Marys River Watershed Council

Marys River Model Watershed Proposal

Science and Neighborhood Ownership in Support of Ecological Integrity

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Introduction

The Marys River Watershed Council is an association of those who live, work and play in the watershed. It is guided by a Board of Directors elected by the members to be representative of watershed residents. Over the past four months, with the support of Meyer Memorial Trust and the Bonneville Environmental Foundation, our Board, staff and volunteers have developed a flexible, long-term strategy for watershed conservation. We aim to bring together science and neighborhood ownership in support of ecological integrity, by focusing our restoration activities in priority sub-watersheds where they will have the greatest ecological benefit and social learning effect. Our knowledge about the watershed as a social and ecological system is far from complete, thus we intend to improve our understanding and approaches to restoration by viewing our strategies as learning opportunities. This approach will require monitoring of both implementation and ecological effectiveness.

We believe that with a clearly articulated philosophy, a program strategy that includes restoration, conservation policy, outreach and education, we can greatly increase the resilience of our watershed to potential disturbance. We use expert knowledge and information to inform our planning; neighborhood vision for the trajectory of each stream system will define the scope, intensity, pace and in some cases the nature of our restoration work. Fundamental to our approach is to let the fish, in our case cutthroat trout, tell us where watershed conditions are better or worse, and then to work with neighborhood landowners to shape a strategy to improve watershed function and condition, in the context of local geomorphology and land use.

Neighborhoods are fundamental to creating persistent ecological change in the watershed. We can only protect gains if a functional watershed supporting a diversity of native plant life and wildlife is a shared value among landowners, who understand and embrace the upstream-downstream and lateral connectivity of the system. Our approach is persistent but unhurried, to work at the pace most comfortable for those who will be learning to share their land with beavers, native vegetation and overbank flows. Although our planning and design process may begin slowly, we expect to see at least three series of interconnected projects implemented in each of our priority sub-watersheds over the next ten years.

Watershed Background

The Marys River Watershed encompasses 193,600 acres draining to the Willamette River. The headwaters originate on the east slopes of the Oregon Coast Range, with the uppermost headwaters flowing from the north and east slopes of Marys Peak, the highest point in the range at 4,095 ft. Our focal sub-watersheds are TumTum River, Greasy Creek, Woods Creek and Beaver Creek. We chose these basins as our model sub-watersheds because their principal streams ranked highly (>0.6 on a 0-1.0 scale) on the Cutthroat Trout Habitat Suitability Index (Figure 1). The HSI was developed in partnership with Joan Baker and Patti Haggerty at the Environmental Protection Agency, adapted from earlier modeling and data collection conducted by the Pacific Northwest Ecosystem Research Consortium for the entire Willamette River basin (MRWC 2003).

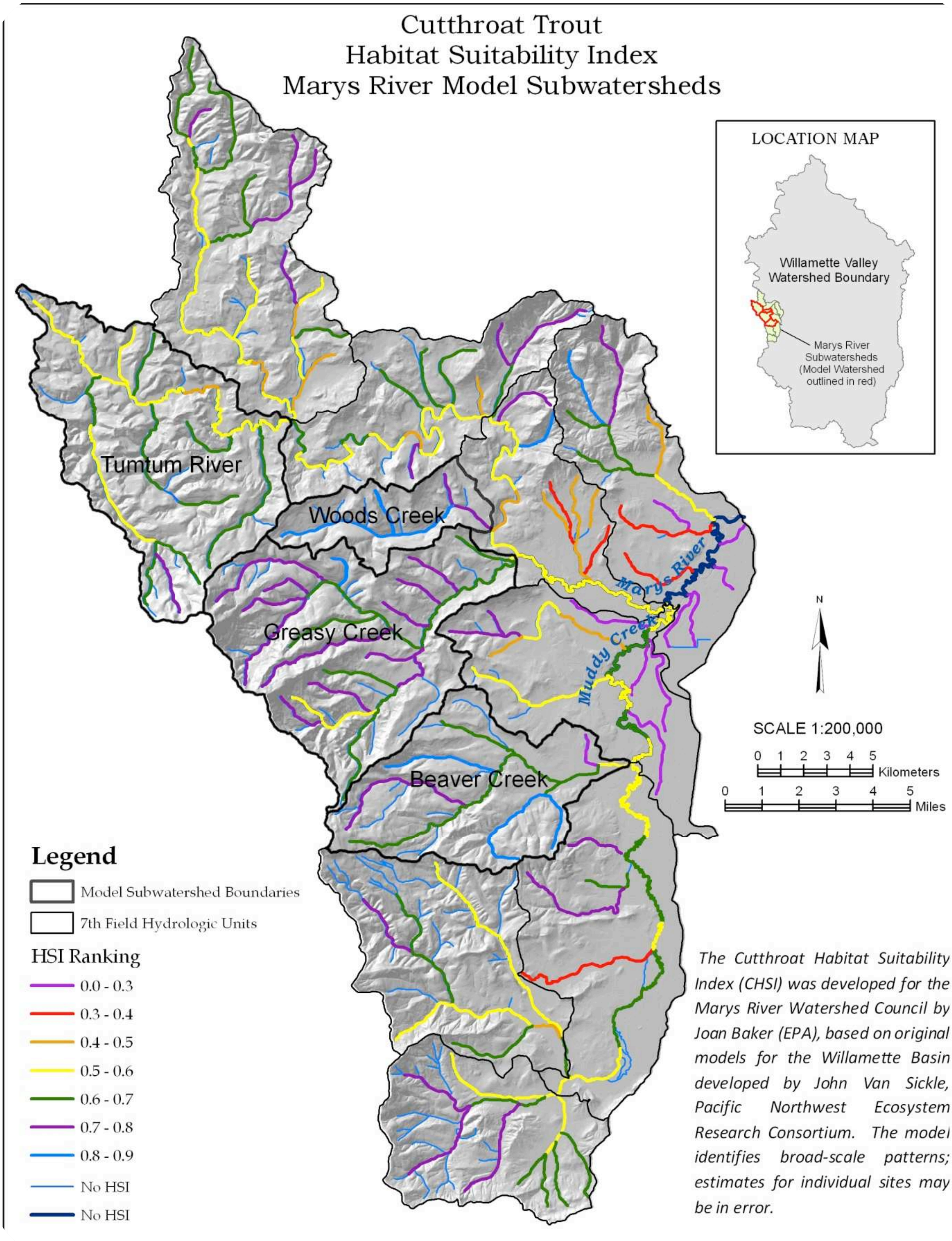


Figure 1. Cutthroat Habitat Suitability scores for streams in Marys River model subwatersheds.

Geologically, the Marys River is typical of the west slope of the Willamette Valley. It is underlain by geological formations older than those in the Cascades. Deep marine sandstones and seafloor basalts underlie much of the basin, with igneous rock intrusions in the headwaters of Shotpouch (TumTum), Rock (Greasy Creek) and Beaver Creek. Viewed through an ecoregional lens, Beaver Creek is the most diverse of the four basins in this proposal. It is the only sub-watershed containing a broad swath of Prairie Terrace, characteristic of Marys River's largest tributary, Muddy Creek. The combination of igneous geology (Figure 2) and the potential for mixed snow- and rain-driven hydrology, which extends the season of spring high flows, also distinguish our priority sub-watersheds from other portions of the Marys River.

Approximately one-third of the population (80,000) lives outside the Urban Growth Boundaries of Corvallis and Philomath. Corvallis and Philomath are the only urban areas (<3%) within the watershed. According to the Marys River Watershed Preliminary Assessment (1999), watershed lands are primarily rural and privately-owned (82%). Forty-four percent of the area, primarily along low- to moderate-gradient streams, is actively managed for rural home sites, small farms, small wood lots and pasture. Approximately 32% of the land is managed as industrial forest. Up to 12% of the Marys watershed, mostly along the low-gradient mainstem of the Muddy Creek subbasin, is under intensive agricultural cultivation. Based on the 2001 data from the National Land Cover Data Center, Greasy Creek has the greatest expanse of intact forest cover (Figure 3), due to the joint US Forest Service and City of Corvallis' stewardship of tributary Rock Creek. Rock Creek contributes almost one-half of the City's drinking water.

The Marys River watershed provides habitat for at least nineteen native fish species, and as many as fourteen introduced fish species. Introduced species are present primarily in low elevation streams with elevated summer water temperatures (e.g., Muddy Creek, Lower Marys). While historically steelhead (anadromous *O. mykiss*) may have used the Marys River watershed for spawning and rearing, at present we only observe juvenile fish in the system. The dominant salmonid is Coastal cutthroat trout *O. clarki clarki*, which uses most of the watershed for migration, spawning and rearing. Juvenile spring Chinook *O. tshawytscha* have been observed in the basin; they likely represent hatch-box releases, or possibly down-stream migrants from spawning areas further up the Willamette.

Other fish species of conservation concern include Oregon chub *Oregonichthys crameri* (federally listed as endangered), Pacific lamprey *Lampetra tridentata* (federal species of concern), and sandrollers *Percopsis transmontana* (Oregon "stock of concern"). In the Marys River watershed, Oregon chub are found principally in the Muddy Creek drainage, using slackwater habitats carefully managed to exclude non-native predators. We have observed individual Pacific lamprey in several creeks, and the Marys is one of the systems in the Grand Ronde Tribe's Pacific lamprey migration monitoring project. We know very little about habitat usage for lamprey, and how our conservation work might support their reproduction. The highest concentration of sandrollers (another poorly understood species) we have observed is in Shotpouch Creek (TumTum River).

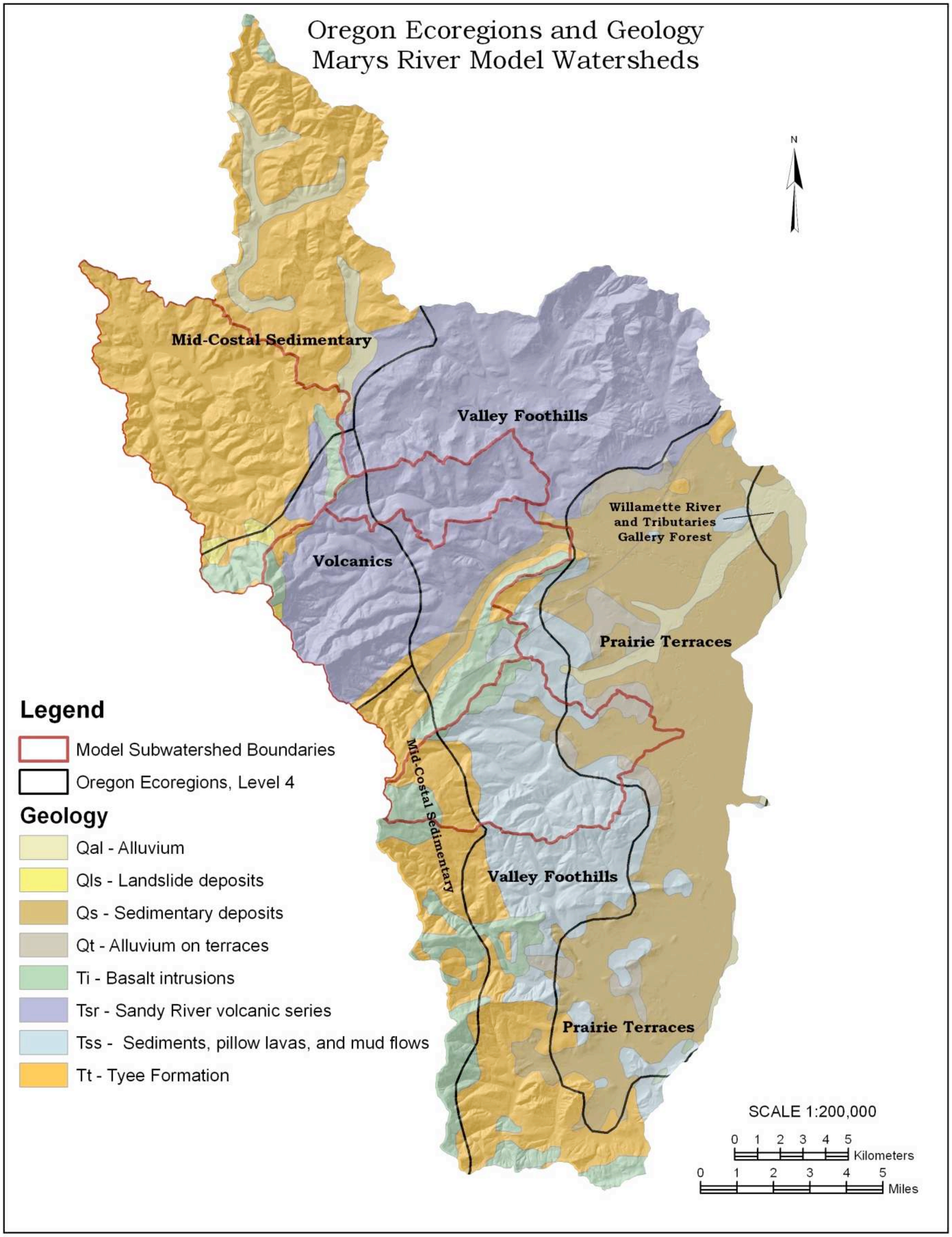


Figure 2. Oregon ecoregions and geology represented in the Marys River watershed. Note the basalt intrusions in the headwaters of TumTum, Beaver and Greasy creeks and the Prairie Terrace

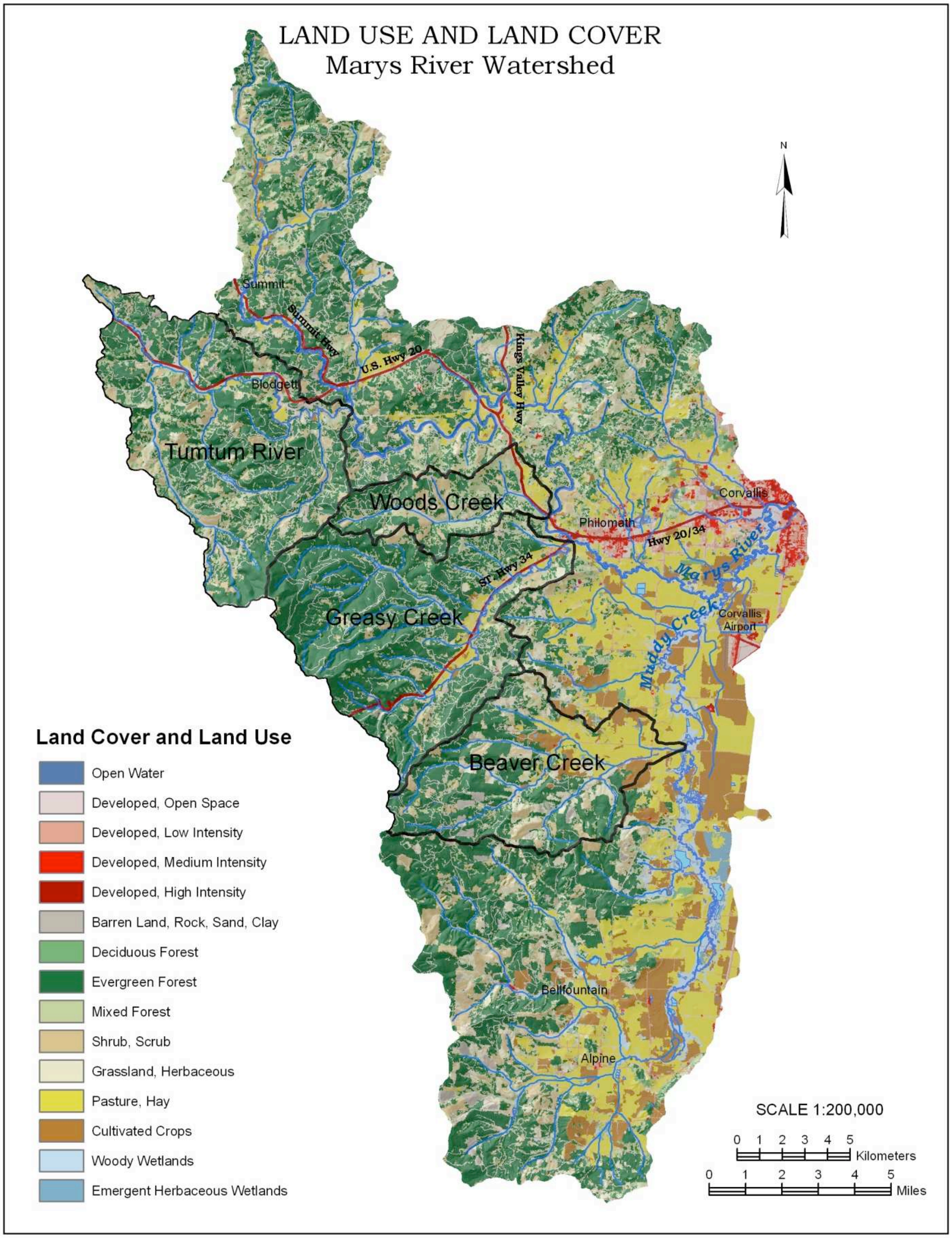


Figure 3. Land use and land cover and model subwatershed boundaries, Marys River watershed. Source: National Land Cover Data (2006).

The Marys River watershed also provides habitat for many sensitive reptile, amphibian, bird, mammal, insect and plant species (Ecosystems Northwest 1999, pp. 57-62). While most of these species are not focal targets for our restoration work, our site-level projects benefit several sensitive reptile, amphibian, and bird species described in the Oregon Conservation Strategy (2006). Our role in upland conservation is to expand the network of landowners hosting and maintaining habitats of concern under Benton County's Prairie Conservation Strategy (i.e., upland prairie/savanna, oak woodland and wet prairie), and to support the recovery of Fender's blue butterfly and to prevent the decline of Taylor's checkerspot butterfly (USFWS Prairie Species Recovery Plan for Oregon and Washington).

Three of our model sub-watersheds drain from the flanks of Marys Peak, while Beaver Creek flows from Flat Mountain at 2,664 ft (Figure 4). Greasy Creek is the largest of the sub-watersheds by area, and is the most populous (Table 1). Lot sizes differ substantially across the basins. Starker Forests is a very significant landowner in all our model watersheds, and has its largest holdings in the TumTum River basin. The USFS and BLM manage federal forest lands in Greasy (Rock) and Beaver creeks, respectively.

Subwatershed	**Beaver**	**Rock (Greasy)**	**Other Greasy**	**Woods**	**Shotpouch & Bark (TumTum)**	**Other TumTum**	**Total**
Area, mi^2	23.2	14.9	20.1	9.4	16.3	19.1	103
# creek-side landowners	102	8	128	44	32	47	361
Mean >1+ cutthroat density, $\#/m^2$	0.11	0.16	TBD	0.28	Bark 0.11 Shotpouch 0.14	TBD	

Table 1. Area, occupancy and current mean cutthroat density for model sub-watersheds.

We are in the process of mapping mean adult cutthroat trout density by pool sampled. Cutthroat appear to inhabit most of the 2^{nd} order streams, and likely use many 1^{st} order tributaries for spawning. Figure 5 depicts Oregon Department of Forestry's fish-bearing streams and other streams (fish absent and unknown). Presence/absence has not been confirmed for many potential spawning tributaries.

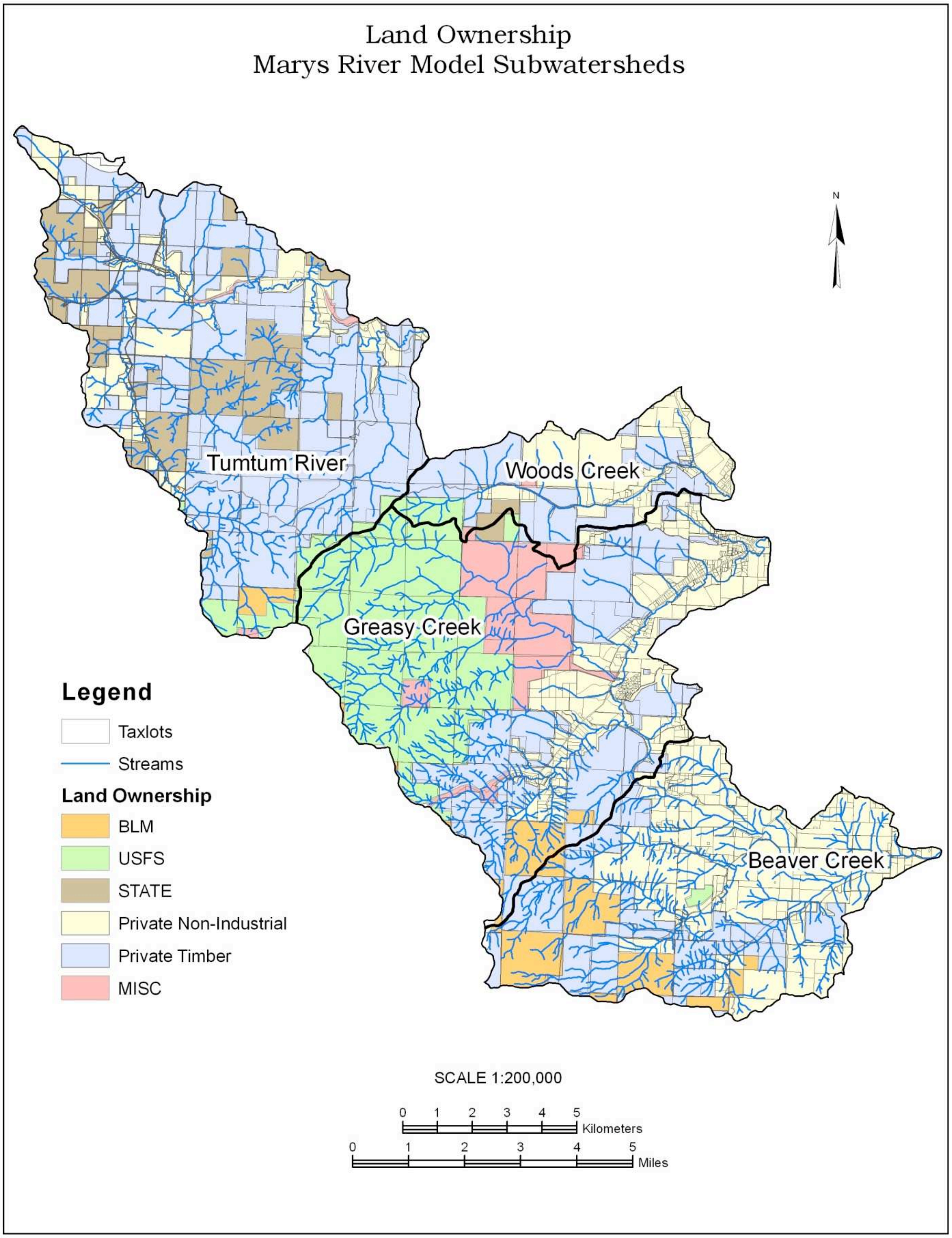


Figure 4. Land ownership and tax lots, Marys River model subwatersheds.in Beaver.

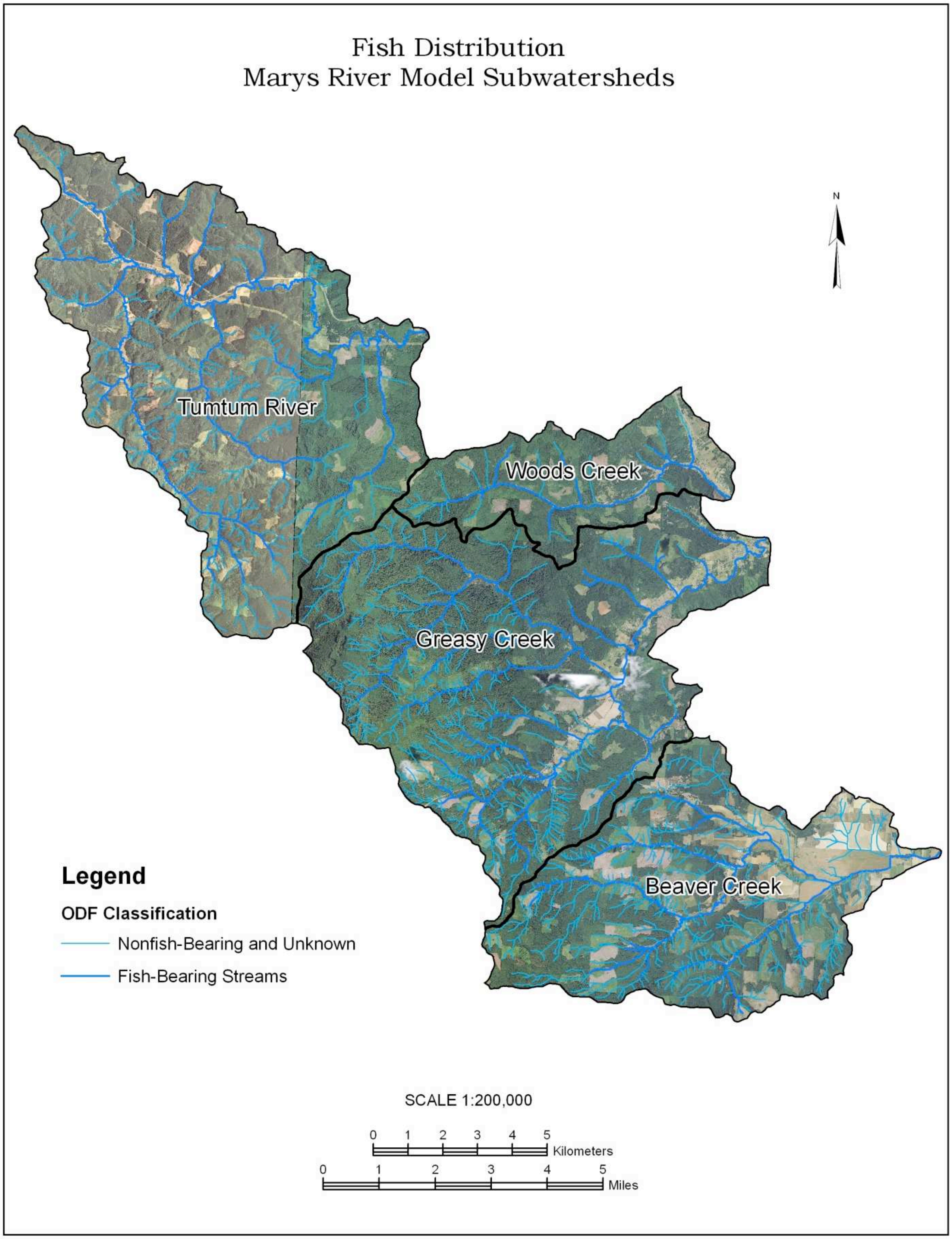


Figure 5. Fish-bearing and other streams in the Marys model subwatersheds, displayed over 2005 (Lincoln County) and 2009 (Benton County) orthophoto imagery.

The Model Watershed Project

Vision

"We bring science and neighborhood ownership together in the support of ecological integrity."

The Marys River Watershed Council sees itself as one of a team of watershed councils experimenting and adapting to determine the best ways to achieve significant and lasting ecological gains for Willamette Valley streams. Bonneville Environmental Foundation provides technical assistance, fundraising and conservation policy leadership, which can make the whole more than the sum of the parts. We expect the relationship with our fellow councils, Bonneville Environmental Foundation staff and Meyer Memorial Trust to be one of give and take, built on trust and support for innovation.

Our mission is to assist landowners in exercising good stewardship of their lands and waters. We believe the best way to accomplish this is to engage people neighborhood by neighborhood in a concerted effort to address subbasin-specific limitations. This allows us to develop integrated restoration strategies, while building a common understanding of the upstream-downstream effects of restoration projects and land management. More importantly, building shared values around watershed stewardship at a neighborhood level increases the probability that restoration projects will be monitored and maintained by the community over the long-term.

Restoration Priorities

Our Conservation Action Planning process was led by a Strategic Planning Team consisting of two current Board members (Thom Whittier, Meleah Ashford), two past Council Steering Committee members (Tom Murphy, Curt Seeliger), Council Coordinator Xan Augerot and Council Outreach Coordinator Karen Fleck Harding. Our initial list of restoration priorities and threats emerged from a Board-Planning Team workshop (November 2009). We held a public meeting (December 2009), where our restoration priorities were reaffirmed and we received many good suggestions regarding ecological attributes valued by the community, participatory monitoring strategies, outreach, and knowledge exchange. Subsequently, the Strategic Planning Team chose to combine three conservation targets under the umbrella category Stream Systems (channel, riparian, floodplain and wetlands), because they were linked identically in our conceptual diagram. As we learn more about our stream systems through restoration and monitoring, we may be able to partition streams based on gradient, geology, and discharge, and to better differentiate associated threats, strategies and desired future conditions.

Our final set of conservation targets is:

- Coastal cutthroat trout
- Stream systems (channel, riparian, floodplain and wetlands)
- Oak, savanna and prairie systems
- Neighborhood Ownership

Threats

Our Board and Strategic Planning Team chose not to identify threats with specific human activities, because we believe that carries an implication of landowner intent to degrade systems. We chose instead to identify human activities as contributing factors. The most serious threats (high) are channel simplification and low summer stream flows (Table 2). Channel simplification includes both historic activities (e.g., channel straightening, splash damming, woody debris removal) and current processes (e.g., woody debris removal, ongoing channel incision resulting in increased stream power). Riparian degradation and loss of habitat connectivity were ranked as intermediate threats, both because they are not as extensive and, with committed investments, are reversible. We ranked non-point source pollution as low (excluding excessive temperature), but there is limited routine water quality monitoring in the Marys River watershed. This will likely change under Senate Bill 737, which will require Corvallis to monitor for a list of 118 "persistent pollutants". The City of Corvallis currently monitors temperature, turbidity, pH, dissolved oxygen, conductivity, and bacteria at seven sites within city limits on a monthly basis. We have not seen evidence of toxic effects on fishes.

We identified three principal threats to neighborhood ownership of watershed restoration. They are loss of control and ownership, loss of social connectivity, and limited access to usable ecological knowledge. The first two are pervasive, affecting community organizations and agencies as well as individual landowners. They are ranked as moderate threats, because addressing them fully is time- and skill-intensive. The last threat is ranked as low; many local residents are knowledgeable about watershed systems and ecological best management practices. Information is abundant, but often overwhelming in quantity and difficult to scale down to decision-making at the tax lot scale. Local landowner interest is strong, counterbalancing some of the negative contributing factors.

Although our Board and Strategic Planning Committee recognized climate change as a potential threat to our conservation targets, we chose not to highlight it in our conservation strategy. Climate change can be a divisive subject, and we believe that the best way to address the threat is to increase the functional and species diversity of our targets, thereby increasing watershed system resilience in the face of change.

Threats	Ranking	Stresses	Contributing Factors
Channel simplification	High	Increased winter stream power; disconnect of channel from floodplain; decrease in instream habitat quality; decreased in habitat quality; decrease in wetland habitat quantity and quality	Channel straightening (historic); removal of large woody debris and beaver dams (ongoing). Driven by desire to protect infrastructure and arable land.
Riparian degradation	Medium	Increase in stream nutrients; bank instability; increased turbidity; increased solar gain (elevated T); loss of LWD; reduced prey abundance	Headwater timber harvest, rural residential development, crop and grazing land demand.
Low summer flows (and water temperature)	High	Elevated stream temperature	Rural residential development, agricultural drain-tiling and ditches, oversubscribed surface & ground water. Driven by changes in agricultural crops, agricultural and residential water demand.
Loss of habitat connectivity	Medium	Floodplain constraint; slope failure and associated increased sediment/bedload; passage fragmentation	Transportation infrastructure, residential land practices, headwater timber harvest, invasive species, agricultural land demand. Exacerbated by shortage of habitat maintenance skills and capacity.
Non-point source pollution (excluding water temperature)	Low	Increased BOD; direct toxicity – lethal and sublethal effects	Residential land practices, residential and agricultural chemical applications, headwater timber harvest, increased livestock on small holdings. Exacerbated by shortage of habitat maintenance skills and capacity.
Loss of control & ownership	Medium	Overwhelmed by the task of watershed restoration; lack of gratification; hassle; fear and uncertainty	Bureaucracy and inflexibility on part of funders and regulators, government control and regulation, liability concerns.
Loss of social connectivity	Medium	Lack of knowing neighbors; distrust of agencies and outside organizations	Not enough staff or landowner time for interaction or to get to know the neighbors; counterbalanced by strong landowner interest.
Limited access to usable ecological knowledge	Medium	Overwhelmed by the task of watershed restoration; lack of gratification; hassle	Poor intergenerational knowledge transfer, lack of locally tailored information materials, bureaucracy and inflexibility affecting nature of educational materials.

Table 2. Ranked threats, associated stresses and contributing factors. See also Figure xx, Marys Conceptual Model.

Former dairy pasture on Shotpouch Creek (TumTum River)

Conceptual Model

Over the past four months, we developed a conceptual model (situation analysis) to describe how we envision the interaction of contributing factors (orange boxes) and threats (pink boxes) affecting our conservation targets (green ovals) in the Marys River watershed (Figure 6). Once we were confident we had clearly represented the social and economic contributing factors, we developed a suite of strategies (yellow hexagons) we could apply to either directly or indirectly reduce threats and improve the status of restoration targets. Our conservation strategies are classified into three groups: Habitat Restoration (H1-H6), Outreach and Education (O1-O7) and Conservation Policy (C1).

Our model places equal emphasis on outreach and restoration strategies as a means to achieve lasting ecological gains for watershed function. We believe that, for any restoration project to achieve its long-term ecological intent, the landowners and their upstream and downstream neighbors must embrace and own the project. System change requires social change at the level of the 2nd order stream (Strahler).

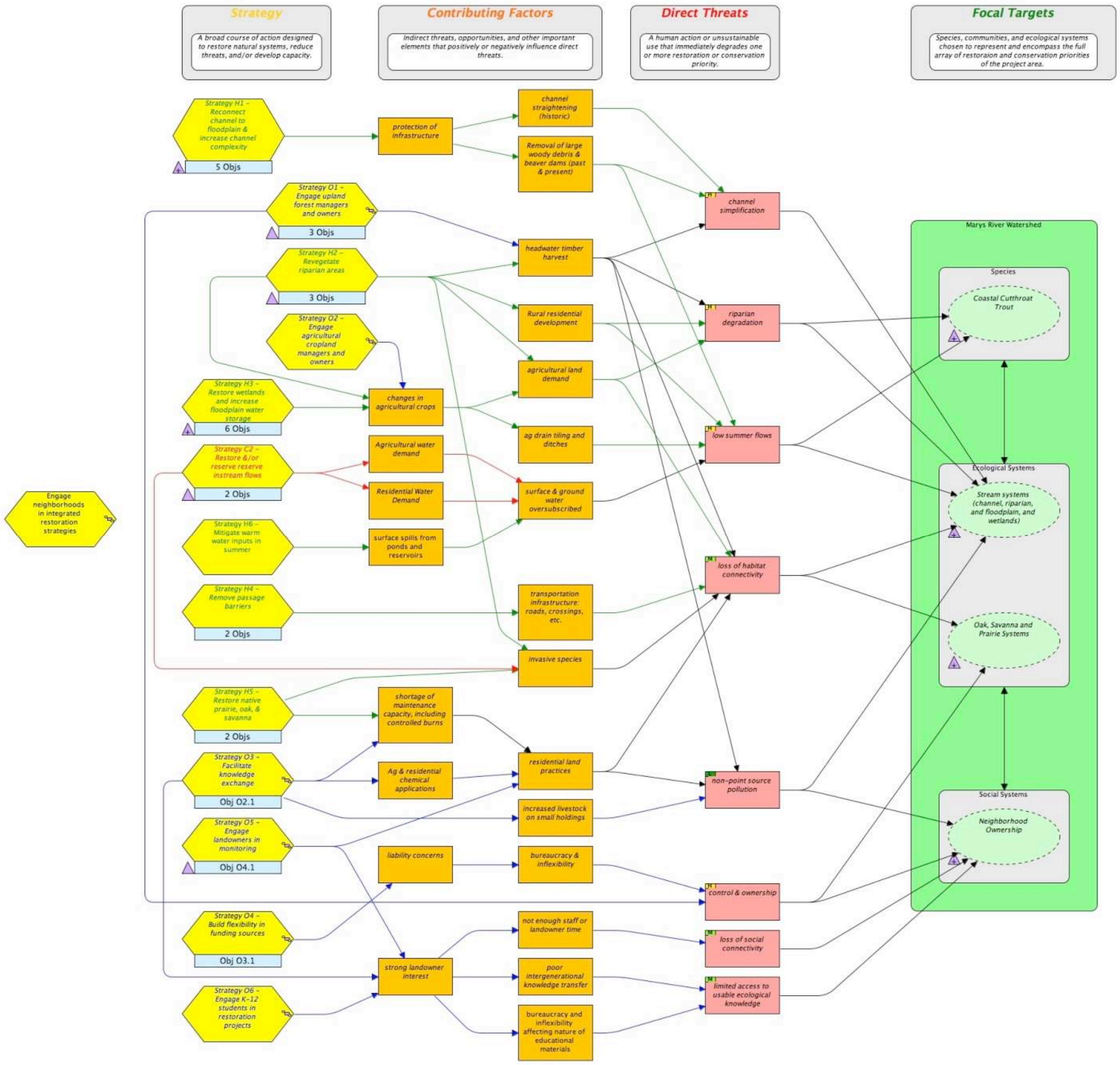


Figure 6. Conceptual model describing context for the Marys River Model Watershed project. Green ovals=targets; pink boxes=threats; orange boxes=contributing factors and opportunities; yellow hexagons=strategies.

Strategy Development

Goals

The long-term goal for each of our priority targets is described below. Targets are highlighted in bold italics. Each goal is characterized by a set of ecological attributes and associated indicators, which characterize the target's viability. The targets, attributes, indicators and current status of each indicator (if known) are presented in Table 3. Desired future condition (DFC) will be determined as we learn more about the streams in our sub-watersheds and the aspirations of neighborhood residents.

Establishing healthy populations of ***coastal cutthroat trout (CCT)*** is our flagship goal. Healthy populations are abundant, exhibit a complex spatial structure, and express a diversity of life history traits and migratory behaviors. CCT serve as a charismatic public focus and act as a meaningful indicator of our cumulative efforts to improve the ecological integrity of our watershed. The viability of these populations is important to help us achieve our social and environmental goals. Our work will be directed toward expanding available cutthroat habitat, increasing cutthroat populations, and informing us about differences in the way resident and fluvial cutthroat use our streams. Improved CCT habitat will also provide improved conditions for *O. mykiss*.

Past and present land use practices have a direct effect on ***stream systems (channel, riparian, floodplain and wetlands)***. We will engage interested landowners to rehabilitate and maintain streams as valued neighborhood assets using the most effective strategies at our disposal, such as floodplain reconnection, fish passage restoration, re-vegetation, landowner monitoring and conservation easements. Our goal for stream systems is cool waters flowing through complex stream channels connected to floodplains occupied by native vegetation, including mature Douglas fir and Western redcedar as well as red alder, cottonwood, willows, and other species favored by beavers. Lower Beaver Creek traverses the Prairie Terrace ecoregion (Level IV; Thorson et al. 2003), and a sub-goal for this system is to reestablish off-channel wetlands and gallery forests, to store wet season precipitation and feed it slowly to Beaver Creek through underground flows in the summer.

The restoration and maintenance of ***upland prairie and savanna, oak woodlands, and wet prairie*** has been identified as an important goal at the local, state and federal levels (e.g., Draft Benton County Prairie Conservation Strategy, 2009; ODFW Oregon Conservation Strategy, 2006; and USFWS Draft Recovery Plan for Prairie Species in Western Oregon and Southwest Washington, 2008). Our goal is to support the maintenance of an interconnected network of oak woodland, savanna and wet prairie habitats, to provide habitat for threatened and endangered species, supporting the biological and functional diversity of our watershed. We will continue to facilitate restoration projects, habitat maintenance strategies and landowner outreach toward this end.

Measuring Ecological Uplift					
Target	**Attribute**	**Indicator**	**Priority**	**Current Status**	**Desired Future Condition**
Coastal Cutthroat Trout	Abundance of >1+ year old cutthroat trout	relative density per unit area	High	Poor to Fair	Good to V. Good, place-dependent
Stream Systems (channel, riparian, floodplain & wetland)	Water quality	temperature regime	High	TBD	TBD
		dissolved oxygen		TBD	TBD
		dissolved N		TBD	TBD
		dissolved P		TBD	TBD
		bacteria		TBD	TBD
		turbidity		TBD	TBD
	Instream habitat quality and quantity	pool frequency		TBD	TBD
		pool quality--complexity, depth, surface area, ***cover***		TBD	TBD
		substrate size composition, basalt headwaters		TBD	TBD
		substrate size composition, sedimentary headwaters		TBD	TBD
		level of incision		TBD	TBD
	Flow regime	summer stream flow		TBD	TBD
		fall-spring water retention	High	TBD	TBD
	Floodplain interaction	off-channel habitat quantity, winter		Poor (qualitative assessment)	TBD
	Riparian vegetation	shade density		TBD	TBD
		canopy composition		TBD	TBD
		buffer width		TBD	TBD
		presence of invasives: knotweed, ivy, nightshade		TBD	TBD
		beaver spp component--vine maple, cascara, alder, etc.	High	TBD	TBD

	Anthropogenic disturbance	checklist for presence/absence		TBD	TBD
	Biotic integrity	fish assemblage IBI		TBD	TBD
		insect assemblage IBI		TBD	TBD
		insect assemblage tolerance index		TBD	TBD
		% non-native fish individuals		TBD	TBD
Wetland Systems	Extent by type	periodic orthophoto assessment	High	TBD	TBD
	Water retention	% decrease in winter peak flows at stream gauges	High	TBD	TBD
Upland Prairie & Savanna	Habitat quality-area	acres of upland prairie and savanna hosting ***Benton County Prairie Conservation Strategy*** species	High	TBD	TBD
Wet Prairie	Habitat quality-area	Acres of wet prairie habitat hosting ***Benton County Prairie Conservation Strategy*** species	High	TBD	TBD
Oak Woodland	habitat quality-area	Acres of oak woodland habitat	High	TBD	TBD
Neighborhood Ownership	trust	# of landowners demonstrating apparent change in attitude toward restoration programs or stewardship activities	High	TBD	TBD
	ecological understanding	# of landowners demonstrating a change in understanding of ecological concepts or stewardship behavior	High	TBD	TBD

Table 3. Targets and associated ecological attributes, indicators, current status and Desired Future Condition. For additional detail, please see Marys Matrices.xls, worksheet Marys Uplift.

Self-determination by watershed neighborhoods is the foundation for long-term environmental stewardship, social and ecological function. The value of ***neighborhood ownership*** of the stream and its watershed is reflected in all of our goals and strategies. The Council seeks to promote this ownership by promoting a two-way exchange of expert knowledge and local knowledge and by engaging landowners in sub-watershed discussions about their desires for their land.

We have not yet settled on a monitoring strategy for the Marys River Model Sub-Watersheds. Our Ecological Uplift (Viability Analysis) Matrix (Marys Matrices.xls, Marys Ecological Uplift worksheet) depicts a large suite of potential ecological attributes and indicators, many of which will likely be components of the Willamette Model Watershed Uplift Monitoring Plan. At the Council level, we favor an approach which emphasizes stream gauging on at least three of our focal streams, combined with temperature monitoring and a rotating cycle of snorkel surveys to determine changes in relative abundance of cutthroat trout over time. We believe that an increase in the mean summer low flow, a reduction in summer water temperature, and a decrease in the mean and variance of winter peak flows are the best integrated measure of the ecological uplift we are trying to create through stream system restoration projects and our concerted program of landowner engagement and knowledge exchange. Physical habitat surveys are time and labor intensive, and the resulting data are often plagued by observer bias.

Strategies

The Marys River Watershed Council selected fourteen **strategies** that we hypothesize will reduce critical threats affecting our targets. Our strategies fall in three groups: Habitat Restoration (H1-6), Outreach and Education (O1-7), and Conservation Policy (C1). The following section provides an overview of our rationale for each strategy.

The core of our Habitat Restoration strategies is to **renew channel-floodplain complexity (H1)**, in order to retain fall-winter-spring flows and release them more slowly into the dry summer months. To achieve this objective, we believe we must put in place a threshold number of floodplain connectivity projects on each focal stream. (In most but not all cases, focal streams are equivalent to 7th field hydrological units (HUCs)). Some HUC 7's contain multiple focal streams). By convening landowners at the neighborhood or focal stream scale, we are more likely to address the full range and spatial extent of limiting factors, in concert.

Log structures and graded riffles are designed to increase streambed roughness, creating collection sites (depositional areas) for woody debris, gravels and leaf litter. In the near term, we expect to see areas of scour increasing pool habitats, areas of gravel deposition providing in-stream water storage, and improved pool quality through woody debris cover. We expect log structures to backwater winter high flows into natural and created alcoves, to provide off-channel fish refugia from high velocity winter flows. In the long term, we believe these projects may slowly reverse incision processes which are currently simplifying in-stream habitat. Beaver dams play a similar role to large woody debris jams, but tend to create larger impoundments and slackwater areas. We expect that by using a key log strategy, we may be able to draw beaver to specific locations to accelerate channel aggradation.

Riparian revegetation (H2), sometimes accompanied by fencing, frequently occurs in tandem with floodplain-channel reconnection projects. Riparian plantings are intended to stabilize streambanks and increase sediment deposition in overbank flows in the near term, and to eventually provide shade to the stream, habitat for terrestrial insects (cutthroat prey), a food source for beavers, and in-stream large woody debris.

In low gradient stream segments, our goal is to **increase off-channel floodplain water storage (H3)** in wetland swales. By selectively redirecting or eliminating ditches or removing drain tiles, we can disconnect portions of the floodplain from the stream channel during fall-winter-spring high flows. The intent is to reduce winter runoff from agricultural fields and increase summer flows, with the added benefit of increasing wetland habitat area for biodiversity values.

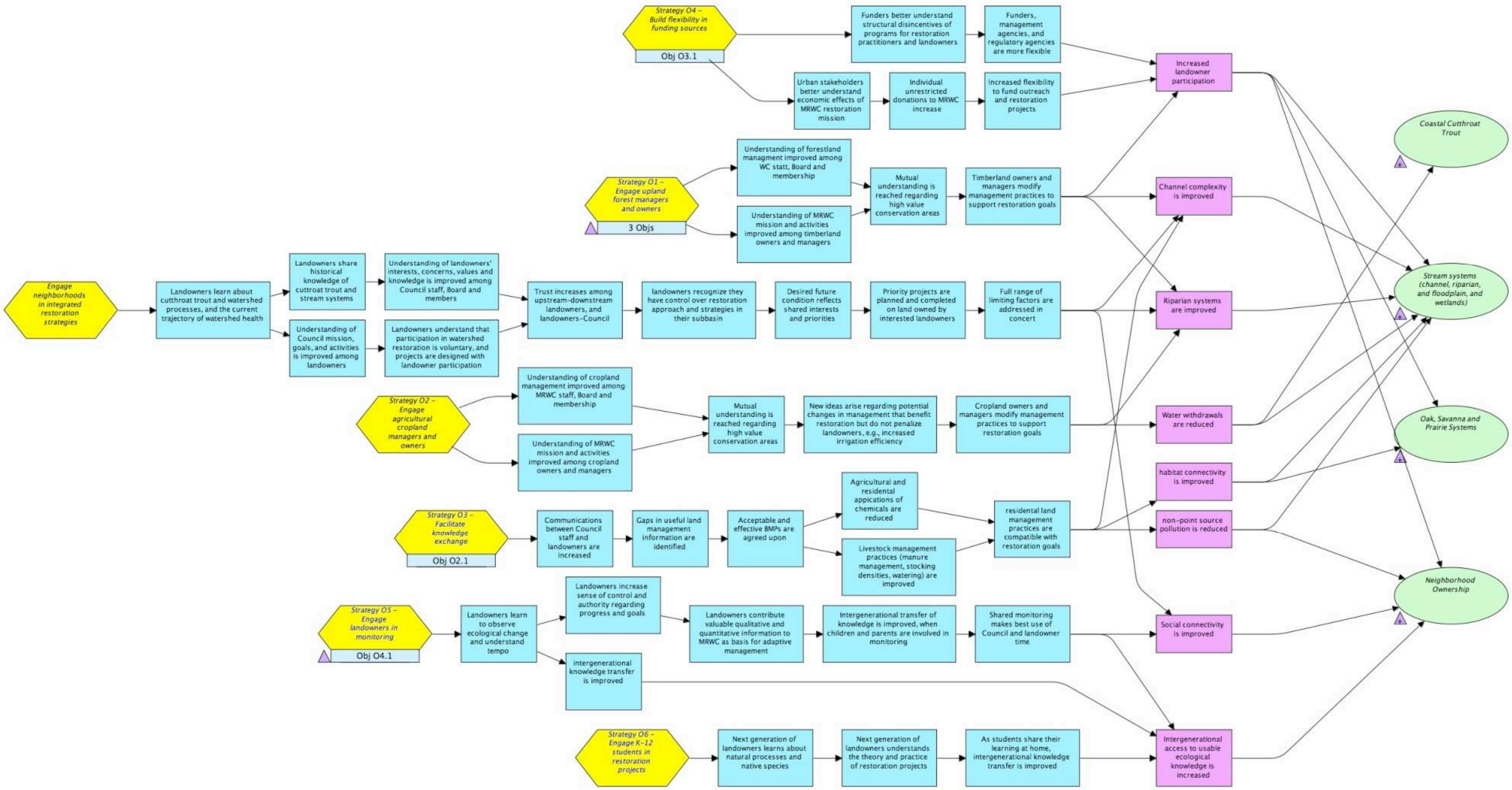
In the Marys River watershed, many fish passage barriers have already been replaced by timber landowners, Benton County, BSWCD, and the MRWC. **Removal of fish passage barriers (H4)** is a lower priority strategy, which will be addressed in concert with the full suite of Habitat Restoration Strategies on a stream neighborhood basis. Each perched culvert is assessed as a juvenile and adult cutthroat barrier, in high and low flows. Culverts that impinge cutthroat trout access to significant areas of spawning habitat, rearing habitat or cold water refuge are top priority for replacement. When financially feasible, we will also consider bedload passage in culvert design.

Excessive summer stream temperatures are a significant limiting factor throughout much of the Marys River watershed. There are many point sources of warm water in our priority sub-watersheds. We will **mitigate warm water inputs in summer (H5)** by encouraging temperature stratification of ponds and retrofitting water releases to eliminate surface spills. Pond mitigation can convert temperature liabilities to assets, often with small financial investments. The City of Corvallis' North Rock Creek reservoir is also intermittently a point source of warm water, and in the long-term we would like to see an automated system that would eliminate surface spills in favor of bottom releases.

Although not directly related to watershed function, **restoration of native prairie, savanna, oak woodlands and wet prairies (H6)** is a conservation priority for the Marys River Watershed Council. Our role is to engage landowners near large existing patches of these landscapes, to increase habitat quantity, quality and connectedness for threatened and endangered flora and fauna such as Fender's blue butterfly and Kincaid's lupine. Historically, these patch habitats were dependent on fire, and at present they require significant active maintenance. Our secondary role is to increase landowner skills and neighborhood capacity for habitat maintenance. By working in these upland habitats, we are able to engage many more households in each watershed neighborhood in active stewardship of watershed lands.

We developed a **results chain** for our Outreach and Education strategies in order to document assumptions and clarify our "theory of change" with respect to the foundational role of our outreach strategies (Figure 7). Our **neighborhood engagement strategy O7**, which rebuilds social connectivity and provides a learning community for restoration professionals and landowners, embraces all of our specific outreach and education (O&E) strategies (O1-O6).

Figure 7. Results chain for integrated outreach strategy.



Our first two O&E strategies are to **engage timber and agricultural landowners and managers (O1 & O2)**. These two industrial land management groups face specific economic and regulatory pressures that are significantly different from rural residential property owners and from each other. These outreach strategies are designed to increase mutual understanding of conservation values and locally workable strategies for conservation on industrial forest lands, small woodlands, and agricultural crop lands. Both strategies are expected to result in increased landowner participation and improvement in riparian areas. Collaboration will also lead to improved channel complexity and reduced water withdrawals, over time.

We believe that learning is a two-way street. Our strategy to **facilitate knowledge exchange (O3)** provides tools to landowners to understand the role of their property within their watershed neighborhood, and to choose land and water management approaches that support watershed function (e.g., best practices for manure management, septic systems, irrigation, chemical use, etc.). We begin by sharing the results of our rapid bioassessments with all landowners, and initiating a discussion about local natural and social history. As we work with each neighborhood, we will support them to share and deepen their local knowledge, both through workshops and trainings provided jointly with OSU Extension and other partners, and by creating neighborhood-specific websites for local history. We also intend to develop more localized knowledge and best practices about beaver ecology and management, and cutthroat trout life history variants. Knowledge exchange will lead to reduced non-point source pollution, increased habitat and social connectivity, and eventually improved channel complexity.

Developing **flexible funding sources (O4)** will allow us to pursue opportunities as they arise, in accordance with our strategic plan. They also allow us to fund some projects and activities directly, rather than through government or foundation funding, which in some cases creates legal obligations, constraints or paperwork which landowners cannot tolerate. We will increase funding flexibility through our own private donor fundraising and by working with others to reduce the disincentives to participation in current government restoration funding programs. Increased landowner participation will help us to improve stream systems, upland prairie, oak and savanna systems, and neighborhood ownership.

Engaging landowners monitoring (O5) will improve their knowledge of watershed function and other aspects of native habitats, as well as increasing a sense of ownership and control. We expect to gain valuable quantitative and qualitative information from landowner participation in photopoint monitoring, flow stage measurements, fish trapping, and temperature monitoring. Spreading monitoring effort across the local neighborhood and across generations reinforces community values, and improves the prospect for persistence of restoration uplift over time.

By **engaging K-12 students in restoration programs (O6)**, we build the knowledge base within the next generation of landowners to read the landscape and understand natural processes. Building off a successful partnership with the Philomath School District and The Freshwater Trust, we intend to expand our K-12 outdoor classrooms to three field sites a year. Students share their lessons with their parents, building greater intergenerational knowledge transfer about family history and land management. This strategy both increases neighborhood ownership and, through frequent, positive media coverage, helps us to diversify our funding base.

Organizing our outreach, restoration and conservation policy work around **neighborhoods (O7)** is the bedrock of our approach. It builds social connectivity, trust, and increased comfort with the downstream effects of upstream projects. Each sub-watershed and focal stream is at a different stage of the neighborhood engagement strategy (Table 4). We are farthest along in Woods Creek, which is our model for success. Landowner interest in Woods Creek is very high. Although there are only 44 landowners abutting the creek, 66 households are on our mailing list, and many upslope landowners are very engaged in the development of local histories and potentially in monitoring, as well. We are already learning that the Shotpouch neighborhood has a different social structure, and we will likely begin our work with three or more clusters of landowners who have shown early interest in stream restoration.

Subwatershed Stages & Status	Beaver	Greasy	Rock	Woods	TumTum
Initial contacts to introduce Council mission and strategy	2007: Muddy Creek meeting; fish passage, fish trapping	2007: Meeting at Grange Hall; fish passage on Blair & Gellatly Creeks, fish trapping	2007: Discussions with City of Corvallis and other neighbors	2005: fish passage projects; 2006: neighborhood meeting, fish trapping	2007: landowner site visits; 2009 fish trapping
RBA access request, all landowners	2009	2010		2008	Shotpouch/Bark 2009; others 2010
RBA survey complete	2009	Summer 2010	2006, 2009	2008	Partial 2009, remainder summer 2010
Neighborhood meetings	neighborhood meetings; Spring-Summer 2010	neighborhood meetings; Winter 2011	Ongoing landowner contact	Ongoing neighbor meetings, 2x/year	Initiated Feb 2010; ongoing
Collaborative project design	2010-2014	2011-2015		Through 2012?	2010-2014
"Early adopter" projects	2008, 2010: fish passage	2008: fish passage; 2010 riparian	2008: fish passage & large wood	2006: fish passage; 2007: knotweed control	2010: alcove creation & riparian
Multi-landowner strategy projects	2011-2015	2012-2016	With Greasy	2008-2010; large wood; alcoves; riparian; pond temp	2011-2015

Table 4. Status of neighborhood engagement process, by sub-watershed.

Our final strategy is to **restore and/or reserve in-stream flows (C1)**. This suite of objectives is a mixed set including policy approaches to increase the amount of water left in-stream in the summer. We have less experience in the water rights arena, and it can be very contentious. In the short-term, we seek to improve irrigation efficiency for rural residential and cropland owners, to reduce water withdrawals from the tributaries. Beaver are an ally in the effort to promote natural water retention in the tributaries, and we will also work to develop a County-wide strategy for beaver tolerance, with the goal of eliminating beaver dam removal.

Associated **Objectives** and **indicators** for each strategy will allow us to monitor and measure their effectiveness (Table 5; Detailed activities may be found in Marys Matrices.xls, worksheet Strategy Effectiveness).

One of 28 log structure on Woods Creek, 2008-09

STRATEGY EFFECTIVENESS	
Strategy H1 – Reconnect channel to floodplain & increase channel complexity	
Objectives	***Implementation Indicators***
Objective H1.1: Increase points of channel-floodplain connectivity 10-fold in each sub-watershed by 2016, using LWD, graded riffles and beavers.	Indicator H1.1: # of LWD structures placed relative to # of appropriate sites & limitations identified in Rapid Bioassessments and subsequent field surveys
Objective H1.2: Increase functional beaver flat area by 200% in five years	Indicator H1.2: # of graded riffles placed relative to # of appropriate sites & limitations identified in Rapid Bioassessments and subsequent field surveys
Objective H1.3: Fully fund all multi-landowner proposals in Model Subwatershed area	Indicator H1.3: # of multi-landowner proposals submitted for funding
	Indicator H1.4: # of alcoves created or reconnected relative to # of appropriate sites & limitations identified in Rapid Bioassessments and subsequent surveys
	Indicator H1.5: # of beaver dams; acreage of beaver flats
Strategy H2: Revegetate riparian areas	
Objectives	***Implementation Indicators***
Objective H2.1: Revegetate riparian areas to increase bank stability and to increase streamside shade to 80% of stream length to reduce summer water temperatures	Indicator H2.1: acres planted, linear miles planted relative to # of appropriate sites & limitations identified in Rapid Bioassessments and subsequent surveys
Objective H2.2: Ensure adequate food source for existing and increased beaver populations in Woods Creek, Greasy Creek, Beaver Cr, TumTum River, by 2018	Indicator H2.2: % plant survival after first season
Objective H2.3: Interplant conifers with fast-growing riparian trees and shrubs, to provide eventual source of persistent in-stream LWD in 50 years	Indicator H2.3: Conifer-dominated canopy in 35% of riparian area by 2040
Objective H2.4: Control invasive species which affect riparian function, to point where expansion is under control (95%); ongoing	Indicator H2.4: Control highly invasive species which affect riparian function, to point where expansion is under control (95%); ongoing

Strategy H3: Restore wetlands and increase floodplain water storage	
Objectives	*Implementation Indicators*
Objective H3.1: Increase off-channel wetlands area by 60% along low-gradient streams within five years, and by 150% within nine years	Indicator H3.1: acres of low-elevation wetlands
Strategy H4: Remove passage barriers	
Objectives	***Implementation Indicators***
Objective H4.1: Unimpeded access to significant spawning, rearing, and cold water refugia habitat for all age classes at all seasons by 2014, maintained over time.	Indicator H4.1: all priority passage barriers replaced or remediated in Model Sub-watersheds
	Indicator H4.2: MOU with Benton County
	Indicator H4.3: Workshop report with specific recommendations for a locally-tailored field research program
Strategy H5: Mitigate warm water inputs in summer	
Objectives	***Implementation Indicators***
Objective H5.1: Reduce summer stream temperatures by removing warm water input from ponds in summer (outflow temperature reductions from 6-15 degrees F) by 2016	Indicator H5.1: Decreased summer temperatures in streams downstream of pond retrofit site.
Objective H5.2: Shift City of Corvallis N Fk Rock Creek reservoir management to eliminate summer surface spill	
Strategy H6: Restore native prairie, oak woodlands and savanna	
Objectives	***Implementation Indicators***
Objective H6.1: Contribute to establishment of functioning network (metapopulation) or large independent population of Fenders blue butterfly (as defined by USFWS Recovery Plan) within the watershed by 2033.	Indicator H6.1: # of acres restored, maintained, enrolled in WHCMP
	Indicator H5.2: # of neighborhood habitat maintenance cooperatives

Strategy O1: Engage upland forest owners and managers	
Objectives	***Implementation Indicators***
Objective O1.1: Increase stream buffers on N-class streams, in high conservation value headwaters; see H2	Indicator O1.1: Increase stream miles surveyed on industrial forested uplands
Objective O1.2: Decrease beaver trapping activities – increase tolerance – mgmt of beaver – compensation for damage	Indicator O1.2: # of stream miles of buffered N-class stream in high conservation value areas
Objective O1.3: Facilitate easement and fee-title acquisition of high value conservation lands, *if they are at risk of conversion*	Indicator O1.3: # of collaborative projects with upland owners
Strategy O2: Engage cropland owners and managers	
Objectives	***Implementation Indicators***
Objective O2.1: Maintain open lines of communication with cropland owners and managers; ongoing.	Indicator O2.1: # of collaborative projects with cropland owners
Objective O2.2: Facilitate easement and fee-title acquisition of high value conservation lands, if they are at risk of conversion	Indicator O2.2: # of stream miles buffered in agricultural fields
Objective O2.3: Increase stream buffers and floodplain wetlands on lowland streams; see H2 and H3	
Strategy O3: Facilitate knowledge exchange	
Objectives	***Implementation Indicators***
Objective O3.1: Increase local knowledge exchange regarding stream, riparian, floodplain and habitat function and best management practices; ongoing	Indicator O3.1: # of landowners attending workshops
Objective O3.2: Increase local knowledge exchange about beaver ecology, management, landowner role; ongoing	Indicator O3.2: # of public history websites developed
Objective O3.3: Facilitate documentation of local oral history for each sub-watershed	Indicator O3.3: cutthroat trout life history/migration workshop designs field research study
Objective H3.4: Develop an understanding of migration timing and triggers for adult and juvenile cutthroat, fluvial and residential, in order to appropriately address habitat connectivity needs for expression of range of life histories	Indicator O3.4: series of beaver meetings hosted

Objective O3.5: Increase community understanding of connection between population growth and pressure on water availability and habitats	Indicator O3.5: quarterly watershed meetings addressing timely themes
Strategy O4: Build flexibility in funding sources	
Objectives	***Implementation Indicators***
Objective O4.1: Develop an individual donor fundraising strategy 2010 and begin phased implementation	Indicator O4.1: 3-fold increase in individual donor income, year over year for three years, stabilizing over time
Objective O4.2: Minimize disincentives from government and private funding programs; ongoing	Indicator O4.2: creation of an endowment
	Indicator O4.3: increase in funder flexibility as measured by reduced paperwork, clearer guidelines, etc.
Strategy O5: Engage landowners in monitoring	
Objectives	***Implementation Indicators***
Objective O5.1: Foster long-term landowner ownership of watershed functionality	Indicator O5.1: # of landowners involved
Objective O5.2: Generate useful quantitative and qualitative information for adaptive management	Indicator O5.2: neighborhood monitoring webpages up and running
Objective O5.3: Involve multiple generations in families	Indicator O5.3: accumulation of long-term data sets for temperature, fish passage timing, flow monitoring
Strategy O6: Engage K-12 students in restoration projects	
Objectives	***Implementation Indicators***
Objective O6.1: Increase student (and future landowner) understanding of watershed, ecology, and stewardship concepts; 700 students, annually	Indicator O6.1: # of children involved in outdoor classroom restoration sites
Objective O6.2: Students and teachers apply watershed and stewardship knowledge to on-the-ground restoration projects, from planning through implementation and monitoring; ongoing	Indicator O6.2: # of teachers & students engaged in outdoor classroom education

Strategy O7: Engage neighborhoods in determining the future of their watershed	
Objectives	***Implementation Indicators***
Objective O7.1: 95% of landowners allowing access for RBAs by 2010	Indicator O7.1: #landowners allowing access for RBAs
Objective O7.2: 80% landowner participation in recommended restoration actions to address identified limiting factors from RBAs by 2016	Indicator O7.2: # landowners participating in restoration actions to address limiting factors raised by RBA and subsequent field visits
Strategy C1: Restore and/or reserve in-stream flows	
Objectives	***Implementation Indicators***
Objective C1.1: Explore options to set aside water rights for in-stream use	Indicator C1.1: increase of in-stream water rights leases and transfers by xx%
Objective C1.2: Decrease pinch period water withdrawals from tributaries by 20% in 10 years.	Indicator C1.2: # of landowners utilizing alternative methods of water capture and storage
Objective C1.3: Eliminate beaver dam removal in key areas, wherever possible; ongoing	Indicator C1.3: reduced landowner reported volume of summer water withdrawals
	Indicator C1.4: developed and accepted policy or MOU on beaver dam relocation

Table 5. Strategies, **objectives** and associated **indicators**. (Activities detail may be found in Marys Matrices.xls, worksheet Strategy Effectiveness).

Council Capacity and Implementation Considerations

The Marys River Council is currently served by three contractors – Council Coordinator Xan Augerot, Education & Outreach Coordinator/Project Manager Karen Fleck Harding, and Accountant Anne White. We conduct our own fiscal management, with an average annual budget of $483,000 over the past three years.

As we increase the pace, scope and intensity of our ground-up watershed restoration strategy, we will need additional staff capacity. In order of priority:

1. Hire a Restoration & Monitoring Coordinator, initially on contract. Full-time spring-summer-fall, part-time winter. We will be looking for an experienced person with technical expertise and excellent interpersonal skills. The Restoration & Monitoring Coordinator will work closely with Outreach Coordinator Karen Fleck Harding, and must have a keen appreciation for the role of local landowners in our neighborhood-based watershed restoration strategy.
2. Provide core funding (50%) for Outreach Coordinator Karen Fleck Harding, so we can continuously respond to landowner interest between project-specific grants. Evaluate whether to convert this work to a staff position.
3. Set aside dedicated funds for data management, analysis and GIS support (contract basis).
4. Support for the conversion of the Council Coordinator from a contract to a staff position. As our program evolves, there will be too much Board-delegated responsibility for the position to continue as a contract role.

At the MRWC, we view K-12 education as integral to our watershed restoration mission. For the past four years, Karen Fleck Harding played a dual role as outreach and education coordinator, developing robust partnerships with The Freshwater Trust, Philomath School District, Corvallis' Lincoln Environmental Middle School, Benton Soil and Water Conservation District, 4-H Wildlife Stewards, the Institute for Applied Ecology and Greenbelt Land Trust. We have a suite of proposals pending (Gray Family Fund at Oregon Community Foundation, Trust Management, and NFWF/EPA Five Star Program) to support a half-time Education Coordinator to continue our student restoration projects in "outdoor classrooms" around the Marys River watershed. We anticipate that the Education Coordinator will also take on the role of volunteer coordinator.

The Marys River Watershed Council will also need material assistance with equipment and supplies to carry out our work, including support for the development of outreach materials, ranging from maps for neighborhood meetings and tours, to posters for Council public meetings. As we develop our individual donor fundraising strategy next year, we will need additional resources to support an overhaul of our website and other promotional materials. We may also choose to hire hourly administrative staff to support three fundraising appeals per year, if we are unable to develop a sufficient volunteer base for that purpose.

As the scope and ambition of our monitoring program becomes clearer over the next two months, we will also need additional field gear and tools for monitoring. Our central question is whether our in-stream and floodplain reconnection restoration work actually increases fall-winter-spring water storage, resulting in higher summer base flows. On Woods Creek, we are also interested in whether our in-stream and floodplain projects reduce the flashiness of the system, dampening peak flows. Secondarily, we would like to know whether there is a threshold level of restoration effort needed to see an effect on flow.

The centerpiece of our monitoring approach will be to instrument at least three of our sub-watersheds with stream gauges. The City of Corvallis is a willing partner in Rock Creek (Greasy), and we are also exploring the interest of the USFS, which owns approximately 75% of the Rock Creek lands. Roy Haggerty (OSU Department of Geosciences) raised funds for a gauge on Beaver Creek, and there may also be interest from the Greenberry Irrigation District (Dan O'Brien). On Rock Creek, we need to determine whether it is worth the expense to link these gauges to the US Geological Survey gauging system for data management (~$15,000/year). We will explore other options and partnerships for Woods and Shotpouch creeks. Our immediate need, regardless of larger monitoring questions, will be for temperature data loggers and other field gear.

We believe that the best indicator of increased in-stream channel complexity, floodplain interaction, and other features that comprise quality cutthroat trout habitat is the abundance of cutthroat in our streams. We would like to conduct repeat snorkel surveys every three years in our model sub-watersheds, on a rotating schedule. Additionally, we would like to host a small workshop of local cutthroat experts to help us devise a simple field research program to determine places and times of habitat use by fluvial and resident cutthroat trout, so we can more clearly interpret the meaning of our relative density data.

REFERENCES

Benton County. 2009. *Draft Prairie Habitat Conservation Strategy*. Available at: http://www.co.benton.or.us/parks/pcs/index.php.

Ecosystems Northwest. 1999. *Marys River Watershed Preliminary Assessment*. Prepared for the Marys River Watershed Council, April 1999.

Marys River Watershed Council. 2003. *Marys River Watershed Council Action Plan.*

National Land Cover Data. 2006. Available at: http://www.epa.gov/mrlc/nlcd-2006.html

Oregon Department of Fish and Wildlife. 2005. Oregon Conservation Strategy. Oregon Department of Fish and Wildlife, Salem, Oregon.

Thorson, T., S. Bryce, D. Lammers, A. Woods, J. Omernik, J. Kagan, D. Pater, and J. Comstock. 2003. *Ecoregions of Oregon*. Available at: http://www.epa.gov/wed/pages/ecoregions/ecoregions.htm

US Fish and Wildlife Service. 2008. *Draft Recovery Plan for Prairie Species of Western Oregon and Southwestern Washington*. Available at: http://www.fws.gov/oregonfwo/Species/PrairieSpecies/

Target	Attribute	Indicator	Measure	Status	Desired Future Condition	Poor	Fair	Good	Very Good	Source & Notes
Coastal Cutthroat Trout					Marys River Viability Analysis					
	>1+	relative density per unit area	mean >1+/sq m per wadeable stream	Poor to fair	TBD	0-0.1/sq m	0.2-0.3/sq m	0.3-0.4/sq m	0.4-0.7/sq m	Preliminary rankings, based on S. Trask best expert judgment; snorkel survey.
	>1+	relative density per unit area	mean >1+/sq m per non-wadeable stream		TBD					Electrofishing; less frequent.
Stream systems (channel, riparian, floodplain & wetland)										
	water quality	temperature regime	7-day moving mean of daily max temperature	TBD	TBD	>12 days with 7-day moving mean of max temp > 18C	>7 and <12	>1 and <7	no days with 7-day moving mean of max > 18C	City monitoring data, MRWC past assessments, RBA temperature loggers
	water quality	dissolved oxygen		TBD	TBD	daily low <4 ppm	daily low 4-6 ppm	daily low 6-8 ppm	daily low >8 ppm	
	water quality	dissolved N		TBD	TBD	> 1000 ug/L		< 750 ug/L		USEPA EMAP
	water quality	dissolved P		TBD	TBD	> 100 ug/L		< 25 ug/L		USEPA EMAP
	water quality	bacteria	# E.coli/ml	TBD	TBD	>406 E. coli/ml, single sample		30day log mean <126 E. coli/ml		DEQ bacteria standards
	water quality	turbidity		TBD	TBD	> 25 NTU	5-25 NTU	2-5 NTU	<2 NTU	USEPA EMAP
	instream habitat quality and quantity	pool frequency		TBD	TBD					initial estimate from RBAs
	instream habitat quality and quantity	pool quality--complexity, depth, surface area, ***cover***		TBD	TBD					initial estimate from RBAs
	instream habitat quality and quantity	substrate size composition, basalt headwaters	Wolman pebble count	TBD	TBD	<30% gravel, cobble	30-50%	50-70%	>70%	
	instream habitat quality and quantity	substrate size composition, sedimentary headwaters	Wolman pebble count	TBD	TBD					
	instream habitat quality and quantity	level of incision		TBD	TBD					initial estimate from RBAs?
	flow regime	summer stream flow	mean & variance of summer base flow	TBD	TBD based on past gauge data & local knowledge					
	flow regime	fall-spring water retention	mean & variance of winter peak flow	TBD	ditto					
	floodplain interaction	off-channel habitat quantity, winter	m/100 m	TBD	TBD					
	riparian vegetation	shade density	densiometer readings	TBD	TBD					
	riparian vegetation	canopy composition	avg proportions per reach	TBD	TBD					EPA data? DEQ?
	riparian vegetation	buffer width	avg width per reach	TBD	TBD					
	riparian vegetation	presence of invasives: knotweed, ivy, nightshade	checklist	TBD	TBD					
	riparian vegetation	beaver spp component--vine maple, cascara, alder, etc.	checklist	TBD	TBD					
	anthropogenic disturbance	checklist for pres/abs	mean # of disturbance types/100 m	TBD	TBD	>2	0.5-2	<0.5	0	modified from Kaufmann (USEPA)
	biotic integrity	fish assemblage IBI	??	TBD	TBD	<40	40-60	60-80	>80	P/F/G/VG would be based on various %tiles of reference sites scores these are placeholders
	biotic integrity	insect assemblage IBI	??	TBD	TBD	<40	40-60	60-80	>80	USEPA EMAP: classes to be based on %tiles from reference site scores
	biotic integrity	insect assemblage tolerance index		TBD	TBD	>5	4 to 5	2 to 4	<2	Whittier et al. 2007a; Whittier & Van Sickle (in review);classes to be based on %tiles from reference site scores
	biotic integrity	% non-native fish individuals		TBD	TBD	>10%	1-10%	<1%	0	Whittier et al. 2007b;classes to be based on %tiles from reference site scores
WETLAND SYSTEMS										
	extent by type	periodic orthophoto assessment	acres/HUC7	TBD	TBD					
	water retention	% decrease in winter peak flows at stream gauges	as above	TBD	TBD					
UPLAND PRAIRIE & SAVANNA										status from County, USFWS, IAE?
Upland Prairie & Savanna	habitat quality-area	acres of upland prairie and savanna hosting ***Benton County Prairie Conservation Strategy*** species	% increase (acres) within 2 km of existing Fender's blue butterfly habitat or 1.5 km from existing Taylor's checkerspot habitat	TBD	TBD					
Wet Prairie	habitat quality-area	Acres of wet prairie habitat hosting ***Benton County Prairie Conservation Strategy*** species	% increase (acres) of wet prairie	TBD	TBD					status from County, USFWS, IAE?
Oak Woodland	habitat quality-area	Acres of oak woodland habitat	% increase (acres) of oak woodland in patches of >10 acres hosting Benton Co Prairie Cons Strategy species (i.e. Acorn woodpecker, Western Gray squirrel)	TBD	TBD					
NEIGHBORHOOD OWNERSHIP										own data
	trust	% increase in landowners demonstrating a change in attitude toward restoration programs		TBD	TBD	less than10%	10-20%	20-30%	over 30%	
	ecological understanding	% increase in landowners demonstrating a change in understanding of or behavior toward ecological concepts		TBD	TBD	less than10%	10-20%	20-30%	over 30%	

Marys River Watershed Council
ACTION PLAN

Strategy Type	**Basis & Assumptions**	**Marys River Model Subwatersheds Summary Statistics**
Geomorphic Opportunities: LWD & Graded Riffles (mi/km)	Based on Rapid BioAssessments. RBAs to be completed 2010 for Greasy and Other TumTum	22.34 mi (35.95 km)
Geomorphic Opportunities: channel reconnection, alcoves (acre/ha)	Based on RBAs where completed.	25.0 acres (10.1 ha)
Potential Barrier Projects (#)	Based on Benton County Fish Passage Inventory and RBAs. Only priority barriers called out in RBAs are noted here.	28
Potential Riparian Revegetation (acre/ha)	Based on RBAs where completed. Buffered linear distance at 50' and 100' to determine range.	174.6-349.84 acres (70.66-141.58 ha)
Potential Fencing Projects (mi/km)	Based on RBAs where completed.	2.5 mi (4.3 km)
Potential Invasive Control (mi/km)	Based on RBAs where completed.	5.23 mi (8.42 km)
Potential Upland Projects: Oak Woodland, Savanna, Prairie (acres/ha)	To be determined by Greasy Creek RBA and outreach. Greasy Cr is a priority prairie restoration area for Benton County and USFWS	TBD
Potential Wetland Restoration (acres/ha)	Based on RBAs where completed. Used 30' buffer for area calculation.	30.4 ac (12.3 ha)
Potential Pond/Reservoir Remediation (#)	Based on RBAs where completed.	7
Flow Opportunity	unchanged from BEF data	
Landowner Status	Expert judgment, Outreach Coordinator	
	Project, ongoing or funded	68
	Favorable	183
	Interested	38
	No Access (RBA)	17
	Unknown (largely upland forest)	179
Projection: NAD_83_OregonStatewide_Lambert_Feet_Intl		

3/23/10

Marys River Model Watershed Proposal
GIS Layer Development Methods and Criteria

For the purposes of restoration, our geographic emphasis is on 1-2% gradient reaches which, given increased hydraulic roughness due to log or boulder placements, have the greatest potential to respond favorably with an increase in channel complexity, including increased sinuousity and aggradation of the streambed to reduce channel incision. If efforts to increase channel complexity are successful, we hypothesize that there will be an increase in in-stream water storage capacity, and floodplain connectivity will also improve, increasing the potential for winter off-channel flow storage. We further hypothesize that increased fall-spring water storage will improve base flows in these reaches and downstream, during the summer low flow or "pinch point" for coastal cutthroat trout. Increased base flow will, in turn remediate summer water temperature stress on trout and other coldwater fishes. These1-2% stream segments provide critical rearing reaches for both resident and fluvial cutthroat trout, and these restoration activities may have a direct benefit for them by expanding summer and winter rearing habitats and improving habitat quality. Upstream-downstream fish passage for all age-classes of cutthroat trout is also a key focus.

The primary source of data for MRWC prioritization of restoration actions is field notes obtained during Rapid BioAssessment snorkel inventories by Karen Fleck Harding (KFH Consulting LLC) and Steve Trask (BioSurveys LLC). Snorkel inventories are conducted during summer low water (high temperature) to determine coastal cutthroat trout *O. clarki* and rainbow/steelhead *O. mykiss* distribution and relative abundance, based on a 20% subsample of pools. This information provides evidence regarding the best habitat "anchors" for cutthroat trout populations in each subwatershed, and information about barriers to juvenile and adult migration. Other quantitative information collected includes water temperature (June-August), pool cover, and water visibility. Qualitative data is collected regarding riparian canopy cover, land use, and geomorphic limitations and opportunities for improving watershed function. Surveys target wadeable streams with sufficient visibility to reliably conduct a snorkel survey, and continue upstream until diminishing flow and/or pool surface area make snorkeling impractical (1st-3rd order streams, with majority 2nd order). There is not yet a formal protocol for this cutthroat "limiting factors" analysis, and not all of this information can be derived from the standard RBA snorkel inventory. BioSurveys LLC is also one of our principal contractors for project design, and some of our action plan priorities reflect multiple site visits to determine optimal project sites and activities.

The next four pages describe 1) the quantitative or qualitative data used to assess locations and project potential; 2) the criteria used to select locations for the MRWC opportunites map; and 2) how the locations of 10-year Priority Actions were chosen for the GIS layer. The Marys 10-Year Action Plan will be revised on the basis of RBAs (Summer 2010) and follow-up landowner design visits to be conducted the following fall, winter and spring.

Barrier replacement or remediation

- Data
    1) Benton County Fish Passage Habitat Inventory
    2) RBA snorkel survey and field notes
- Criteria:
    - Opens access to significant juvenile rearing habitat, winter slackwater refuge from high flows and/or adult fish habitat (thermal refugia, spawning grounds) upstream/downstream, in terms of quantity and quality
    - If winter adult access to spawning grounds is the primary objective and the passage barrier is small (<6-8"), consider backwatering with log placement or graded riffles
    - Landowner interest
- 10-Year Proposed Action:
  All barriers identified in RBA snorkel inventories to date

Channel complexity – LWD placements and graded riffles

- Data: Anchor habitat areas identified in RBA snorkel surveys, ODFW Aquatic Habitat Inventory (1992; Beaver Cr only), and subsequent site visits
- Criteria:
    - Channel not too incised (<4-6 ft?) for gravel aggradation to reconnect channel to floodplain
    - Channel gradient between 1 and 2%
    - Low, broad floodplain surface on at least one side of the channel
    - Reach is relatively unconstrained, affording opportunity for lateral channel expansion or movement
    - Riparian trees available to anchor log placements
    - If no riparian trees available and/or channel is very incised (>6'), graded riffles are an option
    - Landowner interest
- 10-Year Proposed Action:
  All sites highlighted in Rapid BioAssessment recommendations for log placements were included in the Plan.

Floodplain reconnection

- Data: Locations identified during Rapid BioAssessments and subsequent site visits
- Criteria:
    - Presence of historic side channel or alcove, and/or presence of seep/spring
    - Geomorphic position in the landscape, probability of winter inundation in the absence of LWD augmentation if stream were fully functional
    - Potential to backwater stream channel with log placement or graded riffle, to ensure floodplain inundation in winter mean high water events
    - Soil type suitability for bank stability
    - Opportunity to augment site with riparian plantings to shade off-channel habitat and increase bank stability
    - Landowner interest

- 10-Year Proposed Action:
  All sites highlighted in Rapid BioAssessment recommendations for log placements were included in the Plan

Wetland restoration

- Data: Field and orthophoto evidence of historic off-channel wetlands and swales
- Criteria:
  - Opportunity to store winter flows off-channel, with no surface connection to channel, for slow summer hyporheic release into the channel
  - Hydric soils
  - Presence of ash and other wetland plants in area
  - Potential to de-link drainage ditches and tile lines from stream
  - Landowner interest
- 10-Year Proposed Action:
  1. All sites highlighted in RBAs and flagged in subsequent field visits
  2. This is a new project type for MRWC, and we expect to learn from our fellow Councils in the WMWP and from our own experience

Riparian plantings for shade, bank stabilization, beaver forage, and long-term LWD recruitment

- Data:
  1. TMDL shade differential data was reviewed and rejected, due to a) inaccuracy based on visual examination relative to field knowledge; b) analytical results emphasized agriculturally-dominated lowlands, a second-tier priority for MRWC after 1-2% gradient streams, and 3) emphasis on shade function only.
  2. Primary data used in our mapped depiction of priorities was field notes obtained during Rapid Bio-Assessment snorkel inventories.
- Criteria:
  - Local stream temperature in July/August
  - Visual observation of lack of effective canopy cover
  - Geomorphic characteristics appropriate for conifers as well as deciduous trees and shrubs, to provide eventual LWD source
  - Need for beaver forage material, as demonstrated by denuded former beaver flats and known beaver presence
  - Need for riparian plantings as component of bank stabilization projects
  - Higher priority if paired with floodplain reconnection or channel complexity project
  - Landowner interest
- 10-Year Proposed Action:
  1. All sites noted in RBA snorkel inventories for riparian planting were included in our 10-year mapped priorities,
  2. Streams were buffered at 50 and 100 ft to reflect the probable variation in planting widths.

Riparian fencing

- Data: RBA field notes and subsequent site visits
- Criteria:
  - o Livestock present on site
  - o Known elk presence
  - o Potential jeopardy to riparian plantings
  - o Landowner interest
- 10-Year Proposed Action:

  Priority fencing sites are an element of larger, more complex floodplain reconnection, bank stabilization and riparian planting projects.

Streambank stabilization

- Data/opportunity:
  1) Locations identified during RBAs
  2) Locations identified by landowners, prior to RBAs
- Criteria:
  - o Upstream and downstream conditions are such that recovery is feasible and action is likely to be successful (e.g. stream power at erosion location, directionality of flow, bank materials, downstream obstructions)
  - o Significant source of sediment in mean winter flows
  - o Probability that landowner will rip-rap in the absence of other options
  - o Landowner interest
- 10-Year Proposed Action:

  Further projects may be identified in the context of the Summer 2010 RBA. Bank stabilization expected to be an integral component of improving watershed function on Greasy Creek; only one project identified to date.

Invasives removal

- Data/opportunity
  1) Japanese knotweed identified during Woods Creek RBA 2008
  2) Prairie invasives (e.g., false brome, Scotch broom, Himalayan blackberry) interfering with at-risk butterfly habitat improvement
  3) Reed canary grass, Himalayan blackberry, other invasives identified during RBA or project design surveys
  4) Landowner interest
- 10-Year Proposed Action:
  1. Continued Japanese knotweed treatment along Woods Creek riparian corridor
  2. Upland prairie invasives to be assessed in Greasy Creek, Summer 2010
  3. Targeted invasive treatment and removal associated with floodplain reconnection, bank stabilization, and riparian planting projects

Upland prairie, oak savanna and woodland restoration

- Data: field notes by Outreach Coordinator during RBA, followed by site visits
- Criteria:
  - o Priority prairie conservation habitat under Benton County Prairie Conservation Strategy (2010) & USFWS Prairie Species Recovery Strategy (2008)

- Landowner interest
- 10-year Proposed Action
  TBD, based on field work summer 2010 in Greasy Creek

Pond thermal remediation

- Data: pond and stream temperature data collected in conjunction with RBAs
- Criteria:
  - Fish-bearing stream
  - Pond effluent is warmer than ambient stream temperature below the impoundment
  - Pond is either thermally stratified, or has the potential to become temperature stratified through increase in floodgate height
  - Pond can be modified to spill from cooler bottom waters
  - Landowner interest
- 10-Year Proposed Action:
  All sites highlighted in Rapid BioAssessment recommendations for pond remediation were included in the Plan

Water quantity

- Opportunity
  Identify water rights, conduct flow assessment with BEF contract specialist, determine whether there are any opportunities for flow restoration in the model subwatersheds
- 10-Year Proposed Action:
  1. Provide landowners options for more efficient irrigation methods and potential sources of financing through regular outreach
  2. To be determined, based on the results water quantity analyses