City of Lacey
Comprehensive Water Rights Mitigation Plan

Submitted September 2008

Updated December 2010

Subject Applications for Ground Water:
G2-29165
G2-29304
G2-30248
G2-30249
G2-30250
G2-30251

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    - *Groundwater Modeling of Betti and Hawks Acres Well Pumping Increases* (Thomas, 2008a)
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    - *Initial Acquisition and Restoration Assessment of the Smith Ranch* (Anchor QEA, 2010)
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Introduction

This Comprehensive Water Rights Mitigation Plan is an amendment to the comprehensive water rights mitigation plan submitted by the City on September 12, 2008. The purpose of this amendment is to provide more detail on previously described mitigation actions, and to clearly show that Lacey will mitigate predicted impacts to water resources. Although many of these predicted impacts are very small, Lacey is taking a conservative approach to mitigation with the specific actions described herein.

Changes in This Amendment

This Mitigation Plan is a complete package of mitigation actions for the water rights discussed in this Plan. To aid the reader, this amendment is presented as a complete, stand-alone document as opposed to supplemental text.

Major changes from the original submittal include the following:

- Mitigation quantities address predicted impacts in acre-feet per year as well as cubic feet per second, and are grouped by Lacey's three phases of water rights requests.

- For mitigation in the Deschutes River and Woodland Creek basins, this amendment provides quantitative detail on Regional Mitigation actions developed jointly by the Cities of Lacey, Olympia, and Yelm for mitigating predicted impacts using in-kind (flow-related) and out-of-kind (property protection and/or restoration) measures in both basins. Agreements and studies completed since the last submittal provide support for the mitigation quantities proposed. Furthermore, the in-kind mitigation in the Woodland Creek basin has been increased in include some winter flow mitigation, as opposed to the seasonal approach that was originally proposed.

- In this amendment, Lacey is no longer proposing short-term mitigation measures for the Woodland Creek basin. Most of the time period intended to be covered by temporary mitigation has lapsed and the city is currently planning on extending use of its existing water rights portfolio through 2012.

- Backup mitigation for impacts to Olympia's water rights on McAllister Springs were clarified in an interlocal agreement signed by the cities after the cities' mitigation plans were originally submitted. This amendment includes the mitigation and compensation actions agreed upon by Lacey and Olympia.

- For brevity, background information on Lacey's Water Rights Deficit, Ecology Requests for Information in the Mitigation Plan, and basin descriptions are not included in this compilation. Please refer to the previous submittal for that information.

Water Right Applications and Phases

This mitigation plan addresses six applications for ground water rights that request a total of 7,392 acre-feet (Table 1). Locations of these wells are shown in Figure 1. The applications were submitted from 1994 – 2005 with the intent of requesting sufficient quantities to meet projected demand for future build-out of Lacey's urban growth area.

Among these six applications, Lacey has ranked these into phases for relative ease of processing and providing mitigation (Table 1). The top two applications ("Phase 1") are applications G2-30248 and G2-30249, which will be processed through Lacey's active cost re-imbursement agreement with Ecology. These applications are necessary for the city to meet Growth Management Act obligations in the near term. Phase 2 applications are G2-29304 and G2-30251, although at this time only G2-30251 is covered under the cost recovery agreement. Phase 3 applications are G2-29165 and G2-30250. The City is looking for approval of this mitigation plan for all six applications, to provide assurance for additional future water supply for the city, and to use in financial planning for some of the mitigation actions in this plan that require a significant amount of study, planning, and/or expenditure of public resources.

Table 1
Applications for Groundwater Addressed in this Mitigation Plan

Application #	Phase	Priority Date	Well Name	Qi	Qa
G2-29165	3	12/16/94	Existing Wellfield S23: Madrona wells	2,000	2,226
G2-29304	2	09/20/95	Existing Well S27: Evergreen Estates	400	1,000
G2-30248*	1	05/03/05	Proposed New Well: Hawks Prairie #2	800	1,066
G2-30249*	1	04/28/05	Existing Well S29: Betti Well	1,000	600
G2-30250*	3	05/06/05	Proposed New Well: Meridian Campus	800	1,000
G2-30251*	2	05/06/05	Proposed New Well: Marvin Road	1,000	1,500

* These applications are included in Lacey's Cost Re-Imbursement Agreement with Ecology.

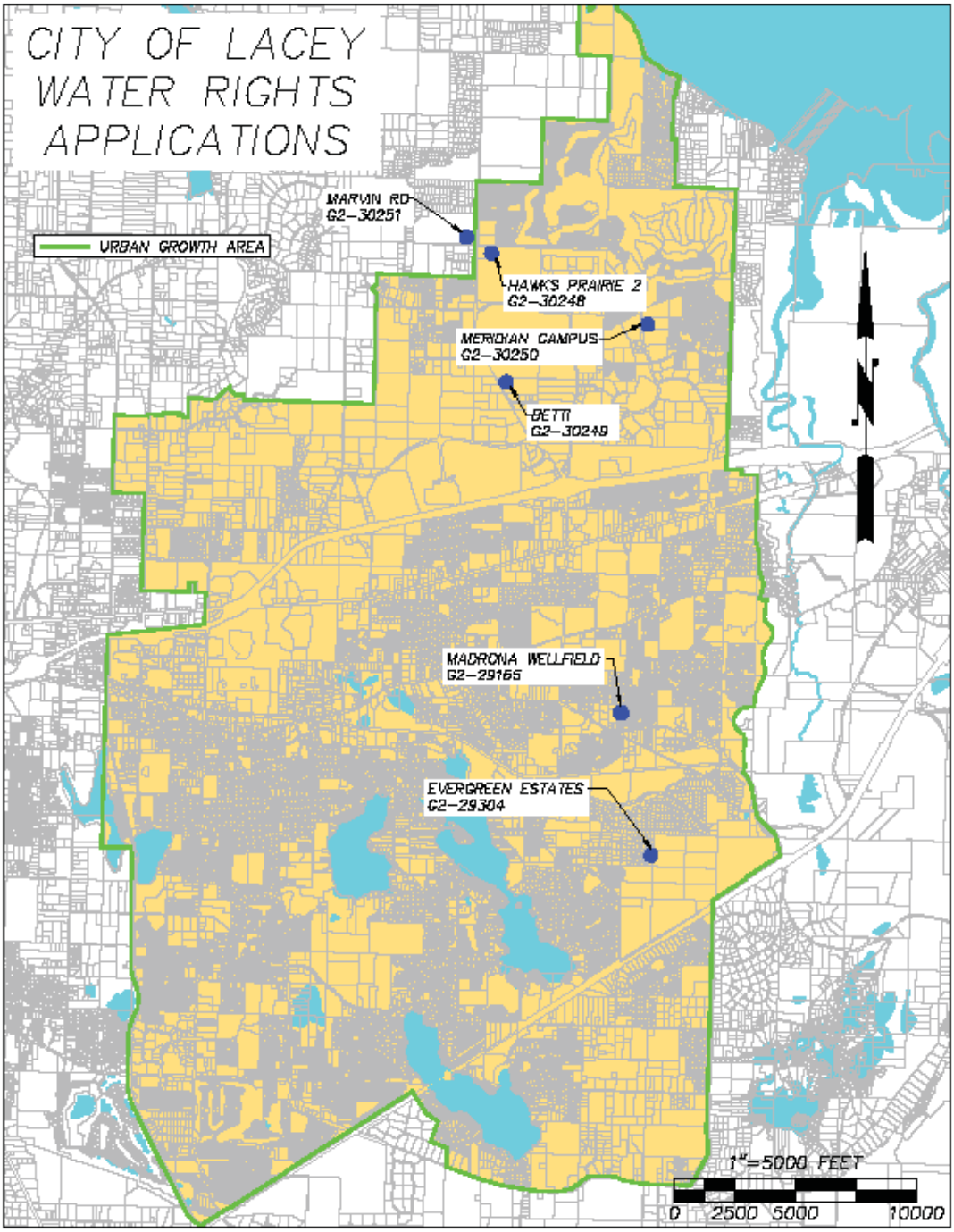

Figure 1. Locations of City of Lacey Water Rights Applications

Lacey's Need for Water Rights and Future Water Supply

Lacey currently holds 8637.8 acre-feet in primary water rights on the main water system. The City's need for additional water rights and water supply is demonstrated by growth pressures in the city and it's Urban Growth Area (UGA) that exceed the city's available supply. Demand projections in Lacey's 2003 Water System Comprehensive Plan predicted a shortfall of water supply by year 2006. Since 2003, Lacey's rights portfolio was increased by 831 AFY in purchased water rights but this was still insufficient for meeting projected demand and the city felt it was necessary to restrict growth. Consequently, in 2006 the city adopted Resolution 917 which places conditions on water availability within the city's UGA. Resolution 917 is attached in Appendix A. Although the city made significant demand-side and supply-side improvements in the water system to reduce overall water demand, and development has been reduced due to the current economic climate, Lacey still expects a shortfall of water supply in the near term. Current estimates are that Resolution 917 and system improvements will allow the city to stretch available water supplies to meet projected demand through year 2012.

Table 2 shows water demand projections through 2029 that are based on population projections made by Thurston Regional Planning Council. Projections through 2022 are from Lacey's 2003 Water System Comprehensive Plan. The city is currently updating its water system comprehensive plan that will include a water rights analysis for the next 6-year and 20-year planning horizons. The projection for 2029 shown in Table 2 is from a draft of this plan, which is in preparation and will still need approval by the state departments of Health and Ecology.

Table 2
Projected Population and Water Demand

Year	Estimated Population Served	Average Day Demand (MGD)	Annual Demand (AFY)
2000[1]	50,557	5.56	6,228
2008[1]	68,940	7.79	8,727
2022[1]	94,816	10.71	11,998
2029[2]	--	13.08	14,651.5

Source of data: [1]City of Lacey 2003 Water Comprehensive Plan (Gray and Osborne, 2003); [2]City of Lacey 2010 Water Comprehensive Plan (Carollo Engineers, in prep.)

Although the 7,392 AFY requested in this mitigation plan exceeds the amount needed to meet the projected 20-year demand, the city needs to plan for the length of time required to obtain new municipal water rights. The city has growth obligations to meet under the state Growth Management Act, which require long-term planning for infrastructure and financing. The amount of water rights requested is based on the city's estimate for supplying a fully built-out urban growth area and infill within city limits, and is anticipated to be a 30-40 year supply of water.

Groundwater Modeling for Predicting Impacts to Water Resources

Mitigation Actions in this plan address impacts to surface water that were predicted using the McAllister Numerical Groundwater Model. This model was originally developed for the City of Olympia for evaluating potential hydrologic impacts to surface water bodies near McAllister Springs and the City of Olympia's proposed McAllister Wellfield. The model has since been updated several times to reflect current pumping conditions, to include currently available information on hydrogeology, and to add additional surface features into the model. The cities consulted with the Nisqually Indian Tribe and Squaxin Island Tribe on the model, and several changes to the model were made based on comments received from the tribes. When changes were made to the model, the cities coordinated on updating and peer-reviewing the model. The model is now considered to be the best available tool for evaluating groundwater interactions in the McAllister area. Because of this, *The Nisqually Watershed Management Plan* (Golder Associates, 2003) recommended that this model be used to predict impacts of large municipal water withdrawals from the McAllister and Yelm sub-basins.

Details on model construction are not provided here, but the most recent, updated version used by Lacey is discussed in Lacey's modeling reports, *Report on Groundwater Modeling of Madrona and Evergreen Estates Well Water Right Applications City of Lacey, Washington (*Golder Associates, 2008*), Groundwater Modeling of Betti and Hawks Acres Well Pumping Increases* (Thomas, 2008a) and *Groundwater Modeling of New Hawks Prairie Area Pumping* (Thomas, 2008b). These reports are provided in Appendix B. The model domain and significant water features included within the model boundaries are shown in Figure 2.

In 2008 the cities conducted a cumulative modeling run to evaluate impacts to surface waters from full pumping of water right requests from Lacey, Olympia, and Yelm. This cumulative model did not reflect all water right requests from Lacey, and Yelm has since revised their water supply strategy. However, the cumulative run was valuable for evaluating whether results from individual model runs completed for each of the cities were comparable with the results from the cumulative run. Overall the cumulative run confirmed that the sum of results from individual model runs was at least as high as the results from the cumulative run. For some surface water bodies, the sum of individual results was higher than the cumulative results.

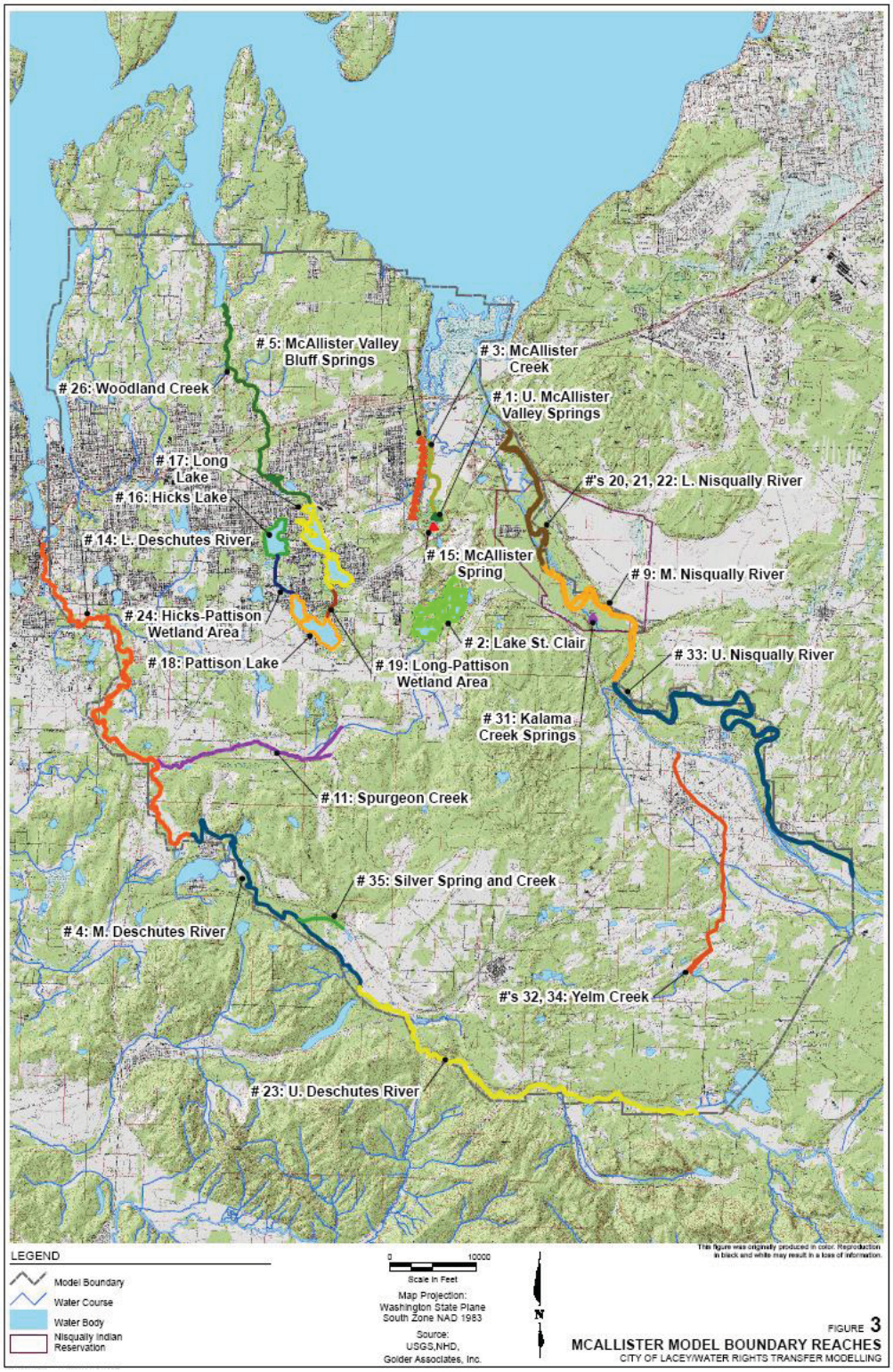

Figure 2. McAllister Numerical Groundwater Model Boundary Reaches (from Thomas, 2008b)

Surface Water Features Evaluated

The purpose of groundwater modeling was to evaluate potential impacts to surface water features that are at least partially supported by groundwater discharge, and consequently could be affected by groundwater pumping. Many of these features have minimum instream flows or closures to new appropriation that are established by rule. The instream flows established for WRIAs 11 and 13 are in WAC 173-511-030 and WAC 173-513-030, and are summarized below in Table 3. These water bodies were the main focus of interest for groundwater modeling that was used to predict impacts from Lacey's water right applications.

Table 3
Regulatory Status of Key Water Bodies in WRIAs 11 and 13

Water Body	Regulatory Status (Chapters 173-511 and 173-513 WAC)
WRIA 11 (Nisqually River Watershed)	
Lower Nisqually River (from RM 21.8 to tidal influence at RM 4.3)	Open year-round, subject to instream flows (600 – 900 cfs, varying seasonally)
McAllister Creek	Closed to new appropriations (year round)
Lake St. Clair	Closed to new appropriations (year round)
WRIA 13 (Deschutes River Watershed)	
Deschutes River (from RM 41 to confluence with Capitol Lake)	Closed to new appropriations April 15 – November 1. New appropriations subject to instream flows in remaining months (150-400 cfs, varying seasonally)
Woodland Creek and all tributaries	Closed to new appropriations (year round)
Long Lake	Closed to new appropriations (year round)
Patterson Lake (a.k.a. Pattison Lake)	Closed to new appropriations (year round)
Hicks Lake	Closed to new appropriations (year round)

In addition to the regulated waterbodies listed above, several features were added to model by request of the Nisqually Indian Tribe and Squaxin Island Tribe. These features include Kalama Spring, Silver Spring, Silver Creek, and Yelm Creek.

Model Accuracy for Predicting Small Depletions

At this time the McAllister Numerical Ground Water model represents the best available science for analyzing the effects of groundwater pumping and making water rights decisions for large water right requests within the model's boundaries. However, for many of the water bodies evaluated the predicted effects are very small relative to measured stream flows and/or the groundwater inflow to each water body. Furthermore, the conservative construction of the McAllister model potentially leads to over-prediction of depletions along the model boundaries, which includes the Deschutes River and Nisqually River (see Figure 2). For example, the McAllister model boundary at the Deschutes River has "constant head" cells only in the shallow (Qva) aquifer and "no flow" cells in the middle (Qc) and deep (TQu) aquifers. In other words, no water enters the middle and deep aquifers from the area outside of the model boundary although in reality water will flow under the river and enter the basin. In the model, this will

force new pumping from deeper aquifers to draw water from other boundaries, including the shallow Deschutes River boundary, and potentially result in over-estimating impacts to the river.

The modelers contracted by the cities (SSPA and Golder Associates) felt it was important to define a margin of error or accuracy limit for the model. If values fall below this limit, it is not clear whether that there will be actual surface water depletions. In discussing the relative accuracy of modeling results, both modelers reported that the model has a high degree of precision, but the accuracy of the model for predicting small flow depletions in areas with large groundwater flow rates is questionable. Regarding the accuracy of the model,

> "As a rule of thumb, it is advised that reaches with predicted depletions that are 1 percent or less of the total groundwater flow rate in the reach should be considered as beyond the accuracy limits of the model." (Riley 2008)

Lacey considered the relative accuracy of the modeling results in the development of mitigation strategies proposed in this plan. Predicted depletions that are above the model accuracy limit are considered to pose greater potential for risk to the resource, and consequently more mitigation is proposed in order to provide a margin of safety. In contrast, predicted impacts that are below the accuracy limit are less accurate and less likely to actually occur. Predicted impacts that are <0.01 cfs or represent <0.1% of the groundwater inflow are considered to be zero impact and no mitigation is proposed for those water features.

Predicted Impacts to Modeled Surface Water Features

The actions provided in this Plan will mitigate predicted impacts quantified by the McAllister Numerical Model, as reported in *Report on Groundwater Modeling of Madrona and Evergreen Estates Well Water Right Applications City of Lacey, Washington (Golder, 2008)* and *Groundwater Modeling of Betti and Hawks Acres Well Pumping Increases* (Thomas, 2008a) and *Groundwater Modeling of New Hawks Prairie Area Pumping* (Thomas, 2008b). These original modeling reports did not include predicted impacts in acre-feet per year. The summary of predicted impacts shown in Tables 4 – 9 include impacts in acre-feet. The source of these tables is a private communication email from Stephen Thomas (Golder Associates) to Mike Gallagher (Ecology) titled "Lacey Revised Depletion Tables Aves" dated January 13, 2009. Overall the results in these tables are the same as in the individual modeling reports, except for the columns showing average annual depletion.

The results from modeling scenarios quantify the maximum year-round impacts as well as the maximum summer impacts. The relative accuracy of the results is shown as the percentage of the total groundwater inflow for each surface water feature. As noted in the discussion on model accuracy for small depletions, predicted depletions that are < 1% of groundwater inflow for each surface feature are considered to be below the accuracy limits of the model, and predicted depletions ≤ 0.01 cfs or ≤ 0.1% of the groundwater discharge are considered to be zero impact.

Table 4. Predicted Groundwater Depletions versus Baseline -- Madrona wellfield #G2-29165

Hydrologic Area/Feature	Highest Annual Discharge Depletion			Summer Discharge Depletion		Average Annual Depletion		
	cfs	*%*	*month(s)*	*cfs*	*%*	*cfs*	*AFY*	*%*
----------McAllister Valley----------								
McAllister Springs	-0.33	-1.1	Feb-Apr	-0.29	-1.1	-0.29	-209	-1.0
Other upper-valley springs	-0.45	-1.1	Mar	-0.40	-1.1	-0.39	-284	-1.0
McAllister Creek	-0.04	-1.2	Jan-Mar	-0.02	-2.1	-0.03	-20	-1.4
Valley-bluff Springs	-0.07	-3.0	Feb-Sep	-0.07	-3.0	-0.07	-49	-2.4
Lake St. Clair	-0.01	-0.7	Sep-Jul	-0.01	-0.6	-0.01	-5	-0.6
McAllister Creek (at Medicine Creek)	*-0.88*	*-1.1*	*Feb-Mar*	*-0.79*	*-1.2*	*-0.78*	*-561*	*-1.1*
----------Upland Lakes and Creeks---------								
Hicks-Long-Pattison Lakes	-0.31	-2.4	Mar	-0.27	-6.1	-0.26	-191	-5.2
Woodland Creek	-0.08	-0.8	Mar	-0.04	-0.9	-0.05	-37	-0.9
Woodland Creek (at Henderson Inlet)	*-0.39*	*-1.7*	*Mar*	*-0.31*	*-3.7*	*-0.32*	*-228*	*-2.8*
----------Nisqually River----------								
Lower reach (15,000-ft above RM4.3)	-0.32	-1.0	Feb-Mar	-0.28	-1.1	-0.28	-201	-1.1
Middle reach	-0.01	-0.1	YR	-0.01	-0.1	-0.01	-8	<0.1
Upper reach	-0.01	<0.1	YR	-0.01	<0.1	-0.01	-6	<0.1
Kalama Creek Spring	<0.01	-	-	<0.01	-	<0.01	-	-
Yelm Creek	-0.01	-0.1	Mar	<0.01	-	<0.01	-	-
Nisqually River (at RM4.3)	*-0.35*	*-0.5*	*Feb-Mar*	*-0.31*	*-0.5*	*-0.30*	*-220*	*-0.4*
----------Deschutes River----------								
Lower reach	-0.08	-0.3	Mar	-0.05	-0.6	-0.05	-39	-0.4
Middle reach	-0.01	-0.1	YR	-0.01	-0.1	-0.01	-8	-0.5
Silver Creek/Spring	<0.01	-	-	<0.01	-	<0.01	-	-
Upper reach	-0.02	-0.1	Jan-Mar	-0.01	-0.1	-0.01	-11	-0.1
Deschutes River (at Tumwater)	*-0.16*	*-0.2*	*Feb-Mar*	*-0.10*	*-0.4*	*-0.12*	*-84*	*-0.3*

Note: Negative rates indicate monthly groundwater discharge depletion versus the Baseline case. % - percentage of Baseline discharge depleted. *month* – month in which highest loss would occur. Summer = Jun-Sep inclusive. YR - indicates equal rate all year.

Source: StephenThomas, sdthomas@golder.com. "Lacey Revised Depletion Tables Aves." Attached to private email message to Mike Gallagher. January 13, 2009

Table 5. Predicted Groundwater Depletions versus Baseline -- Evergreen Estates well #G2-29304

Hydrologic Area/Feature	Highest Annual Discharge Depletion			Summer Discharge Depletion		Average Annual Depletion		
	cfs	*%*	*month(s)*	*cfs*	*%*	*cfs*	*AFY*	*%*
----------McAllister Valley----------								
McAllister Springs	-0.21	0.7	Feb-Apr	-0.19	0.7	-0.18	-133	-0.7
Other upper-valley springs	-0.27	0.7	Jan-Apr	-0.25	0.7	-0.24	-174	-0.6
McAllister Creek	-0.01	0.4	Oct-Jul	-0.01	0.4	-0.01	-5	-0.3
Valley-bluff Springs	-0.02	0.8	YR	-0.02	0.8	-0.02	-13	-0.6
Lake St. Clair	-0.01	0.5	Jan-May	<0.01	-	<0.01	-	-
McAllister Creek (at Medicine Creek)	*-0.51*	*0.6*	*Mar*	*-0.46*	*0.7*	*-0.45*	*-325*	*-0.6*
----------Upland Lakes and Creeks---------								
Hicks-Long-Pattison Lakes	-0.15	1.2	Mar	-0.14	3.0	-0.13	-94	-2.5
Woodland Creek	-0.03	0.3	Feb-Mar	-0.01	0.3	-0.02	-12	-0.3
Woodland Creek (at Henderson Inlet)	*-0.18*	*0.8*	*Mar*	*-0.15*	*1.7*	*-0.15*	*-106*	*-1.3*
----------Nisqually River----------								
Lower reach (15,000-ft above RM4.3)	-0.17	0.6	Feb-Apr	-0.15	0.6	-0.15	-108	-0.6
Middle reach	-0.01	<0.1	-	-0.01	<0.1	-0.01	-5	<0.1
Upper reach	<0.01	-	-	<0.01	-	<0.01	-	-
Kalama Creek Spring	<0.01	-	-	<0.01	-	<0.01	-	-
Yelm Creek	<0.01	-	-	<0.01	-	<0.01	-	-
Nisqually River (at RM4.3)	*-0.18*	*0.3*	*Jan-May*	-0.17	0.3	-0.16	-119	-0.2
----------Deschutes River----------								
Lower reach	-0.04	0.2	Feb-Mar	-0.02	0.3	-0.03	-20	-0.2
Middle reach	-0.01	0.6		-0.01	0.5	-0.01	-5	<0.1
Silver Creek/Spring	<0.01	-	-	<0.01	-	<0.01	-	-
Upper reach	-0.01	0.1	-	-0.01	0.1	-0.01	-6	<0.1
Deschutes River (at Tumwater)	*-0.09*	*0.1*	*Feb-Mar*	*-0.06*	*0.2*	-0.06	-45	-0.1

Note: Negative rates indicate monthly groundwater discharge depletion versus the Baseline case. % - percentage of Baseline discharge depleted. *month* – month in which highest loss would occur. Summer = Jun-Sep inclusive. YR - indicates equal rate all year.

Source: StephenThomas, sdthomas@golder.com. "Lacey Revised Depletion Tables Aves." Attached to private email message to Mike Gallagher. January 13, 2009

Table 6. Predicted Groundwater Depletions versus Baseline -- Betti well #G2-30249

Hydrologic Area/Feature	Highest Annual Discharge Depletion			Summer Discharge Depletion		Average Annual Depletion		
	cfs	*%*	*month(s)*	*cfs*	*%*	*cfs*	*AFY*	*%*
----------McAllister Valley----------								
McAllister Springs	-0.03	0.1	YR	-0.03	-0.1	-0.03	-23	-0.1
Other upper-valley springs	-0.04	0.1	YR	-0.04	-0.1	-0.04	-31	-0.1
McAllister Creek	<0.01	-	-	<0.01	-	<0.01	-	-
Valley-bluff Springs	-0.01	-0.5	YR	-0.01	-0.5	-0.01	-8	-0.4
Lake St. Clair	<0.01	-1	-	<0.01	-	<0.01	-	-
McAllister Creek (at Medicine Creek)	*-0.09*	*0.1*	*YR*	*-0.09*	*-0.1*	*-0.09*	*-64*	*-0.1*
----------Upland Lakes and Creeks---------								
Hicks-Long-Pattison Lakes	-0.03	-4.1	Jan-Oct	-0.03	-4.1	-0.03	-20	-0.5
Woodland Creek	-0.02	-0.2	Dec-Mar	-0.01	-0.3	-0.01	-9	-0.2
Woodland Creek (at Henderson Inlet)	*-0.05*	*-0.2*	*Feb-Mar*	*-0.04*	*-1.5*	*-0.04*	*-29*	*-0.4*
----------Nisqually River----------								
Lower reach (15,000-ft above RM4.3)	-0.04	-0.2	YR	-0.04	-0.2	-0.04	-30	-0.2
Middle reach	<0.01	-	-	<0.01	-	<0.01	-	-
Upper reach	<0.01	-	-	<0.01	-	<0.01	-	-
Kalama Creek Spring	<0.01	-	-	<0.01	-	<0.01	-	-
Yelm Creek	<0.01	-	-	<0.01	-	<0.01	-	-
Nisqually River (at RM4.3)	*-0.05*	*-0.1*	*YR*	*-0.05*	*-0.1*	*-0.05*	*-34*	*-0.1*
----------Deschutes River----------								
Lower reach	-0.01	<0.1	Feb-Mar	<0.01	-	-0.01	-6	<0.1
Middle reach	<0.01	-	-	<0.01	-	<0.01	-	-
Silver Creek/Spring	<0.01	-	-	<0.01	-	<0.01	-	-
Upper reach	<0.01	-	-	<0.01	-	<0.01	-	-
Deschutes River (at Tumwater)	*-0.01*[(1)]	*-0.1*	*Nov-May*	*-0.01*	*-0.1*	*-0.01*[(2)]	*-4*	*<0.1*

Note: Negative rates indicate monthly groundwater discharge depletion versus the Baseline case. % - percentage of Baseline discharge depleted. *month* – month in which highest loss would occur. Summer = Jun-Sep inclusive. YR - indicates equal rate all year. (1) – maximum monthly depletion rate for which >0.1% of baseline occurs; (2) – based on assigning zero monthly depletion for months for which the modeled depletion is <0.1% of baseline discharge.

Source: StephenThomas, sdthomas@golder.com. "Lacey Revised Depletion Tables Aves." Attached to private email message to Mike Gallagher. January 13, 2009

Table 7. Predicted Groundwater Depletions versus Baseline-- Hawks Prairie well 2 #G2-30248

Hydrologic Area/Feature	Highest Annual Discharge Depletion			Summer Discharge Depletion		Average Annual Depletion		
	cfs	*%*	*month(s)*	*cfs*	*%*	*cfs*	*AFY*	*%*
----------McAllister Valley----------								
McAllister Springs	-0.05	-0.2	Sep	-0.05	-0.2	-0.04	-29	-0.1
Other upper-valley springs	-0.06	-0.2	Jun-Dec	-0.06	-0.2	-0.06	-40	-0.1
McAllister Creek	<0.01	-	-	<0.01	-	<0.01	-	-
Valley-bluff Springs	-0.02	-0.7	YR	-0.02	-0.7	-0.02	-12	-0.6
Lake St. Clair	<0.01	-	-	<0.01	-	<0.01	-	-
McAllister Creek (at Medicine Creek)	*-0.13*	*-0.2*	*Aug-Sep*	*-0.13*	*-0.2*	*-0.12*	*-84*	*-0.2*
----------Upland Lakes and Creeks---------								
Hicks-Long-Pattison Lakes	-0.04	-5.8	Feb-Nov	-0.04	-5.8	-0.04	-27	-0.7
Woodland Creek	-0.03	-0.2	Feb	-0.02	-0.4	-0.02	-13	-0.3
Woodland Creek (at Henderson Inlet)	*-0.07*	*-0.3*	*Mar*	*-0.05*	*-2.3*	*-0.06*	*-41*	*-0.5*
----------Nisqually River----------								
Lower reach (15,000-ft above RM4.3)	-0.06	-0.3	Jun-Nov	-0.06	-0.3	-0.05	-39	-0.2
Middle reach	<0.01	-	-	<0.01	-	<0.01	-	-
Upper reach	<0.01	-	-	<0.01	-	<0.01	-	-
Kalama Creek Spring	<0.01	-	-	<0.01	-	<0.01	-	-
Yelm Creek	<0.01	-	-	<0.01	-	<0.01	-	-
Nisqually River (at RM4.3)	*-0.07*	*-0.1*	*Jul-Nov*	*-0.07*	*-0.1*	*-0.06*	*-44*	*-0.1*
----------Deschutes River----------								
Lower reach	-0.01	-0.1	YR	-0.01	-0.1	-0.01	-8	-0.1
Middle reach	<0.01	-	-	<0.01	-	<0.01	-	-
Silver Creek/Spring	<0.01	-	-	<0.01	-	<0.01	-	-
Upper reach	-0.01	<0.1	Feb-Mar	<0.01	-	<0.01	-	-
Deschutes River (at Tumwater)	*-0.02*	*-0.1*	*Apr-Nov*	*-0.02*	*-0.1*	*-0.01*	*-10*	*<0.1*

Note: Negative rates indicate monthly groundwater discharge depletion versus the Baseline case. % - percentage of Baseline discharge depleted. *month* – month in which highest loss would occur. Summer = Jun-Sep inclusive. YR - indicates equal rate all year. (1) – maximum monthly depletion rate for which >0.1% of baseline occurs; (2) – based on assigning zero monthly depletion for months for which the modeled depletion is <0.1% of baseline discharge.

Source: StephenThomas, sdthomas@golder.com. "Lacey Revised Depletion Tables Aves." Attached to private email message to Mike Gallagher. January 13, 2009

Table 8. Predicted Groundwater Depletions versus Baseline -- Marvin Road well #G2-30251

Hydrologic Area/Feature	Highest Annual Discharge Depletion			Summer Discharge Depletion		Average Annual Depletion		
	cfs	*%*	*month(s)*	*cfs*	*%*	*cfs*	*AFY*	*%*
----------McAllister Valley----------								
McAllister Springs	-0.06	-0.2	Sep-Nov	-0.06	-0.2	-0.05	-39	-0.2
Other upper-valley springs	-0.08	-0.2	Jun-Nov	-0.08	-0.2	-0.07	-53	-0.2
McAllister Creek	-0.01	-0.2	Dec-Mar	<0.01	-	<0.01	-	-
Valley-bluff Springs	-0.02	-1.0	YR	-0.02	-1.0	-0.02	-16	-0.8
Lake St. Clair	<0.01	-	-	<0.01	-	<0.01	-	-
McAllister Creek (at Medicine Creek)	*-0.16*	*-0.3*	*Jun-Dec*	*-0.16*	*-0.3*	*-0.15*	*-112*	*-0.2*
----------Upland Lakes and Creeks---------								
Hicks-Long-Pattison Lakes	-0.06	-0.5	Mar	-0.05	-7.6	-0.05	-36	-1.0
Woodland Creek	-0.04	-0.3	Feb	-0.02	-0.6	-0.02	-18	-0.4
Woodland Creek (at Henderson Inlet)	*-0.09*	*-0.4*	*Feb-Mar*	*-0.07*	*-2.9*	*-0.08*	*-54*	*-0.7*
----------Nisqually River----------								
Lower reach (15,000-ft above RM4.3)	-0.08	-0.3	Sep	-0.08	-0.3	-0.07	-52	-0.3
Middle reach	<0.01	-	-	<0.01	-	<0.01	-	-
Upper reach	<0.01	-	-	<0.01	-	<0.01	-	-
Kalama Creek Spring	<0.01	-	-	<0.01	-	<0.01	-	-
Yelm Creek	<0.01	-	-	<0.01	-	<0.01	-	-
Nisqually River (at RM4.3)	*-0.08*	*-0.1*	*YR*	*-0.08*	*-0.1*	*-0.08*	*-59*	*-0.1*
----------Deschutes River----------								
Lower reach	-0.02	-0.1	Nov-Mar	-0.01	-0.2	-0.01	-11	-0.1
Middle reach	<0.01	-	-	<0.01	-	<0.01	-	-
Silver Creek/Spring	<0.01	-	-	<0.01	-	<0.01	-	-
Upper reach	-0.01	-	-	<0.01	-	<0.01	-	-
Deschutes River (at Tumwater)	*-0.04*	*-0.1*	*Dec-Mar*	*-0.03*	*-0.2*	*-0.03*	*-23*	*-0.1*

Note: Negative rates indicate monthly groundwater discharge depletion versus the Baseline case. % - percentage of Baseline discharge depleted. *month* – month in which highest loss would occur. Summer = Jun-Sep inclusive. YR - indicates equal rate all year.

Source: StephenThomas, sdthomas@golder.com. "Lacey Revised Depletion Tables Aves." Attached to private email message to Mike Gallagher. January 13, 2009

Table 9. Predicted Groundwater Depletions versus Baseline -- Meridian Campus well #G2-30250

Hydrologic Area/Feature	Highest Annual Discharge Depletion			Summer Discharge Depletion		Average Annual Depletion		
	cfs	*%*	*month(s)*	*cfs*	*%*	*cfs*	*AFY*	*%*
----------McAllister Valley----------								
McAllister Springs	-0.05	-0.2	Jun-Dec	-0.05	-0.2	-0.04	-31	-0.2
Other upper-valley springs	-0.07	-0.2	Jul-Nov	-0.07	-0.2	-0.06	-43	-0.2
McAllister Creek	<0.01	-	-	<0.01	-	<0.01	-	-
Valley-bluff Springs	-0.01	-0.6	YR	-0.01	-0.6	-0.01	-10	-0.7
Lake St. Clair	<0.01	-	-	<0.01	-	<0.01	-	-
McAllister Creek (at Medicine Creek)	*-0.14*	*-0.2*	*Aug-Sep*	*-0.14*	*-0.2*	*-0.12*	*-86*	*-0.2*
----------Upland Lakes and Creeks---------								
Hicks-Long-Pattison Lakes	-0.03	-4.3	YR	-0.03	-4.3	-0.03	-20	-0.5
Woodland Creek	-0.02	-0.2	Dec-Mar	-0.01	-0.3	-0.01	-9	-0.2
Woodland Creek (at Henderson Inlet)	*-0.05*	*-0.2*	*Mar*	*-0.04*	*-1.6*	*-0.04*	*-29*	*-0.4*
----------Nisqually River----------								
Lower reach (15,000-ft above RM4.3)	-0.09	-0.4	Jul-Aug	-0.09	-0.4	-0.07	-51	-0.3
Middle reach	<0.01	-	-	<0.01	-	<0.01	-	-
Upper reach	<0.01	-	-	<0.01	-	<0.01	-	-
Kalama Creek Spring	<0.01	-	-	<0.01	-	<0.01	-	-
Yelm Creek	<0.01	-	-	<0.01	-	<0.01	-	-
Nisqually River (at RM4.3)	*-0.09*	*0.1*	*Jul-Oct*	*-0.09*	*-0.1*	*-0.08*	*-55*	*-0.1*
----------Deschutes River----------								
Lower reach	-0.01	-0.1	YR	-0.01	-0.1	-0.01	-6	-0.1
Middle reach	<0.01	-	-	<0.01	-	<0.01	-	-
Silver Creek/Spring	<0.01	-	-	<0.01	-	<0.01	-	-
Upper reach	<0.01	-	-	<0.01	-	<0.01	-	-
Deschutes River (at Tumwater)	*-0.02*	*-0.1*	*YR*	*-0.02*	*-0.1*	*-0.02*	*-13*	*-0.1*

Note: Negative rates indicate monthly groundwater discharge depletion versus the Baseline case. % - percentage of Baseline discharge depleted. *month* – month in which highest loss would occur. Summer = Jun-Sep inclusive. YR - indicates equal rate all year.

Source: StephenThomas, sdthomas@golder.com. "Lacey Revised Depletion Tables Aves." Attached to private email message to Mike Gallagher. January 13, 2009

Regional Coordination in Development of Mitigation Actions

An extensive amount of regional coordination went into the development of this plan, and most proposed mitigation actions, particularly the regional actions, are the products of this coordination. The relationships established through watershed planning were instrumental in developing regional mitigation actions that are intended to benefit regional water resources while addressing competing needs for large municipal water rights from the basin. A number of options were considered during the development of this plan and it was necessary to develop a complete package that is feasible, meaningful, and complete. Some of the more innovative actions are those that were developed as regional mitigation actions that are jointly proposed by the cities of Lacey, Olympia, and Yelm for the Woodland Creek, Deschutes River, and McAllister Creek basins. Coordination efforts included the following:

Watershed Planning. Watershed planning authorized under RCW 90.82 has been active in the Nisqually watershed (WRIA 11) since 1999, with the *Nisqually Watershed Management Plan* adopted in 2004, and the *Nisqually Implementation Plan for Watershed Management in WRIA 11* approved by the Planning Committee in 2007. These plans include recommended mitigation strategies which were considered during the selection of individual and regional mitigation actions for this plan. Recommended mitigation strategies included in this plan include: relinquishment of existing water rights/putting active water rights into trust; infiltration of reclaimed water near stream headwaters; on-site and off-site habitat enhancements; transfer of surface rights to groundwater/sub-basin transfer of water that improves streamflow, and stormwater improvements. Several of these actions were included as Regional Mitigation actions that were jointly developed and proposed by the cities of Lacey, Olympia, and Yelm.

Communication with the Squaxin Island Tribe. Lacey, Olympia, and Yelm together met with staff from the Squaxin Island Tribe on several occasions from 2007 – 2010 to discuss modeling results and proposed mitigation actions for the Deschutes River and the Woodland Creek basin. Based on comments received from the Tribe, the groundwater model was updated to better represent the mid-reach of the Deschutes River, and Silver Springs was added as another distinct surface feature. The cities also completed a cumulative model run in 2008 by request of the Tribe. The Tribe's comments were considered as the cities revised mitigation quantities proposed for the Woodland Creek and Deschutes basins, and for developing the list of habitat restoration projects to be included in the Regional Mitigation plan for the Deschutes.

Communication with the Nisqually Indian Tribe. Ongoing communication with the Nisqually Tribe has been occurring through the watershed planning process in WRIA 11. In addition, Lacey met several times with staff from the Nisqually Indian Tribe to discuss Lacey's mitigation plan and actions that will benefit the long-term health of the Nisqually River. These meetings led to voluntary mitigation options for abandoning Lacey's Nisqually valley wells, and for participating in the McAllister/Yelm Stewardship Coalition.

Public outreach to lakes residents. Lacey, Olympia, Yelm, and the Department of Ecology held an outreach event in 2009 for residents at Long, Hicks, and Pattison Lakes to learn about predicted impacts to lake levels and the regional mitigation plan.

Mitigation Program

Lacey's mitigation program is a complete mitigation package for all six of Lacey's water right applications. This mitigation program is organized and presented for each of the surface water basins that will receive mitigation. However, these mitigation actions should be considered in context of the entire package presented.

As noted earlier, groundwater modeling was used to predict impacts to surface water features that are sensitive to groundwater pumping and have regulated instream flows. Lacey's approach to mitigation is to focus on the upper reaches of affected basins. In addition, consideration was given to the relative accuracy of the modeling results in the development of mitigation strategies proposed in this plan. Predicted depletions that are above the model accuracy limit are considered to pose a greater potential for risk to the resource, and consequently more mitigation is proposed in order to provide a margin of safety. For those depletions above the model accuracy limit, mitigation is proposed to address 150% of the predicted impacts during summer low flow periods when instream flows are most sensitive to risk. Alternatively this is expressed as applying a mitigation ratio of 1.5:1. In contrast, predicted depletions that are below the accuracy limit are less accurate and less likely to actually occur. For those impacts, the city does not believe that mitigation is required but instead mitigation actions have been proposed as a margin of safety, particularly to address cumulative impacts. Mitigation for these impacts will strive to completely mitigate predicted values at a 1:1 ratio.

The most significant and innovative elements of this mitigation program are the Regional Mitigation actions that are jointly proposed by the cities of Lacey, Olympia, and Yelm for the Woodland Creek, Deschutes River, and McAllister Creek basins. Regional mitigation actions are proposed for the following water rights requested by the three cities:

- **City of Lacey** – New water right applications G2-29165 (Madrona Wellfield), G2-29304 (Evergreen Estates), G2-30248 (Hawks Prairie #2), G2-30249 (Betti Well), G2-30250 (Meridian Campus), and G2-30251 (Marvin Road);
- **City of Olympia and Nisqually Indian Tribe** – Water right change applications for Certificate Nos. 8030 and S2-001105C (McAllister Springs) and Permit No. 10191 (Abbott Springs); and
- **City of Yelm** – SW Yelm Wellfield water right application G2-29085.

By working together as mitigation partners, the cities developed large mitigation projects that will have more overall benefit to these basins than would have been possible through individual efforts. Regional actions for Woodland Creek and the Deschutes River consist of both in-kind (flow-related) and out-of-kind (riparian protection and habitat improvements) actions that will mitigate predicted impacts from water rights that were individually requested by the cities. In addition, regional mitigation will be provided for McAllister Creek by the City of Olympia, when the city moves its primary source of supply from McAllister Springs to the McAllister wellfield. These regional mitigation actions are described with each of the basin discussions below.

Woodland Creek Basin

Impacts in the Woodland Creek basin will be mitigated using a combination of in-kind and out-of-kind mitigation actions. All of the in-kind mitigation, and some of the out-of-kind mitigation, will be implemented as part of the Regional Mitigation package that is jointly proposed by the cities of Lacey and Olympia. However, because Lacey has larger predicted impacts in the Woodland Creek basin than Olympia, Lacey is proposing additional out-of-kind mitigation to supplement actions to be implemented for the Regional Mitigation program. This section presents the Regional Mitigation program for the Woodland Creek basin as well as Lacey's supplemental mitigation actions.

The following sections describe the predicted impacts to the Woodland Creek basin, and proposed mitigation actions. Although impacts are predicted for the tri-lakes, associated wetlands and the creek, the overall approach to in-kind mitigation is to focus on upper Woodland Creek. The creek experiences low flows and has more potential for fish production than the upstream lakes area, and it is expected that there will be more overall benefit to the system by concentrating mitigation effort on the creek as opposed to the individual lakes.

Lacey's Predicted Depletions

Predicted depletions from Lacey's water right applications are shown in Table 10. The highest cumulative predicted depletion for the entire Woodland Creek basin (modeled at the mouth of the creek at Henderson Inlet) is 0.83 cfs in winter months, and 0.66 cfs in summer months (modeled as June through September). Monthly depletions are predicted to vary by month, as shown in Figure 3. Of note is that the highest monthly depletion is predicted to occur in March, whereas the lowest depletions will be during summer and fall months.

Table 10 Lacey's Water Right Applications Predicted Depletions for Woodland Creek Basin				
Application for Groundwater	**Max Summer Predicted Depletions**	**Max Annual Predicted Depletions**		**Annual Impacts**
	cfs	**cfs**	**Month(s)**	**(AFY)**
Phase 1				
G2-30248 Betti	0.05	0.07	Mar	40
G2-30249 HP2	0.04	0.05	Feb – Mar	29
Subtotal	***0.09***	***0.12***		***69***
Phase 2				
G2-30251 MR	0.07	0.09	Feb-Mar	54
G2-29304 EE	0.15	0.18	Mar	106
Subtotal	***0.22***	***0.27***		***160***
Phase 3				
G2-30250 MC	0.04	0.05	Mar	29
G2-29165 Madrona	0.31	0.39	Mar	228
Subtotal	***0.35***	***0.44***		***257***
TOTAL:	**0.66 cfs**	**0.83 cfs**	Feb-Mar	**486 AFY**

Sources: *Report on Groundwater Modeling of Madrona and Evergreen Estates Well Water Right Applications City of Lacey, Washington (Golder, 2008); Groundwater Modeling of Betti and Hawks Acres Well Pumping Increases* (Thomas, 2008a); *Groundwater Modeling of New Hawks Prairie Area Pumping* (Thomas, 2008b); and "Lacey Revised Depletion Tables Aves" electronic communication from Stephen Thomas to Mike Gallagher, January 13, 2009.

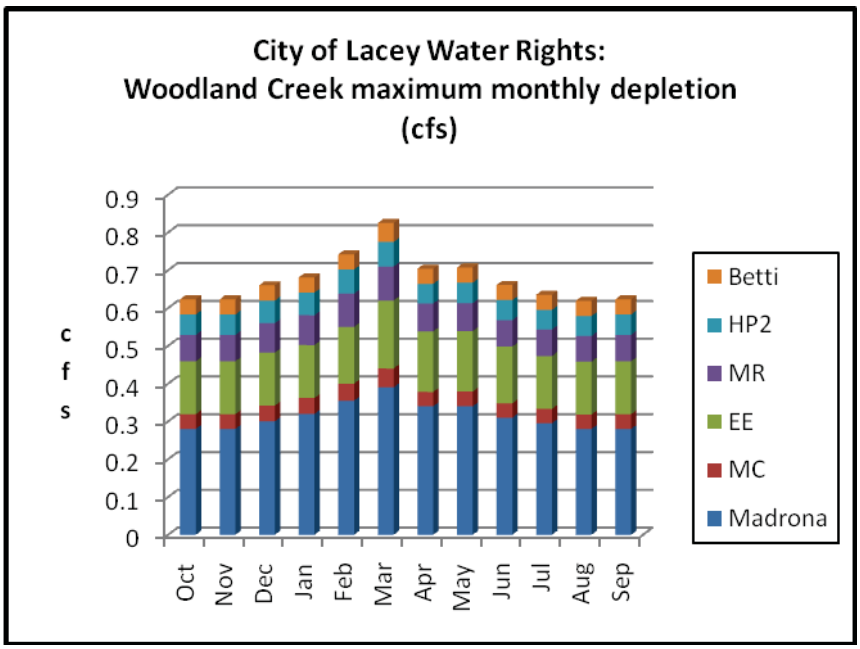

Figure 3. Lacey's maximum monthly depletions from Woodland Creek

Predicted Depletions and Mitigation Quantities for Regional Mitigation in Woodland Creek Basin

Model-predicted depletions to be addressed by the Regional Mitigation program are shown in Table 11. These depletions are the cumulative impacts to the individual lakes, associated wetlands, and Woodland Creek from water rights requested by Lacey and Olympia, and represent flow depletion predicted for the mouth of Woodland Creek at Henderson Inlet. All predicted impacts reported in Table 11 are above the accuracy limit of the model. The city of Yelm is in the process of re-running their modeling scenarios and updating their water rights mitigation plan. Yelm's impacts are not included in this section, although Yelm may be included in regional mitigation at a later date.

As noted earlier, Lacey's approach to mitigation is to provide an additional margin of safety for predicted impacts that exceed the model accuracy limit by providing mitigation at a 1.5:1 ratio. The City of Olympia's mitigation plan takes the same approach to mitigating predicted impacts that are above the model accuracy limit. Consequently, for planning regional mitigation actions a mitigation ratio of 1.5:1 was applied to all depletions that were at or above the model accuracy limit and were used to determine the "mitigation quantities" that are shown in Table 12.

Table 11
Regional Mitigation Program:
Model-Predicted Depletions for Woodland Creek Basin

Application Phase	Max Summer Depletion (cfs)	Max Annual Depletion (cfs)	Annual Depletion (AFY)
Lacey Phase 1	0.09	0.12	69
Lacey Phase 2	0.22	0.27	160
Lacey Phase 3	0.35	0.44	257
Subtotal Lacey	***0.66***	***0.83***	***486***
Olympia Phase 1	0.14	0.15	94.3
Olympia Phase 2	0.02	0.03	17.4
Olympia Phase 3	0.05	0.05	33.3
Subtotal Olympia	***0.21***	***0.23***	***145***
TOTAL:	**0.87 cfs**	**1.06 cfs**	**631 AFY**

Sources: *City of Olympia and Nisqually Indian Tribe McAllister Wellfield Mitigation Plan* (2008); Riley (2008); Sources for Lacey's depletions are cited in Table 10.

Table 12 Regional Mitigation Program: Calculated Mitigation Quantities for Woodland Creek Basin		
Application Phase	**Summer Mitigation Quantity* (cfs)**	**Winter Mitigation Quantity* (cfs)**
Lacey Phase 1	0.14	0.18
Lacey Phase 2	0.33	0.40
Lacey Phase 3	0.52	0.66
Subtotal Lacey	***0.99***	***1.24***
Olympia Phase 1	0.21	0.22
Olympia Phase 2	0.03	0.04
Olympia Phase 3	0.08	0.08
Subtotal Olympia	***0.32***	***0.34***
TOTAL*:*	**1.31 cfs**	**1.58 cfs**

*A mitigation ratio of 1.5:1 was applied to predicted impacts from Table 11 that are at or above the accuracy limit of the model

Predicted depletions from the tri-lakes are included in cumulative impacts shown in Table 11, and are reported as the depletion of groundwater inflow in cubic feet per second. However, predicted impacts to lakes are more easily visualized as changes in lake levels, which are summarized in Table 13. These lake level changes are very small compared to seasonal changes in lake levels which vary annually by 2-4 feet at Hicks Lake, 0.5 – 1.5 feet at Pattison Lake, and 1.5 – 2.0 feet at Long Lake. Because these predicted changes are very small and will not impair the use of water rights from the lakes, regional mitigation is not focusing on direct mitigation to the individual lakes. The mitigation quantity for the Woodland Creek basin includes the predicted impacts to the lakes and in-kind mitigation will focus on upper Woodland Creek. However, some lake impacts may be addressed through in-kind mitigation. This is discussed further in the next section.

Table 13 Maximum Estimated Changes to Lake Levels			
Application	**Hicks (in.)**	**Pattison (in.)**	**Long (in.)**
Lacey Phase 1	0.05	0.11	0.10
Lacey Phase 2	0.10	0.28	0.26
Lacey Phase 3	0.20	0.41	0.41
Subtotal Lacey	0.35	0.80	0.77
Olympia Phase 1	0.09	0.21	0.19
Olympia Phase 2	0.02	0.04	0.04
Olympia Phase 3	0.03	0.07	0.07
Subtotal Olympia	0.14	0.32	0.30
TOTAL*:*	0.5 in.	1.1 in.	1.1 in.

Source: "Analysis of Lake Level Deficit", electronic communication from Peter Brooks to Tom Loranger, Phillip Crane, and Mike Gallagher , January 23, 2009.

Regional In-Kind Mitigation for the Woodland Creek Basin: Reclaimed Water Infiltration

The cities propose to focus the full mitigation quantity for the entire basin on upper Woodland Creek. Flow-related mitigation for all predicted impacts in the Woodland Creek basin will be provided by a regional reclaimed water infiltration facility to be located near the headwaters of Woodland Creek in Lacey. The source of the reclaimed water will be Class A reclaimed water produced at the LOTT Clean Water Alliance (LOTT) water treatment plant on Martin Way. The infiltration facility will infiltrate reclaimed water year-round, with the purpose of recharging groundwater that provides base flows to Woodland Creek. Whereas infiltration of reclaimed water was also proposed in the cities' original mitigation plans submitted in 2008, the original proposal was for seasonal infiltration. This proposal to provide year-round infiltration will provide more flow mitigation than originally proposed by the cities, and is based on a study conducted from 2009 – 2010.

Infiltration capacity of the site was evaluated from both field tests and groundwater modeling using a localized model that was developed from the McAllister Numerical Groundwater Model (PGG, 2010; see Appendix C). Modeling results indicate that the site has the capacity to infiltrate large quantities of water without flooding the site. The site also has the capacity to infiltrate water year-round, although infiltration rates will have to be adjusted seasonally. Modeling indicates that the site capacity for infiltration is 1.3 MGD during dry (summer) months, and 0.3 MGD during wet (winter) months. These rates are predicted to increase Woodland Creek flow by 66% of the summer infiltration rate, and 85% of the winter infiltration rate.

The locations where reclaimed water are predicted to discharge to Woodland Creek will depend on the infiltration rate that will be allowed for this facility, which in turn will be defined by water quality permit parameters. The facility will need to be approved for coverage under LOTT's reclaimed water permit for reclaimed water produced at the Martin Way Reclaimed Water Plant, although it is anticipated that the water quality permit requirements will allow for the construction of a facility that infiltrates between 0.8 MGD and 1.3 MGD in the summer. At the lower rate, 0.8 MGD, reclaimed water is predicted to discharge in the mid- and lower areas of the creek north of Martin Way. At higher rates, reclaimed water is predicted to enter the creek in the upper reach and could even discharge into the creek in the immediate vicinity of the infiltration pond. In addition to augmenting groundwater, infiltrated reclaimed water will increase base flows in Woodland Creek because the hydraulic gradient of the native groundwater will be affected by the reclaimed water mound that will form in the vicinity of the infiltration site. Downstream of the infiltration site, the mound of reclaimed water will force more native groundwater into the creek in gaining reaches and springs (see Figures 4 and 5). Upstream of the mound, the lakes and the creek will lose less native groundwater to the aquifer. The end result is that even at the lower-end summer infiltration rate of 0.8 MGD, the proposed infiltration facility will increase flows in Woodland Creek although not all of the increased flow in the creek will be discharged reclaimed water. The infiltration facility may also reduce some of the predicted impacts on the tri-lakes from additional pumping of new water rights.

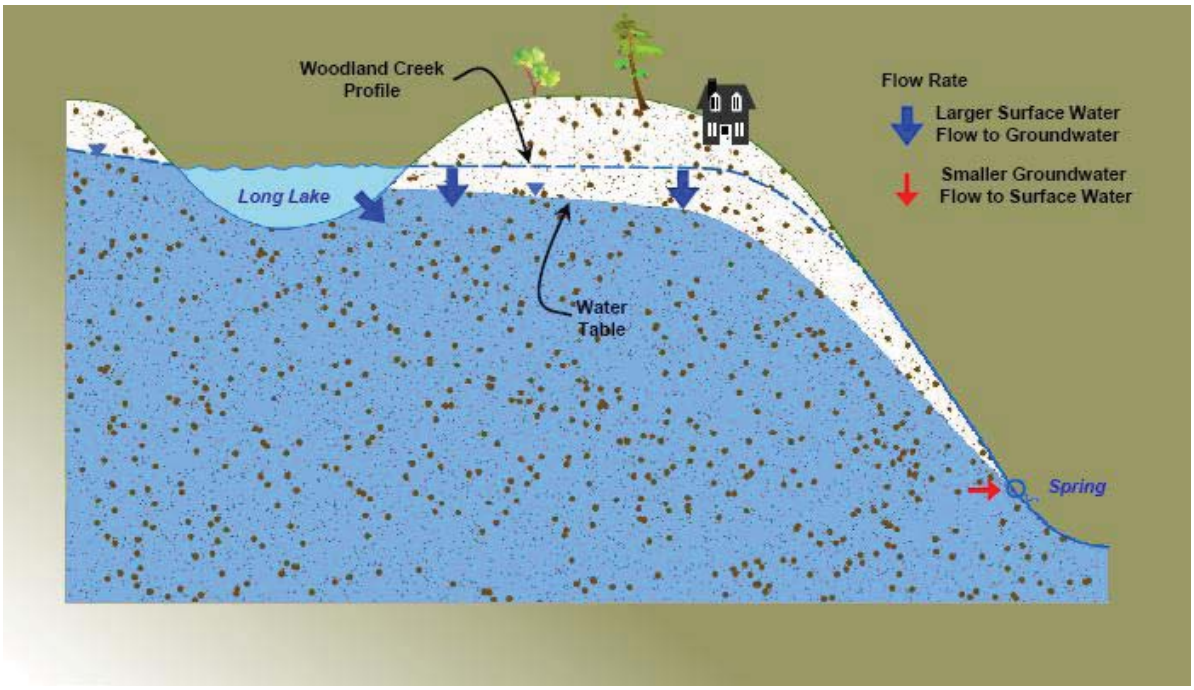

Figure 4. Baseflow Effects – Current Condition Before Reclaimed Water Infiltration

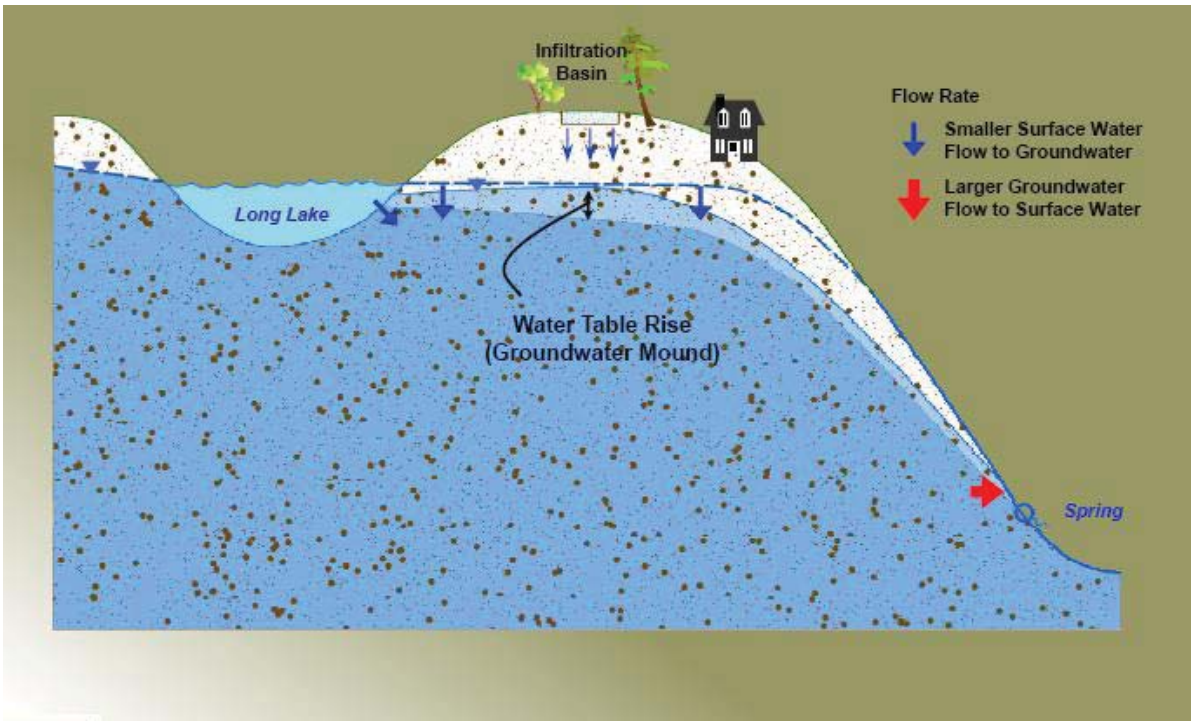

Figure 5. Baseflow Effects – Future Condition with Reclaimed Water Infiltration

The modeled relationships between infiltration rate and streamflow increases at the mouth of Woodland Creek were used to calculate the amount of infiltration that will be needed for each phase of water rights (Table 14). Based on these relationships the facility will need to infiltrate up to 0.79 MGD to mitigate summer impacts the cities' Phase 1 and Phase 2 water rights, and up to 1.28 MGD to mitigate Phases 1, 2, and 3. Winter infiltration capacity is sufficient for mitigating Phase 1 only. To address the balance of winter impacts, the cities are proposing out-of-kind mitigation to supplement the in-kind mitigation. Out-of-kind mitigation is discussed in the next section.

Table 14
Regional Mitigation for Woodland Creek:
Mitigation with Reclaimed Water

	Summer Flow Mitigation			Winter Flow Mitigation	
Application	Mitigation Quantity (cfs)[1]	Infiltration rate needed for 0.8 MGD facility[2] (MGD)	Infiltration rate needed for 1.3 MGD facility[3] (MGD)	Mitigation Quantity (cfs)[1]	Infiltration Needed for 0.3 MGD winter capacity[4] (MGD)
Phase 1					
Lacey	0.14	0.16	0.14	0.18	0.14
Olympia	0.21	0.23	0.20	0.22	0.17
subtotal	*0.35*	*0.39*	*0.34*	*0.40*	*0.31*
Phase 2					
Lacey	0.33	0.37	0.32	0.40	--[5]
Olympia	0.03	0.03	0.03	0.04	--[5]
subtotal	*0.36*	*0.40*	*0.35*	*0.44*	--[5]
Phase 3					
Lacey	0.52	--[5]	0.51	0.66	--[5]
Olympia	0.08	--[5]	0.08	0.08	--[5]
subtotal	*0.60*	--[5]	*0.59*	*0.74*	--[5]
TOTAL:	1.31 cfs	0.79 MGD	1.28 MGD	1.58 cfs	0.31 MGD

[1] See Table 12; this includes the mitigation ratio of 1.5:1
[2] At 0.8 MGD, the model predicts flow to Woodland Creek will increase by 58% of summer infiltration rate
[3] At 1.3 MGD, the model predicts flow to Woodland Creek will increase by 66% of summer infiltration rate
[4] Regardless of the summer infiltration rate, the site's winter infiltration capacity is predicted to be 0.3 MGD. The predicted increase to flow in Woodland Creek is 85% of winter infiltration rate
[5] Infiltration amount would be beyond what model predicts for site infiltration and facility size.

It is important to recognize that modeling was based on a conservative conceptual design for the infiltration facility. As noted in the infiltration analysis report, optimizing the design of the facility may increase the actual infiltration capacity at the site. It will be necessary to confirm

the actual site capacity for infiltration by monitoring the facility when it is in operation. Consequently, the cities are proposing to take an adaptive management approach for mitigation for phasing in mitigation for Phases 1 and 2, and then Phase 3. Data collected during implementation of Phases 1 and 2 of mitigation will be used to further optimize design of the facility by the time Phase 3 water rights will be exercised. Based on Lacey's timelines for phasing in use of new water rights, Phase 3 mitigation will not need to be operational earlier than 2020. This is based on modeling for both the water rights impacts analysis and the infiltration facility analysis. For impacts analysis, pumping achieved steady-state after six years, whereas for the infiltration facility, travel time to Woodland Creek was up to four years for the 0.8 MGD summer infiltration rate. Consequently, in-kind mitigation for each water right phase should start when the water rights start to be exercised.

To evaluate how much streamflow will be replaced by infiltration in terms of AFY, we need to use the streamflow/infiltration rate relationships used in Table 14. The infiltration analysis report concluded that on an annual basis the site can infiltrate 550 AFY using the conservative conceptual design of infiltrating 0.8 MGD in summer and 0.3 MGD in winter, but did not quantify streamflow increase in acre-feet. However, using the streamflow/infiltration rate relationships, a facility that infiltrates 550 AFY should replace 319 – 468 AFY of streamflow. Given that the annual impacts from Phases 1 and 2 are predicted to total 341 AFY, a 0.8 MGD infiltration facility should completely replace the volume of water depleted on an annual basis from Phases 1 and 2, while mitigating summer flow impacts in cfs at 1.5:1. If a 1.0 – 1.3 MGD facility is permitted through the reclaimed water permit, the amount of water replaced on an annual basis will be at a higher percentage, and should be sufficient for mitigating Phase 3 impacts.

Because shallow groundwater levels will be affected by precipitation, it is important to plan for meeting mitigation goals during years of extreme precipitation patterns. The cities propose to maximize infiltration at the site on a seasonal basis to ensure that the 5-year average of maximum infiltration rates is at least the summer infiltration rate needed for mitigation as shown in Table 14. This will mean that during unusually dry years more water can be infiltrated, which will provide more benefit to stream flows during those years when it is needed. It will also compensate for unusually wet years when infiltration will have to be reduced to avoid local discharge at the site. As noted above, monitoring the site during the first several years of implementation will provide a baseline for determining how much additional capacity is available at the site for providing this operational flexibility, and for mitigating Phase 3 water rights.

The Regional reclaimed water infiltration facility will be operational in 2012, to coincide with first phase of use of water rights. Significant work and coordination for implementing this mitigation project has already been completed, all of which demonstrate the project's feasibility and the Cities' commitment to completing this project as scheduled. The following are key points about the facility:

- The facility will infiltrate Class A reclaimed water, which is currently produced at LOTT's Martin Way Reclaimed Water Plant.

- The design capacity of LOTT's Martin Way Reclaimed Water Plant is 2 MGD. An interlocal agreement between LOTT, Thurston County, and the cities of Lacey, Olympia, and Tumwater distributes allotments of reclaimed water from this plant to LOTT (0.25 MGD), Olympia (0.3 MGD) and Lacey (1.45 MGD). The Reclaimed Water Distribution Agreement No. 1 is included in Appendix C. The quantities allotted to Lacey and Olympia are sufficient for water rights mitigation proposed in this plan.
- The WRIA 11 Nisqually Watershed Planning Unit provided a letter of support for securing grant funding for this reclaimed water infiltration project (See Appendix C). Lacey was awarded an EPA grant for a portion of the construction costs of the infiltration facility. Construction of the facility will be scheduled for 2011 - 2012.
- Infiltration of reclaimed water for groundwater recharge purposes is an approved use on LOTT's reclaimed water permit for the Martin Way reclaimed water plant. The Woodland Creek infiltration facility will also be regulated under LOTT's permit, although an amendment will be required for this infiltration location. LOTT has been participating in discussions with Lacey, Olympia, Ecology's Water Quality Program, and Washington State Department of Health regarding permitting issues for the proposed facility.
- A mounding study, which is required for reclaimed water permitting, has already been completed and is part of the facility infiltration analysis report that is in Appendix C (PGG 2010).
- The facility will be owned and operated by the Cities of Lacey and Olympia. An interlocal agreement for cost sharing the design and construction of the facility is attached in Appendix C.

Regional Out-of-Kind Mitigation for Woodland Creek: Riparian Land Protection

Regional out-of kind mitigation will complete mitigation for Lacey's Phases 1 and 2 and Olympia Phases 1, 2, and 3. Yelm may also elect to participate in regional out-of-kind mitigation, pending updated modeling results. Lacey is proposing additional non-flow mitigation for Phase 3 that is separate from this regional mitigation proposal but will complement the regional package. Lacey's supplemental out-of-kind mitigation for Phase 3 is discussed in the next section.

Whereas infiltration of reclaimed water in the upper Woodland Creek basin will both replace and enhance flows during summer, and replace the annual amount of water depleted from the basin year-round, the site infiltration capacity in winter months is not sufficient for completely replacing depletions predicted for winter months. The site's winter infiltration capacity is predicted to be 0.3 MGD, which is considerably lower than the infiltration rates that would be needed for using the infiltration facility to mitigate all predicted winter depletions (see Table 14).

In addition to in-kind mitigation for the Regional Mitigation package for Woodland Creek, Lacey, Olympia and Yelm propose to jointly pursue the purchase of property or conservation easements along Woodland Creek to increase the amount of undeveloped protected land along the creek. This will augment 498 acres of existing buffers, parks, and protected open space in

the basin. For mitigating water rights, Washington State Department of Fish and Wildlife (WDFW) recommends combining stream flow augmentation with riparian land reserves (Beecher 1998). Riparian land protection will supplement the available in-kind mitigation for winter months, and since the benefits will be year-round, this will further increase summer mitigation. As stated by WDFW,

> "The purpose of riparian land reserves is to maintain structural integrity of the stream channel and protect groundwater-stream interactions. Maintaining vegetation and trees will provide a source of large woody debris (LWD), which is important in dissipating energy of flood waters, thereby reducing erosion and stream widening. LWD also increases depth and provides cover, as well as substrate for benthic insect production. Vegetation protects soil from rills during high rainfall, thus reducing fine sediment input. The reserves serve as groundwater recharge areas."

In addition to being a viable mitigation option, riparian land acquisition in the Woodland Creek basin was highly recommended in the *City of Lacey: Woodland Creek Riparian Habitat Assessment* for protecting forested stream buffer (Agua Tierra Environmental Consulting 2003). Riparian land reserves will also complement recommendations in the water quality improvement reports for the Henderson Inlet Watershed TMDL, which recommend preserving mature trees ("site-potential shade") for ensuring the continued compliance with state water quality standards for stream temperature and dissolved oxygen in the mid- and lower reaches of Woodland Creek (Hempleman 2006; 2008).

The Cities are proposing to purchase approximately 30 acres of undeveloped property in the basin that includes creek frontage. To meet this goal of purchasing 30 acres, the Cities of Lacey and Olympia have already purchased 10.5 acres of undeveloped property that includes frontage along both Woodland Creek and Fox Creek (Figure 4). This property is within Lacey's Urban Growth Area and includes approximately 650 feet of Fox Creek frontage, and 1,000 feet of Woodland Creek frontage. An added benefit of this property is that the other side of Woodland Creek is owned by the City of Lacey, so now both sides of the creek are protected. Although this property was acquired prior to approval of Lacey and Olympia's water rights, Ecology provided written acknowledgement that this property was purchased for mitigation purposes. The letter from Ecology is provided in Appendix C. The cities are currently pursuing the acquisition of approximately 20 additional acres of undeveloped property. In addition to providing creekside protection, there will be hydraulic benefits from removing developable creekside property from development.

A final consideration is that 30 acres of undeveloped property will keep 126 acre-feet of infiltrated precipitation from being altered from the natural hydrologic regime. Further, long-term stewardship of jointly acquired properties will be assured by zoning, conservation easements, or other legal constraints against development, timber harvest, or vegetation removal. The cities will also manage the properties to control noxious weeds and vehicular access. These constraints on land use will not restrict opportunities for habitat restoration projects on these properties, and the cities intend to make these properties available for enhancement projects.

Figure 6. Riparian Protection Property on Fox Creek

Supplemental Out-of-Kind Mitigation for Lacey's Phase 3 Winter Impacts

As discussed above, the regional mitigation program will mitigate Lacey's predicted summer impacts for Phases 1 – 3, and predicted winter impacts for Phases 1 and 2. Supplemental out-of-kind mitigation discussed here is for addressing the 0.44 cfs winter impact predicted for Lacey's Phase 3.

Using the same approach used for Regional out-of-kind mitigation in the Deschutes River basin, Lacey is proposing to include in-stream restoration projects in the menu of habitat restoration and protection options for completing out-of-kind mitigation in the Woodland Creek basin. A list of potential projects is in *City of Lacey: Woodland Creek Riparian Habitat Assessment* (Agua Tierra Environmental Consulting 2003). This habitat assessment noted that many segments of Woodland Creek exhibit relatively intact and functioning riparian habitat conditions that should be protected, while other reaches are extensively denuded of vegetation and/or diminished in hydraulic habitat complexity. Consequently, the top three recommendations from the assessment include 1) protect and preserve the condition of existing good quality channel and buffer areas; 2) mitigate ongoing accelerated erosion rates; and 3) increase hydraulic complexity within existing good reaches by increasing the amount of large woody debris (LWD) within the system (Agua Tierra Environmental Consultant 2003). The general categories of habitat projects from the report are listed in Table 15.

Given that exercising Phase 3 water rights is likely to be no earlier than 2018, it would be more opportune to select specific projects when Phase 3 water rights are issued. To guide the selection of riparian property acquisition and/or restoration projects that will protect ecological functions of Woodland Creek, City staff will consult with the Squaxin Island Indian Tribe and the Washington State Department of Fish and Wildlife in selecting projects to be completed. To complete this, the City will commit to investing $500,000 in property acquisition and/or restoration projects over a ten-year period.

Table 15
Categories of Habitat Restoration Projects for Woodland Creek

Buffer Restoration and Protection
Channel and Buffer Preservation
LWD Installation
Restore Channel Morphology
Eroding Bank Shape and Re-vegetation
Instream Habitat Modification
Improve Fish Passage
Public Education
Trash Removal

Source: *City of Lacey: Woodland Creek Riparian Habitat Assessment* (Agua Tierra Environmental Consulting 2003).

Margin of Safety provisions

In addition to mitigation actions discussed above, the City will undertake the following actions to enhance hydrologic and/or ecological conditions in the Woodland Creek Basin and to further ensure that all impacts are completely mitigated.

- For each application, the mitigation quantities were determined using the highest model-predicted values. As shown in Figure 3, the maximum predicted value for summer is much higher in comparison to predicted values for the rest of the summer months. Use of this maximum value for determining in-flow mitigation will result in greater overall flow mitigation in the basin during summer months.
- The Squaxin Island Tribe has requested that the McAllister Numerical model be refined to better reflect how the Woodland Creek basin is represented. The City is committed to coordinating with other model users and stakeholders to make changes to the model as data become available.
- The City adopted language in the City of Lacey Development Guidelines that prohibits new exempt wells on properties that are served by the city water utility. The updated guidelines are also more specific about when new development and redevelopment properties must hook up to city water (as opposed to being self-supplied from alternative water sources), and when existing exempt wells on redeveloped property must be decommissioned.
- The cities of Lacey, Olympia, and Yelm intend to establish and support a Woodland Creek and Deschutes basin stewardship group. Actions that could be taken by this group include model refinements, coordinating monitoring and data collection within the basin, and coordinating joint mitigation within the basins. The cities will work with Ecology and the Squaxin Island Tribe to determine the membership of this group.
- Lacey's 2010 Stormwater Design Manual proactively requires the use of low impact development techniques for all new development/redevelopment projects that are subject to the manual's full requirements. This element is more stringent than Ecology's current stormwater manual.
- In 2008 Lacey constructed a stormwater treatment facility at St. Martin's University campus, consisting of three large ponds with a design capacity of 42.1 acre-feet of storage. This facility provides enhanced infiltration and water quality treatment of stormwater from a 430-acre urban basin that previously discharged directly into College Creek, a tributary to Woodland Creek near Martin Way. Increased detention of stormwater was listed as one of the preferred mitigation strategies in the *Nisqually Watershed Management Plan*, for addressing impacts from groundwater withdrawals from the McAllister and Yelm sub-basins.
- Through the City's cross-connection control program, irrigation pumps were removed from 19 lakeshore properties on the Tri-Lakes in 2005. The City has started a

program to routinely inspect these properties to verify they no longer irrigate using lake water.

- In 2006 the city transferred portions of water rights from three wells in west Lacey, and one (small) entire water right in east Lacey. The new point of withdrawal is the Madrona Wellfield in east Lacey. Effects of these transfers were modeled, and showed that the four transfers result in a shift in surface water impacts from the Woodland Creek basin to the McAllister sub-basin. This was a benefit to the basin because the shift in impacts to McAllister was primarily during winter-spring months, when higher flows are able to maintain beneficial uses. The overall benefit to the Woodland Creek basin from these transfers is 0.10 cfs in summer months, and 0.15 cfs in winter months.

McAllister Creek Basin

Lacey's predicted impacts in the McAllister Creek basin will be addressed through the Regional Mitigation Program, which is entirely flow-based mitigation. The following sections describe predicted impacts to the McAllister Creek basin, and proposed regional mitigation.

Lacey's Predicted Depletions

Lacey's predicted impacts to the McAllister Creek basin were evaluated both for impacts to the city of Olympia's water rights at McAllister Springs as well as impacts to the creek near its mouth. Although Olympia is planning to transfer its McAllister Springs water rights to a new wellfield that the city will jointly develop with the Nisqually Indian Tribe, McAllister Springs will be Olympia's primary source of supply through 2012.

Tables 16 and 17 show that the majority of Lacey's predicted impacts to McAllister Springs is from Lacey's Phase 3 applications. The only predicted depletions that are above the model accuracy limit are for application G2-29165.

Table 16
Lacey's Water Right Applications
Predicted Depletions for McAllister Springs

Application for Groundwater	Max Predicted Impacts		Max Summer Impacts	Annual Impacts
	cfs	Month(s)	cfs	(AFY)
Phase 1				
G2-30248	0.05	Sep	0.05	29
G2-30249	0.03	All year	0.03	23
Subtotal	***0.08***		***0.08***	***52***
Phase 2				
G2-30251	0.06	Sep - Nov	0.06	39
G2-29304	0.21	Feb – Apr	0.19	133
Subtotal	***0.27***		***0.25***	***172***
Phase 3				
G2-30250	0.05	Jun - Dec	0.05	31
G2-29165	0.33	Feb - Apr	0.29	209
Subtotal	***0.38***		***0.34***	***240***
TOTAL:	**0.73 cfs**		**0.67 cfs**	**464 AFY**

Sources: *Report on Groundwater Modeling of Madrona and Evergreen Estates Well Water Right Applications City of Lacey, Washington (Golder, 2008); Groundwater Modeling of Betti and Hawks Acres Well Pumping Increases* (Thomas, 2008a); *Groundwater Modeling of New Hawks Prairie Area Pumping* (Thomas, 2008b); and "Lacey Revised Depletion Tables Aves" electronic communication from Stephen Thomas to Mike Gallagher, January 13, 2009.

Table 17 Lacey's Water Right Applications Predicted Depletions for McAllister Creek Basin*				
Application for Groundwater	**Max Predicted Impacts**		**Max Summer Impacts**	**Annual Impacts**
	cfs	**Month(s)**	**cfs**	**(AFY)**
Phase 1				
G2-30248	0.13	Aug-Sep	0.13	84
G2-30249	0.09	All year	0.09	64
Subtotal	***0.22***		***0.22***	***148***
Phase 2				
G2-30251	0.16	Jun - Dec	0.16	112
G2-29304	0.51	Mar	0.46	325
Subtotal	***0.67***		***0.62***	***437***
Phase 3				
G2-30250	0.14	Aug - Sep	0.14	86
G2-29165	0.88	Feb - Mar	0.79	561
Subtotal	***1.02***		***0.93***	647
TOTAL:	**1.91 cfs**	Feb-Mar	**1.77 cfs**	**1,232 AFY**

* Sources are same as for Table 16. Values in this table include impacts to McAllister Springs from Table 16

Regional Mitigation for McAllister Creek Basin: Olympia's McAllister Wellfield

Model-predicted depletions for Lacey and Yelm, and flow increases from Olympia, are shown in Table 18. Predictions for each city's water rights represent the cumulative change to McAllister Springs and the remaining McAllister Springs complex, predicted at the mouth of McAllister Creek (at Medicine Creek).

Regional mitigation in the McAllister Creek system will be provided when Olympia transfers its water rights and withdrawals from McAllister Springs to its new McAllister wellfield, anticipated to occur in late 2012. This regional mitigation action was originally recommended in the *Nisqually Watershed Management Plan* (Golder Associates, 2003), which notes that flows in McAllister Creek will increase when Olympia moves its withdrawals, and recommends that mitigation for regional water supplies should take a comprehensive approach.

As shown in Table 18, when Olympia ceases its withdrawals from McAllister Springs and moves its withdrawals to the McAllister wellfield, flow in McAllister Creek will increase considerably even though use of the wellfield will also exert an effect on McAllister Creek. Those pumping effects from the wellfield are included in the flow benefit for Olympia shown in Table 18. Overall, when Olympia moves its withdrawals from the springs to the wellfield, predicted impacts from all three cities will be fully mitigated and still improve McAllister Creek flows by 4.6 – 16.6 cfs during summer months.

Table 18 Regional Mitigation Program: Model-Predicted Depletions for McAllister Creek Basin[1]			
Application Phase	**Max Annual Depletion (cfs)**	**Max Summer Depletion (cfs)**	**Annual Depletion (AFY)**
Lacey Phase 1	0.22	0.22	148
Lacey Phase 2	0.67	0.62	437
Lacey Phase 3	1.02	0.93	647
Subtotal Lacey	***1.91***	***1.77***	***1,232***
Total Olympia	***+6.72 – 18.72***[2]	***+6.78 – 18.72***[2]	***+ 7260***
Total Yelm SW1A	***0.21***	***0.21***	NA
TOTAL*:*	**+4.44 – 16.44 cfs**	**+ 4.64 – 16.59 cfs**	**+ NA**

Sources: *City of Olympia and Nisqually Indian Tribe McAllister Wellfield Mitigation Plan* (2008); Riley (2008); "2010 Modeling Results: Yelm Well SW1A Hydrologic Impact Assessment" (Brown 2010); Sources for Lacey's depletions are cited in Table 10.
[1] McAllister Creek at Medicine Creek
[2] Positive values indicate seasonal increases in creek flow resulting from Olympia moving its water withdrawals from McAllister Springs to Olympia's McAllister wellfield.

Because Lacey does not plan to exercise Phase 1 or Phase 2 water rights before to Olympia moves its withdrawals from the springs, Lacey will be able to avoid impacts to McAllister Creek flows in the interim. In the event that Olympia cannot cease withdrawals from the springs to provide regional mitigation, Lacey will address impacts to Olympia's McAllister Springs water rights separately (discussed below). Additional impacts to flows in McAllister Creek would not be measurable because the creek is tidally influenced throughout its length and because flows would be controlled by City of Olympia withdrawals. The preferred scenario, though, is for regional mitigation to be provided when Olympia successfully transfers their source of supply to the wellfield.

Backup Mitigation for Impacts to Olympia's Water Rights on McAllister Springs

Lacey's applications for Phase 1 and Phase 2 water rights are anticipated to be approved before Olympia moves its withdrawals from McAllister Springs in 2012. The predicted impacts from these applications are very small and below the accuracy limit of the groundwater model, but it is anticipated that impacts to Olympia's water rights can be avoided altogether by not exercising Phase 1 and Phase 2 rights until Olympia moves its withdrawals. However, if Lacey needs to exercise Phase 1 applications before then, mitigation for impacts to Olympia's water rights is addressed in an Interlocal Agreement between the City of Lacey and the City of Olympia for Water Rights Mitigation, dated October 10, 2008. This agreement is included in Appendix C.

The interlocal agreement for water rights mitigation between Lacey and Olympia includes both short-term and long-term measures for avoiding impacts to Olympia's water rights, or for compensating Olympia for those impacts in the event that Olympia's water right transfers are denied. In summary, this agreement includes the following:

- For Phase 1 applications (G2-30248 and G2-30249), in the short term Lacey will avoid impacts to Olympia's water rights at McAllister Springs through pumping management. As noted above, Lacey does not plan on needing to exercise these rights before Olympia moves its withdrawals in 2012. However, if Olympia's water right transfers from McAllister Springs are denied, Lacey will compensate Olympia for long-term impacts to their McAllister Springs water rights by deeding over 24.14 AFY in water rights for G2-30248, and 14.48 AFY in water rights for G2-30249.

- Phase 2 applications consist of G2-29304 and G2-30251. In the short term, impacts from G2-29304 will be avoided through pumping management at Lacey's Evergreen Estates well from June through September. Impacts from G2-30251 will be addressed by amending the wholesale water agreement between the cities so that Lacey pays for an additional 38,880 gallons per day of peak capacity from July through October, effective when the Hawks Prairie 2 well is in operation and until Olympia reduces its withdrawals at McAllister Springs by at least 5 cfs as a result of water rights transfers to the wellfield. However, as noted above Lacey does not plan to exercise Phase 2 water rights before Olympia moves its withdrawals in 2012. However, if Olympia's water right transfers from McAllister Springs are denied, Lacey will compensate Olympia for long-term impacts to their McAllister Springs water rights by deeding over 90.70 AFY in water rights for G2-29304, and 28.96 AFY in water rights for G2-29351.

Phase 3 applications (G2-29165 and G2-30250) are dependent on Olympia moving its withdrawals from McAllister Springs in order to avoid impairment to Olympia's water rights. Alternatively, this could be revisited if Lacey and Olympia agree to amend the interlocal agreement.

Margin of Safety Provisions

Overall, when Olympia completely terminates its withdrawals from McAllister Springs there will be more than sufficient long-term mitigation for impacts predicted for all three cities. In addition to this direct mitigation, the following assure that impacts will be completely mitigated in this basin:

- Model-predicted impacts that were below the accuracy limit of the model were included in the mitigation quantities.
- Lacey will actively participate in a McAllister/Yelm sub-basin Stewardship Coalition. The purpose of the Coalition is to enhance the protection of the sub-basins by overseeing implementation of recommendations from the McAllister sub-basin plan of the Nisqually River Watershed plan, and tracking how water resources within the sub-basin are used and managed. This Coalition will create a partnership that includes the Tribe, the cities of Lacey, Olympia, and Yelm, and other participants, and will be consistent with the mission of the Nisqually Planning Unit: "*To maximize the ability of the Nisqually Watershed to produce high quality ground and surface water, while protecting and managing the related resources to support environmental, social, economic, and cultural values.*"

Nisqually River Basin

The lower mainstem of the Nisqually River is open year-round to appropriation, subject to seasonal instream flows for RM 4.3 that are regulated in Chapter 173-511-030 WAC. Currently there is no flow gage at RM 4.3 for documenting whether instream flows are met at this control point, but there are no indications that flows and flow-associated beneficial uses are not met at RM 4.3. Flows in the Nisqually River are mainly controlled by operation of the Alder/La Grande dams by Tacoma Power, and the river diversion through the Centralia City Light power project. These projects are regulated by the Federal Energy Regulatory Commission (FERC) and are required to be operated to ensure sufficient instream flows for fish in the river. Generally, Tacoma Power's downstream flow obligations are greater than the minimum flows established for RM 4.3. Further, flows do not appear to impair the fish resources in the river, in that the Nisqually Chinook Recovery Plan (Nisqually Chinook Recovery Team, 2001) does not list flow in the lower mainstem reach as a limiting factor to chinook recovery in the basin.

Given that water from the lower reach of the Nisqually River should be available for appropriation, predicted depletions will not impair existing water rights or require mitigation. In consideration of instream flows, Lacey is proposing voluntary actions in Nisqually Basin. These are intended to complement the overall mitigation package, and to provide a margin of safety if instream flows are not met in the future.

Lacey's Predicted Impacts

Lacey's predicted depletions in the basin are limited to the lower reach of the Nisqually River within 15,000 feet above RM 4.3 (Table 19). All of Lacey's predicted impacts are below the accuracy limit of the model.

Minimum instream flows established at RM 4.3 range from 600 – 900 cfs. Compared to these, Lacey's total maximum summer depletion of 0.77 cfs represents approximately 0.1% of the lowest instream flow established for summer months. This very low predicted depletion will not impair existing water rights, and given the magnitude of flows in the river is not likely to be a measurable impact.

Table 19 Lacey's Water Right Applications Predicted Depletions for Nisqually River Basin				
Application for Groundwater	**Max Predicted Impacts***		**Max Summer Impacts***	**Annual Impacts**
	cfs	**Month(s)**	**cfs**	**(AFY)**
Phase 1				
G2-30248	0.07	Jul - Nov	0.07	44
G2-30249	0.05	All year	0.05	34
Subtotal	***0.12***		***0.12***	***78***
Phase 2				
G2-30251	0.08	All year	0.08	59
G2-29304	0.18	Feb - Apr	0.17	119
Subtotal	***0.26***		***0.25***	***178***
Phase 3				55
G2-30250	0.09	Jul - Oct	0.09	220
G2-29165	0.35	Feb - Mar	0.31	***275***
Subtotal	***0.44***		***0.40***	
TOTAL:	**0.82 cfs**		**0.77 cfs**	**531 AFY**

* for Nisqually River at RM 4.3

Voluntary Mitigation

Lacey's very low predicted depletions will not impair water rights or instream uses in the river. However, Lacey is proposing voluntary mitigation actions to address Lacey's share of cumulative impacts to this basin and to provide a margin of safety if data indicate that instream flows are not met.

First, Lacey will actively participate in a McAllister/Yelm sub-basin Stewardship Coalition. The purpose of the Coalition is to enhance the protection of the sub-basins by overseeing implementation of recommendations from the McAllister sub-basin plan of the Nisqually River Watershed plan, and tracking how water resources within the sub-basin are used and managed. This Coalition will create a partnership that includes the Tribe, the cities of Lacey, Olympia, and Yelm, and other participants, and will be consistent with the mission of the Nisqually Planning Unit: "*To maximize the ability of the Nisqually Watershed to produce high quality ground and surface water, while protecting and managing the related resources to support environmental, social, economic, and cultural values.*"

Second, for mitigating Phase 3 water rights Lacey will voluntarily discontinue the use of its two wells located in the Nisqually Valley. The city will first need to determine how to supply fire flows to valley residents and businesses without the wells, and to successfully transfer the water rights for these wells to another location that can be used by the city. The primary water right associated with these wells is for 270 acre-feet, and has a priority date of 04/06/72.

Deschutes River Basin

Lacey's predicted impacts in the Deschutes River Basin will be addressed through the Regional Mitigation Program that is jointly proposed by the cities of Lacey, Olympia, and Yelm. The cities are proposing the following mitigation actions for the Deschutes Basin:

- Flow mitigation for the closure period through acquisition and retirement of irrigation water rights, and
- Land acquisition and habitat restoration for predicted non-closure period impacts.

To date, the three Cities have laid the groundwork for ensuring that these actions will provide full mitigation and can be completed prior to exercising of the cities' water right requests. To this end, the cities have signed two Interlocal Agreements to formalize this collaborative effort. Copies of the Interlocal Agreements, and Amendment, are provided in Appendix D. Work on these interlocal agreements have included a variety of specific actions, including:

- Updating groundwater model features to better reflect features within the Deschutes River Basin;
- Research into consumptive water rights available within the Deschutes River Basin;
- Negotiations with water rights holders for acquisition of priority water rights;
- Two option agreements for the purchase of water rights finalized and the third in negotiation;
- Negotiations and finalization of an option agreement to purchase the Smith Ranch for non-flow mitigation;
- Research, field work, and a habitat restoration feasibility assessment report produced on the Smith Ranch; and
- Discussions with the Squaxin Island Tribe regarding priorities for water rights acquisitions and habitat restoration.

The following describe predicted impacts to the Deschutes River basin, and proposed regional mitigation.

Lacey's Predicted Depletions

Lacey's model-predicted depletions for the entire basin, predicted for E Street Bridge in Tumwater, are shown in Table 20. All maximum predicted impacts are very small and well below the accuracy limit of the model. For the Deschutes River, as with other water bodies where modeling results fall below the model accuracy limit, modeling results are inconclusive as to whether pumping from Lacey's wells will impact surface water in the Deschutes River. As discussed on page 7, the groundwater modelers contracted by the cities cautioned about the accuracy of small predicted depletions from areas with high groundwater inflow. Furthermore, the conservative construction of the McAllister model potentially leads to over-prediction of depletions along the model boundaries, which includes the Deschutes River.

Despite the potential for predicted impacts to overestimate the sum of Lacey's impacts to the Deschutes River, Lacey is proposing mitigation for all predicted impacts to the Deschutes River

given the sensitive nature of this basin and the potential for cumulative impacts. Mitigation is provided as a margin of safety for Lacey's cumulative impacts.

Table 20
Lacey's Water Right Applications
Predicted Depletions for the Deschutes River Basin

Application for Groundwater	Max Predicted Impacts		Max Summer Impacts	Annual Impacts
	cfs	Month(s)	cfs	(AFY)
Phase 1				
G2-30248	0.01	--	0.02	10
G2-30249	0.02	--	0.01	4
Subtotal	***0.03***		***0.03***	***14***
Phase 2				
G2-30251	0.04	Dec - Mar	0.03	23
G2-29304	0.09	Jan - Mar	0.06	45
Subtotal	***0.13***		***0.09***	***68***
Phase 3				
G2-30250	0.02	All year	0.02	13
G2-29165	0.16	Feb - Mar	0.10	84
Subtotal	***0.18***		***0.12***	***97***
TOTAL:	**0.34 cfs**		**0.24 cfs**	**179 AFY**

Predicted Depletions for Regional Mitigation in the Deschutes River Basin

Model-predicted depletions to be addressed collaboratively by the Cities of Lacey, Olympia, and Yelm for the Regional Mitigation Program are shown in Table 21. These depletions represent impacts to the upper, middle, and lower reaches of the basin, and are quantified as the flow depletion predicted near the mouth of the Deschutes River in Tumwater.

The volume of depletions in acre-feet was split out between the closure period and the non-closure period because the regional in-kind mitigation program will focus flow replacement during the closure period.

Table 21 Regional Mitigation Program: Model-Predicted Depletions for Deschutes River Basin[1]				
Application Phase	**Closure Period**		**Winter Period**	
	Max Summer Depletion (cfs)	**Closure period Depletion (AF)**	**Max Winter Depletion (cfs)**	**Winter period Depletion (AF)**
Lacey Phase 1	0.03	11.13	0.03	2.80
Lacey Phase 2	0.09	32.21	0.13	36.26
Lacey Phase 3	0.12	44.77	0.18	51.68
Subtotal Lacey	0.24	***88.11***	0.34	***90.75***
Olympia Phase 1	0.16	60.49	0.24	66.68
Olympia Phase 2	0.02	11.17	0.04	12.31
Olympia Phase 3	0.06	21.40	0.09	23.59
Subtotal Olympia	0.24	***93.10***	0.37	***102.58***
Yelm SW1A	0.19	***65.8***	0.24	***64.9***
TOTAL:	**0.67 cfs**	**247.01 AF**	**0.95 cfs**	**258.23 AF**

[1] For Deschutes River at Tumwater
Sources: *City of Olympia and Nisqually Indian Tribe McAllister Wellfield Mitigation Plan* (2008); Riley (2008); "2010 Modeling Results: Yelm Well SW1A Hydrologic Impact Assessment" (Brown 2010); Sources for Lacey's depletions are cited in Table 10.

Regional In-Kind Mitigation for Deschutes River: Water Rights Acquisitions

Chapter 173-513 WAC closed the Deschutes River to further appropriation from April 15 to November 1. For the regional mitigation program, the cities of Lacey, Olympia, and Yelm propose to provide in-kind mitigation during the closure period through the acquisition and retirement of water rights. During months outside of the closure period, any mitigation requirement is dependent on instream flows. The cities have been collaboratively pursuing the acquisition of consumptive irrigation water rights that will mitigate predicted impacts by returning actual water to the river during the critical low-flow closure period. Irrigation rights comprise the largest water rights available for purchase in the basin, and these rights specify a withdrawal period within the closure period.

The regional package of water right acquisitions in the Deschutes River currently proposed by the cities of Olympia, Lacey and Yelm is presented in Table 22. The cities have the Smith and Jensen water rights under contract for purchase. The third water right is in the process of negotiation for purchase. The cities propose to acquire an equivalent amount of water for the third water right if acquisition of this right is unsuccessful. The cities are confident that these water right acquisitions will be completed during Phase 1, even though mitigation for later phases not be required until much later.

Table 22 also indicates with cities' intention of equally splitting the mitigation credit from this water rights acquisition package. However, final water rights credit will be determined by Ecology.

Table 22 Regional Mitigation Program: Package of Deschutes River Water Rights Acquisitions			
Water Right Certificate	Modeled River Reach[1]	Qa	Qi
S2-00972CWRIS Dillard and Juanita Jensen	Upper	100 AFY	0.50 cfs
G2-26862GWRIS Ron Smith Farms	Upper	170 AFY	300 gpm (0.67 cfs)
Irrigation Water Right[2]	Middle	60 AFY	0.37 cfs
Totals		330 AFY	1.54 cfs
Total potential water available to each city		**110 AFY**	**0.51 cfs**

[1] As defined in the McAllister Groundwater Model. -- See Figure 2, page 6
[2] In negotiation for acquisition at this time. May include acquisition of surrounding land.

The cities also gave higher priority to the acquisition of surface water rights from the upper and middle reaches of the Deschutes River, to ensure that mitigation was in the same reach as, or upstream of, predicted impacts. For Lacey, this approach provides a considerable amount of additional benefit to the upper reach of the river, since the majority of Lacey's predicted impacts are in the lower reach. Table 23 quantifies how the specific locations of these water rights correspond to predicted depletions by reach of the Deschutes River. Using ratios as a method of comparison, both the upper and middle reaches of the Deschutes River will receive a significant amount of flow benefit relative to Lacey's predicted impacts, both in terms of AFY and in cubic feet per second.

Table 23 Deschutes River Flow Mitigation during Closure Period: Lacey's Mitigation Ratios By River Reach						
Deschutes River Reach	Lacey's Cumulative Impact[1]		Flow Mitigation Quantities		Mitigation Ratio (mitigation/cumulative impact)	
	AF	cfs	AF	cfs	AF	cfs
Upper Reach	7.9	0.02	90 [2]	0.39	11.4:1	19.5:1
Middle Reach	35.7	0.09	110 [3]	0.51	3.1:1	5.7:1
Lower Reach	88.1	0.23	110 [3]	0.51	1.2:1	2.2:1

[1] For Lacey Phases 1 – 3. Cumulative impacts for middle and lower reaches include the upstream impacts
[2] Smith and Jensen water rights
[3] Smith, Jensen, and irrigation water rights

This package of water rights acquisitions exceeds the mitigation goals for predicted depletions that are below the accuracy limit of the model. In both the Upper and Middle reaches, mitigation goals are exceeded significantly for both annual quantity and instantaneous flow. Again, actual water right credit provided by this package of water rights will depend on Ecology evaluation of beneficial use history and other factors.

A significant amount of work and coordination for implementing in-kind mitigation has already been completed, all of which demonstrate the feasibility of this mitigation approach and the Cities' commitment to providing in-kind mitigation. Under contract with WestWater LLC, the Cities have negotiated two option agreements for purchase of irrigation water rights, and are in negotiations for acquisition of a third irrigation water right in the middle reach of the Deschutes River. Figure 7 shows these acquisitions on a map of the Deschutes River. Appendix D provides a more detailed review of these water right acquisitions. Appendix D also includes copies of the Option Agreements for the Smith and Jensen rights, as well as copies of the Beneficial Use Analyses (BUA) for the Ron Smith water right (G2-26862GWRIS) and the Jensen water right (S2-00972CWRIS). Beneficial use information on the third irrigation water right in the middle reach will be forthcoming when acquisition terms are finalized.

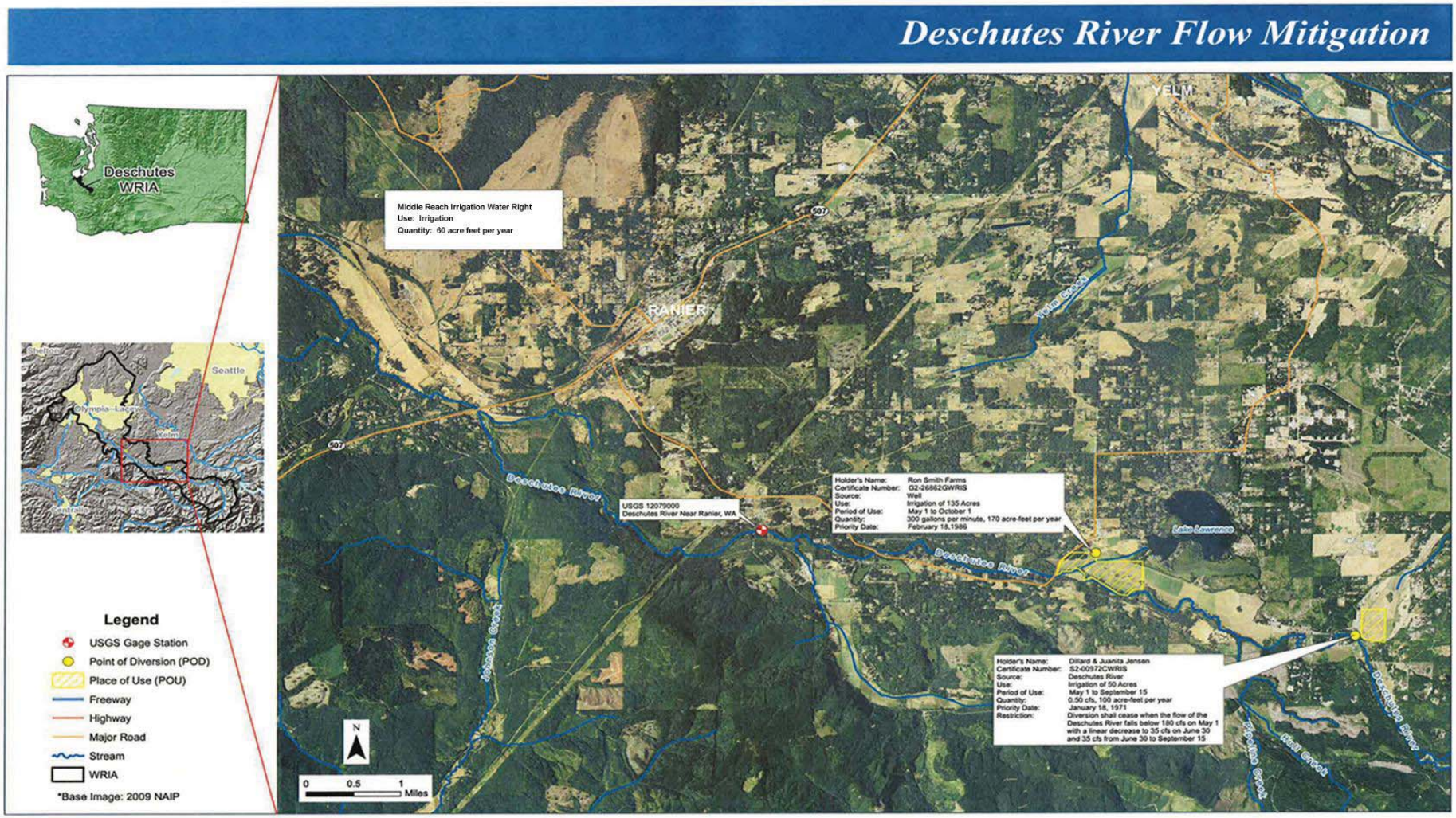

Figure 7. Deschutes River Flow Mitigation

Regional Out-of-Kind Mitigation for Deschutes River: Land Acquisition and Habitat Restoration

During the non-closure period, which is regulated by established instream flows, the Cities propose to provide substantial "non-flow" mitigation which will benefit salmonid habitat year-round, and will not exacerbate winter high-flow conditions.

Our review of the Deschutes River USGS stream flow data at the Tumwater gage indicates the river meets or exceeds the established in-stream flow more than 70% of the time during the non-closure (or "winter") period. Water is theoretically available for appropriation during these periods when instream flows are met. Conversely, these same historical data suggest the river fails to meet minimum in-stream flows approximately 30 percent of the non-closure period. These periods of winter low flows suggest, therefore, that mitigation is warranted to offset predicted winter impacts.

The Cities evaluated options for providing flow mitigation during winter low flow periods, and found two principal challenges: 1) the lack of active water rights with winter time use that can be purchased and retired, and 2) the inability to predict low flows and time mitigation actions so as to address low flows and not exacerbate high flows/flooding.

The Cities propose land acquisition and habitat restoration as the most appropriate strategy for "winter" impacts. These actions can have greater biological benefits during the winter than flow mitigation. For example, in the Deschutes, one of the primary limiting factors for fish in the winter is the availability of off channel rearing habitat and/or large woody debris that provide protection from high main stream flows. In addition, these restoration actions will have year-round (high flow and low flow) benefits.

A significant amount of work and coordination for implementing out-of-kind mitigation has already been completed, all of which demonstrate the feasibility of this mitigation approach and the Cities' commitment to providing this mitigation. The Cities have signed an Option Agreement to jointly purchase over 200 acres of the Ron Smith Farm, which is located in the upper reach of the Deschutes River. This Option Agreement is included in Appendix D. This property is currently a sheep ranch and has been altered considerably from a natural condition. The property includes Deschutes River frontage, most of the frontage of the outlet channel from Lake Lawrence, and springs and seeps that flow via the outlet channel to the Deschutes River. This is our proposed acquisition and habitat restoration site for mitigation in the Deschutes River for non-closure periods.

To evaluate the Smith Ranch's potential for water rights mitigation, the cities contracted with Anchor QEA to conduct an acquisition and restoration assessment of the site. This site is uniquely situated to provide habitat restoration benefits, as noted in the Anchor QEA report,

> *"*The Smith Ranch property is an appropriate site to acquire in order to meet desired outcomes for mitigation associated with the Cities' proposed water rights applications. The Smith Ranch is an ideal location to provide mitigation for

predicted flow depletions to all the downstream segments of the river. In this way, the benefits derived from property acquisition, cessation of intensive agricultural land practices, and recommended restoration actions will benefit the full extent of the watershed that is predicted to be impacted by the water withdrawals."

Anchor QEA identified a number of restoration options for the site, and then utilized a point system for quantifying habitat depletion points based on predicted impacts, and mitigation "credit" points for each property protection and restoration action. This point system was adapted from the methodology used in the Salmon/Washougal Basin for quantifying habitat mitigation. We recognize that use of this credit/debit system in the Deschutes Basin is subjective and relies heavily on professional judgment, but it does provide a method of quantifying the mitigation value of the projects that are included in this mitigation plan. The Anchor QEA report, *Initial Acquisition and Restoration Assessment of the Smith Ranch*, is included in Appendix D.

Table 24 is reproduced from the Anchor QEA report and summarizes the habitat depletion points that were calculated based on the cities' cumulative predicted impacts that were available at the time the report was completed. The predicted depletions and the depletion points have since reduced as a result of Yelm's revised modeling scenario for Yelm Well SW1A. This information will be updated when Yelm submits its Mitigation Plan.

Table 24
Winter Flow Depletion Impact Calculation for Cities of Olympia, Lacey and Yelm

River Reach	Reach Length	Predicted Maximum Winter Impacts Flow Depletion[1,2]		Scoring System for Depletion Points per 0.1 cfs-mile	Depletion Points
		Incremental Depletion in Reach	Cumulative Depletion		
Upper Deschutes	8.8 miles	0.39 cfs	0.39 cfs	10	343
Middle Deschutes	7.0 miles	0.14 cfs	0.53 cfs		371
Lower Deschutes	11.0 miles	0.53 cfs	1.06 cfs		1,166
				Total to Mitigate for Winter Flow Depletions	1,880

Notes:

1 Flow depletion sources: Golder 2008; Thomas 2008a, 2008b, and 2008c; Riley 2008; and City of Olympia and Nisqually Indian Tribe 2008. The depletions listed in the table are the cumulative predicted depletions for the following water right applications:

- **City of Lacey** – New water right applications G2-29165 (Madrona Wellfield), G2-29304 (Evergreen Estates), G2-30248 (Hawks Prairie #2), G2-30249 (Betti Well), G2-30250 (Meridian Campus), and G2-30251 (Marvin Road)
- **City of Olympia and Nisqually Indian Tribe** – Water right change applications for Certificate Nos. 8030 and S2-001105C (McAllister Springs) and Permit No. 10191 (Abbott Springs)
- **City of Yelm** – Phases I and II of new water right applications G2-29084, G2-29085, and G2-29086 (SW Yelm Wellfield)

2 The numbers in Table 24 represent the worst-case impact scenario, and do not include updated flow depletion modeling results from "2010 Modeling Results: Yelm Well SW1A Hydrologic Impact Assessment" (Brown 2010). Modeling results show that Yelm's impacts are reduced with their new pumping proposal.

The cities propose a package of actions that will provide a total of 4327 mitigation points, which is well in excess of the calculated habitat depletion points. This results in a ratio of 2.3:1 for non-flow mitigation actions. Figure 8 shows the approximate locations of the proposed habitat restoration actions. These actions include the following:

- Acquire the Smith Ranch and cease farming activities by November 2012
- Reshape the existing channel from the Main Spring (2A)
- Re-establish the wetland around smaller springs on the ranch (2D)
- Construct a small live cribwall to address erosion along the Deschutes River (3A)
- Replant high density 50-foot riparian buffer and install buffer fence along the river (4A)
- Replant low density 50 to 200-foot riparian buffer from the Deschutes River (4B)

The benefits of these specific actions were summarized by Anchor QEA (2010):

> "These recommended actions were selected because each action make significant contributions to address the habitat limiting factors, immediately address some of the most impactful alterations resulting from the intensive agricultural practices, and set the stage for future restoration. The benefits of these actions would extend far beyond the boundaries of the property, thereby significantly contributing the restoration of the Deschutes River watershed. "

Land acquisition and habitat restoration activities are being jointly pursued by the Cities, and the three cities will be working collaboratively to implement the entire package of acquisition and restoration actions listed here. Upon approval of water rights by Ecology, the cities will update the Deschutes Interlocal Agreement to define proportional cost shares and implementation responsibilities for the restoration actions.

The timeframe of proposed actions is shown in Table 25, and assumes that water rights decisions are made in 2010. This timeframe ensures that winter mitigation for all three of Lacey's water rights phases will be completed well in advance of the use of these rights. In fact, whereas Lacey's Phase 1 winter impacts are very small (0.03 cfs) compared to Phase 3 impacts (0.18 cfs), most of the actions in Table 25 will be completed while Lacey is exercising Phase 1 water rights.

Table 25 Schedule for Land Acquisition and Mitigation Actions In Deschutes Basin	
Action	**Timeframe[1]**
Complete property acquisition	2011
4A (partial) – Install Buffer Fence 200 feet from Deschutes River and along mouth of Lake Lawrence outlet	2011
4A (partial) – Replant High Density 50-foot Riparian Buffer	2011 to 2013
3A – Construct Live Cribwall Along One Eroding Reach of Deschutes River	2013 to 2015
2A – Reshape Existing Channel from Main Spring	2013 to 2015
2D – Re-establish Wetland Around Smaller Springs	2013 to 2015
4B – Replant Low Density 50- to 200-foot wide Riparian Buffer	2014 to 2016

[1] Time frame assumes water rights decisions are made in 2010

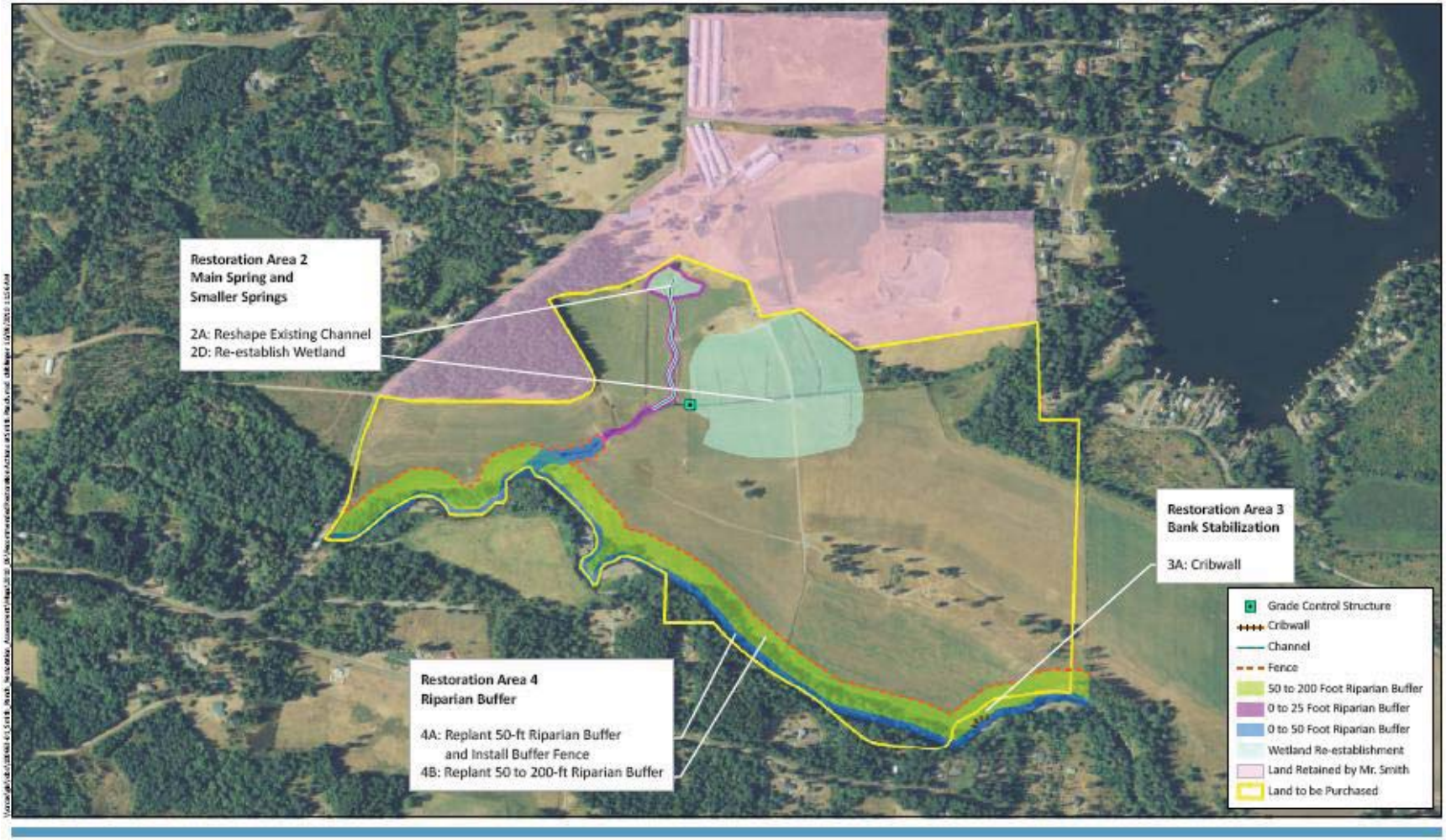

Figure 8. Proposed Restoration Actions at Smith Ranch (from Anchor QEA 2010)

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Appendices (on CD)

A. City of Lacey Resolution 917

B. Groundwater Modeling Reports
- *Report on Groundwater Modeling of Madrona and Evergreen Estates Well Water Right Applications City of Lacey, Washington* (Golder Associates, 2008*)*
- *Groundwater Modeling of Betti and Hawks Acres Well Pumping Increases* (Thomas, 2008a)
- *Groundwater Modeling of New Hawks Prairie Area Pumping* (Thomas, 2008b

C. Woodland Creek Attachments
- *Woodland Creek Reclaimed Water Infiltration Facility Analysis* (Pacific Groundwater Group, 2010)
- Reclaimed Water Distribution Agreement No. 1 Between the LOTT Wastewater Alliance, Thurston County and the Cities of Lacey, Olympia and Tumwater
- From Nisqually Planning Unit: Letter of Support for City of Lacey's Proposed Reclaimed Water Infiltration Facility
- Interlocal Agreement Between the City of Lacey and the City of Olympia for Water Rights Mitigation
- From Tom Loranger, Department of Ecology: Purchase of Land Pursuant to Lacey's Mitigation Plan

D. Deschutes River Attachments
- Interlocal Agreements Between the Cities of Olympia, Lacey and Yelm For a Water Rights Acquisition Strategy (Phase I, Phase II, and Phase II Amendment)
- Option Agreement with Ron Smith for Water Right G2-26862
- Option Agreement with Ron Smith for Purchase of Land
- Beneficial Use Analysis for Ron Smith Water Right G2-26862
- Option Agreement with Dillard and Juanita Jensen for Water Right S2-00972C
- Beneficial Use Analysis for Jensen Water Right S2-00972C
- *Initial Acquisition and Restoration Assessment of the Smith Ranch* (Anchor QEA, 2010)