account for any augmented flow through the protected reach.

When utilizing a continuous stage recording device to develop a stage-discharge relationship, it is recommended that a minimum of five flow measurements be collected at varying stage height levels throughout the irrigation season (or year), to develop a satisfactory stage-discharge relationship. QLEs are strongly encouraged to plan on taking measurements at each of these monitoring locations at least 6 times per year in the event that one of their measurements cannot be used for establishing a decent stream stage-discharge relationship. Once a transaction has been monitored for numerous seasons, and reliable stage-discharge relationship has been established, the number of site visits may be reduced, assuming a stable channel cross-section within the monitoring reach. It should be noted that Monitoring Technicians should always be cognizant of stream dynamics and high water flow events, which can change cross-sectional area, downstream surface elevation controls, shift deployed instruments, housing or staff gages. Surveying all instruments to known local benchmarks annually to identify any potential elevation change shift is recommended to ensure sound QA/QC of all data collected in the field.

Requirements are:

- Monitoring of one continuous stage recorder at/near the POD location (upper most location of the protected reach) in tandem with monitoring of the project POD withdrawals (if still operating), so that cumulative flows can be quantified at the POD. Recorders should be set at 15-minute intervals and stream-discharge measurements collected at a minimum of 5 times per year or season at various wade-able stage heights.
- Stage discharge relationships and rating curves should be calculated at the end of the irrigation season and reported with associated project maps, photos and other relevant information to help characterize the monitoring site and data collected throughout the season.

Suggested:

- Monitoring of one continuous stage recorder at the end of the protected reach. Stage recorders should be set at 15 minute intervals and stream-discharge measurements collected at a minimum of 5 times per year or season at various wade-able stage heights.

4.2.4 Equipment for Tier 2 Flow Monitoring

Flow monitoring equipment should include:

- USGS approved Flow Current Meter with wading rod
- Field Tape and Field Notebook
- USGS approved Continuous Stage Recorders
- Staff gages, flagging and stakes/rebar
- Housing hardware for Stage Recorders (i.e. pipe or pvc)
- Survey equipment/auto-level and stadia rod

NOTE: Flow monitoring equipment selection varies depending on both the hydrologic conditions and available resources in the potential transaction location. Therefore, while no

specific flow monitoring equipment is recommended, a short description of available equipment is provided in Appendix C.[40]

4.2.4 Recommended Monitoring Methodology for Tier 2 Flow Monitoring

While this Flow Restoration Accounting Framework does not require a specific streamflow monitoring methodology, USGS-approved protocols and methods as described in Rantz *et al.* (1982) and Olsen and Norris (2007) are the recommended and preferred flow monitoring methodologies. Stream-gaging equipment and methods should be determined by site cross-section depth and estimated stream discharge at the time of gaging, per the USGS protocols. USGS has approved a variety of types of flow meters and methods that are unique to the wide range of streamflow conditions throughout the country (Olsen and Norris 2007). The Flow Restoration Accounting Framework does not include an exhaustive list of USGS-approved methodologies; instead, the QLEs should select an appropriate methodology for the channel and hydrologic characteristics of the transaction site.

All flow meters and stage recorders should be used according to their operational manuals and relevant USGS protocols and recommendations. Discharge measurement data collection should always be recorded in field notebooks and in appropriate handheld computer equipment such as computer laptops or personal digital assistants (PDAs) using standardized USGS data sheets.

4.3 Reporting Requirements for Tier 2 Flow Accounting

4.3.1 Reporting Forms for Tier 2 Flow Accounting

CBWTP sends active Tier 2 monitoring forms to the QLE's by April 15th of each year. QLE's may then consult with CBWTP about project tier placement or request changes to the list if deemed necessary. Flow Monitoring Form forms are typically due back to the CBWTP by April 1st of the following year after the monitoring season with QLE monitoring reports and flow data. The detailed data forms for Tier 2 monitoring are included in Appendix D.

4.3.2 Photo Point Reporting for Tier 2 Flow Accounting

Photo point monitoring can be incorporated at POD and stream-discharge monitoring locations to demonstrate any issues with contractual compliance or any evidence of stream conditions that pertain to the intent of the transaction. It is suggested that photos be taken at the center of every cross-section when conducting streamflow discharge measurements: one looking upstream and the other looking downstream. The time, date, picture number, stream location, GPS coordinates (as available), and any other relevant information should be recorded when possible. For Tier 2 monitoring, one photo per monitoring location should be shared with CBWTP accompanying all associated flow information for that project location each year.

[40] An overview of several flow current meters, pressure transducers, and staff gages are presented in Appendix C. This description is taken directly from: R. Holmes et al., *NFWF–CIG Field Monitoring Protocols* (Dec 2013). This handbook is available upon request at NFWF and is being developed for the NFWF Natural Resource Conservation Service Conservation Innovation Grant (CIG) that is described in Section 1.5 of this document.

5. Tier 3: Aquatic Habitat Response

5.1 Intent of Tier 3 Aquatic Habitat Response

This tier will be designed in collaboration with ongoing monitoring and evaluation efforts in order to leverage existing data and scientific investment and identify and fill any existing data gaps essential for project evaluation. Tier 3 tracks changes in flow-related limiting factors by accounting for aquatic habitat metrics along a specified section of the protected reach during the period of ecological significance. The habitat metrics are defined by the objective of the transaction in addressing key limiting factors that are unique to the location and purpose of the transaction.

Tier 3 is based on the assumption that flow is always a limiting factor in streams with active water transactions. Thus, the goal of Tier 3 is to track changes to identified aquatic habitat limiting factors that may result from flow augmentation throughout the length of the protected reach.[41] Aquatic habitat changes will be tracked during the period of ecological significance and will be calculated as a percent change towards improving specified limiting factors.

5.2 Description of Tier 3 Aquatic Habitat Response

Aquatic habitat indicators are intended to measure and quantify flow-related aquatic habitat characteristics that may change in response to flow transactions along a protected stream reach. Indicators of aquatic habitat changes include: wetted area, wetted width, pool volumes, velocity profiles, temperature and critical riffle analysis.

Metrics for these indicators include changes in the standard deviation of flow velocity, as well as percent change to the depth, wetted width, and velocities over the course of the monitoring season and from year to year. The percent change calculations will be used to evaluate the degree to which the needle has moved towards improving the limiting factors of flow or passage, and other limiting factors explicitly described for individual basins.

As a general rule, three conditions guide the identification and selection of Tier 3 monitoring efforts:

> 1) If the transacted flows[42] are equal to or greater than 50 percent of median daily low flows of the targeted reach, for the period of ecological significance during the prior decade,[43] and the term of the transaction is greater than or equal to 10 years.
>
> 2) If transacted flows provide the water to meet an established flow target and the term of the transaction is equal to or greater than 10 years.

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[41] These limiting factors are of significant importance to BPA in Priority BiOp areas.

[42] Total transacted flow is calculated for the entire protected reach and may include either a single transaction or cumulative transacted flows for that reach.

[43] In many cases, flow data is limited and a full decade of data is not available. Under those conditions, a best estimate of average flows during the low flow season will suffice to determine the approximate percentage increase in flows that will result from both individual and cumulative transactions. If data are not sufficient to develop median daily low flow, the project will remain in Tier 2.

3) The stream reach includes monitoring efforts by partner agencies and has been identified as a priority stream reach for monitoring in management and agency documents.

CBWTP and the QLEs will collaboratively develop a monitoring plan for each Tier 3 project. A monitoring plan should be included to the CBWTP proposal checklist for all future projects, and should provide the following elements:

- implemented transactions,
- ongoing monitoring efforts in the region or locale that provide partnership opportunities,
- biological and hydrological goals of transaction implementation, including the limiting factors to be addressed, and
- an estimate of the potential impact of water transactions on aquatic habitat and identified limiting factors.

5.3 Reporting Requirements of Tier 3 Aquatic Habitat Response

The CBWTP Tier 2 Monitoring reporting form, which is required for all stream-discharge monitoring sites (Tiers 2-4), will be required for all Tier 3 transactions. Other reporting requirements for objectives such as critical riffle, temperature or specific hydraulic parameters, such as wetted areas, wetted widths or pool volumes will be coordinated between CBWTP and the QLEs in accordance with their individualized Tier 3 monitoring plans.

6. Tier 4: Ecological Function

6.1 Intent of Tier 4 Ecological Function

The Ecological Function Tier relates transaction and flow-specific monitoring data gathered in Tiers 1, 2, and 3 with broader effectiveness monitoring efforts in priority regions throughout the Columbia Basin. Tier 4 is designed to nest within the Columbia Habitat and Monitoring Program (CHaMP) and other BPA-funded monitoring programs to ensure both biological and basin-wide integration. Two primary objectives guide this tier.

1. Biological Monitoring Integration: The CBWTP Flow Restoration Accounting Framework is designed primarily to track the contributions of water transactions to improvements in flow, which is a limiting factor to ESA-listed Evolutionarily Significant Units (ESUs) and other at-risk species of concern. The framework is not designed to track other limiting factors to fish survival or to conduct fish population monitoring. However, the CBWTP recognizes the importance of coordinating with biological monitoring efforts in order to correlate, to the greatest extent possible, changes in flow-related aquatic habitat metrics with changes in biological metrics. Monitoring under this tier will therefore be carried out in close collaboration with organizational partners and agencies collecting biological monitoring data.

2. Basin-wide Integration: In a concerted effort to coordinate and connect with broader basin-wide biological monitoring efforts, Tier 4 is designed to integrate with BPA-funded fish monitoring and research efforts.

6.2 Tier 4 Locations

Site selection for this tier will be evaluated according to the following criteria to:

- determine the role of transactions along the reach,
- evaluate the degree of hydrologic and social complexity along the reach,
- identify additional monitoring activities along the reach,
- integrate with CHaMP and ISEMP monitoring sites along the reach,
- funding and collaboration potential.

Collaborating with local partner organizations, larger regional monitoring programs, as well as state and federal agencies is essential to Tier 4 monitoring efforts. Therefore, these locations will be identified and generally dependent upon a greater effort underway beyond the normal scope or capacity of the CBWTP or QLE's typical work plan. The CBWTP does hope that it may be in a position to offer monetary and capacity resources to assist the monitoring efforts of local organizations attempting to address ecological questions that are of interest and relevant to each of the partners. However, it is anticipated that most of the CBWTP/QLE monitoring contributions to this Tier 4 level would be focused primarily upon existing Tier 3 monitoring methods and how to build out from there.

6.3 Reporting Requirements of Tier 4 Ecological Function

Reporting requirements, including data formats, timing, and QA/QC, will be developed in close coordination with CBWTP and additional partners. It is anticipated that this Tier 4 monitoring would essentially be maintaining Tier 3 methods identified above in section 5.0 – Aquatic Habitat Response. Some other techniques such as macro-invertebrate monitoring or fish survey data from snorkeling, as well as water quality analysis may be initiated, however, techniques and methods would be dependent upon need and available capacity.

7. Data Analysis, Interpretation, and Context

7.1 CBWTP Data Gathering and Reporting

The CBWTP obtains monitoring reports annually from all QLEs during the winter period following the summer irrigation season. All active water transactions will be reported in either their Tier 1 Compliance Workbook or the Tier 2 Flow Tracking and Accounting Workbook. Tier 2 transactions will share data validating the location, amount and timing of flows throughout the term of the contracts. The Tier 2 workbooks will be supplemented by each QLE' s individual Monitoring Reports showing processed flow information, raw data, pictures and other supplementary project information providing context to the deals implementation.

The CBWTP is then responsible for compiling and synthesizing data collected from the QLE's and then conducting a final report to BPA. Individual QLE's and their respective project portfolios performance can then be determined, and reported collectively on behalf of the entire program, focusing on the compliance Tier 1 and the Tier 2, amount of flow restored instream reported. While the compliance reporting portion (Tiers 1 and 2) of flow restoration is the foundation of the programs reporting, a secondary objective is to attempt to roll-up this data into other habitat RM&E reports for BPA to better assess and determine project outcomes.

In order to assist with data management and programmatic understanding and reporting, the CBWTP has begun developing a geospatial database of our project portfolio and accompanying data. The CBWTP has identified: 1) flow project stream reach locations, 2) established stream flow targets, timing and objectives, 3) flow target methodology used, 4) flow regime deficit, and 5) the annual restored flow rate/volume, in order to evaluate streamflow restoration impacts to date. While this analysis does not take into account many important limiting factors such as water temperature, it does allow for a quantifiable and measureable hydrological impact due to CBWTP investments.

Currently, the CBWTP has plans to begin assessing all active projects throughout the Basin with this analysis, and will report in this manner with our compliance flow information collected through Tier 2 monitoring as well. Additionally, analysis of other limiting factors and project effectiveness, specified in Tier 3 will begin in FY2016.

7.2 Determining: Flow Regime Deficits and Flow Targets

It is necessary to define the hydrologic flow regime deficit in order to understand and analyze the extent to which the amount of transactional water restored instream is meeting the established flow target or goal. A flow regime deficit (dewatering) is in essence the percentage of flow that is diverted or appropriated for out of stream water purposes during the period of ecological significance. This number or percentage scales with varying stream-discharge throughout the year and can be determined in two steps:

i. Assess stream-discharge in the "targeted reach" prior to restoration, and then

ii. Compare this amount to expected stream-discharge rates that would naturally flow through an unimpaired stream system during the same period and location, without irrigation and other out of stream water-use demands.

Hydrologic Flow Regime deficits occur on regulated stream systems that have been determined to be flow limited or dewatered due to anthropogenic impacts or out of stream water-use demand (i.e. diversions and dams). Dewatering can be a chronic or perennial issue on an over-appropriated stream system, while on other streams with less out of stream water use demands, the dewatering occurs more intermittently or periodically, exacerbated primarily by lack of precipitation. These deficits should be established for specific project locations and targeted stream reaches, as well as for a specific period. Deficits of chronically dewatered streams are typically anywhere from 50-100% during the low flow periods, while periodically dewatered streams tend to have a <50% deficit, dependent upon water right demands.

Flow targets around the Columbia Basin have generally been determined and/or established by State Fish and Wildlife Agencies, which consider "flow deficits" (i.e. water-use conditions and patterns) when assessing streamflow needs for a fishery or targeted fish species, a specific life-stage, or other limiting factors such as those discussed in Section 5.0 - Tier 3. However, other types of state agencies such as the department of water resources or environmental quality equivalents also have the ability to recommend and/or establish flow targets on stream systems, driven by regulatory and/or beneficial-use impairment issues.

Currently, "flow targets" have generally been established for almost every priority tributary dewatered in the Columbia Basin, where the CBWPT supports flow restoration. All of the state's throughout the Columbia Basin tend to use their own methodologies for establishing flow targets dependent upon the biological or hydrological objectives. However, all methods have fundamental commonalities derived from hydraulic parameters such as wetted area for their basis towards available habitat.

When a stream system does not have a flow target that has been determined by a state fish and wildlife agency, QLEs have often collaborated with a biologist who has local stream knowledge to determine a reasonable and prudent flow target based on Professional Judgment (PJ) to guide their flow restoration effort. Alternatively, a QLE Determined (QD) flow target is defined based on a QLEs local knowledge of the hydrologic regime during the period of ecological significance.

While CBWTP recognizes that across the basin various methodologies have and are being utilized to determine "flow targets" for streamflow, and some of which are setting minimal flows, while others desire a more optimal flow, the underlying approach is that all streams the CBWPT supports streamflow restoration on have some sort of established "flow target" for restoration guidance. The CBWTP fully recognizes that a flat-lined hydrograph is not ideal for natural processes, and these flow targets should assess the natural unimpaired hydrologic regime when being determined. However, flow targets should always be evolving and based upon best available science and empirical data when established, additionally, meteorological, riparian and stream conditions are always changing, making it necessary for periodic revisiting of the "targets" to best inform adaptive management strategy.

For programmatic assessments and reporting, the CBWTP has developed a classification system to catalogue the flow targets of all the project stream systems in our geo-database where work is currently being supported. Additionally, CBWTP is collecting the methodology used to determine the flow target, a flow deficit estimate for the stream system, as well as the annual restored flow. Comparisons of these variables allows for a simplistic analysis to evaluate our

streamflow restoration actions and success. The "flow target" methodology classification is based upon seven classes in the CBWTP database:

- QD (QLE Determined) – Flow targets established by QLE project managers and/or CBWTP, for a target restoration base flow benchmark, determined without a physical hydrological or biological quantitative assessment.
- PJ (Professional Judgment) – When QLE's have consulted with a fisheries biologist, agency or tribe with local stream knowledge and no quantitative data or analysis to determine desired base flows.
- OM (Oregon Method) – Determined with a quantified physical habitat and hydraulic assessment by Oregon Department of Fish and Wildlife.
- WP (Wetted Perimeter Inflection Point Method) – Commonly, used in Montana by Department of Fish Wildlife and Parks for determining desired minimum flows on tributary stream systems.
- PHAB (PHABSIM or Physical Habitat Simulation)[44] – Typically used by Idaho Department of Fish and Game (IDFG) and Washington Department of Fish and Wildlife (WDFW) in their respective states, determined by extensive physical habitat and habitat suitability index curves to determine optimal flows for specific fish species and/or life stage.
- IFIM (Instream Flow Incremental Method) – Typically integrates RHABSIM[45] or PHABSIM and various other inputs such as social, economic, empirical data and consensus building amongst stakeholder experts. This methodology is the most legally defensible for determining flow targets or streamflow management actions, however, is also the most expensive and time consuming to implement.
- Unknown – typically early programmatic deals, no longer active, with less background data and information (this is used in database for previously CBWTP funded deals and should not be utilized moving forward as all streams must have a target with explanation).

As the CBWTP works to better collect project information from the QLEs, many of these parameters will be requested to be input in newer versions of the transactional checklist proposals. Attaining the highly valuable "pre-deal" hydrologic baseline on targeted stream

[44]The **PHABSIM (Physical Habitat Simulation System)** technique developed by Dr. Robert Milhous enables the quantitative prediction of suitable physical habitat in a river reach for chosen species and lifestages under different river flow scenarios, based on field measurements, hydraulic calibration, and species physical habitat preferences (depth, velocity, and substrate). Source: Ecological Engineering Volume 16, Issue 1, October 2000, Pages 153–158

[45] **RHABSIM (Riverine HABitat SIMuation)** is a fully integrated program for river hydraulics and aquatic habitat modeling using the Instream Flow Incremental Methodology (IFIM). Running in Microsoft Windows and DOS, it is an extensive conversion of the PHABSIM hydraulic and habitat simulation system developed by the U. S. Fish and Wildlife Service. Source: http://trpafishbiologists.com/rindex.html

reaches is critical to CBWTP reporting and programmatic assessments. The transactional checklist proposal is the best logical place to identify and capture this information, so the CBWTP will be continuously working on the project "questionnaire" and database structure to reflect the integration of the Flow Restoration Accounting Framework into our daily programmatic work and record key background project information identified in this document.

8. Conclusions and Future Trajectory of Flow Restoration Accounting Framework

Although the CBWTP began implementation of Tier 1 Monitoring during the 2014 summer irrigation season, and then added Tier 2 Monitoring in 2015, QLEs and partners have monitored stream-discharge for contracted water rights since the inception of the program in 2003. The CBWTP has reviewed and supported over 430 transactions to date, all having some level of compliance monitoring prior to implementation of the Flow Restoration Accounting Framework protocol. In Figure 9.1 below, all CBWTP projects are shown by QLE project development.

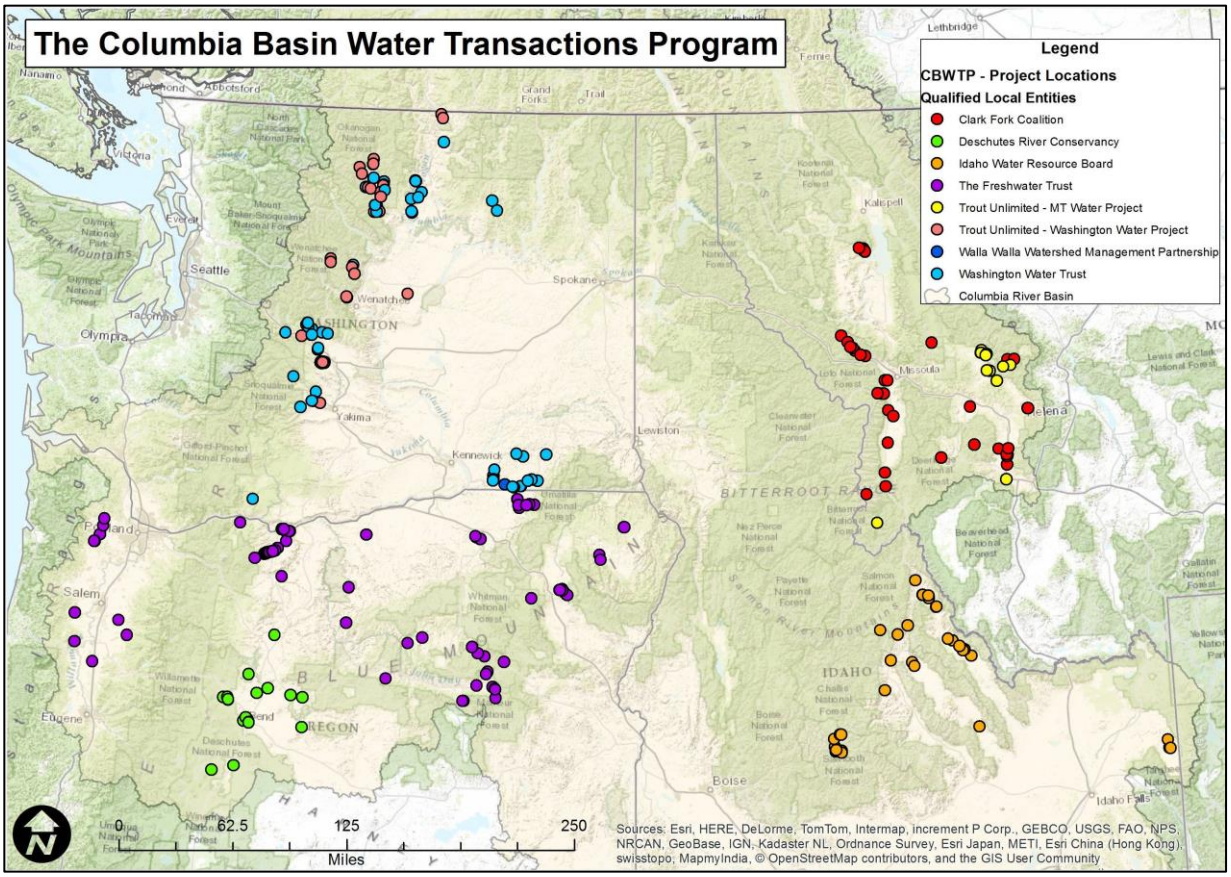

Figure 9.1 CBWTP Transaction locations from 2003-2014 implemented by QLEs

Concerning future monitoring plans, the CBWTP anticipates adding Tier 3 level monitoring to the program officially in 2016, although some QLEs have been partnering with fish and wildlife agencies and/or conducting some degree of Tier 3 monitoring since the beginning of the program. Currently, Tier 3 plans will likely involve the CBWTP selecting a handful of priority streams to invest additional monitoring and analysis, per the Tier 3 metrics for quantification and reporting purposes. CBWTP does not anticipate shifting additional monitoring work onto the existing QLE responsibilities beyond their compliance monitoring, and hopes to implement the bulk of this work internally or with consultants.

Regarding the implementation of Tier 3 monitoring work, the CBWTP plans to design these efforts so that a project's "transactional objective" or "primary hydrological/biological

objective", will guide the monitoring methods selected. In essence, if a transactional objective is to improve "passage" or connectivity conditions for specific life-stage, such as spawning, then monitoring parameters such as wetted width, wetted area or critical riffle would possibly be utilized to "test" the projects effectiveness and measure before and after outcomes. If enhancing or maintaining desirable stream temperatures were the primary objective of the project, then temperature monitoring, Dissolved Oxygen monitoring, pool volumes or wetted areas could be applied to the project stream to assess project outcomes. Basically, the selection of monitoring methods will be determined and driven by the goals of the transaction, as seen on the example flow chart in Figure 9.2 below.

Transactional Objective		Tier 3 Techniques/Methods	Tier 4 Techniques/Methods
Over-summering	→	Wetted Area, Wetted-Width/Wetted P, Pool Volumes, Temperature/DO	Snorkel Survey, Electro-fish Survey, Macro-Invertebrate Studies, Redd Counts
Passage/Migration	→	Critical Riffle, Wetted Width/Wetted P, Temperature/DO, Wetted Area	Pit-Tag Array, Redd Counts, Fry Traps, Snorkel Surveys
Connectivity	→	Critical Riffle, Wetted Width/Wetted P, Wetted Area, Temperature/DO	Pit-Tag Array, Redd Counts, Snorkel Surveys
Water Quality (DO and Tw)	→	Temperature / DO, Pool Volumes	Snorkel Survey, Electro-fish Survey, Macro-Invertebrate Studies
Over-wintering	→	Wetted Area, Wetted-Width/Wetted P	Macro-Invertebrate Studies
Pulse Flows/Flushing Flows	→	Wetted Area, Wetted-Width/Wetted P	Fry traps, Electro-fish Survey, Macro-Invertebrate Studies, Redd Counts

Figure 9.2 CBWTP Example Tier 3 and 4 Monitoring Flow Chart (techniques, methods and metrics not finalized).

Concerning the Tier 4 Monitoring efforts, the CBWTP currently has no intention of actively seeking to lead in this arena nor do we have the expertise or capacity. However, it may decide to be the lead in communications and data sharing with greater monitoring efforts across the basin if all stakeholders and partners agree that it makes the most sense. To date, QLEs have been the lead in any of these types of efforts, what few that exist, but CBWTP is open to the idea of playing this role if needed. The Tier 4 work would likely be that of coordinating and sharing data and metadata about projects and ongoing monitoring efforts supported by the program.

Figure 9.3 below, provides a preliminary view of FY2015 CBWTP active water transactions distributed into the relevant tiers of this Flow Restoration Accounting Framework. This preliminary table is presented here to provide context and an approximation of how many

streams are being currently monitored at Tier 1 and Tier 2 levels, as well as what percentage of the portfolio are in Tiers 3 and 4, and so forth.

FY 2015 Monitoring	CBTWP Total	Percent Totals	DRC	CFC	WWT	TU-WA	TU-MT	TFT	WWWMP	IWRB
TIER 1	**218**	**100%**	27	19	34	28	11	61	2	36
TIER 2	**165**	**76%**	27	14	22	20	11	41	2	28
TIER 3	**87**	**40%**	27	3	13	12	5	21	0	6
TIER 4	**36**	**17%**	0	0	10	11	0	10	0	5
TOTAL	**218**		27	17	34	28	11	61	2	36
Tier 1 Streams	**104**	**100%**	6	15	16	15	9	25	1	17
Tier 2 Streams	70	67%	3	12	9	10	9	16	1	10
Tier 3 Streams	25	24%	3	2	5	4	4	3	0	4
Tier 4 Streams	11	11%	0	0	2	2	0	2	0	5

Figure 9.3 CBWTP Preliminary Tier Monitoring Portfolios of Active Water Transactions for FY2015

The CBWTP expects to have around 75% of the project portfolio being actively monitored for stream-discharge on approximately 70 stream systems throughout the basin. Approximately 87 Tier 3 projects will be implemented on 25 stream systems. This initial distribution of CBWTP projects is very encouraging for our flow compliance monitoring effort as it indicates a solid proportion of actual instream flow-gaging, allowing solid opportunities to scale up monitoring and data collection into the Tier 3 or Tier 4 effectiveness arena.

Upon completion of the fiscal year 2015 monitoring efforts, the CBWTP will work to address areas of this document and our programmatic protocol that may require modification. As indicated previously in this document, the CBWTP has intended for this Flow Restoration Accounting Framework to evolve through adaptive management and testing on the ground, to identify any omissions or oversights of approach, implementation, processing or reporting. Any modifications to the Flow Restoration Accounting Framework will be reported annually in this document to assist with better understanding and lessons learned of the CBWTP challenges and experiences of managing a basin-wide flow monitoring effort of this magnitude.

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Appendix A: Water Transactions Mechanisms

Annual Lease: The leasing of water instream for a single year/season.

Short-Term Lease: A short-term lease is one that secures flow instream from 2–9 years/seasons.

Long-Term Lease: A long-term lease is one that secures flow instream for 10 or more years.

Acquisition: An acquisition is the purchase of flow through a water transaction.

Acquisition with Land: An acquisition with land is the purchase or securing of flow through a water transaction that is obtained by acquiring the land to which it is appurtenant.

Forbearance Agreement: A forbearance agreement removes a specified number of irrigated acres for a full-season by contract alone, so no state agency approval is required. The contract affects the landowner's action. Compliance is measured by verifying the acres under contract are not irrigated. The amount of water that would otherwise be diverted to satisfy the need is assumed to be left instream or could be monitored at the POD for verification. The fallowing of acres will lead to a reduction in consumptive use volume as well as diverted volumes.

Diversion Reduction Agreement: A diversion reduction agreement establishes the partial use of a water rights annual duty, therefore it creates a reduction in the historical and/or annual a diverted volume at the headgate or at the POD The source of the saved water that enables the diversion reduction is not specified in the contract. It may come from any reduction in water use or increase in water use efficiency, so it does not necessarily mean a reduction in irrigated acres or in consumptive use. The contract affects the irrigator, those on a shared diversion, or the irrigation district, irrespective of any infrastructure improvements.. The reduction must be tied to a specified amount or formula to make it possible to monitor compliance.

Minimum Flow Agreement: A minimum flow agreement is a water transaction that is enacted when flows at a designated location reach a designated level, typically requiring water-users to maintain this predetermined level of flow for a specified duration of an irrigation season.

Source Switch: A source switch is changing the POD from one source and/or location to another one. This change can be to another source of surface water, groundwater, or stored water.

Conserved Water: A portion of water saved due to improvements in water management infrastructure or other conservation measures reallocated for other beneficial uses.

Stored Water: Acquisition of an interest in water stored in a reservoir that is a sufficient enough volume to influence timing and quantity of releases. This is generally applicable when the water is impounded for diversionary purposes.

Split Season: A split season agreement refers to the acquisition of an interest in the portion of a water right not diverted during a particular part of a season or when tributary flows are at a certain level, in order to keep water instream at a particular time.

Full Season: A full season agreement is the acquisition of an interest in that portion of a water right not diverted during a full irrigation season in order to keep water instream.

Appendix B: Flow Monitoring Equipment

Please note: this description is taken from:

Holmes, S.R., Willis, A.D., Nichols, A.L., Jeffres, C.A. Deas, M.L., Purkey, A. 2013.*Water Transaction Monitoring Protocols: Gathering information to assess instream flow transactions*. Prepared for the National Fish and Wildlife Foundation. December, 2013. 45 pp.

This handbook is available upon request at NFWF and is being developed for the NFWF Natural Resource Conservation Service Conservation Innovation Grant (CIG) that is described in Section 1.4 of this document.

E.1 Introduction

Flow monitoring is required for any flow transaction, regardless of the transaction objective. Flow monitoring allows transaction participants to confirm the quantity and timing of flow transactions. Due to the critical nature of flow monitoring data, selecting appropriate flow monitoring equipment (i.e., flow current meters, stage recorders, and staff gages) is important. Flow monitoring equipment selection will depend on both the hydrologic conditions and available resources in the potential transaction location. As such, no specific flow monitoring equipment is recommended at this time. To illustrate the different characteristics of flow monitoring equipment, an overview of several flow current meters, continuous stage recorders, and staff gages are presented.

E.2 Flow Current Meters

Multiple varieties of flow-current meters are available on the market, and they tend to be the most widely used handheld equipment for measuring stream-discharge. Typical meters use a top-setting wading rod to allow for depth adjustment and measure velocity by mechanical, electromagnetic, or ultrasonic Doppler design. Mechanical meters operate where stream velocity is related to the angular velocity of the rotor, with the rotors operating on a vertical (cup-type) or horizontal (propeller-type) axis counting the revolutions of the rotor over a defined period of time (Herschy 1985). The Price-AA and pygmy current meters discussed below operate on a vertical axis. Electromagnetic meters, such as the Hach FH950 which recently replaced the Marsh-McBirney Flow Mate series, have bulbs or heads with two electronic contact points, which measures stream velocity using electronic magnetic induction. Ultrasonic Acoustic Doppler meters like the Son-tek Flow Tracker series integrate a velocity sensor, depth sensor, data logger, and cross-section information to estimate discharge based on the velocity area-method for calculating flow (SonTek - www.sontek.com).

To identify the optimal flow meter for a specific project, one must determine the anticipated stream velocities and cross-sectional depths. Below are several common current meters and their recommended specifications for instream gaging to better assist with determining the optimal current meter for a specific project or monitoring program.

(i) Hach FH 950 – Portable velocity meter with an accuracy of +/- 2% of reading+/-0.05 feet per second (ft/s) through the range of 0 - 10 ft/s; ± 4% of reading from 10 to 16 ft/s.. Battery life is designed for heavy typical day use. Weighs 1.5 lbs. and comes with 20 ft. cable, with no moving parts requiring zero mechanical maintenance.

(ii) Price-AA Meter Model 6200 – Designed by USGS, this mechanical meter's range is 0.1 ft/s to 25 ft/s (Rickly Hydrological Company - http://www.rickly.com/sgi/AA.htm). It comes with a USGS standard rating table to convert revolutions to stream velocity in either feet per second (English) or meters per second (metric).

(iii) Price Pygmy Current Meter – This meter is designed for small, shallow stream gaging with less than 1 ft depths. It is similar in design to the Price-AA meter developed by USGS; however, it is two-fifths the size and has no tail-piece. Its velocity ranges are 0.20 ft/s to 4 ft/s or less.

(iv) SonTek – Flow Tracker ADV – This acoustic Doppler velocimeter is designed for depths down to 2 cm (1 in.) with velocity ranges of +/-0.0003 ft/s to 13 ft/s, making it ideal for small flow rates or small streamflow gaging.

E.3 Continuous Stage Recorders

Continuous stage recorders are devices that collect time series water depth (stage) data for a specified interval. With daily streamflow fluctuations, stage recorders allow technicians to capture this variability and to display points of maximum and minimum stage height over a certain time period.

There are a variety of continuous stage recorders that represent a range of costs, accuracy, software requirements, and deployment hardware requirements. The latter should be taken into account prior to deciding which stage recorder is optimal for a specific monitoring program. Steel pipe or PVC pipe housing is typically required to protect the instruments and act as a "stilling well"; however, these hardware configurations and installations can be costly for organizations with restricted monitoring budgets. Most stage height recorders are programmed to function over a specific depth range. The accuracy for each recorder is a percentage of the maximum recommended depth. Some continuous stage recorders currently available are:

- Solinst – Levelogger Gold Model 3001
- Geo Scientific Ltd – AquaRod
- TruTrack ltd – WT-HR Water Height Data Logger
- Global Water Instrumentation Inc. – WL 16 Data Logger

E.4 Staff Gages

There are two types of staff gages, vertical and inclined. The vertical staff gage is the most commonly used and is referenced in this document. A staff gage is typically a metal, plastic, or fiberglass plate with calibrated incremental lengths, usually expressed in feet, that is used to measure stage height. Typically, a staff gage is used to reference other continuous stage recording devices to check for calibration; however, they can be used instream with periodic flow measurements to develop discharge-rating curves.

Appendix C: Tier 1 Compliance Monitoring Form

The Compliance Monitoring Form includes five individual tabs that must be filled in by the QLEs. The five tabs are summarized as:

- Read Me – Instructions on how to gather and record data within the workbook
- Tab 1: Transaction List – NFWF will complete this tab prior to the monitoring season and send to each QLE.
- Tab 2: Tier 1 Compliance Summary – This is intended to be the roll-up summary of all compliance monitoring data for each transaction within a QLE.
- Tab 3: Photo Log – While photos are not required to verify compliance with an agreement with a water right holder, photos that demonstrate any issues that were encountered is encouraged.
- Tab 4: Field Form for Each Monitored Transaction – This form contains all of the information presented in Tabs 5 and beyond. However, this format can be printed and taken into the field on monitoring visits.
- Tab 5 and on: This form records data gathered for each monitoring visit for an individual transaction and is referenced in rolling up all the monitoring information into Tab 2.

Tab #1 – Transaction List for <QLE Name>				
General Transaction Information	**Input 1**	*Filled in by NFWF*	Transaction Number	
	Input 2	*Filled in by NFWF*	Transaction Name	
	Input 3	*QLE Entry*	Transaction Type	
	Input 4	*QLE Entry*	First Year Water Instream	
	Input 5	*QLE Entry*	Last Year Water Instream	
	Input 6	*QLE Entry*	Period of Instream Use	
	Input 7	*Filled in by NFWF*	Monitoring Tier Association	Tier 1
		Filled in by NFWF		Tier 2
		Filled in by NFWF		Tier 3
		Filled in by NFWF		Tier 4
	Input 8	*Filled in by NFWF*	Comments on Tier Associations	

Tab #2 - Tier Compliance Summary for <QLE Name>			
Transaction List for <QLE Name>	**Input 1**	Filled in by NFWF	Transaction Number
	Input 2	*QLE Entry*	Actual Number of Observations for the Transaction
	Input 3	*QLE Entry*	Number of Observations with Evidence of Water Use Outside the Terms of the Agreement
	Input 4	*Drop Down: QLE Entry*	QLE Reported Compliance Status for Tier 1 (Dark Green, Green, Yellow, Red, Purple)
	Input 5	*QLE Entry*	If monitoring was NOT completed, please explain
	Input 6	*QLE Entry*	QLE Staff Initials
	Input 7	*Filled in by NFWF*	Verification Status
	Input 8	*Filled in by NFWF*	Verification Notes

Tab #3 - Photo Points	
QLE Entry	Photo Point #
	Associated Transaction #
	Photo Point name / location
	Photo Point Latitude
	Photo Point Longitude
	What Photo is Evidence of

Tab 4 & 5 – Field Monitoring Data

Transaction Number:									
Visit #									
Date of Visit									
Initials of Person Monitoring									
Where/how did you make the observation? (Please circle relevant answer)		On Property	From Car	From Boat	Telephone Call	On Website	Other (specify)		
Name/description of what was observed?									
What was the type of observation? (Please circle relevant answer)		Visual	Personal Communication	Staff Gauge	Flow Measurement	Remote Sensing	Other (specify)		
For leases, transfers and/or forbearance agreements. (Please circle relevant answer)	**Was the fallowed field being irrigated outside the terms of the agreement?**	Yes	No	Did Not Observe	Not Relevant				
For Diversion Reduction Agreements, Source Switches, Conserved Water Projects, and other deals where the irrigator is shutting off or reducing their diversion: (Please circle relevant answer)	**Was water being diverted outside the terms of the agreement?**	Yes	No	Did Not Observe	Not Relevant				
	What is the diverted amount (cfs) allowed by agreement								
	What is the diverted amount (cfs) measured/observed?								
For Minimum Flow Agreements: (Please circle relevant answer)	**Was water being bypassed outside the terms of the agreement?**	Yes	No	Did Not Observe	Not Relevant				
	What is the amount of minumum flow (cfs) allowed by the agreement?								
	What is the minimum flow measured and observed (cfs)?								
Evidence of Observation (Please circle relevant answer)		Site Visit Notes	Map w/ Dated Imagery	Dated Photo of Field	Dated Photo of Diversion/Staff Gauge	Diversion Records/Logs	Screen Shot of Gage	Communication Logs	Other (specify)
Documentation Included? (Please circle relevant answer)		Yes	No						
Document Name									
Site Visit Notes & Comments (including explanation of "Other" response in drop down menus)									

Appendix D: Tier 2 Flow Monitoring Form

The Flow Monitoring Form includes four individual tabs that must be filled in by the QLEs. The four tabs are summarized as:

- Read Me – Instructions on how to gather and record data within the workbook
- Tab 1: Transaction List – NFWF will complete this tab prior to the monitoring season and send to each QLE.
- Tab 2: Stream Monitoring Points – This is intended to identify the number of monitoring points within each Protected Stream Reach.
- Tab 3: Data Form for Streams – This form collects all the flow measurements for accounting for transacted water within a stream reach.
- Tab 4: Photo Log – While photos are not required to verify compliance with an agreement with a water right holder, photos that demonstrate any issues that were encountered is encouraged.

Tab #1 - Transaction List for <QLE NAME>				
General Transaction Information	**Input 1**	*QLE Entry*	Protected Stream Reach (In which monitoring will take place)	
	Input 2	*Filled in by NFWF*	Transaction Number	
	Input 3		Transaction Name	
	Input 4		Transaction Type	
	Input 5		First Year Water Instream	
	Input 6		Last Year Water Instream	
	Input 7		Period of Instream Use	
	Input 8		Monitoring Tier Association	Tier 1
	Input 9			Tier 2
	Input 10			Tier 3
	Input 11			Tier 4
	Input 12		Comments on Tier Associations	

Tab #2 - Stream Monitoring Points			
Monitoring Points within Protected Stream Reaches	**Input 1**	*QLE Entry*	Name of Protected Stream Reach
	Input 2		Length of Protected Reach
	Input 3		Monitoring Points
	Input 4		Transaction Number
	Input 5		Monitoring Location (POD or End of Protected Reach (EPR))
	Input 6		LAT Decimal Degrees (45.11111)
	Input 7		LONG Decimal Degrees (-118.11111)
	Input 8		River Mile Location (rm 0.0)
	Input 9		Description of Monitoring Point Location

Tab #3 - Tier 2 Form for Protected Reach (to be filled in by QLE)			
Name of Stream Reach	**Input 1**	Basic Data	Monitoring Point within Protected Reach
	Input 2		Visit#
	Input 3		Date of Visit
	Input 4		Initials of Person Monitoring
	Input 5	Flow Monitoring Results	Type of Observation
	Input 6		Instrumentation
	Input 7		Discharge Observed in cfs
	Input 8	Accounting Information	What baseline (without transaction flow) would likely have been present during this period of ecological significance (in cfs)?
	Input 9		What is the paper amount of transacted flow for this time?
	Input 10		What amount of transacted flow should be present (in priority) at this time?
	Input 11		At this time are water rights on the creek subject to regulation (curtailment)
	Input 12		What is the total amount of flow that should be present at this time? (Including downstream deliveries)
	Input 13		Is the transacted flow (in piority) being delivered instream at this time?
	Input 14		If Required, was User or Watermaster Called?

Tab #4 - Photo Points	
QLE Entry	Protected Reach
	Stream Monitoring Point #
	Date of Photo
	Photo File Name
	What Photo is Evidence of
	Notes