Lacey, Olympia & Yelm Mitigation Strategy (To meet municipal water supply needs for the next 20-40 years)

A challenging mitigation of surface water impacts from projected long term well pumping for three separate cities located in the Nisqually and Deschutes Watersheds

Thurston County Water Utility Purveyor
Technical Workgroup Meeting
October 31, 2012

Mike Gallagher
Water Resources Program
Southwest Regional Office

What are the issues?

Lacey, Olympia and Yelm all need reliable water sources for the next 20 – 40 years to accommodate for expected growth to these cities

- **Lacey and Yelm** applied the right to withdraw 8,334 acre-feet/year of **new** groundwater
- **Olympia** (and the **Nisqually Indian Tribe**) applied for a water right **change** to withdraw 29,209 acre-feet/year of groundwater instead of diverting the same amount from current surface water sources
- Modeling of these proposed groundwater withdrawals show direct impacts in the Deschutes and Nisqually Rivers and Woodland and McAllister Creeks. All basins subject to conditions of instream flow rules (WAC 173-511 and WAC 173-513)
- **So,** Lacey, Olympia, Yelm and the Nisqually Tribe were required to mitigate for modeled impacts to Nisqually and Deschutes Rivers and McAllister and Woodland Creek sub-basins

Convergence of Multiple Opportunities

- Lacey, Olympia and Yelm shared the same groundwater model
- Lacey, Olympia and Yelm shared in mitigation planning, development and cost
- The combined mitigation involves purchasing and retiring of water rights, out-of-kind mitigation (land purchase and improvements), reclaimed water, improved stream flow and additional agreements
- One Indian Tribe directly involved (MOA Between Olympia and Nisqually Tribe)
- Another Indian Tribe (Squaxin Island Tribe) needed to be convinced of degree of mitigation to be provided and they set a very high bar
- All this required a lot of work and coordination by and between all parties

This effort provides a good example and a precedent of how joint mitigation could be a beneficial process for other local governments, especially in the procurement of long-term municipal water supplies.

What is an Acre-Foot?

- One acre-foot of water = one acre of land under 1 foot of water.
- One acre is 43,560 square feet (208.7' x 208.7')
  - 43,560 x 7.48 gallons/square foot = 325,851 gallons
- **SO** one acre-foot of water = ~ 326,000 gallons of water
- **VISUALIZE**
  - A football field under 1 foot of water = **~1 AF of water**
  - A standard Olympic swimming pool: (50m L x 25m W x 2m D) = ~660,000 gallons of water = **~2 AF of water**

What is a cubic foot of water?

- One cubic foot of water (1’ x 1’ x 1’) = 7.48 gallons of water
  - **VISUALIZE:**

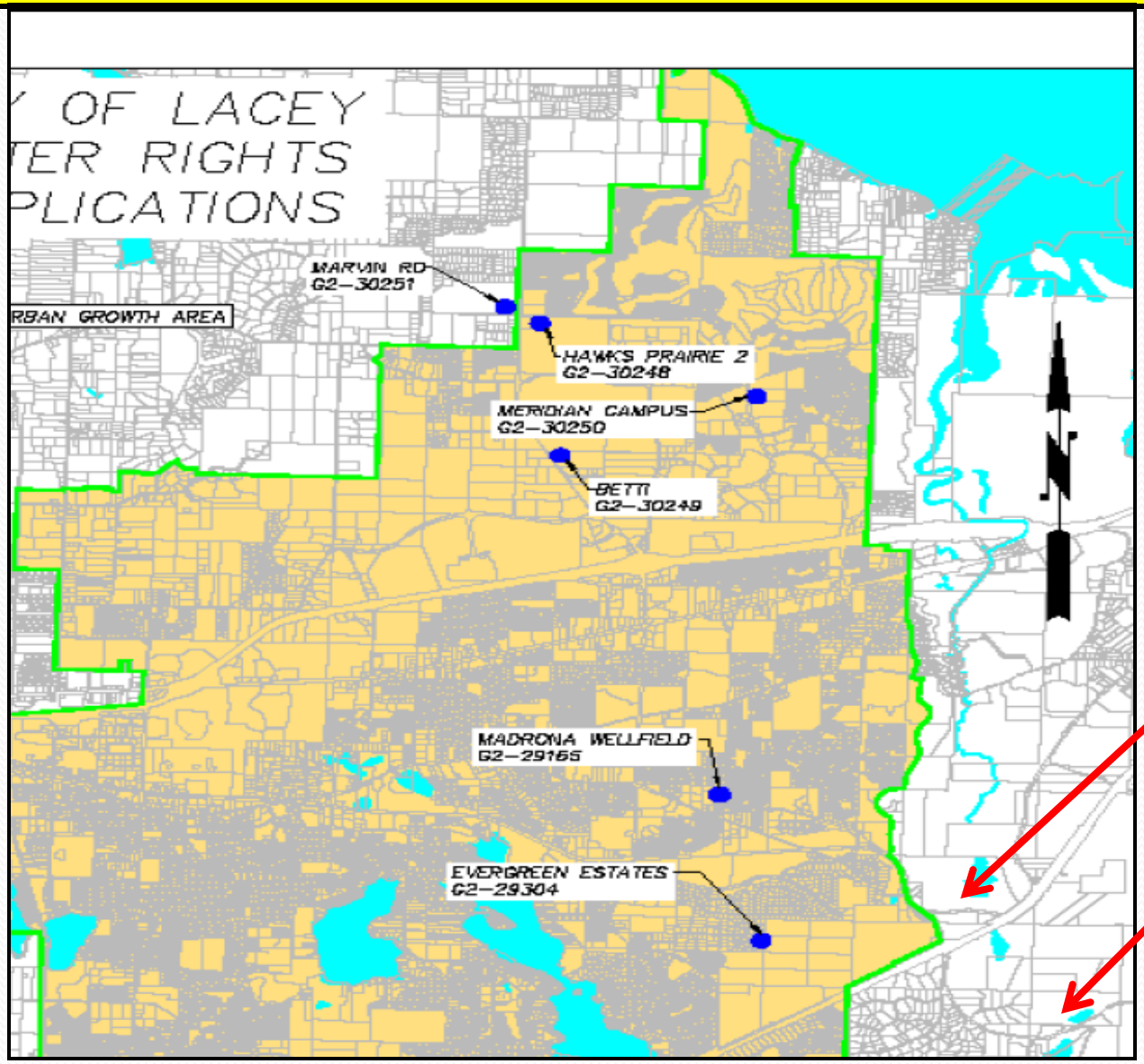
    One 5 gallon bucket and another 2.5 gallon bucket = 7.5 gallons – this amount of water flowing by every second = **1 CFS**

Total Water Requested for Lacey Applications (in AFY)

Application Number	Lacey's Priority	Priority Date	Qa (in AFY)
G2-30248 Hawks Prairie #2	1	05-03-05	1,066
G2-30249 Betti Well	2	04-28-05	600
G2-29304 Evergreen Estates	3	09-20-95	1,000
G2-30251 Marvin Road	4	05-06-05	1,500
G2-29165 Madrona Wellfield	5	12-16-94	2,226
G2-30250 Meridian Campus	6	05-06-05	1,000

TOTAL: 7,392 AFY

Lacey Water Right Application Locations



Well Information for Six Lacey Water Rights

Water Right	Qa (AFY)	Well Depth (BGS)	Screened Interval (BGS)	Screen Diameter	Aquifer
G2-30248 **Hawks Prairie #2**	1,066	656’	498-648’	20”	TQu
G2-30249 **Betti**	600	392’	293-375’	20”	Qc
G2-29304 **Evergreen Estates**	1,000	282’	256-276’	14”	Qc
G2-30251 **Marvin Road**	1,500	850’	507.5 – 624.5’	8”	TQu
G2-29165 **Madrona Wellfield**	2,226	2 @ 334’ 1@ 338’	259-329’ & 262-334’ 259.5 – 262.5	14” 18”	Qc Qc
G2-30250 **Meridian Campus**	1,000	667’	497-657’	8”	TQu

Lacey's Projected Schedule of Wellfield Development

- Six applications requesting a total of **7392 AFY**
- Application priority

Phase One

1. G2-30248 (Hawks Prairie #2)
2. G2-30249 (Betti Well)

Phase Two

3. G2-29304 (Evergreen Estates)
4. G2-30251 (Marvin Road)

_____

Total: 4166 AFY – (sufficient for supplying growth for next 20 years)

Lacey currently has rights to 13,572 AFY of water via 39 existing Water Right Certificates and Permits

- For beyond the next 20 years – Lacey requested approval of the following applications to provide assurance for additional future water supply to the city

Phase Three

5. G2-29165 (Madrona Wellfield)
6. G2-30250 (Meridian Campus)

_____

Total: 3226 AFY (+ 4166 AFY = 7392 AFY)

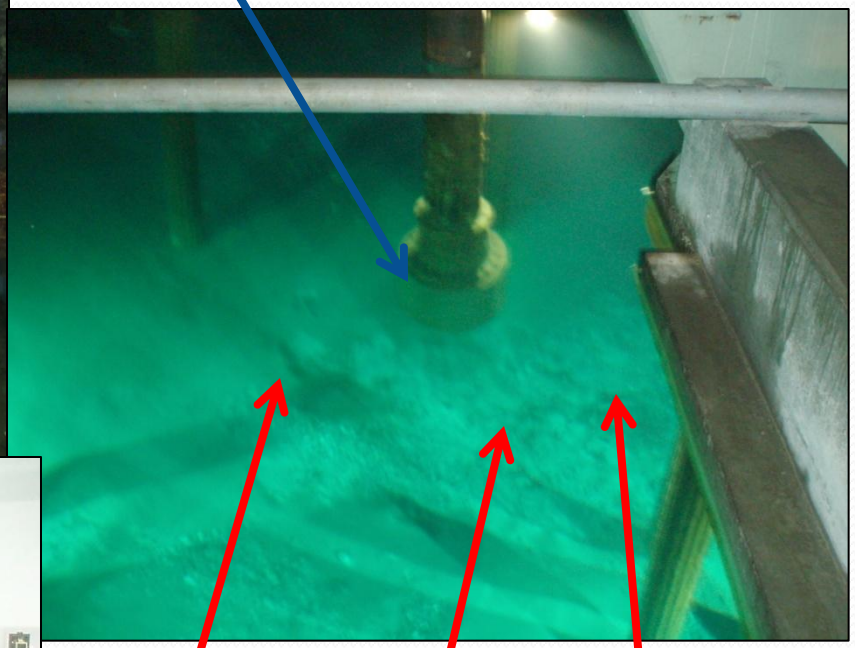
Total Water Requested for Olympia Water Right Change Applications (in AFY)

Water Right	CFS (Qi)	MGD	GPM	AFY (Qa)
Certificate 8030 McAllister Springs	25	16.16	11,220	18,099
S2-001105C McAllister Springs	5.33	3.44	2392	782 (primary) 3088 (supplemental)
Permit # 10191 Abbott Springs	10	6.46	4488	7240*
TOTAL		26.06		29,209 AFY

* Abbott Springs Water Right # 10191 does not specify a Qa, so 10 cfs x 24 hrs/day x 365 days = 7240 afy

McAllister Springs – Home of Olympia's Current Water Supply

Well Screen



10,000 GPM bubbling out of the ground

Planned McAllister Wellfield Location
(about 1 mile SSE of McAllister Springs)

NW

NE

Location of initial test well

Visualize four 20" diameter production wells in this large field, each pumping 3,600 GPM *(26,000,000 Gallons/Day)*

The McAllister Gravels (MG) deposits occur in the McAllister Springs area on the western side of the Nisqually River Valley. These deposits consist of highly permeable gravel-fill deposits of over 400 feet in thickness in a former pre-Vashon river channel. This channel was incised after deposition of pre-Vashon Glaciation deposits and was subsequently filled (aggraded) during the Vashon age glacial episodes.

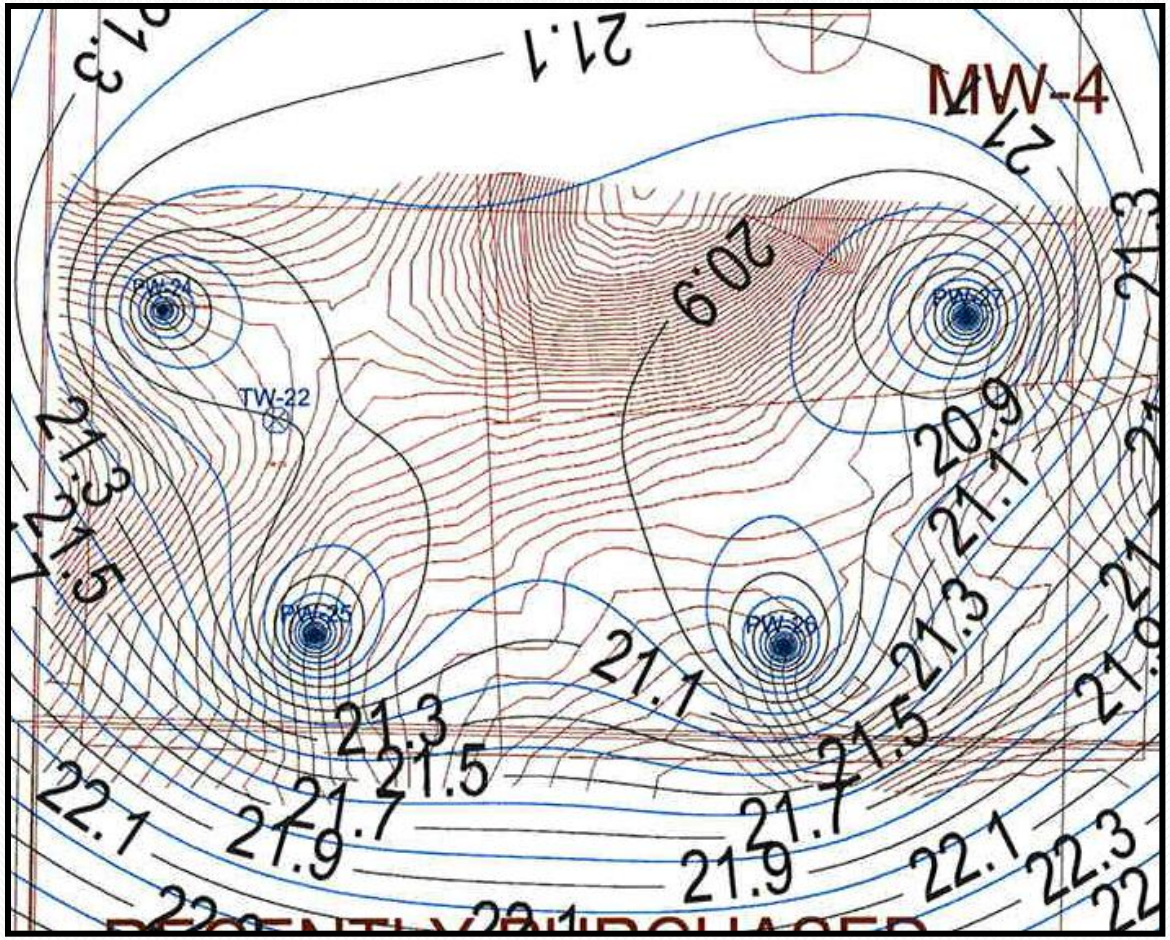
The highly productive McAllister Gravels Aquifer occurs within the MG deposits.

Olympia's Planned McAllister Wellfield

29,209 AFY Withdrawal spread over 4 wells

Well Number	Projected Qi (GPM)	Well Depth (BGS)	Screened Interval (BGS)	Screen Diameter	Aquifer
1	3,600	~ 400'	~200-400'	18 – 20"	McAllister Gravels Aquifer
2	3,600	~ 400'	~200-400'	18 – 20"	McAllister Gravels Aquifer
3	3,600	~ 400'	~200-400'	18 – 20"	McAllister Gravels Aquifer
4	3,600	~ 400'	~200-400'	18-20"	McAllister Gravels Aquifer

Proposed Configuration of the McAllister Wellfield



McAllister Wellfield
Schedule of Well Development

PHASE	Expected Completion Date	Max. Production in MGD	Cum. Proportion of Build-out
I	2014	17	65%
II	2014-2018	20.1 (19.6 for Olympia and 0.5 for Tribe)	77%
III	2058	26.06 (23.06 for Olympia and 3.0 for Tribe)	100%

Following the transfer of production from the springs to the wellfield @ end of Phase I, the City and Tribe to negotiate future use of McAllister and Abbott Springs properties w/ intent to ensure a "perpetual state of conservation" for those properties as Olympia deeds the springs to the Tribe for cultural and spiritual purposes.

Yelm's Water Right Application

Application #	Priority Date	Source	(Qi) GPM	(Qa) AFY
G2-29085	1-10-94	1 well	2100	942

- **Yelm presently has 827.92 AFY of water rights –** primarily from Wells 1A and 2 located in downtown Yelm, both are less than 100' deep and are screened in highly productive Advance Vashon Outwash (Qva) Aquifer

- **With this request for new water Yelm will have a total of 1769.92 AFY in water at full build out.**

Yelm Wells 1A and 2

Current Water Source

Both wells are screened in the Qva Aquifer

Yelm's New Well

Yelm's SW Well 1A is a 633' deep well capable of pumping 2,100 GPM

2,100 GPM being transported 4000' west during 72-Hour pump test

Sand and Gravel Sample from Aquifer Zone

Well Information for Yelm's Water Right

Water Right	Qa (AFY)	Well Depth (BGS)	Screened Interval (BGS)	Screen Diameter	Aquifer
G2-29085	942	633	369'-437', 487'-547' 611'-625'	8" 8" 8"	TQu

- This is the only well in the area screened in the deep (Tqu) aquifer
- Depth to groundwater at 102' BGS (so 531' of water in well)
- Up to 240' of available drawdown
- 72 hour pump test 1800-2000 GPM. 82 feet of drawdown.

Water Quality

- Water was cold, clear and odorless
- Slightly elevated manganese (0.15 mg/L)
  Secondary (aesthetic) limit is 0.05 mg/L

The Groundwater Model

Groundwater model was originally developed for Olympia by Camp Dresser and McKee in 2002 to evaluate potential hydrologic impacts to surface water bodies in the vicinity of the proposed McAllister Wellfield. The model is based on a pre-existing numerical model originally developed by the U.S. Geological Survey (USGS - Drost et al., 1999).

Over time, the model was significantly refined by CDM and more recently by Golder Associates, SS Papadopulos & Associates and Shannon and Wilson.

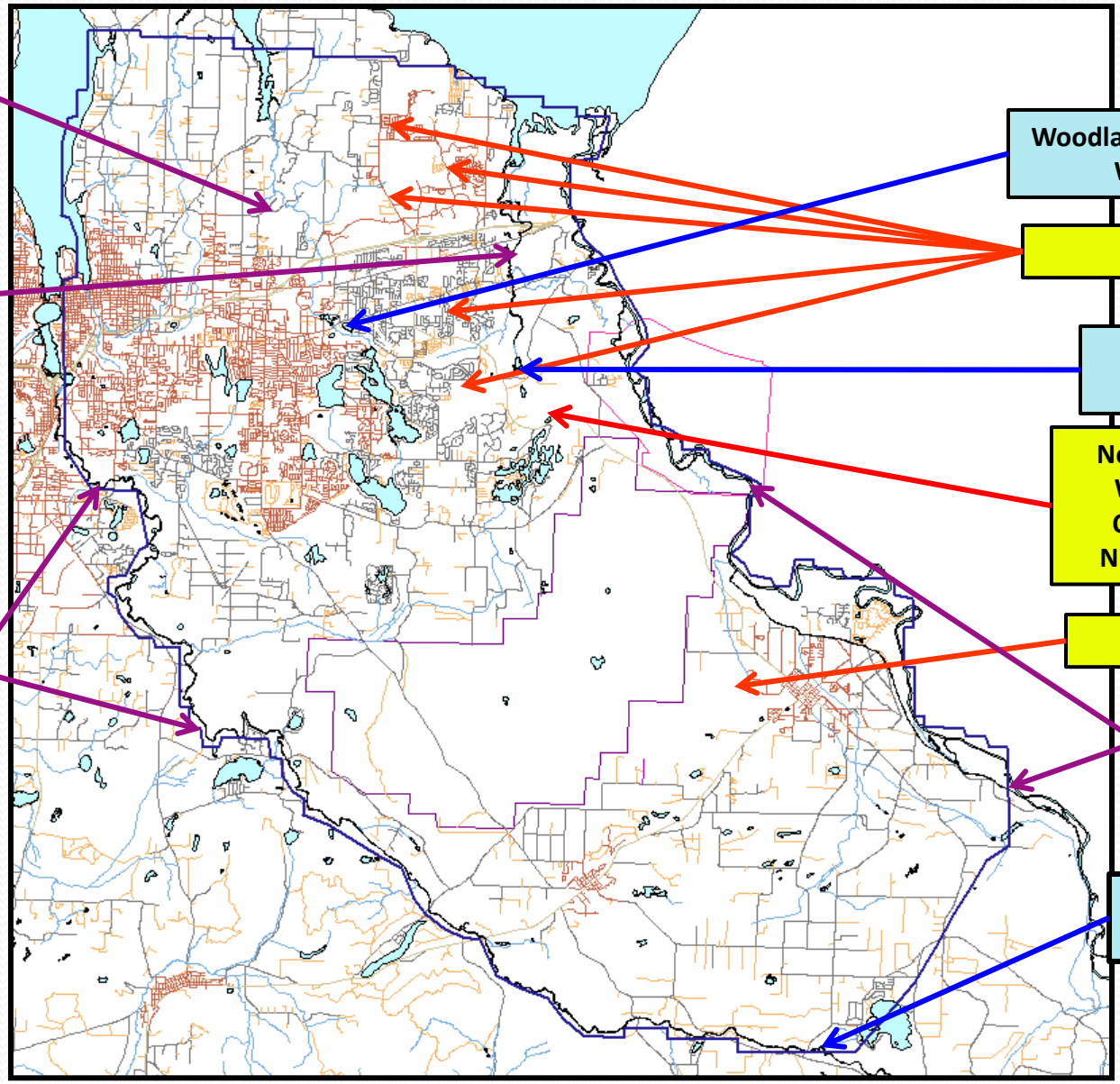
Olympia, Lacey and Yelm agreed to have their modeling consultants coordinate any changes with each other and to peer-review the model each time it was changed. Both Nisqually and Squaxin Island Tribes, and Ecology were consulted on modeling efforts as well.

The model covers an area approximately 15 miles (north-south) by 8 miles (east-west) in extent. It extends from the Deschutes River on the west to the Nisqually River on the east, and from McAllister Springs upstream to a point above McKenna on the Nisqually River and to approximately Lake Lawrence in the Deschutes River watershed. Within this area, the model grid ranges from 100-foot spacing in the vicinity of the wellfield to 1,000-foot spacing in other areas. The model has nine distinct geologic layers including aquifers and aquitards. It simulates flow through the aquifers, interactions between aquifers, flow gradients, and recharge and discharge to streams and springs. The rivers in this model, Nisqually and Deschutes, are modeled as no-flow boundaries for the purposes of model development.

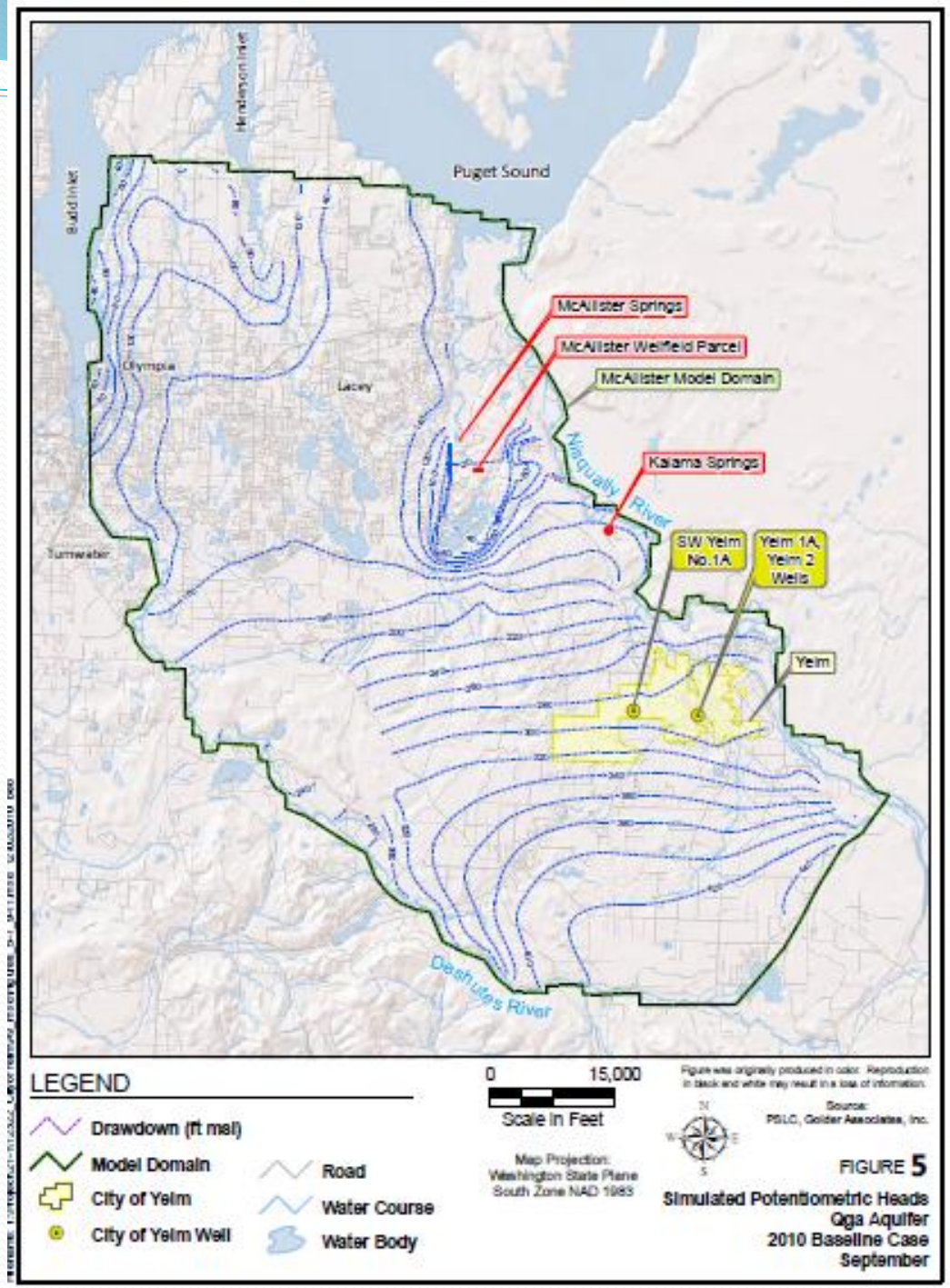
Hydrostratigraphic Units

UNIT	DESCRIPTION
Recessional Outwash (Qvr) *Model Layer 1*	Qvr sediments are composed primarily of sand and gravel. Wells logs for the area indicate a thickness to range between 10-50 feet thick.
Till (Qvt)	Qvt is a mixture of compacted clays and silts, with unsorted sands, gravels, cobbles and boulders often referred to as till or "hardpan" ranges from 35 to 85 feet thick, and is considered a confining layer and its cemented conditions limit its water transmitting capacity. The Qvt deposits confines the groundwater in the deeper Qva layer.
Advance Outwash (Qva) *Model Layer 3*	Qva deposits lie beneath and are confined by the overlying Qvt till, is a permeable aquifer unit and consists generally of gravel in a matrix of sand with some sand lenses. ranging in thickness between 15 – 85 feet, and is the primary source for domestic and municipal water supplies.
Kitsap Formation (Qf)	Qf is a low-permeability, fine-grained confining layer, ranging in thickness between 25 to 80 feet, that separates the overlying Qva unit from the deeper Qc and TQu units. The Qf unit is composed of predominantly clay and silt, with some local layers of sand and gravel, and may include some till or till-like deposits and minor amounts of peat and wood.
Salmon Springs Drift (Qc) *Model Layer 5*	Qc lies beneath the Kitsap Formation and ranges in thickness from 15-50 feet. This unit consists of primarily coarse-grained sand and gravel and is generally characterized by oxidized red or brown staining (iron-oxides). Qc is the target aquifer for 3 of Lacey's new water rights.
Unconsolidated and undifferentiated deposits (TQu) *Model Layer 8*	TQU is a layering of unconsolidated and undifferentiated deposits consisting of glacial and non-glacial sediments of clay, silt sand and gravel and is known to consist of layers of fine-grained confining beds and coarse-grained aquifer units. The TQu unit is widespread throughout the region, but its thickness and groundwater capacity are not very well known. The TQu is the target aquifer for Yelm's SW Well 1A and for 3 of Lacey's new water rights.
Bedrock (Tb)	The deepest hydrogeologic unit in the area is the consolidated bedrock, identified as the Tb Unit. This bedrock unit consists of sedimentary claystone, siltstone and sandstone and igneous bodies of andesite and basalt. The Tb unit is known to contain some water in fractures and joints, but is considered to be an unreliable sources of water due to low yields and poor water quality.

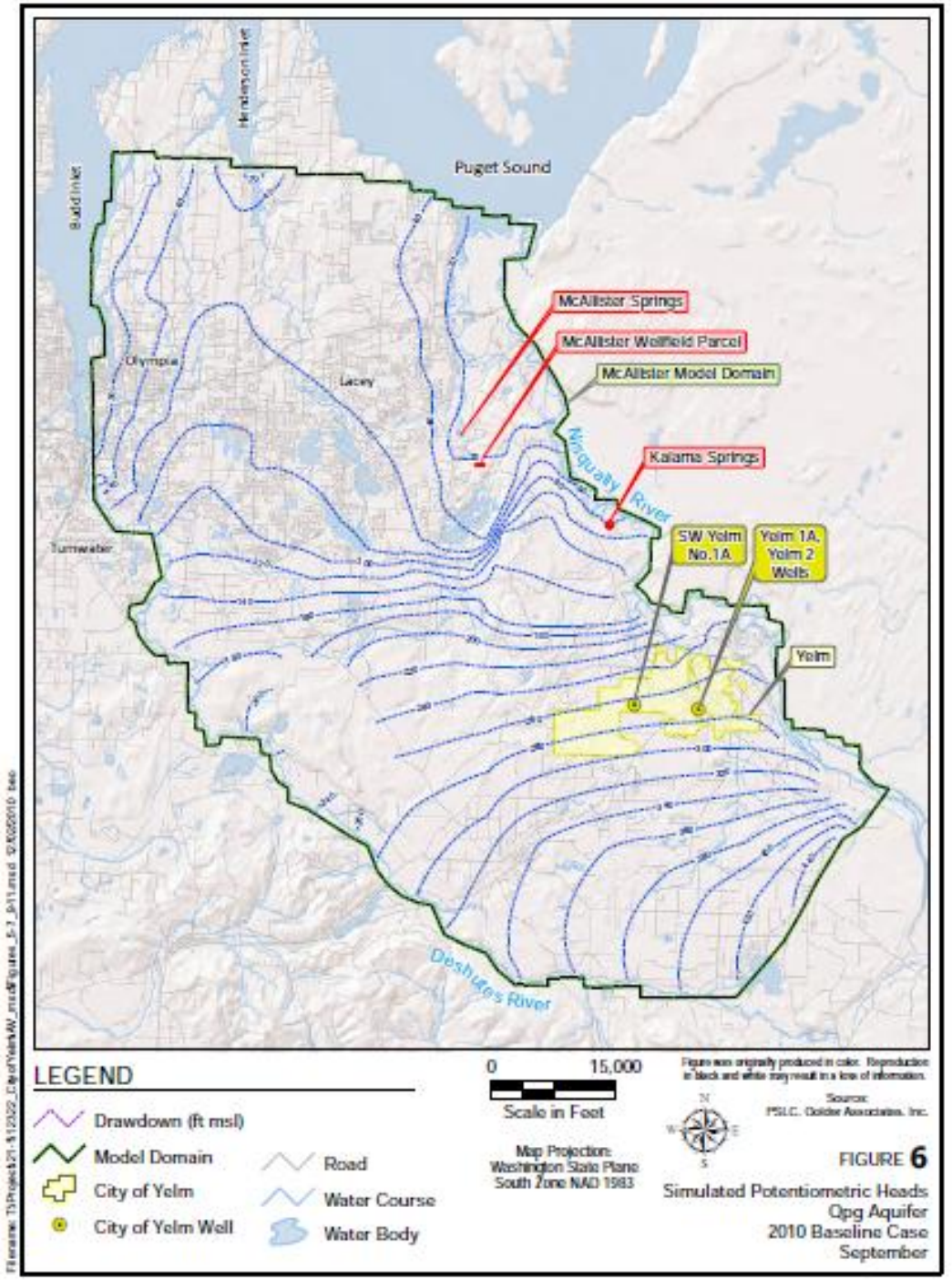
Groundwater Model Area



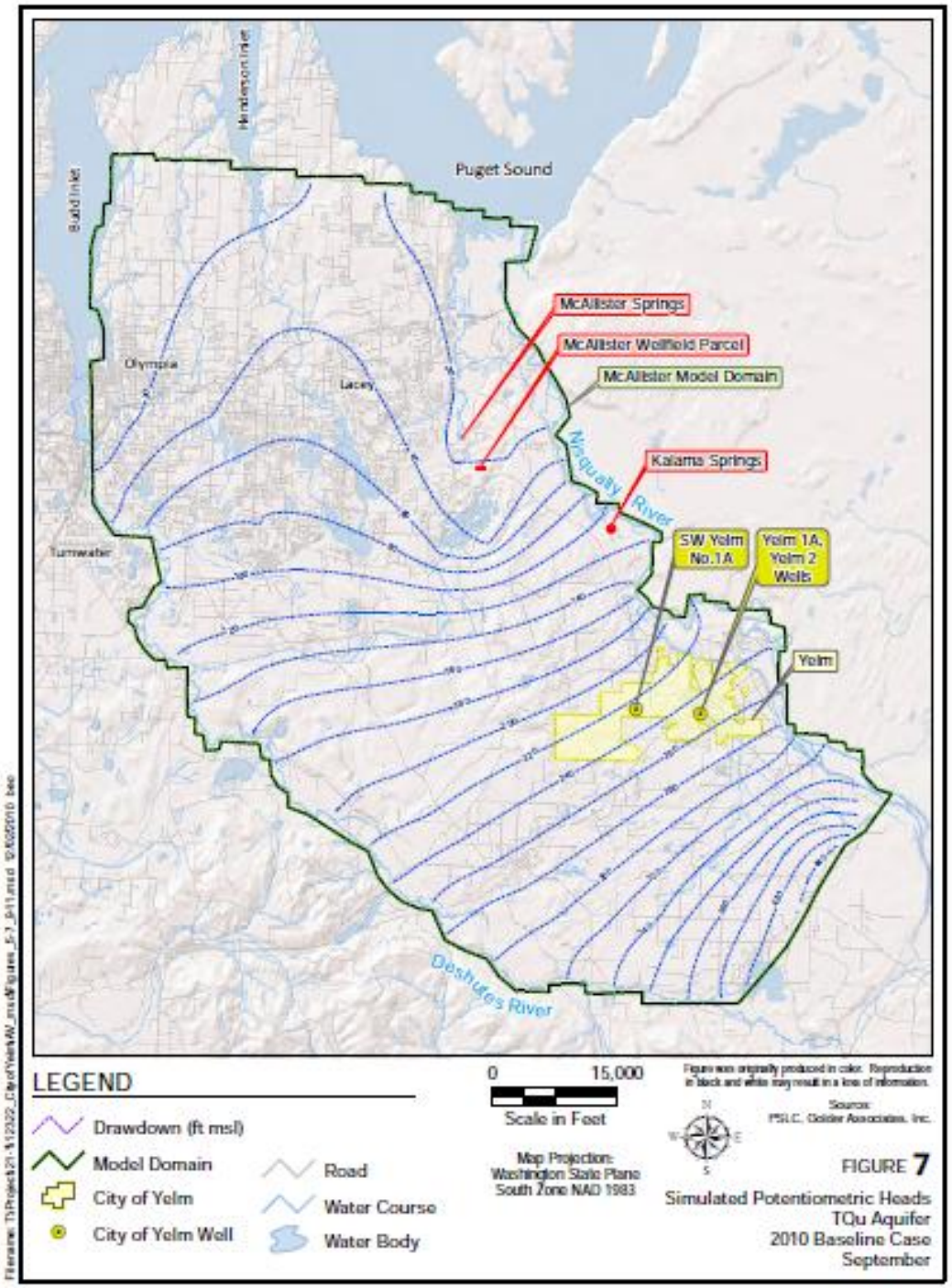
Modeled Potentiometric Heads of the Qva Aquifer



Modeled Potentiometric Heads of the Qc Aquifer



Modeled Potentiometric Heads of the TQu Aquifer



Accepted Model Limitations

Margin of error or accuracy limit for the model:

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. 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 (SSPA and Golder) 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.

Model is considered conservative:

Since the model boundary at the Deschutes and Nisqually Rivers 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/leave 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 conservative construction of the model potentially leads to over-prediction of depletions along the model boundaries, which includes the Deschutes River and Nisqually River.

Predicted Depletions

- The model calculated (predicted) annual and summer depletions for various surface water bodies in the study area based on projected (at full build) out pumping rates for Lacey's 6 applications, Olympia's 3 change applications and Yelm's 1 application.
- Surface water bodies included
  - **Woodland Creek** and Longs, Hicks and Pattison Lakes
  - **McAllister Springs** and Creek, nearby springs and Lake St. Clair
  - **Deschutes River:** Upper and Middle Reaches, Silver Spring, and Lower Reach/Spurgeon Creek
  - **Nisqually River:** Upper and Middle Reaches, Yelm Creek, Kalama Creek Spring, Lower Reach

Mitigation – In a Nutshell…

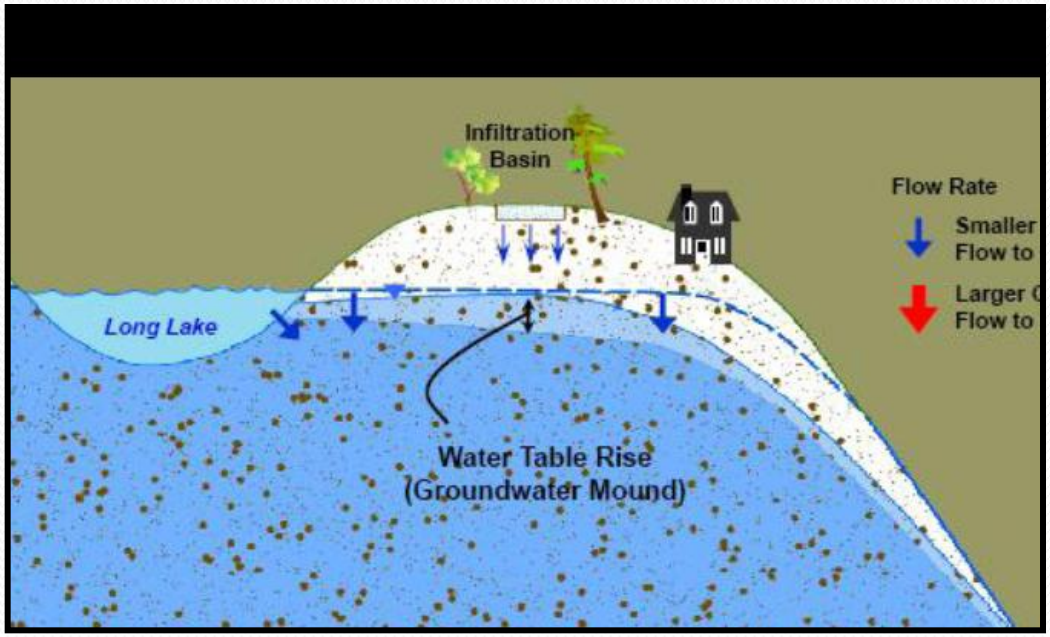
- **Woodland Creek** – Infiltrate reclaimed water
- **McAllister Creek** – Move away from the springs to a nearby well field
- **Nisqually River** – Minimum flows are not affected (Thanks to Alder Dam/Tacoma Power keeping river flow above instream flow levels)
- **Deschutes River** – Buy up existing water rights, retire them and also do “out-of-kind” mitigation at a ranch purchased jointly by Lacey, Olympia and Yelm

Model-Predicted Depletions for Woodland Creek Basin

Application Phase	Annual Depletion (AFY)
Lacey Phase 1 Lacey Phase 2 Lacey Phase 3 Sub-total (Lacey)	69 160 257 **486**
Olympia Phase 1 Olympia Phase 2 Olympia Phase 3 Sub-total (Olympia)	94.3 17.4 33.3 **145**
Yelm (New Well)	**15**
TOTAL	**646 AFY [or 0.9 CFS]**

Woodland Creek Mitigation

- **Long-Term Mitigation** consists of construction of Woodland Creek Regional Reclaimed Water Infiltration Facility – to be jointly constructed and operated by Lacey and Olympia.
- Plan is to infiltrate water that will surface at the springs N of Martin Way during critical low-flow months of May – October – at a projected rate of 0.8 to 0.9 MGD
- Reclaimed water piped from LOTTs Martin Way Reclaimed Water facility to Woodland Creek Community Park (via Carpenter Road)



Woodland Creek Regional Reclaimed Water Infiltration Facility

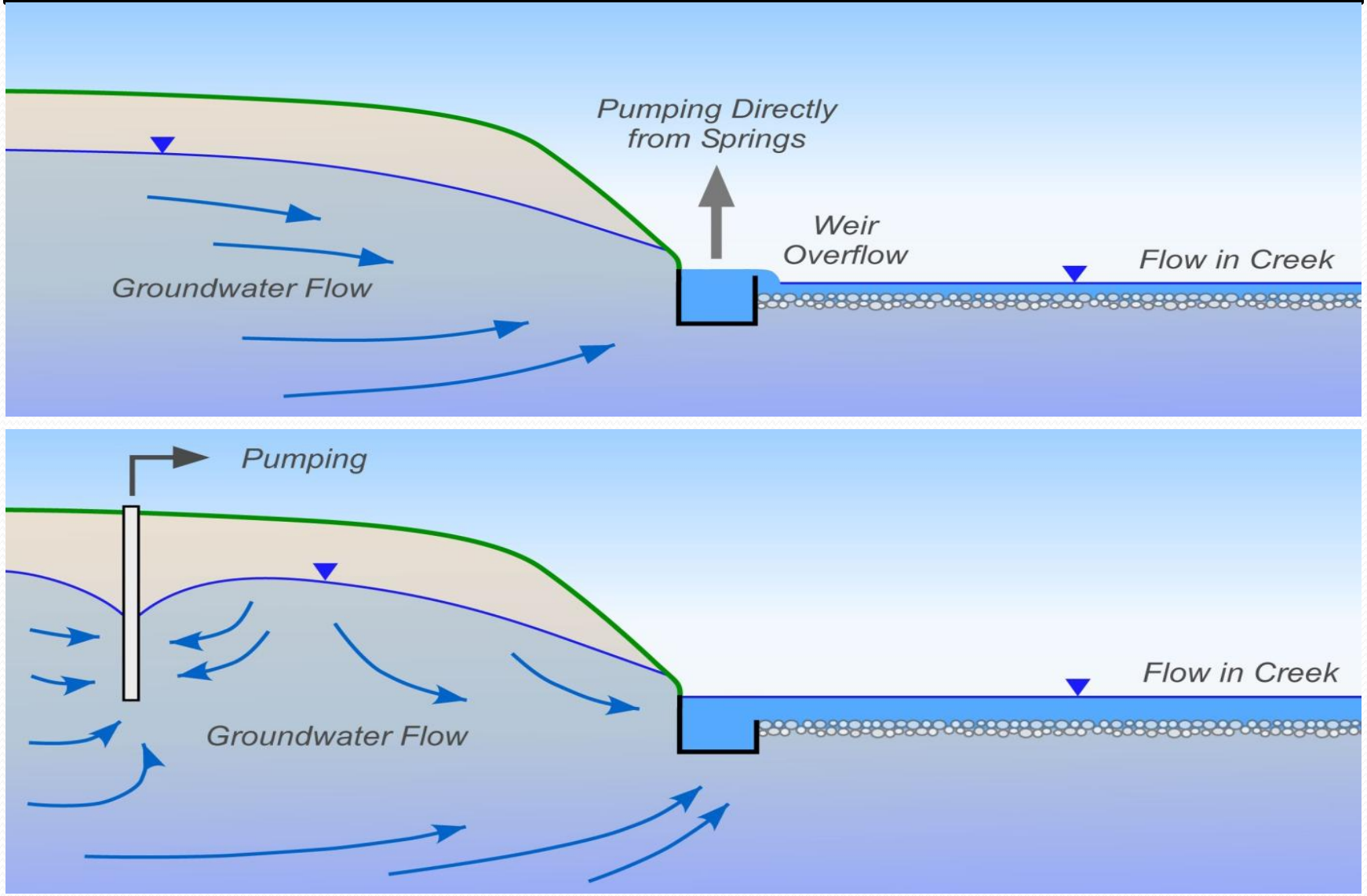
Model-Predicted Depletions for McAllister Basin

Application Phase	Annual Depletion (AFY)
Lacey Phase 1	52
Lacey Phase 2	172
Lacey Phase 3	240
Sub-total (Lacey)	**464**
Olympia Phase 1	(4864)
Olympia Phase 2	(581)
Olympia Phase 3	(1815)
Sub-total (Olympia)	**(7,260)**
Yelm (New Well)	**119**
TOTAL	**(6677 AFY) [or +9.35 CFS]**

McAllister Creek Mitigation

- **Long-term mitigation:**
  - To be provided after Olympia moves to the new McAllister Wellfield…when this happens, flows in the creek are predicted to improve by 9.8 – 16.9 cfs (4400 – 7600 GPM)
  - **SO** when Olympia completely terminates its withdrawals from the Springs there will be more than sufficient long-term mitigation for impacts predicted for all three cities.

Modeling Predicts Increase to McAllister Springs Discharge When Olympia Wellfield Developed



Model-Predicted Depletions for Nisqually Basin (including Yelm Creek)

Application Phase	Annual Depletion (AFY)
Lacey Phase 1	78
Lacey Phase 2	178
Lacey Phase 3	275
Sub-total (Lacey)	**531**
Olympia Phase 1	2585
Olympia Phase 2	309
Olympia Phase 3	965
Sub-total (Olympia)	**3,859**
Yelm (New Well)	**235**
TOTAL	**4625 AFY [or 6.47 CFS]**

Nisqually River Mitigation

- Area of model predicted impacts are primarily within the 15,000 foot reach upstream of RM 4.3 (where there currently is no flow gage) and where WAC 173-511 sets instream flow at 600 cfs (September 1-30).
- FERC requirements at Alder Dam can also be a factor during low flow conditions. Nisqually Tribe is consulted when Tacoma Power needs to adjust release from Alder Dam.
- Nisqually Chinook Recovery Plan states flow in lower Nisqually mainstem is not a limiting factor to Chinook recovery in the Nisqually Basin.
- **For Yelm Creek** – City of Yelm to increase discharge to Cochrane Park reclaimed water facility and coordinate with Nisqually Tribe on completing out-of-kind mitigation projects –
  - Yelm Creek channel restoration between 103rd Ave and 1st St.
  - Create continuous vegetated buffers along Creek
  - Install a stream gage on Yelm Creek
  - Remove riprap weirs at pipeline crossing

Model-Predicted Depletions for Deschutes Basin

Application Phase	Closure Period Depletion (AFY)	Winter Period Depletion (AFY)
Lacey Phase 1	11.13	2.80
Lacey Phase 2	32.21	36.26
Lacey Phase 3	44.77	51.68
Sub-total (Lacey)	**88.11**	90.75
Olympia Phase 1	60.49	66.68
Olympia Phase 2	11.17	12.31
Olympia Phase 3	21.40	23.59
Sub-total (Olympia)	**93.10**	102.58
Yelm (New Well)	**65.8**	64.9
TOTAL	**247.01**	**258.23**

247 + 258 = 500 AFY [0.7 CFS]

Deschutes River Mitigation

- Especially challenging – Deschutes is a narrow basin, flow at USGS Rainier Gage ranges from a low of 25-30 cfs in Summer to over 800 cfs in Winter.
- Lacey, Olympia and Yelm purchased two summertime irrigation water rights in the upper Deschutes Basin and will use these water rights for mitigation purposes
- Additionally, the three cities did a major land purchase and plan to do habitat restoration for out-of-kind mitigation

Deschutes River Water Rights Acquisitions

Water Right Certificate	Modeled River Reach	Qa	Qi
G2-26862GWRIS Ron Smith Ranch	Upper	**170 AFY**	**0.67 CFS**
S2-00972CWRIA Dillard and Juanita Jensen	Upper	**100 AFY**	**0.50 CFS**
TOTALS		**270 AFY**	**1.17 CFS**
Available to each City for mitigation credit		**90 AFY**	

Land Purchase and Habitat Restoration

The second major element of the Deschutes River Basin mitigation package involves the acquisition and restoration of farm land in the upper reach of the Deschutes River.

These projects will serve to offset predicted winter flow depletions in the river system.

This “non-flow” package will involve acquisition of nearly 200 acres of farm land, and restoration projects that will benefit the entire river system, including reshaping a tributary stream channel, replanting riparian buffers, installing a live cribwall along the river, and reestablishing a wetland on site.

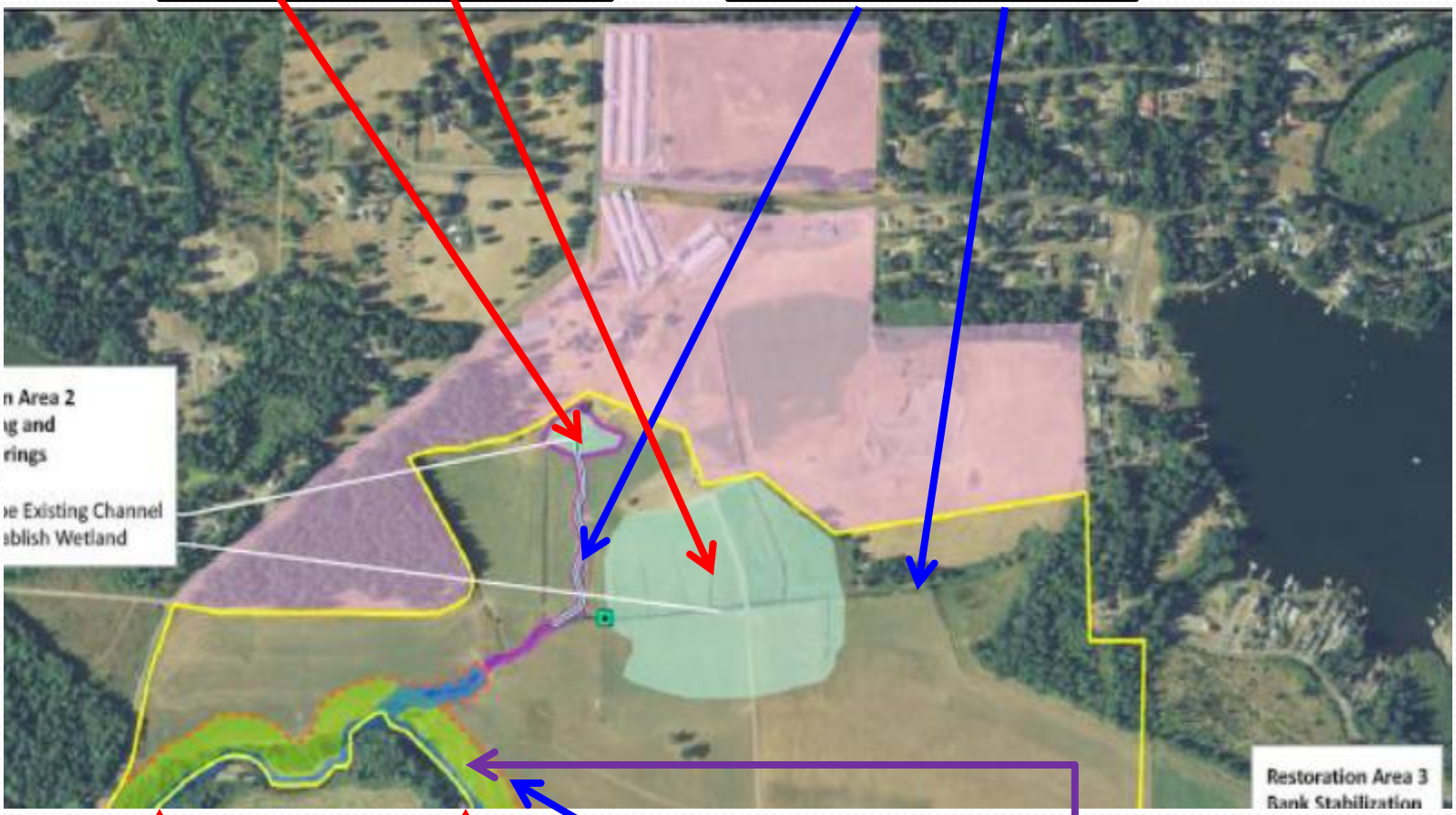
Smith Ranch

Lacey, Olympia and Yelm have jointly purchased 200+ acres of this ranch to conduct out-of-kind mitigation actions

Looking due East

Deschutes River - looking West

Out-of-Kind Mitigation at Smith Ranch



Estimated Mitigation Costs

Restoration Action	Estimated Cost Range
Property purchase/Termination of input animal waste to river	n/a
2A- Reshape existing channel from main spring	$350,000 - $575,000
2D- Re-establish wetland around smaller springs	$250,000 - $350,000
3A- Live cribwall along one eroded reach of Deschutes River	$50,000 - $75,000
4A-Replant high density 50’ riparian buffer and install buffer fence	$580,000
4B – Replant low density 50-200’ wide riparian buffer	$160,000
TOTAL	**$1,389,000 to $1,740,000**

Mitigation Successes

- Lacey, Olympia and Yelm will have small impact to the Lower **Nisqually River**, but minimum instream flows not reached due to Alder Dam "controlling" lower river flow
- Streamflow in **McAllister Creek** increases by 9.35 CFS
- Lacey and Olympia to mitigate impacts in the **Woodland Creek** Basin with development and operation of the Woodland Creek Reclaimed Water Infiltration Facility
- For the **Deschutes River**, the 3 Cities have negotiated a purchase/sale agreement with Smith Ranch with the ranch's 170 AFY irrigation water right of water and the Jensen Farm's 100 AFY irrigation water right
- All purchased water rights to be split 3 ways equally for respective mitigation credit in Deschutes Basin
- Ecology also invoked "Overriding Consideration of Public Interest" (OCPI) provision [**RCW 90.54.020(3)(a)**] since not all mitigation covered year-round pumping impacts from all of the new wells at full buildout

Ecology Decision

- Lacey, Olympia and Yelm's mitigation package as a whole that was proposed is acceptable for the submitted applications:
  - Lacey X 6 new applications
  - Olympia X 3 change applications
  - Yelm X 1 new application

- **Provision in each permit that the Cities are required to jointly submit an annual Mitigation Summary Report to Ecology by January 31 of each year, starting in 2013.**

Current Status

- **Olympia's** Water Right Change Applications:

  All 3 Permits issued

- **Lacey's** New Water Right Applications:

  All 6 Permits issued

- **Yelm's** New Water Right Application:

  Appealed to PCHB by 9 nearby property owners who reside outside city limits and have exempt wells - Ecology, Attorney General, Yelm and their attorneys following up on PCHB appeal. PCHB hearing scheduled for December 2012.

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Olympia's McAllister Wellfield Construction Presently Underway

New McAllister Wellfield


Souvenir
McAllister
Wellfield
Rocks
These glacial rocks come from 300 feet below ground. Please take one if you'd like!


13-9
13-10


CAUTION
CAUTION
CAUTION

Thank you

Contact Information:

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WASHINGTON STATE DEPARTMENT OF ECOLOGY