



THE SUMMIT

News From and For the Washington GIS Community

Pierce County PALS Aims to be Best Permitting Agency

By: Aaron Petersen

The Pierce County Planning and Lands Services department (PALS) uses an assortment of GIS technologies to help make decisions and assist customers. The mission of PALS is to “Deliver timely, consistent decisions and information to promote the development of better communities within Pierce County.” In order to fulfill this mission, PALS issues building and land development permits and provides property information. GIS technologies are used to help PALS staff in this effort, as well as making community planning and environmental decisions related to constraints and development.

What is the Best Permitting Agency?

To make PALS a more efficient department, an ambitious goal of “Creating/Being the Best Permitting Agency in the State” was established in early 2011. The program adopted to reach this goal is entitled Best Permitting Agency (BPA). One of the main goals of BPA is to improve the permitting process. This was to be accomplished by maximizing the deci-

sion making authority within PALS, improving customer satisfaction, and integrating more technology into the process.

The BPA effort included many improvements to the technology used by PALS staff and external customers. These improvements include changes to the department website, to the permitting software, and to the permitting database. Both PALS staff and external customers are now able to utilize online resources to accomplish basic land use and development business as well as look up property information. External customers can sign up to receive automatic updates regarding submitted projects.

Improvements were also made to the GIS data and software. Rapid updates of existing and new applications have greatly improved the availability of information to the external customer when researching an individual property. At the same time, edits to the underlying GIS data have improved the level of understanding by customers.

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President’s Column

By: Heather Glock

Welcome to the summer issue of **The Summit!** As I write this, we’re enjoying a long stretch of fantastic summer weather Washington-style (i.e., no humidity like in Minnesota where I grew up). I trust you are taking some time to enjoy it – it’s not hard to do given the abundance of amazing geography we have to enjoy here in Washington.

It’s been a couple of months since the annual Washington GIS Conference in Tacoma. You’d think we would take a bit of a breather after the event, but it’s been quite busy. Here are some of the things we’ve been working on:

As many of you know, our 2015 conference will be in partnership with the Oregon chapter of URISA next May. Plans are well

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Pierce County PALS Best Permitting Agency Effort

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Since the inception of BPA, PALS has made measurable strides toward reaching its established goals. Some of the internal benefits include: staff receiving fewer phone calls regarding status of a submitted project, 25% fewer costumers coming into the Development Center, and improved communications between county departments and other agencies. Benefits to the public include reduced trips to the PALS office by an estimated 36-50,000 miles a year, faster turnaround on information requests, and greatly improved access to information.

GIS Software within PALS and Pierce County

Within Pierce County government, the Information Technology Department, Applications and GIS Services (AGS), is responsible for the maintenance and creation of GIS packages/applications. AGS does this work with input from other county departments and external customers that use GIS. PALS is an end user of these packages for both staff and ex-

ternal customers. PALS staff makes use of three different software packages on a daily basis. The most advanced is an ESRI desktop product: CountyView Pro. This software is used for data creation and editing as well as creating custom maps. Most staff use a web-based application named CountyView Web for completing site-specific research relating to permits and projects. This package also allows users to quickly create a map from a list of preset map templates. Another application named Quickview, also web-based, allows staff to quickly look up and create a report featuring all of the mapped details of an individual property.

Pierce County's AGS has also developed two web-based applications that can be accessed by external PALS customers to retrieve information related to the same geographic information available to PALS staff. Customers can view information about a location of interest in either a tabular format or an interactive map service. For example, one can use these applications to determine the zoning of a parcel and if a wetland has been mapped on the property. The information is

accessed in About My Property (<http://yakima.co.pierce.wa.us/AboutMyProperty/>) or via Public GIS (<http://matterhorn3.co.pierce.wa.us/publicgis/>) directly from the Pierce County or PALS websites.

The first, About My Property (Figure 1), allows a user to look up a tax parcel and retrieve site-specific tabular information using links named "Tell Me More." The majority of PALS customers research existing property constraints, and how this might influence the development of the property. Therefore, of particular interest are the Current Zoning and Possible Site Constraints commonly referred to as Critical Areas. One limitation of this application is that the research area is limited to a single tax parcel at a time. If any Possible Site Constraints are found on the property, the customer has the option to click and get more information. The detailed description also includes a link to contact PALS staff and determine if further review or development proposal alternatives may be

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Figure 1. About My Property information return

Property Information for Tax Parcel 0320133700		Date: 06/25/2014
About the Property:		
Site Address	4213 PIONEER WAY E	Tell Me More
Range, Township, Section	Range 03E Township 20N Section 13	Tell Me More
Jurisdiction	Unincorporated Pierce County	Tell Me More
School District	SD #003 PUYALLUP	Tell Me More
Fire District	FPD #014 RIVERSIDE	Tell Me More
Community Plan Area	Mid-County Community Plan	Tell Me More
Current Zoning	Agricultural Resource Land	Tell Me More
Urban Growth Area	No	Tell Me More
Right-Of-Way Needs Area	Yes	Tell Me More
Traffic Impact Areas	TSA_3	Tell Me More
Transfer Development Rights	N/A	Tell Me More
Application/Permits	Yes	Tell Me More
About the Property's Natural Environment:		
Development Moratorium	No	Tell Me More
Marine Shoreline Salmon Habitat	No	Tell Me More
Open Space Corridors	OSIC, Salmon, DNR Hydro	Tell Me More
Shoreline Environment	No	Tell Me More
Possible Site Constraints:		
Aquifer Recharge Area	Yes	Tell Me More
Erosion Hazard	No	Tell Me More
Fish and Wildlife Habitat	PC Hydro, WDFW Fish Distribution, WDFW Priority Habitat and Species, WDFW Salmonid Stock Inventory, WDFW Wildlife Observation (point)	Tell Me More
Flood	Yes	Tell Me More
Possible Floodway	Yes	Tell Me More
Landslide	Yes	Tell Me More
Mine Hazard	No	Tell Me More
Seismic Hazard	Yes	Tell Me More
Volcanic Hazard	Yes	Tell Me More
Wetlands	County Flood Zone, FEMA Flood Zone, County Wetland, National Wetland, Hydrology, Hydric Soils	Tell Me More

Dick Thomas Award Winners

By: Sarah Myers, GISP

Three students presented their projects at the eighth annual Richard 'Dick' Thomas Memorial Student Presentation Competition and Award on Wednesday, May 14, 2014 at this year's Washington GIS Conference (May 12-14) at the Greater Tacoma Convention and Trade Center in Tacoma. The Washington State Chapter of the Urban and Regional Information Systems Association (WAURISA) established this award to honor Washington State GIS pioneer and mentor, Richard 'Dick' Thomas by continuing his work of encouraging students to excel in their studies and transition successfully into GIS careers.

This year's topics were quite diverse. Anna Yost presented her work in modeling and creating elk habitat. William Jonsen and Haley Duke discussed runoff volume in three Bothell watershed basins. And Emily Spahn and Sarah Shores demonstrated for the crowd their implementation of a tree inventory for Seattle Parks.

First Place: Anna Yost

Anna is a student at Central Washington University. Her project was done with the guidance and support of her Professor, Dr. Bob Hickey. Her project was titled "Modeling elk habitat suitability in the North Cascades."

Her abstract is as follows:

Abstract: The Washington State Department of Fish and Wildlife (WDFW) would like to adjust the distribution of elk on the landscape in the North Cascades to reduce negative impacts to private property while maintaining a healthy population of elk. Elk management goals can be achieved through a combination of practices, such as forage enhancement that encourage elk in tolerated areas, and fencing, hazing, and/or hunting of elk in areas of low tolerance. This project focused on mapping elk habitat suitability across the 8,000 km² North Cascades elk management area and then identifying potential areas of high elk tolerance which would be suitable for forage enhancement. GIS tools were leveraged to evaluate elk home ranges using Kernel Density Estimation, classifying key landscape vegetation parameters using satellite imagery, calibrating a custom elk habitat suitability model, and evaluating the landscape for potential elk forage enhancement locations. Outputs from the GIS analysis were communicated to WDFW and the Elk Forage Enhancement Working Group, a collaborative multi-stakeholder committee

who evaluates the predicted elk habitat suitability within the context of various resource management constraints. Landscape-scale elk resource management issues were quantified using GIS tools, and the realities of land ownership, land use limitations, seasonal variability, and the dynamic nature of elk herds were all considered in order to produce final recommendations for elk forage enhancement in the North Cascades.

Anna's prize included:

- Dick Thomas Award Plaque
- \$1000
- One year membership in WAURISA
- Free registration to the 2015 Washington-Oregon Regional GIS Conference in Vancouver, WA
- Publication of paper in *The Summit*

In addition, her professor, Dr. Bob Hickey, was awarded a cash prize of \$250.

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Dick Thomas Award Winners

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Second Place: William G. Jonsson and Haley J. Duke

William and Haley are students at the University of Washington, Bothell. Their advisor was Santiago Lopez, PhD and their presentation was titled "Flow accumulation and runoff volume of three watershed basins in the City of Bothell."

Their abstract and paper is published in this issue of *The Summit* following this overview.

The prize for second place was:

- Dick Thomas Second Place Award Certificate
- \$300
- One year membership in WAURISA
- Publication of paper in *The Summit*

Third Place: Emily Spahn and Sarah Shores

Emily and Sarah study at the University of Washington, and their paper was titled "Development of a Tree Inventory and Tree Data Collection Framework for Seattle Parks." Their advisor was Harvey Arnone.

Here is their abstract:

Tree inventories are useful tools for cities to monitor the current urban forest to meet future canopy goals, track maintenance history, assess wildlife habitat, plan work, document memorial trees, plan volunteer events, and assess tree values. Though the City of Seattle's Parks and Recreation Department [Parks] has a fair amount of data on existing trees in parks, the department does not have a tree inventory. For our student project, we developed a tree inventory and data collection framework for Parks.

Parks has started developing tree inventories several times, but no efforts were maintained, and only sporadic GIS tree data are currently available for Parks' trees. These past efforts highlight the importance of making a tree inventory simple to use by many people.

The project required the review of other tree inventories in the region, and we worked with the University of Washington, City of Seattle's Transportation Department, and Seattle Audubon Society to gather this information. We met with Parks staff, including arborists, GIS professionals and field crew personnel, to determine what data should be collected and to what level of detail.

We developed a framework for field work assignments and data collection, based on ArcGIS Online and Collector. We plan to test the system and tools by developed the inventory for a small Seattle park as a proof-of-concept.

Project deliverables will include a tree inventory which combines the data we collect along with that collected during earlier efforts, in addition to the mobile tool framework. We hope that we have made the tools straightforward and easy to use, and that Parks will adapt our efforts to their needs.

Third place prize was:

- Dick Thomas Third Place Award Certificate
- \$200
- One year membership in WAURISA
- Publication of paper in *The Summit*

Thanks!

Thank you to everyone who made the competition a resounding success. A big thank you to the students who submitted their abstracts and showed us the exciting things they are doing in the profession.

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Thank you also to the competition committee, Nick Hetrick, Molly Jackson, Winston McKenna, Jennifer Schmidt, Steve Schunzel, and Reuben Weinsilbourn. The committee helped me reach out to professors, review and update the competition rules, score the abstracts and finally attend the conference so they could judge the presentations. Without the committee, the students and dedication professors, the competition could not happen!

This year like others, the presentations were exceptional, and we were pleased with the turnout and dedication of the students. However, there is always room for improvement, and for finding new and different ways to encourage students. If you are interested in exploring how to improve the competition, or you're interested in being a judge for our next conference, please contact Sarah Myers, sarah@penlight.org.

We look forward to seeing you next year at the ninth annual Richard 'Dick' Thomas Memorial Student Presentation Competition and Award at the Washington-Oregon Regional GIS Conference (May 4 - 6, 2015) at the Hilton Hotel in Vancouver, WA. Student presentations will be Wednesday, May 6, 2015.



Sarah Myers (right) presents the Dick Thomas Award Plaque to first-place award winner Anna Yost.

Winner of Second Place Paper: Runoff and Flow Accumulation in Three Watershed Sub-basins in Bothell, WA

By: Haley Duke and William Jonsson

Abstract

This study combines vector overlay techniques and raster modeling within a geographic information system framework to analyze water infiltration and flow in three of the twenty-two watershed basins in the City of Bothell. Based on two year and one-hundred year maximum precipitation values during six hour periods for the greater Seattle area, and saturated infiltration rates for known surface soils and slopes, this study tried to specifically estimate runoff volumes and flow accumulation values for the Blythe Creek, Horse Creek, and Maltby Hill Creek watershed sub-basins in the City of Bothell. Results show that flow accumulation during a maximum rain event with a frequency of two years, when assessed as a function of rate versus total area of the basin, in Horse Creek basin experienced approximately 4x the amount of accumulation (per square foot) than Blythe Creek basin, and 1.7x the amount of accumulation (per square foot) than Maltby Hill Creek basin. The methods, data sources, and equations this study is based on can be used by the City of Bothell to complete run off and flow accumulation models of the remaining nineteen sub-basins in order to assess which areas are at a critical stage for intervention in case of a large scale rain event.

Introduction

The City of Bothell is located to the northeast of Lake Washington, within the Lake Washington/Sammamish watersheds (USGS Washington Water Resource Center, 2014), contributing through the Sammamish River. The city has been investing in a massive "Downtown Revitalization Project" aimed to update the town, improve traffic flow, improve infrastructure, promote tourism, and help make Bothell a *walkable community* (Downtown Bothell, 2011).

In addition to the revitalization project, Bothell has been working with students at the University of Washington on an environmental restoration project in North Creek Forest – just north of the University of Washington Bothell campus – to

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Pierce County PALS Best Permitting Agency Effort

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needed.

The second web-based application, Public GIS (Figure 2), allows a user to view most of this same information through an interactive map application. A PALS customer can view zoning, additional development information, possible site constraints, and wetlands. A user can also view aerial photographs and terrain when using the Public GIS application. An additional benefit is that a user can research information over a larger area than just one property.

GIS Updates and BPA

Implementation of the BPA program allowed PALS staff the chance to review how the GIS system (data and software) were supporting the permitting process. This review resulted in a number of improvements to both the data and software. AGS released the current version of Public GIS at the same time PALS was going through the implementation of BPA. This updated version provided PALS the opportunity to increase the number of datasets that were available to the public.

In the previous version of Public GIS, only a few datasets such as zoning and urban/rural designations were available to the public. In the new version, PALS was able to expand the list to include commonly requested items such as wetlands and related data, shoreline environments, and all possible site constraints.

Some of the GIS datasets were redesigned for improved symbolization and interpretation. For example, a new wetland dataset was created for the Public GIS application. PALS utilizes three different wetland surveys as sources to display and monitor wetlands. A new dataset containing all three inventories allows users to more easily determine if a wetland may exist and its official source.

At the same time as the Public GIS application enhancements, improvements were also made to the About My Property application. The largest change was reformatting the function known as "Tell Me More." This function is found on each returned line (Figure 1) in the table and is used as a key to access the results. An example of the reformatted "Tell Me More" result is found in Figure 3. This change has made the user query more comprehensive and understandable at the

same time. A user of About My Property can now determine if the parcel being researched has a history of land use or building permits. If there are previous permits, a direct link to the online permit website is provided. One last change made to About My Property is the ability to easily link the parcel and information being researched to Public GIS, where more detailed information on wetlands, for example, can be found in an interactive map viewer.

Results and the Future

GIS has played a vital role in achieving two goals of BPA: improving customer satisfaction and integrating more technology into the process. PALS customers can now retrieve a great deal of information via Public GIS and About My Property websites. Customers now save time, as fewer need to come in person to the PALS office looking for information

about a location of interest. If they have taken advantage of accessing these portals, they are usually more informed when contacting PALS staff to discuss a property. Since customers are finding more information online any time that is convenient to them, the PALS Development Center is less crowded. As a result,

PALS staff is more efficient in assisting customers applying for land use and/or building permits. External customers and PALS staff can now discuss geographic information over the phone while looking at this same mapped information through the same interface.

PALS will continue to make improvements to the GIS data and software as part of the BPA effort. PALS is currently working with the Pierce County IT department on making upgrades to the About My Property website. The application website will be branded to look like other Pierce County websites. Additionally, PALS is working to include additional pertinent information from the permit tracking software and database. From the "Tell Me More" link, a customer will be able to see detailed staff comments regarding items such as critical areas and zoning for a parcel the has previously been reviewed. Next, PALS is hoping to automate the creation of a dataset that will display and attribute permits as they are initiated.

Benefits to the public include reduced trips to the PALS office by an estimated 36-50,000 miles a year.



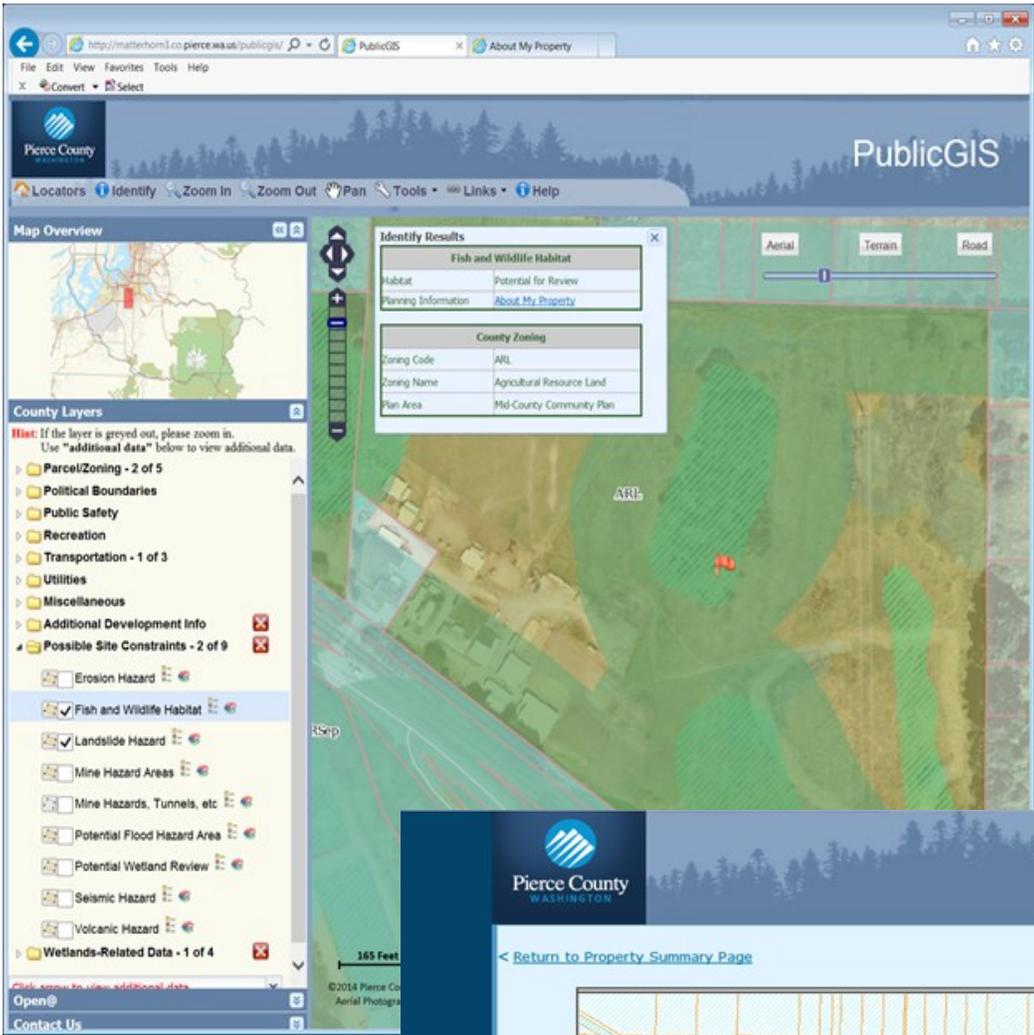


Figure 2. Public GIS window.

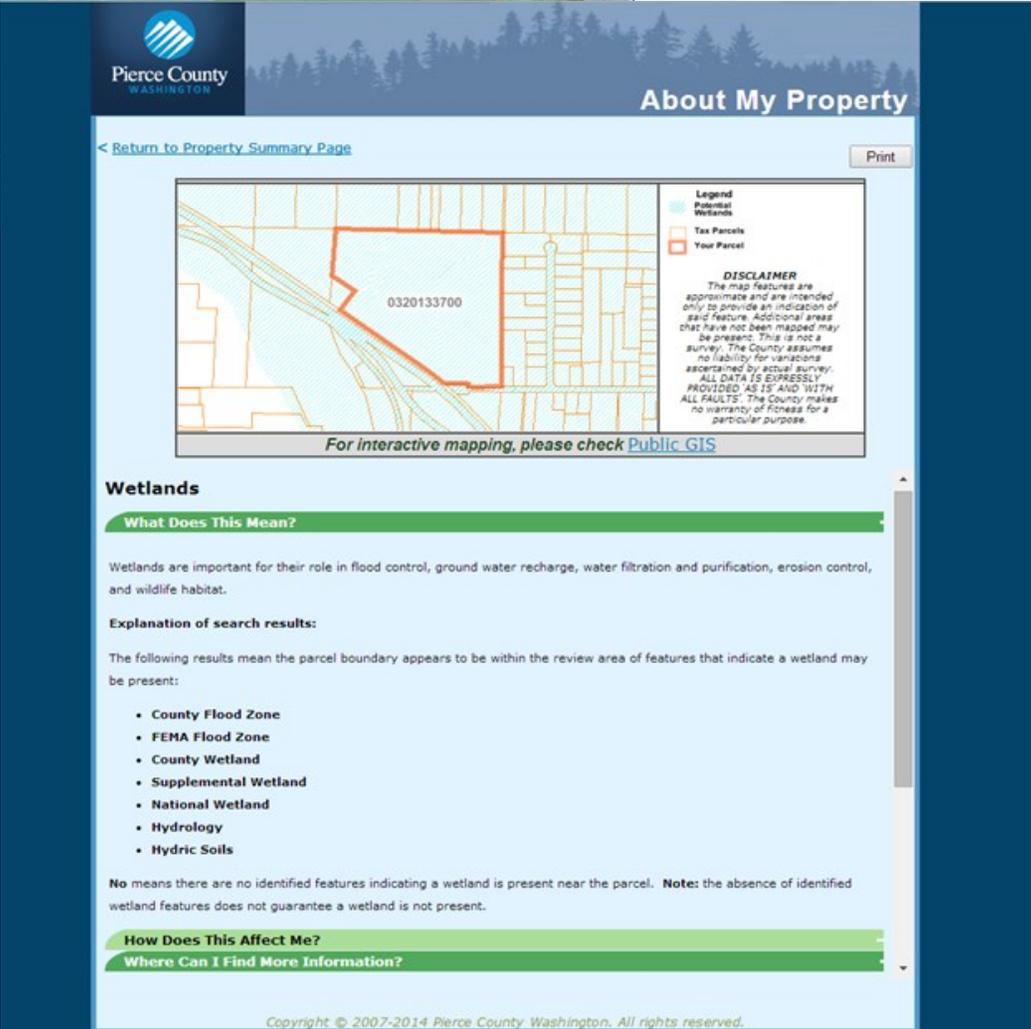


Figure 3. About My Property return of wetlands “Tell Me More”.

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WAURISA GIS Conference Outcomes

The 2014 WAURISA GIS Conference was held May 12-14 at the Tacoma Convention Center, thanks to the efforts of the Conference Committee led by Chuck Buzzard. Three submissions regarding the conference have been combined in this section: first you will find an overview of the Thought Leaders and Closing Session by David Howes, followed by the Board of Directors election results by Ian Von Essen and the Map Poster Contest results by Suzanne Shull. Congratulations to Dr. Sabah Jabbouri on winning The Summit Award—GIS Person of the Year. You can look forward to reading his story in the Fall issue of *The Summit*.

Thought Leaders and Closing Session - by David A. Howes

A primary goal for WAURISA's 2014 Washington GIS conference was to support the theme of *Communicating Our World* by trying out some approaches for encouraging greater communication and networking opportunities for attendees. One of these approaches was the inclusion of theme tables at lunchtime on the first day of the conference. A larger endeavor was the establishment of what we called a "Thought Leaders" group to help gather ideas and stimulate conversations related to the conference theme, with a particular focus on the three questions that were originally asked in the Call for Papers:

- How have you communicated the value of GIS to your organization or clients?
- How has your use of GIS supported a communication effort?
- How have you improved communication between participants in your GIS projects?

As well as compiling ideas from direct conversations and presentations, we also established a "Contribution Collection Station," where attendees could record their thoughts on easel pads, rate the comments using sticky dots, and discuss the points that were raised. The Thought Leaders then helped orchestrate a new closing discussion during which contributions to the conference theme were summarized and the audience was invited to elaborate on the summary. The make-up of the group and the results of the exercise are presented below. Since this was the first time we'd tried the approach, reflections on the process itself are also included and may serve to help others who wish to implement something similar at future events.

The Thought Leaders

The following individuals kindly agreed to be members of the Thought Leaders group:

- Breece Robertson - National GIS Director, The Trust for Public Land and conference keynote presenter
- Geoff Almvig - GIS Manager, Skagit County

- Stephen Beimborn - GIS Manager, Seattle Public Utilities
- Tami Faulkner - GIS/IT Supervisor, Thurston GeoData Center
- Parker Wittman - GIS Manager, Aspect Consulting, LLC

Discussion Topics

As it turned out, contributions to the conference theme from the collection station, presentations and discussions often spanned more than one of the three theme questions listed above and typically related to two of them. It made sense, therefore, to frame our closing discussion in terms of general topics rather than the three questions themselves.

Four general topics were identified to provide the foundation for the discussion:

- Standards and Best Practices
- GIS Turf Wars
- Becoming the GIS Yoda
- Education and Interaction

The Thought Leaders developed summary slides to introduce each topic and seed audience participation in the closing discussion. We allowed ten minutes of discussion time per topic and all participants were asked to state their name and organization to provide some context for their thoughts. The seed points and a brief set of responses are provided below (with the responses treated anonymously out of respect for the participants). Without the context of the full discussion, some of the points may be a little unclear, but I'm sure fellow attendees would be willing to elaborate. The goal of the whole exercise is, after all, to encourage positive interaction.

1. Standards and Best Practices

Conversation seed points from initial attendee contributions

- Retaining/fostering institutional knowledge
- Mentoring
- Documenting business needs/practices

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WAURISA GIS Conference Outcomes

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- “Don't do this” list
- How do you prioritize your work?
- Importance of project management

Closing discussion responses

A mentor/mentee database would be helpful

Washington now has a “Women in GIS and Technology” group, which was active at the conference, promoting, for example, networking and personal branding (the topic of a session in the GIS Communication track)

Prioritization:

Use the food chain approach - address the most important items first

Meet as a team and assign priorities, apply executive decision making

Ensure good communication - always ask if in doubt

“Duke it out” - conduct an ROI evaluation, use facts and data to make decisions

Documenting: adopt a wiki approach

2. GIS Turf Wars

Conversation seed points from initial attendee contributions

- Cease-fire? Earned 10 dots at the Collection Station
- Bomb away? Earned 3 dots

Closing discussion responses

IT people tend not to be knowledgeable with respect to GIS - a combined GIS/IT degree program may be helpful (and could be in development locally)

Some have had a good experience with IT staff

From a former school teacher and IT person who taught applications: Application users tend to be IT-ignorant, IT people tend to be application-ignorant

It's a matter of understanding others; e. g., IT people, from their perspective, need to take time to “cross the tracks”, it's a learning process, “walk a mile in their shoes”

From someone who has worked with CAD, IT etc. for many years: Took CAD and surveying classes, very helpful in understanding others and their needs

Need to move beyond simply describing turf wars and look for positive ways to resolve differences

3. Becoming the GIS Yoda

Conversation seed points from initial attendee contributions

- What does it mean?
- What should they do?
- Educate others about GIS

Avoid esoteric GIS jargon

Create metadata and documentation

Facilitate interagency cooperation

Closing discussion responses

What is meant by “yoda”? The master, teacher

Yoda translated knowledge, helped get past struggles

Need to keep language simple enough

Help get people over difficult hurdles

“GIS therapy:”

Ask participants in a project what's the most important thing for them and listen carefully

Consider time, image and cost in assessing suitable responses (from Don Barden's book *The Perfect Plan*, referred to in the *Keys to Independent GIS Consulting* session)

From a 911 manager who's visited all 39 counties: continually looking for “yoda” skills in local offices



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David Howes (far left) moderates the Thought Leaders at the Closing Session (L-R:) Stephen Beimborn, Tami Faulner, Geoff Almvig, Breece Robertson, Parker Wittman

Maps are very helpful in creating “a-ha” moments, people quickly see their value

4. Education and Interaction

Conversation seed points from initial attendee contributions

- What GIS-related skills are
- Well addressed in education?
- Not well addressed in education?
- How do you replicate/build on the value of conferences within your organization?
- How can we enhance communication with/between executives and elected officials?

Closing discussion responses

Need new presentations and required skills

From a part-time GIS analyst:

See IT needs in a lot of GIS job descriptions

Feel unqualified because many jobs are increasingly becoming IT-/web-based

May be a problem for “middle-agers”

From a certificate program student: Most jobs require a bachelor-level degree

It would be helpful if GIS hirers would communicate with Human Resources departments to explain what’s really required, which may help them realize the value of certificate programs

URISA is working on promoting the value of certificate pro-

grams at the national level and developing educational standards

A GIS career demands lifelong learning - instead of “conferences,” it may be better to refer to events as “symposiums” or something that expresses “learning opportunities” (i.e., professional development)

Become a GIS evangelist

Expand on the GIS “fan base” - introduce GIS to a broader audience

From a GIS educator: Talk to non-GIS professionals and get them excited about the technology and how they can use it

Create vertical career opportunities

There is no single “vanilla” GIS flavor, accept diversity

From a GIS educator: At San Diego State University, GIS professionals served as course advisors and presented on topics such as how to find a GIS job

GIS should be a standard class in K-12 programs

Leverage the holistic nature of GIS

Deliverables

An important goal for the closing discussion was to develop a set of deliverables in the form of short statements that, ideally, summarized key positive points from the conference con-

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WAURISA GIS Conference Outcomes

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versation on communication and would serve as a basis for positive action within the GIS community. The following statements were identified with support from the attendees:

- Walk a mile in their shoes
- Create an inspiring teachable moment
- Be a mentor to the education community

If everyone who attended the discussion or reads this article were to take steps based on one of these statements, our GIS community would benefit significantly. The statements also provide a basis for ongoing interactions to consider how well our efforts are working and how we can expand the set to include other positive intentions. Ideally, this will extend the spirit of the conference well beyond the closing discussion and make a strong and positive difference for everyone involved.

Reflections on the Process

In general, the Thought Leaders idea seemed to work reasonably well, especially for a first attempt. As always, there is room for improvement and the following comments may be helpful to anyone wishing to extend and develop the approach.

After a slow start, the amount of activity at the Contribution Collection Station grew rapidly. For a two-day event, however, an earlier push for contributions may help to maximize the value of the approach.

It would have been valuable to have included greater involvement by the Thought Leaders themselves in the closing discussion. We were keen to encourage as much audience participation as possible, but the discussion might have benefited from their comments.

Generating audience interaction was slightly difficult to begin with and it was a little awkward having to choose someone to start the conversation, but it wasn't long before we had a healthy conversation under way.

From the post-conference survey responses, some appreciated the Thought Leaders concept and enjoyed the closing discussion and some were ambivalent, although the general response seemed to be favorable.

As with all other aspects of the conference, this was entirely a volunteer-led activity and we are grateful to those who complimented us on our activity and provided help. Any suggestions for improving this sort of activity are most welcome, but please be prepared to help us develop better ideas and enhance the overall experience for you and your fellow GIS professionals accordingly. Your contribution will be appreciated.

WAURISA Board Election Results - by Ian

Von Essen

The 2014-2015 WAURISA Board of Directors is shown in the table below. An asterisk indicates the individual was elected at the 2014 Conference.

Position	2014	Election Year	Time Remaining in Term
President	Heather Glock	Odd	1 year
Vice President	Ian Von Essen	Odd	1 year
Secretary	Sarah Myers	Odd	1 year
Treasurer	Don Burdick*	Even	2 years
Past President	Ann Stark	Odd	1 year
Board position 1	David Howes	Odd	1 year
Board position 2	Dana Trethewey	Odd	1 year
Board position 3	Josh Sisco	Odd	1 year
Board position 4	Josh Greenberg*	Even	2 years
Board position 5	Renee Quenneville*	Even	2 years
Board position 6	Cort Daniel*	Even	2 years

Map Poster Contest Results - by Suzanne Shull, GISP



At the 2014 WAURISA conference, attendees voted for the winners of the ever-popular Map and Poster Contest, run by Suzanne Shull. The winner in each category received a \$50 gift card from Amazon.com.

Category	Winner & Map Title	Map Description
<p>Best Cartographic Design: Judging criteria: Efficiency in communication of intended message and maximization of the user's cognitive experience.</p>	<p>Patrick Jankanish, Tahoma School District "Stormwater Neighborhood Atlas"</p>	<p>The Tahoma School District Stormwater Neighborhood Atlas, a Client Services project of the King County GIS Center for, and in collaboration with, Sustainability Ambassadors, uses expressive maps along with inspiring text and photographs to engage and ultimately involve readers in actions that can protect, preserve, and improve the world around them. As part of a tool for both classroom and community, the maps provide geographic context and reveal environmental characteristics for the district schools and their neighborhoods. As works that are visually and intellectually stimulating, the maps communicate compelling, curiosity-arousing perspectives on the school district's world.</p>
<p>Best Analytic Presentation: Judging criteria: Communication of the problem/project to be solved and presentation of the analytic procedures.</p>	<p>Emelie Healy, Stormwater Infiltration Feasibility of the Miller-Walker Basin: Communicating Results, Guiding Progress</p>	<p>What is stormwater infiltration and how can we identify and communicate where opportunities exist for stormwater retrofit projects? The Miller and Walker Creeks are located in King County and drain into Puget Sound in the City of Normandy Park. The aquatic habitat in the creeks is highly degraded due to urbanized hydrology, down-cutting, road crossings, outfalls, channelization, and lack of native vegetation. Stormwater retrofit projects, with strong reliance on low impact development (LID) elements, are necessary in order to improve the streams more quickly.</p>
<p>Best Data Integration: Judging criteria: Relevance and select variety of chosen data sources (surveying, remote sensing, GPS, etc.) and data formats (raster, vector, text, etc.) to the problem-solving and mapmaking processes.</p>	<p>Liz O'Dea, Conceptual Model of Oil Movement In and Out of Washington State</p>	<p>This map displays the movement of crude oil from Canadian oil sands and North Dakota/Montana Bakken shale via railroad and pipeline through Washington State to refineries and export terminals.</p>
<p>Best Online Interactive Map: Judging criteria: Clear, effective design to maximize user understanding and experience of map interaction and application usage.</p>	<p>Janice Baird, Skagit County iMap</p>	<p>iMap allows interactive viewing of Skagit County geographic information. A simple set of tools allows users to "quickly" view different maps, such as, property, crime, aerials and much more. A strong set of search tools makes it easy to navigate to an address, parcel id number, or street.</p>

King County GIS Center Helps Youth Sustainability Ambassadors Engage Community

By: Greg Babinski, GISP

Sustainability Ambassadors is a non-profit organization empowering youth to catalyze community sustainability. Founded in 2012 by long time educator and strategic storyteller, Peter Donaldson, Sustainability Ambassadors is an innovative youth leadership program training exceptionally self-motivated young people (ages 13-21) as skilled ambassadors capable of tracking and communicating improvements in sustainable community conditions across generations and community sectors.

With funding from the State Farm Youth Advisory Board for a “Stormwater Pollution Solutions” student service-learning grant, Peter approached the King County GIS Center with the idea for a sustainability-themed atlas comprised of multiple stormwater indicator maps for the Tahoma School District in suburban King County: a “Stormwater Neighborhood Atlas.”

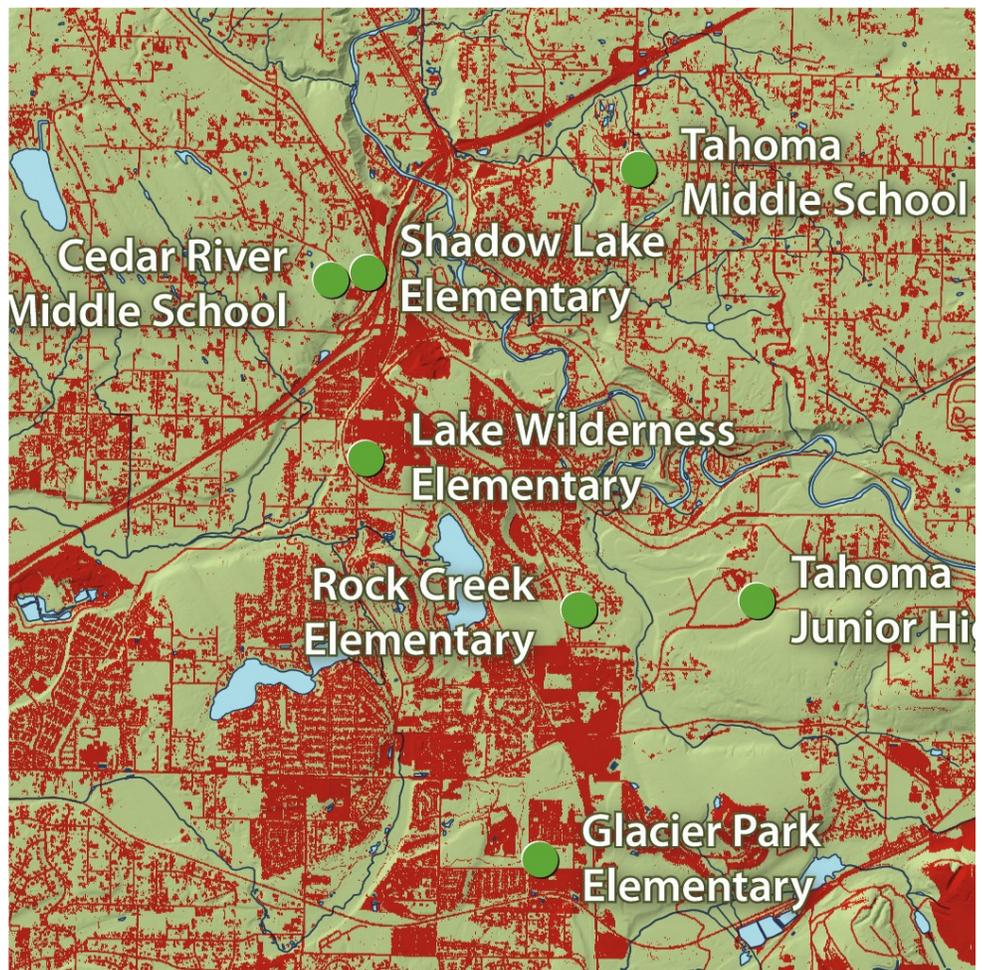
The atlas would serve as a community outreach tool to show students and the broader community the environmental conditions of their neighborhoods. The atlas would also highlight unique projects to restore and enhance the environment at the district’s own school sites, such as pervious pavement installation and rainwater harvesting.

Local student Sustainability Ambassadors are working with the school district, the Chamber of Commerce, the Rotary Club and the City of Maple Valley to distribute the Stormwater Neighborhood Atlas in appropriate classrooms throughout the district, in the public library, and for casual viewing in doctor and dentist waiting rooms and in the lobbies of other public spaces from coffee shops to city halls. The school district benefits by using the atlas to teach about stormwater pollution solutions through geography. The city benefits by using the atlas as a tool for educating property owners in neighborhoods related to each school campus about best management practices for reducing polluted runoff on site. This

helps the city meet their NPDES Stormwater Permit obligations for public education and outreach.

The process of engaging the community and producing the Tahoma School District “Stormwater Neighborhood Atlas” was designed from the beginning to be replicable for additional school districts and community groups throughout the Puget Sound region. As the Sustainability Ambassadors program engages with more communities, the intention is to create additional atlases that are similar in nature to the Tahoma atlas, but that are customized to each community’s unique geography and environment. The King County GIS Center’s process is designed to accommodate additional community groups as they partner with Sustainability Ambassadors.

The King County GIS Center’s unique cartographic and de-



Sample Atlas Page showing schools and impervious surface.

sign capabilities, and its direct access to King County's extensive GIS data resources, were invaluable to this project. The KCGIS Center is known for its ability to produce high-quality cartographic products. While GIS software can be used to generate maps, the KCGIS Center has developed processes to employ GIS data, GIS and graphic arts tools, and decades of design experience to create exceptional maps. Sustainability Ambassadors desired an end product that would be not just utilitarian but also beautiful, and could thus inspire the community as they embarked on environmental restoration projects. The KCGIS Center's special talents were essential in this regard, as was the hands-on design collaboration that occurred between the King County GIS Center, Mr. Donaldson and the Sustainability Ambassadors student team.

The "Stormwater Neighborhood Atlas," both intrinsically and as an example of a collaborative effort, demonstrates the KCGIS Center's ability to successfully partner with community groups to create beautiful and unique products with an eye toward the future.

View the digital atlas here: <http://www.sustainabilityambassadors.org/stormwater-atlas>

For more information about the King County GIS Center, see: www.kingcounty.gov/gis

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Spring GIS Events Roundup

Editor's Note: Spring has been a busy time for GIS events both near and far. This section includes the following event overviews: Hexagon International Users Conference by Ivar Husa, APCO-NENA 911 Conference by Khalid Khan, Green River Community College GIS Presentations by Heather Glock, and Washington Women in GIS and Technology by Tonya Kauhi.

Hexagon International Users Conference: HxGN Live 2014 - by Ivar Husa

At HxGN Live 2014, GIS professionals, engineers, metrologists, and others met in Las Vegas to share information, attend technical training, and meet vendors. The scale of the event seemed rather enormous to me, as it involved over 4,000 participants from around the globe.

Hexagon is a global conglomerate with arms that engage with smaller enterprises, such as public safety (my area) to huge ones such as supertanker construction and open-pit mining. Creating and managing spatial data was a significant component of the event.

The theme of the event was *Creating Great Stories*, and the CEOs addressing audiences emphasized the value of interacting with one another. By getting to know one another, we

have the opportunity to be inspired to find breakthrough solutions. Though technical tracks put people into seats to hear presentations, organizers set aside blocks of time each day specifically for interaction. Rubbing shoulders with peers is a great way to expand one's horizons.

I met people from such far-flung locations as South Africa, Germany, and Great Britain, but *my* most meaningful interactions were with GIS professionals from Public Safety Access Points from around the country. GIS folks from at least four Washington counties were in attendance.

I had an extended conversation about new energy technology with a Los Alamos scientist building a 100MW heat exchanger having supercritical carbon dioxide as coolant. How 'cool'

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Hexagon International Users Conference: HxGN Live 2014 - by Ivar Husa

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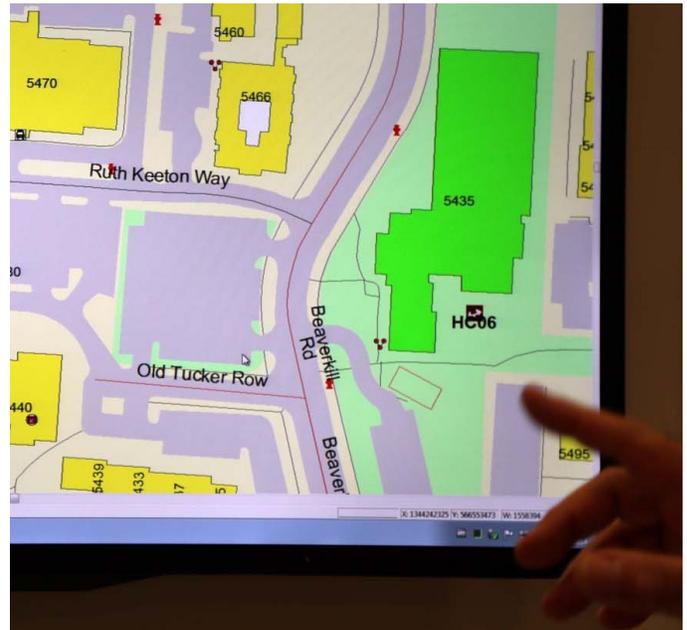
is that?

Mobile Apps and The Cloud were probably the technical themes that spanned the broadest range of companies and products in attendance. Almost everybody wants to take advantage of the computing capacity of our smart phones.

The showroom floor was littered with whiz-bang tools and props. One metrology company touted their surface contour capturing tool, demonstrating it over a Tesla Model S, all-electric sedan. Its optical sensing approach gathers data in 4" wide swaths, where competitors would drag a stylus to capture a line of measurements instead.

Another exhibitor let you navigate through LiDAR-generated scenes from a Mayan temple via novel software using a game controller or Wii. On a related note, one of the more inspiring exhibitors was [CyArk](#). These people aspire to digitally preserve world heritage sites, before they are erased from the earth. They plan to have 3-D scanned 500 world heritage sites in a period of 5 years. They are seeking partners to contribute expertise, time, and or money to digitally preserve more sites.

This convention helped me look at the world through a wider-angle lens as well as develop specific skills I can use supporting my 9-1-1 dispatch center. I plan to attend next year. See you there?



Public safety is my 'beat'. Mappers showed their work.



Total Station and scanning surveying equipment (3-D), with the latest features and software were being demonstrated by many vendors. One vendor showed a perhaps improbable vehicle-mounted LiDAR.

I like to evaluate the success of a conference experience not by the number of presentations I attended but by the quality of the presentations themselves. This year's Public Safety Communication Conference of the Washington State Chapter of APCO/NENA in Kennewick was definitely a quality experience.

APCO (Association of Public-Safety Communications Officials) and NENA (National Emergency Number Association) are international agencies that present their members' views before communications regulatory agencies and policy-making bodies. GIS plays an important role in Public Safety communications, and this role will increase with Next Generation 911 (NG-911).

The GIS tracks were educational and informative. I listened to presentations on GIS data development for (NG-911), statewide GIS data collection requirements, and was able to participate in a question and answer session regarding the work the State 911 Office is doing to help coordinate GIS data development statewide. I also had plenty of opportunities to

interact with the GIS professionals that were presenting at the conference before and after their presentations. This was especially important to me since opportunities are little bit more limited at a national level conference where there are so many more attendees. The vendors were knowledgeable, inviting and professional when it came to marketing their hardware, software, and E-911 services.

From the presentations, I got a good understanding of the work that is being done at the national and local levels towards GIS data development for NG-911. Overall I found the conference productive, meaningful and the perfect venue to meet with some of the GIS professionals I'd previously only met on conference calls. Topics of discussion included address point collection, PSAP (Public Safety Answering Point) polygon boundaries, edge matching and wireless sector coverage areas.

In some of the cases I realized how perspectives differ depending on which side of the mountains you live on. But

(Continued on page 19)



2014 Northwest GIS Users Conference

“Working Across Borders”

October 13 – 17, 2014 | Lynnwood, Washington

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Keynote Speakers

Dr. Dominique Bachelet | Senior Climate Change Scientist at the Conservation Biology Institute, Associate Professor in the Dept. of Biological and Ecological Engineering at Oregon State University & former Director of Climate Change Science for the Nature Conservancy.

David DiBiase | Leader of the Education Team within Esri's Industry Solutions Group. Founded and led the Penn State Online GIS Certificate and Masters (MGIS) degree programs.

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Washington State Chapter of APCO-NENA Conference - by Khalid Khan

(Continued from page 17)

however perspectives may differ, our common goal is to work towards a statewide NG-911 system that can route 911 calls using GIS data. Much work is being done in WA State related to NG-911 GIS data development, more still needs to be done - especially for areas in the state that need financial and technical assistance to help them catch up to NG-911 standards. It is no small task to build a statewide NG-911 GIS data system for call routing amongst 39 counties with various levels of GIS functionality. Representatives from the State 911

Office and members of the state NG-911 GIS Subcommittee who were present at the conference got an earful about what some of the frustrations are with GIS data development, maintenance, financing and professional GIS support in areas of WA State where GIS technology and expertise is limited. Chapter conferences like APCO/NENA give us opportunities to work together, discuss, identify, resolve and offer our services to one another for solutions that some of us have resolved and other will experience as we move towards NG-911 statewide.

Green River Community College GIS Student Presentations - by Heather Glock

Green River Community College (GRCC) held its 6th edition of graduating GIS Student project presentations on the afternoon of June 12, 2014. I was lucky enough to be able to attend several of the presentations. Joining me were a handful of other GIS professionals, GRCC administration staff, and non-program students interested in seeing GIS technology applied to the real-world.

This event was well-organized (including a delicious lunch!), and portions of it were filmed by a student videographer. Students presented on projects ranging from analysis of campus population demographics to the history of the fur trapping industry across North America. Their project work benefited departments within the college as well as outside interests. Presenters came from backgrounds ranging from Running Start Program, worker retraining, advance degree holders, veterans, as well as traditional college students.

Every presentation was well-prepared, invited questions, and shared the humor *and* frustration that comes along with doing project work. Though a scheduling conflict meant I wasn't able to see all of the presentations, highlights from those I did see included:

Henry Isenberg, a Running Start student, studied demographic analysis to benefit the college's Institutional Research Office. He was approached by the director of institutional research, Cynthia Requa, and asked to help analyze demographics of current enrollments along with those of the

college's service area in order to find areas for increased outreach to attract new students. Henry's work will be carried forward next fall by new students entering the program.

Joshua Prescott, a Navy veteran, developed a data model and used it to field-inventory the campus stormwater system. His colleague, Scott Nickels, did the same for the campus natural gas network. For the first time, the college facility department has access to this information digitally as a network dataset. Under the guidance of Rob Huxford, a program graduate now employed by the campus facility department, the work

these two students did has significantly increased the facilities department's maintenance and planning efficiency.

Vanessa Sawyer, a photogrammetrist graduating the program as a worker retraining student, also used 3D analysis to show the interesting relationship between City of Renton hazard areas and

new housing developments on the waterfront. Her analysis indicates people seem willing to accept the trade-off of living in beautiful new housing with water views even though the housing is sited adjacent to hazard areas (e.g., old chemical sites) that may pose a health risk.

Kenneth Liesse, another worker retraining student, shared ground-breaking work for the campus Aviation department using 3D GIS to help aviation students understand airspace classifications. Using his work, the students are now able to understand these airspace concepts in half the time it used to take when the lecture methods used paper and 2D illustrations.

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Kenneth Liesse used 3D GIS to help students understand airspace concepts in half the time it used to take.

Green River Community College GIS Student Presentations - by Heather Glock

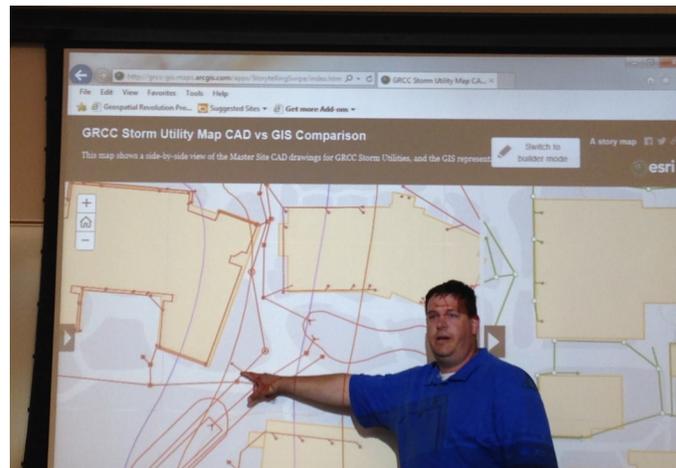
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Mary Lotfield, a Master's student, presented her work done on behalf of local author Joy Keniston-Longrie, mapping the history of the North American fur trapping industry. Mary's maps will be featured in Keniston-Longrie's book on the subject.

Aside from their curriculum workload, the GIS program students also belong to the college's GIS Alliance, where they work with area high school and middle school classes to introduce students to the geospatial industry. This adds an enriching dimension to their studies, and hopefully, this outreach will result in some of these middle and high-school students eventually becoming GIS students at the college.

The Green River Community College GIS program has been led by Dr. Sabah Jabbouri since 2006. Sabah has worked tirelessly with the advice of a GIS Advisory committee to turn out well-educated GIS analysts using modern GIS technologies and current analysis methods. Most of his students graduate with job offers in place, or plans to continue their education by applying their GIS education to their major. In addition to running the program, Sabah spends time advocating

for colleges across our state to recognize introductory GIS classes as a requirement for degree completion regardless of major, as is done with English and math courses. Sabah was the recipient of WAURISA's Summit Award this year. We wish Sabah and all of his students many years of continued success!



GRCC student Joshua Prescott explains his stormwater system inventory results.

Washington Women in GIS and Technology - by Tonya Kauhi

What has the Washington Women in GIS and Technology (WWGT) group been doing this spring?

In May numerous members of WWGT group attended the WAURISA 2014 Washington GIS conference. Thanks to the coordination of Amanda Taub, we gathered for a breakfast meeting on the second day of the conference where over 25 women including Breece Robertson, the National GIS Director for The Trust for Public Land and the conference keynote speaker, started the day together. Several WWGT members also presented at the conference. Jennifer Radcliff (Port of Tacoma) participated in a panel with other GIS coordinators to discuss GIS communication. Renee Quenneville (Pierce County) discussed asset management using ESRI's Collector application. Heather Glock (ESRI) participated in a session about Data Visualization. Joanne Markert (Leon Environmental) and Maria Sevier (NW GIS Consulting) participated in a panel on GIS Professional Networking and Business Building. Amber Raynsford (The Watershed Co.), Tonya Kauhi (GeoEngineers, Inc.) and Christina Gonzales (GeoEngineers, Inc.) presented a session on Personal Branding.

At our June meeting, Jason Taylor (Floyd!Snider) provided an interactive demonstration of Python, ArcGIS, and a handful of open source tools (such as GDAL) to develop raster-based modeling and interpolation processes. GeoEngineers hosted the event at their Tacoma office.

The Washington Women in GIS and Technology group was created for South Puget Sound women working in GIS and technology to meet, network, brainstorm and learn from one another. The group meets quarterly.

The group has recently expanded beyond the South Puget Sound; in fact during our last call, we had one person call in from Spokane. And it is not just for women anymore; we have had interest from a couple of men wanting to participate. Although our group was started by women who share the GIS profession, whoever shares this interest is welcome to join.

Please join us for the next meeting scheduled for Wednesday, August 13th, 2014 at the GeoEngineers Tacoma office; 1101 South Fawcett Ave, Suite 200, Tacoma, WA, 98402.

Follow us here on [LinkedIn](#).

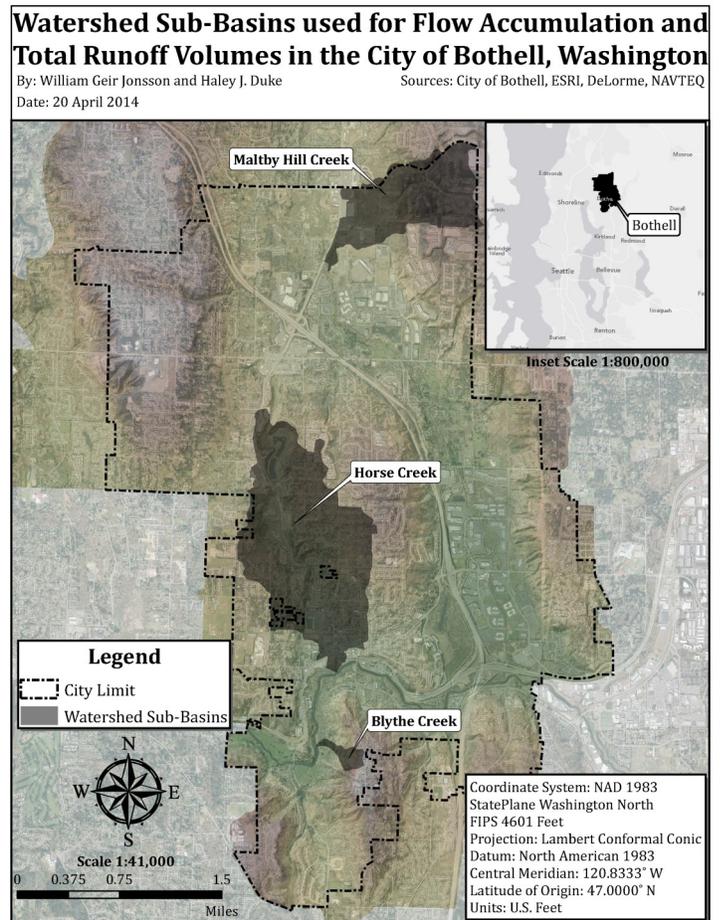
Winner of Second Place Paper: Runoff and Flow Accumulation in Three Watershed Sub-basins in Bothell, WA

(Continued from page 5)

help encourage indigenous species to continue living in the area, and to improve connectivity to the various animal communities near the I-405 corridor. Community partners (Friends of North Creek Forest, 2013) and university students have also been assisting the city by performing stream health assessments along North Creek and its tributaries, and surveying slope degradation in Queensborough/Crystal Creek. Some of the programs at UW that have assisted the city include the UW Restoration Ecology Network, the Hydrogeology, Geomorphology and GIS classes at UW Bothell.

Part of improving the city's infrastructure includes improving the mechanisms for handling surface water runoff within the twenty-two sub-basins (see Map 1: *Watershed Sub-Basins used for Flow Accumulation and Total Runoff Volumes in the City of Bothell, Washington*). One major project the city is currently undertaking is rerouting Horse Creek. Horse Creek is one of the largest sub-basins within the city, and is channelized underground in downtown. According to Andy Loch, the Surface Water Program Coordinator for the City of Bothell, when the creek is rerouted, it will be widened to better accommodate the increased flow volume it has received in recent years.

A contributing factor to the amount of runoff is the amount of impervious surface within each basin. Bothell's Surface Water Management department requested an impervious surface analysis of each of their sub-basins, in January 2014, to help quantify the significance of each impervious surface within the basins, and to help determine where funding could be invested most effectively to reduce the amount of runoff within each basin. This impervious surface data will be incorporated into the next revision of the Health Assessment of



City of Bothell's Streams (City of Bothell, 2014). After completing the initial impervious surface analysis for the city, we wanted to examine the potential effects increased impervious surface area has on runoff volume. How does an increase in impervious surface in a watershed affect the flow accumulation and total volume of runoff from a significant rain event?

Methods

We selected three separate watershed sub-basins within the city with disparate total areas and impervious surface percentages: Blythe Creek, Horse Creek, and Maltby Hill Creek (see table 1 for details on each basin). Each of these sub-basins was then overlaid with soil, elevation, and impervious surface data, provided by the City of Bothell's GIS department.

Table 1: Total impervious surface within Blythe Creek, Horse Creek, and Maltby Hill Creek. Impervious surface area is expressed in m², total surface area is expressed in km², and the ratio of impervious surface to total surface area is expressed as a percentage. Values are based on vector-polygon shapefiles provided by the City of Bothell's GIS department.

Basin	Impervious Area (m ²)	Total Area (km ²)	% Impervious Surface
Blythe Creek	2817.25	0.08603	3.27%
Horse Creek	1028985.04	2.89035	35.60%
Maltby Hill Creek	331627.37	1.23185	26.92%

(Continued on page 23)

Winner of Second Place Paper: Runoff and Flow Accumulation in Three Watershed Sub-basins in Bothell, WA

(continued from page 21)

$$q = \frac{w^2}{2 \times K_{sat}}$$

Figure 1. Manley (1977) equation. Used to calculate rate of runoff for an individual cell (q) with an established rainfall rate (w), and saturated hydraulic conductivity (K_{sat}).

$$R = q \times A$$

Figure 2. Runoff volume adaptation of Manley's equation, where total rate of runoff for an area (R) is calculated by multiplying the rate of runoff (q) by the total area of a given surface type (A).

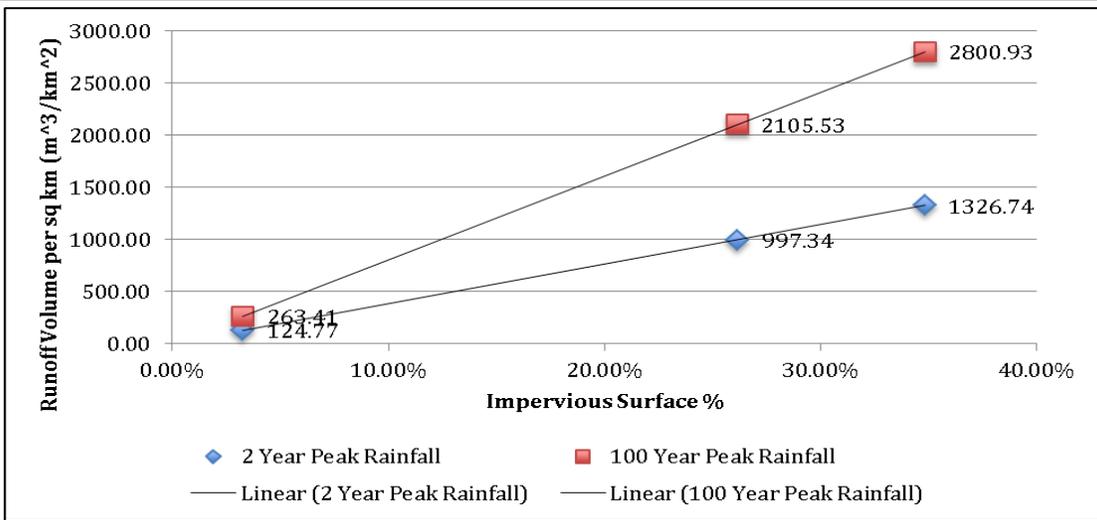


Figure 3. Graphical comparison of runoff rates per km² for Blythe Creek (left), Horse Creek (right), and Maltby Hill Creek (center) basins in 2 year peak ($r=1.00$; $n=3$) and 100 year peak ($r=1.00$; $n=3$) rainfall events. Values represent the total runoff in the basin per hour, and normalized by dividing by the total area of the basin. See table 4 for raw numerical values.

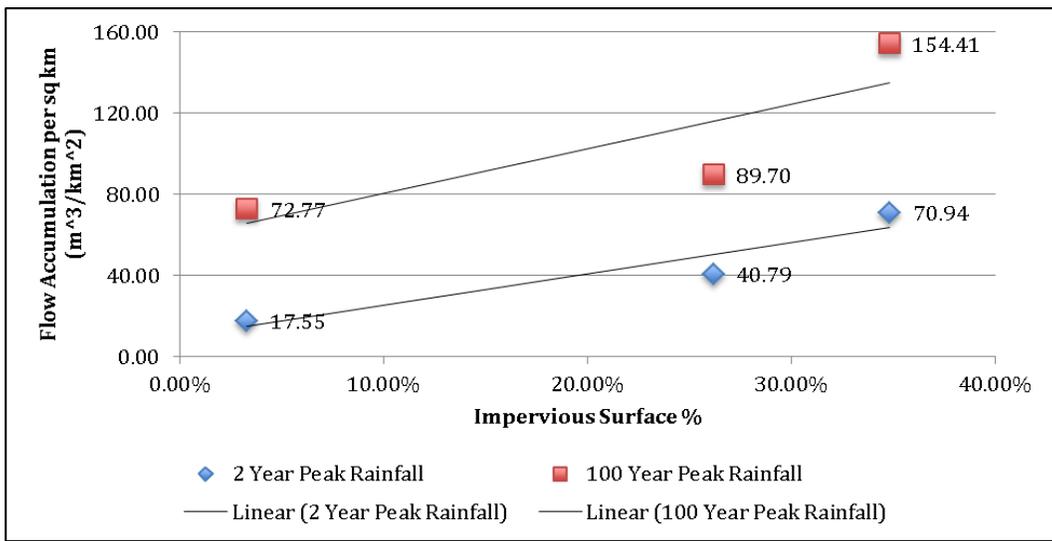


Figure 4. Graphical comparison of peak flow accumulation rates per km² for Blythe Creek (left), Horse Creek (right), and Maltby Hill Creek (center) basins in 2 year peak ($r = 0.944$; $n=3$) and 100 year peak ($r = 0.833$; $n=3$) rainfall events. Values represent the highest rate of flow through measured in an individual cell per hour, and normalized by dividing by the total area of the basin. See table 4 for raw numerical values, and attached maps for flow accumulation models. See Maps for 2 year and 100 year flow accumulation models of Blythe Creek, Horse Creek, and Maltby Hill Creek.

Table 2: Saturated hydraulic conductivity estimates for soil types found within the Blythe Creek, Horse Creek, and Maltby Hill Creek sub-basins. K_{sat} values are represented in units of inches per hour. Higher values indicate that water is able to travel through a soil more readily. Water bodies and impervious surface were assumed to allow no infiltration. Values are calculated from estimates provided by the US EPA (US EPA, 1986) and the Soil Survey Staff at the Natural Resource Conservation Service (Soil Survey Staff, NRCS, USDA, 2014).

Soil Type	K_{sat}
Alderwood gravelly sandy loam	67.00000
Alderwood urban land complex	65.00000
Alderwood-Everett gravelly sandy loam	67.00000
Arents, Alderwood material	6.00095
Custer fine sandy loam	1.99984
Everett gravelly sandy loam	67.00000
Impervious	0.00000
Indianola loamy fine sand	1.99984
Kitsap silt loam	0.85093
McKenna gravelly silt loam	53.50000
Mukilteo muck	0.42520
Norma loam	1.27559
Puget silty clay loam	0.42520
Ragnar-Indianola	67.00000
Seattle muck	0.42520
Terric medisaprists	1.27559
Water	0.00000

Table 3: Rainfall rates for Bothell, Washington based on maximum volumes measured in 6-hour increments with a 2 year and 100 year frequency as measured by the National Oceanic and Atmospheric Administration (Miller, Frederick and Tracy, 1973). Rate in inches per hour is a mean value calculated from the total volume measured in 6 hours.

Frequency	Rate (in/6 hrs)	Rate (In/hr)
2 years	0.90000	0.15000
100 years	1.90002	0.31667

(Continued from page 21)

ment. The soil data included characterizations of the most prominent soil structures in an area. Elevation was provided in a two-foot interval contour dataset. Impervious surface data included sub-characterizations in 9 separate categories: bridges, buildings, decks, driveways, parking lots, patios, roads, sidewalks, and "other" (to account for all impervious surfaces that did not fall into one of the other eight categories).

The soil characterizations provided by the city were then

separated according to their sedimentary distribution using the Soil Characterization guide from the Natural Resources Conservation Service (Soil Survey Staff, NRCS, USDA, 2008). The sedimentary distributions were then categorized according to their hydraulic conductivity, using data provided by the US EPA and the Soil Survey Staff at the Natural Resource Conservation Service (US EPA, 1986; Soil Survey Staff, NRCS, USDA, 2014; see table 2 for hydraulic conductivity values).

Precipitation rates were calculated using maximum rainfall data collected by the National Oceanic and Atmospheric Ad-

How does an increase in impervious surface affect the runoff from a significant rain event?

ministration (Miller, Frederick and Tracy, 1973). Using the 2 year and 100 year maximum rainfall for rain events lasting 6 hours in the Bothell area, we calculated the mean rainfall rate for a typical heavy rain (2 year frequency) and an exceptionally heavy rain (100 year frequency; see table 3 for rainfall rates). We constructed weight rasters for each sub-basin by overlaying the impervious surface data on top of the soil data and applying the Manley (1977) equation to each rain event, using map algebra (see figure 1 for equation). Due to the design of the Manley equation, as the hydraulic conductivity approaches 0, the calculated runoff approaches infinity. To account for this discrepancy, areas covered in impervious surface or water bodies were assumed to allow no infiltration, and therefore all precipitation from these areas was assumed to be runoff. We constructed a flow direction raster by converting the contour elevation model into a filled, high-resolution (2 foot cell size) digital elevation model. Runoff volume for each cell was then used to calculate the total runoff volume for each basin (see figure 2 for equation).

Results

Comparing total runoff rate and flow accumulation within the three basins during both 2 year and 100 year frequency peak rain events, without normalizing for total surface area of each basin, indicated that there was a significant correlation between the total amount of surface area and the expected rates of runoff and flow accumulation (2 year runoff: $r=0.895$; 100 year: $r=0.895$; 2 year flow accumulation: $r=0.853$; 100 year flow accumulation: $r=0.852$; $n=3$). When runoff vol-

(Continued on page 24)

Winner of Second Place Paper: Runoff and Flow Accumulation in Three Watershed Sub-basins in Bothell, WA

(Continued from page 23)

umes and flow accumulation rates were then normalized for total surface area of the basins, by dividing the runoff and flow accumulation of each basin by the total area of each basin, the linear correlation between the amount of impervious surface and the total runoff rate, and flow accumulation rate, became even more pronounced. Runoff rates as a ratio of m³ runoff per km² became a direct linear correlation (see figure 3); however, flow accumulation rates as a ratio of m³ accumulated per km² indicated a possible exponential relationship (see figure 4).

Conclusions

There appears to be a direct, linear correlation between the percentage of impervious surface in a basin and the total volume of runoff it produces (see table 4, and figures 3 and 4 for runoff and flow accumulation rates). Flow accumulation also appears to have either a direct or an exponential relationship with increases in impervious surface percentages in a basin. However, there are three main constraints we see as possibly limiting our ability to draw a concrete conclusion: sample size, variation in hydraulic conductivity, temperature, and increasing hydraulic head.

For this initial study, we selected only three separate basins. While these three basins contain differing characteristics that we wanted to account for in our calculations – such as area, percentage of impervious surface, and mean slope – we feel that drawing concrete conclusions based on such a small

sample size would be premature. The findings of this study do, however, indicate that further research including several, if not all, basins in the City of Bothell is indicated.

Within soils with similar or identical characterizations (e.g. Alderwood gravelly sandy loam, or Indianola loamy fine sand) there is significant variation of hydraulic conductivity rates, as indicated by disparate values presented by the US EPA Hydraulic Conductivity method manual (1986) and the Natural Resource Conservation Service Soil Survey Staff (2014), which depends on a variety of sub characteristics including the duration of a rain event, the porosity of a given sample, the temperature of the soil, how compressed the soil is, as well as the interconnectedness of gaps in the soil (Brooks, Ffolliott, Gregersen, and DeBano, 2003).

Increases in soil saturation can change the amount of water that is absorbed. While we have based our calculations on completely saturated values, the actual hydraulic conductivity in the beginning of a rain event will be significantly higher, thereby reducing the amount of runoff. The level of compression within a section of soil will also vary considerably between two points within an area with a single soil type. This variation can be the result of surface disturbance – such as construction – or the amount and duration of weight applied on the surface – a dirt or gravel road will likely be more compressed than an open field. As a soil becomes more compressed and more mixed, the interconnectivity of the gaps between particulates will be reduced, which will influence the rate at which it can absorb water. Finally, the hy-

When runoff volumes and flow accumulation rates were normalized, the linear correlation became even more pronounced.

Table 4. Summary of Blythe Creek, Horse Creek, and Maltby Hill Creek sub-basins in Bothell Washington. Total runoff volume and flow accumulation are given as rates in terms of m³ H₂O/hour. Area is calculated in km².

Characteristic	Blythe Creek		Horse Creek		Maltby Hill Creek	
	2 year Peak	100 year Peak	2 year Peak	100 year Peak	2 year Peak	100 year Peak
Total Area	0.086 km ²		3.006 km ²		1.301 km ²	
Percentage of Impervious Surface	3.27%		35.60%		26.92%	
Total Runoff Volume	39.5 m ³ /hr	148.9 m ³ /hr	4,103.5 m ³ /hr	8,962.4 m ³ /hr	1,351.0 m ³ /hr	2,978.4 m ³ /hr
Peak Flow Accumulation	1.51 m ³ /hr	6.26 m ³ /hr	213.3 m ³ /hr	464.2 m ³ /hr	53.1 m ³ /hr	116.7 m ³ /hr

draulic head, the distance between the surface and the top of the water table, will vary throughout an area based on the resistance of the surrounding soils to the movement of water, the slope and elevation of the soil, and the duration of a recent rain event. As the hydraulic head rises, the more resistant the soil matrix will become to accepting additional water. To better account for these variables, we recommend that further research conducted to estimate runoff volume and flow accumulation will include multiple basins, preferably more than twenty, to better determine any correlating factors between basins.

Acknowledgements

We would like to give special thanks to Santiago Lopez and Rob Turner from the University of Washington Bothell, and Andy Loch from the City of Bothell for all their help and support in completing this project. Santiago Lopez was our GIS mentor throughout the project. Rob Turner was instrumental in giving us advice on using the data we had available to calculate runoff. Andy Loch, our contact from the Surface Water Management Department in the City of Bothell, was tremendously helpful in getting the raw data we needed to complete the project.

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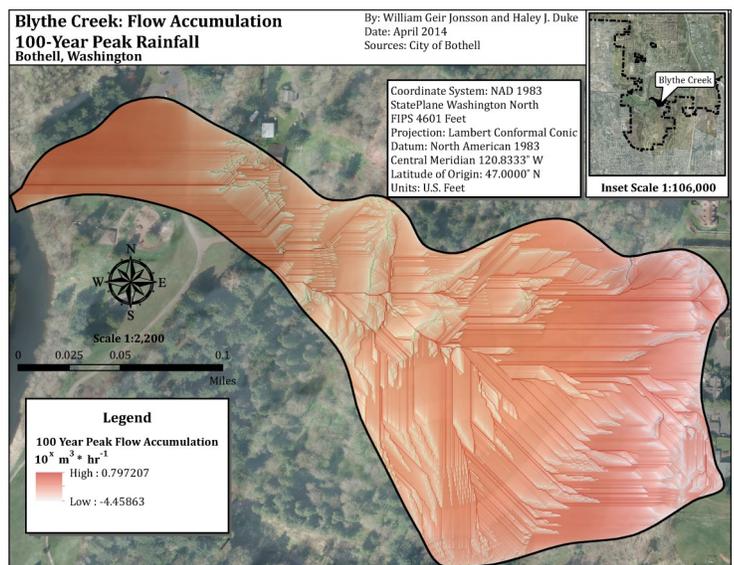
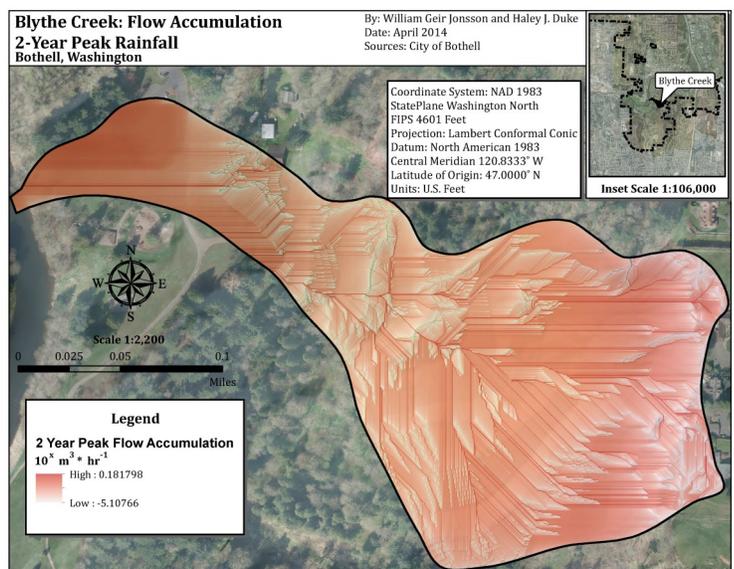
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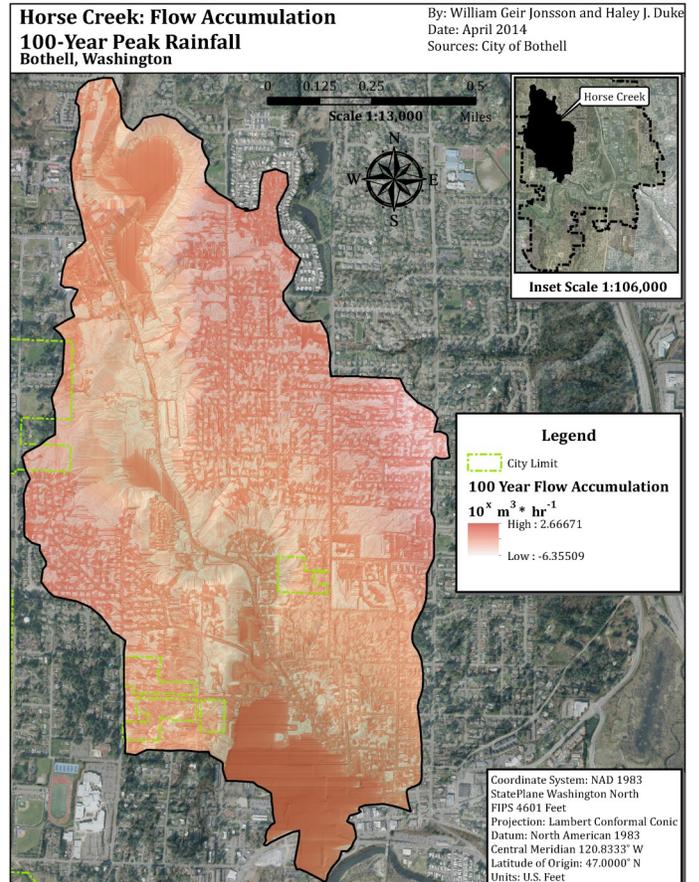
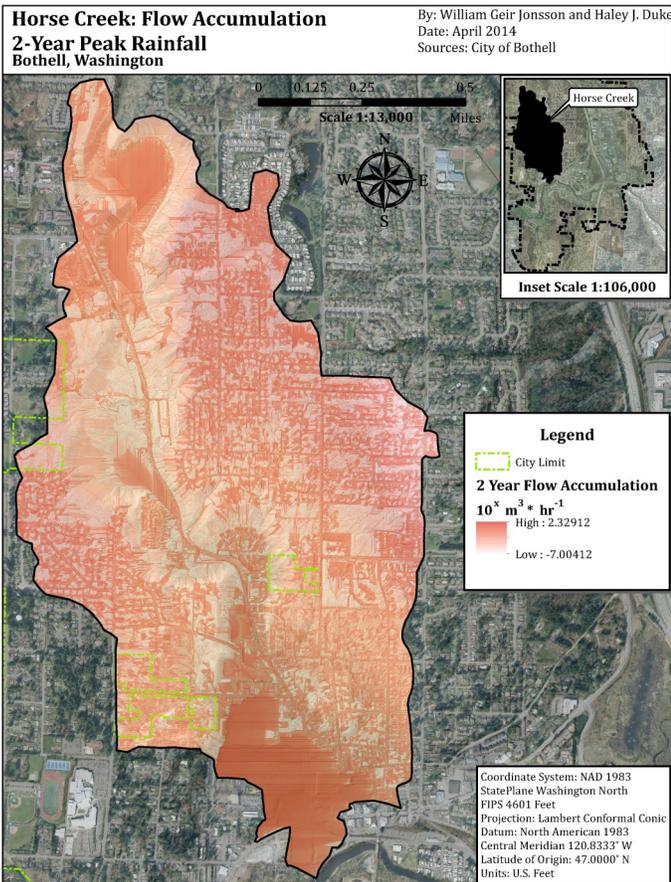
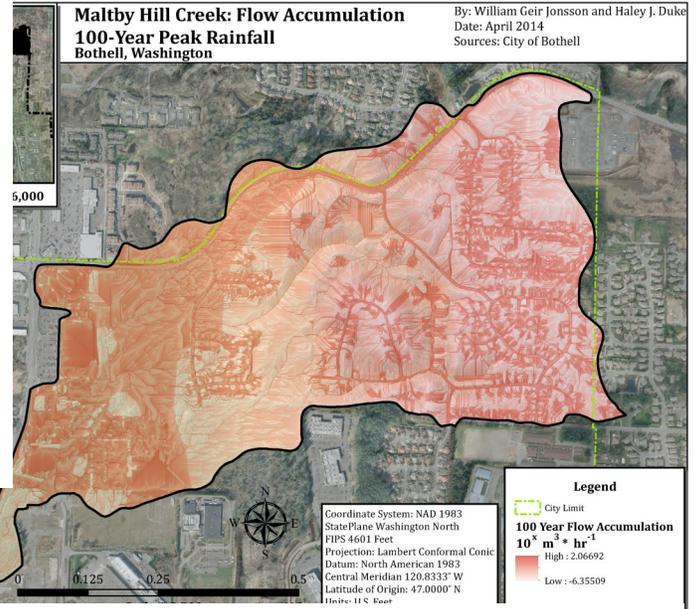
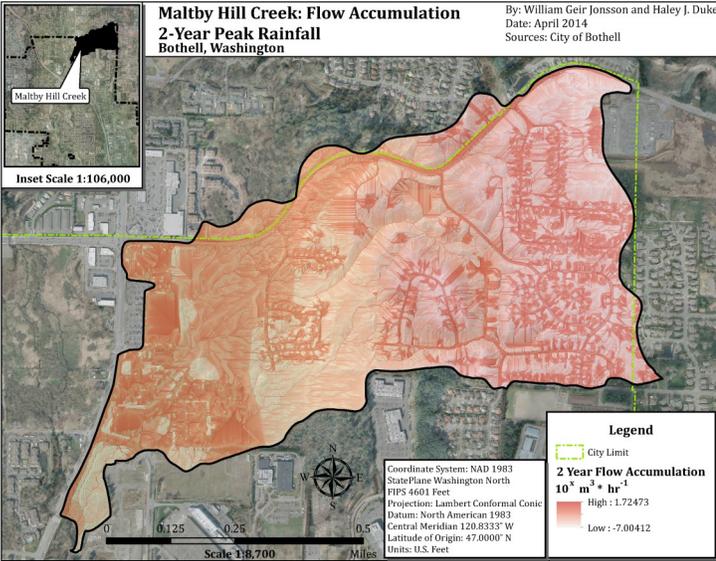
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Maps continue on following page.



Winner of Second Place Paper: Runoff and Flow Accumulation in Three Watershed Sub-basins in Bothell, WA



President's Column

(Continued from page 1)

underway with WAURISA Secretary Sarah Myers serving as our conference chair. And lucky for us, the 2015 URISA GIS-Pro will be held in Spokane in October. WAURISA, along with the Northwest GIS Users' Group and the Northern Rockies Chapter of URISA, will join forces to support this event. This will serve as a great opportunity for our members east of the Cascades to have a conference in their backyard.

We have resurrected our dormant Outreach Committee. This committee is now called the Community Engagement Committee, and it is headed up by Anna Yost, a recent Master's graduate from Central Washington University. The focus of the committee will be to promote geospatial technology awareness in business verticals including K-16 education, business, legislature, as well as geospatial-related industries such as surveying. We're developing a compendium of resources for our membership to draw from to engage these

The Advocacy committee came through with flying colors, and we are truly impressed with the knowledge, experience, and enthusiasm embodied by this group.

communities, and we're working on a way to connect members seeking to collaborate on these engagements.

Recently, WAURISA was made aware of a proposed state rule here related to the practice of land surveying that could dramatically impact the work of GIS practitioners if it were

enacted. We contacted International URISA's

Advocacy committee for help in crafting a

[response](#) to the proposed rule. The Ad-

vocacy committee came through with

flying colors, and we are truly im-

pressed with the knowledge, experi-

ence, and enthusiasm embodied by

this group. The experience kicked-off

interest between URISA chapters and

International URISA to share know-how in

the area of effective advocacy. We're actively

working with URISA to bring these skills to our chapter. It'll

add a great benefit to what we can offer to our members in

addition to the education and networking opportunities we

make available.

Finally, I want to acknowledge our annual election results

by welcoming Renee Quenneville to our board, and congrat-

ulating returning board members Don Burdick, Josh Green-

berg, and Cort Daniel. These folks keep us fiscally sound,

keep our business systems running, and develop great

workshop content for our members and the greater geospa-

tial community. Combined with the other seven mid-term

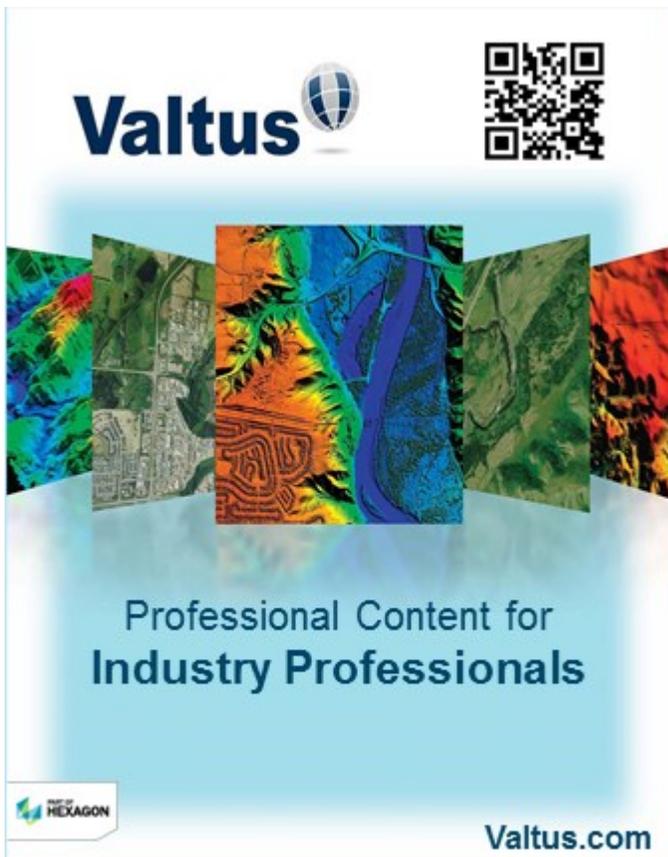
board members, we continue to move forward, constantly

looking for ways to provide more value to our members.

If you have an education, networking, or advocacy idea

you'd like to discuss, please drop me a line at president@waurisa.com

Cherish the rest of these summer days. I'll see you in the fall!

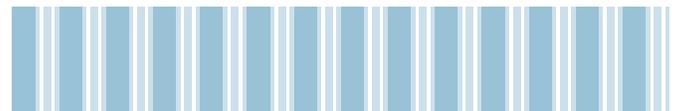


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Editorial

By: Eadie Kaltenbacher, GISP

What an exciting time to be part of GIS in Washington State. WAURISA's annual conference just came to a close, and attendees walked away inspired to try new GIS tools and techniques; as well as improve their communication. At least three other GIS events took place in the State (see Spring GIS Events Round-up beginning on Page 15), and more are planned soon. Also at this time of year, many students are graduating from GIS programs and looking to bring their energy and new-found knowledge to the workplace.

It is a great honor to collect submissions related to these activities (and many more) and gather them into *The Summit*. Over the past few issues, I have been lucky to have the editing help of GIS community leaders Karl Johansen and Greg Babinski. These editors would provide edits within a week of the publication date.

However, some of the proposed edits offered more opportunity than a week's worth of turnaround could provide. For example, an editor might propose providing more detail on certain aspects of the story, or streamlining other aspects. I want to give authors the chance to take advantage of these suggestions with enough time to implement them. So we will be trying out a new process beginning with the Autumn Issue.

Authors will now be welcome to submit an optional "First Draft" version of their story for review of content. The deadline for First Drafts will be a month before the Final Draft deadline.

All Final Drafts will continue to go through proofreading for typos and grammatical errors. The deadline to submit Final Drafts will remain the same (one week prior to publication). Please see the table below for upcoming deadlines.

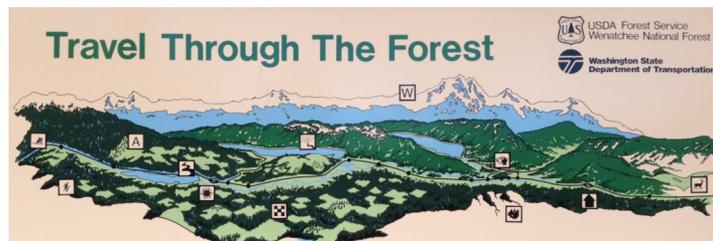
I hope this process will help to build up the high quality of *The Summit* by showcasing your stories in the best possible light.

UPCOMING DEADLINES

Submit articles to *The Summit* for publication by:

	Autumn Issue	Winter Issue
First Draft (optional)	9/17/2014	12/16/2014
Final Draft	10/17/2014	1/16/2015

Public Maps in Washington



Pictorial map illustrating points of interest; spotted just outside Cle Elum.

Literary Corner

“**S**he bought a plan of Paris, and with the tip of her finger on the map she walked about the capital. She went up the boulevards, stopping at every turning, between the lines of the streets, in front of the white squares that represented the houses. At last she would close the lids of her weary eyes, and see in the darkness the gas jets flaring in the wind and the steps of carriages lowered with much noise before the peristyles of theatres.

-from *Madame Bovary*, by Gustave Flaubert

The Summit is the newsletter of WAURISA. To encourage the discussion of issues and ideas of importance to the Washington GIS community, we welcome letters to the editor or opinion essays. Letters should be a maximum of 100 words and essays should be limited to 500 words.

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ACSM – Washington State Section

www.wss-acsm.org

Cascadia Users of Geospatial Open Source

groups.google.com/group/cugos

Contact [Karsten Venneman](#)

Central Puget Sound GIS User Group

Join Listserve [here](#)

Central Washington GIS User Group

Meets the 2nd Wednesday of each month.

Contact [Amanda Taub](#)

Cowlitz-Wahkiakum GIS User Group

Meets the last Wednesday of each month at 3:00 pm at the Cowlitz-Wahkiakum Council of Governments meeting room, 207 North 4th Ave, Kelso WA.

Contact [TJ Keiran](#)

King County GIS User Group

www.kingcounty.gov/operations/GIS/UserGroups.aspx

Meets 1st Wednesday every other month at 11:00am at the KCGIS Center, 201 S. Jackson Street, Seattle WA, Conf Room 7044/7045.

Northwest Washington GIS User Group

www.wvu.edu/huxley/spatial/nwwgis/nwwgis_mtg.htm

Southeast Washington/Northwest Oregon GIS User Group

<http://gisgroup.wordpress.com>

Washington Geographic Information Council (WAGIC)

geography.wa.gov/wagic

Join Listserve [here](#)

Washington Hazus Users Group

<http://www.usehazus.com/wahug>

Contact [Kelly Stone](#)

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