Apr 6th, 9:00 AM - 9:15 AM

Groundwater availability for summer low flows: co-production and shared application of hydrogeologic tools and information

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Groundwater Availability for Summer Stream Flows

April 6, 2018

Session 3.1.A: The Application and Creation of Knowledge that Leads to Action to Restore and Protect an Ecosystem

Rick Dinicola (presenter), Lonna Frans, Wendy Welch
US Geological Survey Washington Water Science Center
I am a river,  
The source or running water.  
I end at the sea.

Dept. of Ecology photograph, North Fork Stillaguamish River, courtesy of Steve Hirshey. Haiku by Davis Guest.
...but not so much about groundwater

From a permit-exempt well owner: “Just enough to supply my family home”
...but not so much about groundwater

From a farmer:
“Yes, a bit more, but I help to feed my community”
...but not so much about groundwater

Groundwater dreams of a salmon: “Stuff of life!”
...but not so much about groundwater

Or heaven forbid through the eyes of a hydrogeologist!
A shared understanding groundwater is a “wicked problem”

- Generally underground, out of sight
- Big ranges of space and time scales
- Complex language/jargon
- Unwieldy computer models
- Hard to illustrate how it flows
- Much conventional wisdom about groundwater is not wise...
  ...but true wisdom is difficult to gain!

**Today’s Goals**

- Garner interest in developing a shared understanding of groundwater in Puget Sound
- Describe USGS groundwater activities to facilitate such understanding through collaborative work with “science users”
Groundwater availability and summer stream flows

- Groundwater availability includes:
  - Quantity and quality of groundwater
  - Laws, rules, regulations, and socioeconomic factors
- It is intricately tied to availability of surface water
- Groundwater discharge sustains summer low flows
  Salmon spawn in groundwater!
- Groundwater also sustains municipal/domestic uses, irrigation, fish hatcheries, drought mitigation...
- Thus, groundwater availability is often at the core of conflict between water use and instream flows
USGS Collaborative Groundwater Studies in Puget Sound

- Chimacum Creek
- Subase Bangor
- Bainbridge Island
- Kitsap Peninsula
- Johns Creek
- Thurston County
- Lower Skagit Basins
- Puyallup Basin
- Chambers-Clover Creek
Regionalizing groundwater knowledge across Puget Sound

2016-0103 NTA - Groundwater Budgets and Summer Low Flows (in progress)

- Generate current and future GW budgets for all Puget Sound subbasins
  - Current and future (~2050) monthly recharge, pumpage, groundwater discharge, streamflows
  - Future reflects Δ population, land-cover, climate
- Identify relative resilience of summer low flows
- Collaborate with users how to best compile and deliver information
  - WRIAs or smaller? Uplands and lowlands?
  - Story Maps? Interactive website?

Looking for feedback!
Simple annual groundwater budgets

**Explanation**
- Height of bar is total recharge
- **Gray** = Pumpage
- **Orange** = Discharge to Puget Sound/Skagit valley
- **Blue** = Discharge to streams/lakes

**Lower Skagit Basins**

GW budgets with refined water use and discharge

**Explanation**

**Pumpage**
- All other wells
- Domestic wells
- Public Supply wells

**Discharge**
- to Puget Sound
- to Nisqually River
- to streams/lakes

### Refs:
GW budgets by individual aquifers (Kitsap Model)

- Requires a transient GW flow model (adds complexity)
- Water budgets (in-out-up-down) generated for each aquifer
- Pumpage assigned to specific aquifers, thus...pumping impacts for different aquifers simulated
- Changes in storage over time
- Highlights dynamics and exchanges between all aquifers and surface water

Ref: USGS Scientific Investigation Reports 2016–5052
Variation in annual GW budgets over time (Kitsap model)

<table>
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<tr>
<th>Year</th>
<th>Recharge</th>
<th>Discharge to SW</th>
<th>Total pumpage</th>
<th>GW storage</th>
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</tbody>
</table>

Refs: USGS Scientific Investigation Reports 2016–5052
GW budgets under Δwater-use & climate scenarios (Kitsap Model)

Percent Change in Monthly Freshwater Discharge to Streams

With +15% pumpage

With -15% recharge

Refs: USGS Scientific Investigation Reports 2016–5052
Next steps towards regionalizing GW knowledge

2018-20 Near-Term Action proposals

• Collaborative integration of GW budget data into ESSB 6091 (“Hirst fix”) watershed planning/restoration efforts

• Technical support for a Summer Stream Flow Implementation Strategy

• Streamlined modeling approaches focused on pumping and Summer Stream flows

ESSB 6091 Net Ecological Benefits Assessment Process

• More facilitating shared understanding of groundwater

Working towards a comprehensive model for the Puget Sound Regional Aquifer System
Conclusions

• Collaboration with users/stakeholders allows us to chip away at the “wicked problem” of groundwater

• Regionalizing knowledge helps inform where to focus protection/restoration of summer stream flows across Puget Sound

• Findings to date highlight that we are blessed with (relatively) abundant groundwater, but with equally abundant socioeconomic, legal, and cultural challenges

• With our reliable recharge and modest groundwater use, many options are available for sustainable paths forward
Thank you

Fish Trap Creek, Photo by Steve Cox