



EDITOR'S NOTES

Chris Pitre, Golder Associates

It's a Mad Mad Mad Mad Water World. The mix of references to the "Mad Mad Mad Mad World" 1960's comedy and the futuristic "Water World" 1980's movie is apt for today's Washington water law situation. In "Mad World," a crazy chase develops when people fail to agree on sharing a treasure. In "Water World," sea water has flooded the world but drinking water is rare (let alone streamflow).

In Washington State, water is a treasure that we can't seem to agree on how to share. There is apparently lots of water some of the time and in some places, but not a drop to drink. To be sure, the energy being applied to finding solutions is enormous. Watershed planning has raised the public awareness of water resource management challenges. The Columbia River Initiative that is planning for reliable water supply in the Columbia Basin is moving forward. Despite cynicism by some, much is being developed now across the spectrum. Compared to 10 years ago, numerous water supply projects, both small and large, are being advanced based on environmental responsibility. Water right applicants are more likely now to build alliances and identify, and attempt to resolve, concerns of others before submitting applications.

The cost of operating this way is enormous. Some say the price is still a steal compared to the value of the resource.

One challenge that we are all hobbled with is the state water law structure. As attractive as it is to replace it in its entirety, so many people are vested in portions of it that it is not at all likely to be replaced. Instead, evolution occurs through small tweaks mostly through court cases, and to a smaller degree via legislative bills.

In 2003, the "Muni Bill" was passed in an attempt to provide water to municipalities for future growth. Recent requests were submitted by tribes, environmental interests and private citizens to rescind portions of that bill. The article on the next page by Kenneth Gish of the law firm Preston Gates & Ellis outlines the request to rescind portions of the Muni Bill. The petitioners appear to have a strong case. Many people are wondering how this will play out. How will the state respond? Are the petitioners setting the stage for the next move? When will that next move be? Will municipalities have to apply for new water rights every five years as growth continues? Stay tuned "As the Water World Turns".

An example of environmentally responsible water resource management is illustrated by the United States Army Corps of Engineers with a new fish passage structure at the Howard Hansen Dam (Page 4). As mentioned in the article, "If you don't hear about Hanson Dam or the Green River on the news...it pretty much shows we're doing our job." Consider you heard about their work here.

Last year's student award recipients report on their research work in this newsletter. Applications are now being accepted for this year's fellowship awards. Also, if you recognize someone who has contributed to the management of Washington State water resources, consider nominating them for the Outstanding Service Award. – Happy reading!

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Constitutionality of Municipal Water Rights Challenged

By Jessica Andrade and Kenneth Gish,
Preston Gates & Ellis

On May 22, 2006 ten Washington State Tribes ("Tribes") wrote to Washington State Attorney General Rob McKenna requesting that he institute an action to challenge the constitutionality of the municipal water bill, Second Engrossed Second Substitute House Bill 1338 ("SESSH 1338"). Nearly three weeks later on June 8th, Earthjustice sent a similar letter on behalf of a coalition of water rights holders, commercial fishermen, the Washington Environmental Council, the Sierra Club, and the Center for Environmental Law and Policy (collectively, "Earthjustice"). Earthjustice makes essentially the same constitutional challenges to SESSH 1338 as the Tribes.

SESSH 1338, passed in 2003, declared some unused municipal water right certificates to be valid, and to expand the definition of "municipal water supply purposes." Earthjustice and the Tribes (collectively, "Petitioners") claim that this "retroactive expansion" of senior water rights under SESSH 1338 abrogates junior Petitioner water rights such that it violates the due process clauses of the Washington State and United States Constitutions. In addition, Earthjustice also claims certain injuries to aesthetic enjoyment and conservation interests. If the Attorney General were to comply with the request, or if the Petitioners were to initiate their own suits, many Washington State municipalities' water rights would likely be challenged.

The genesis of the municipal water rights issue. In recent years municipal water rights have become controversial, mainly because many of those water rights were granted on the basis of "system capacity." More commonly described as the "pumps and pipes" method, system capacity measuring grants certificate holders a vested right to as much water as their constructed water works system can hold. In Washington State, the Department of Ecology measured water rights by "system capacity" for some forty years before 1998. In the 1998 *Theodoratus* case, the Washington State Supreme Court announced that vested water rights must be measured by "beneficial use," noting that case law and statute required "actual application of water to beneficial use in order to perfect an appropriative right before a final certificate of water right may be issued." The court declined to rule, however, that this requirement applied to municipal water right applicants as well as private applicants.

In response to the confusion that *Theodoratus* created regarding municipal rights, the legislature passed SESSH 1338. SESSH 1338 amended RCW 90.03.330 to recognize all past "system capacity" water rights certificates as valid, to expand the definition of "municipal water supply purposes," and to require beneficial use for all future water

rights certificates. The Petitioners claim that these and other provisions of SESSH 1338 violate substantive and procedural due process under the Washington State and United States Constitutions by wrongly abrogating water rights, that they raise fiscal issues that give the Petitioners standing as taxpayers, that they raise separation of powers issues, and that consumption of water under the new municipal water rights scheme presents conservation concerns.

Tribal and Earthjustice Claims

● **Unconstitutional infringement.** The Petitioners claim that SESSH 1338's provisions unconstitutionally abrogate water rights guaranteed to them by treaty and water right certificate. The Tribes' treaty fishing rights give them an interest in in-stream flows, and Earthjustice's clients possess individual water rights certificates that also give them an interest in such flows. Because the in-stream flow rights that partially quantify both Tribal and Earthjustice client's rights were established mainly in the 1970s, those rights are junior to municipal water rights granted earlier through system capacity certificates. Petitioners argue that such senior rights are expanded in several ways by SESSH 1338, and that as a result their water rights are infringed. Moreover, those vested interests in water rights, the Petitioners argue, are property interests protected by the Due Process Clauses of the Washington State and United States Constitutions.

● **Elimination of beneficial use requirement.** The Petitioners argue that SESSH 1338's expansion of the definition of municipal water uses and validation of "system capacity" certificates given for such uses unconstitutionally infringes their water rights. Petitioners argue that the expansion of municipal water supply purposes allegedly includes private parties that fell within the *Theodoratus* court's beneficial use requirement. They further claim that the subsequent validation of the system capacity certificates of such parties, violated the due process clauses of the Washington and United States constitutions. Specifically, Petitioners argue that where municipal water rights were retroactively perfected, or where non-municipal water uses were redefined as municipal so that they could be retroactively perfected, junior Petitioner rights to the same instream flows were wrongly infringed.

● **Retroactive exemption from relinquishment.** The Petitioners argue that SESSH 1338's redefinition of municipal water uses unconstitutionally exempts parties from the "relinquishment" requirement of RCW 90.14.160. Water rights "claimed for municipal water supply purposes" are exempt from relinquishment under RCW 90.14.120(2)(d). Petitioners claim that by expanding the definition of

“municipal water supply purposes,” SESSHB 1338 retroactively exempts additional parties from relinquishment and effectively resurrects their relinquished water rights. This resurrection, the Petitioners argue, infringes on their junior water rights to relinquished portions of instream flow.

● **Changes in place of use requirement.** The Petitioners further argue that SESSHB 1338’s designation of municipal water suppliers’ water system plan boundaries as their “place of use” retroactively changes the place of use requirement. Under RCW 90.02.380(1) water rights are “appurtenant to the land or place upon which the same is used” and place of use may not be changed unless “change can be made without detriment or injury to existing rights. Petitioners allege that SESSHB 1338’s expansion of municipal “place of use” boundaries includes areas that are not in many municipal water suppliers’ water rights certificates. Accordingly, where the re-definition of “place of use” expands service areas, the Petitioners argue that the overall use of water rights will be increased, thus negatively affecting return flows and infringing Petitioner water rights.

In addition, the Petitioners argue that SESSHB 1338 violates procedural due process. Specifically, the Petitioners argue that it allows for alteration of the place of use of a water right without the procedural safeguards instituted for other place of use changes in RCW 43.21B.110(1), 90.03.280, 90.03.380(1), and 90.44.100(2). Petitioners argue that in order for SESSHB 1338 to conform with procedural due process, they must receive due notice, opportunity to protest, and a provision that decision makers take into account the rights of affected junior water rights holders.

● **Elimination of population and service connection limits.** Finally, the Tribes alone argue that SESSHB 1338 eliminates limits on population and service connections for municipal water rights certificates in such a way that they infringe on the water rights of other users in the same basin. The Tribes note that many water rights certificates contain express limitations on population numbers and service connections that the water right may be used to serve. SESSHB 1338 states that “for a municipal water supplier that has an approved water system plan...the service connection figure in the application or any subsequent water right document is not an attribute limiting exercise of the water right as long as the number of service connections...is consistent with the approved water system plan...” It also states the same with reference to population. The Tribes claim that these eliminations, when coupled with the expansion of municipal water supply purposes, allow private and public water providers to expand their services and deplete others’ share of the relevant instream flow.

As with the changes in the “place of use” requirement, the Tribes allege that the elimination of the population and service connection limitations vio-

lates procedural due process. Specifically, the Tribes note that lifting of the limitations does not require change of use application to the Department of Ecology under RCW 80.03.380(1). In addition, the eliminations operate as change in law rather than administrative changes, and as such there is no opportunity for negatively affected water rights holders to comment on the process or have their interests considered. This, the Tribes claim, violates procedural due process.

Likelihood of Future Actions. The Petitioners’ future actions with regard to their claims will depend on the actions of the Attorney General. Both the Tribes and Earthjustice request that the Attorney General initiate suit to challenge the constitutionality of SESSHB 1338. It is unclear whether this request would fall under the purview of the Attorney General’s duties. Under the Washington State Constitution, § 21, “[t]he attorney general shall be the legal adviser of the state officers, and shall perform such other duties as may be prescribed by law.” RCW 43.10.030 and .040 list several duties of the Attorney General, none of which involve suits questioning the constitutionality of statutes. However, the Washington Supreme Court has ruled that where the subject at hand “is a matter of public concern” the Attorney General may bring an action on behalf of the State. Considering the public concerns that Earthjustice alleges in their letter, the Attorney General may have a basis for initiating a suit on behalf of the state. It is uncertain, however, whether he will elect to do so.

Though it is unclear whether the Attorney General will satisfy the Petitioners’ requests, it is clear from either letter’s notation of taxpayer standing that the letters may just be a procedural step rather than serious requests. Early in the either letter the Tribes and Earthjustice write that they are seeking a taxpayer action. For taxpayers to have standing to challenge governmental acts, the taxpayer must first request action from the Attorney General and be refused. Accordingly, the purpose of both the Tribes’ and Earthjustice’s letters may only be to preserve their standing as taxpayers in a suit that they will initiate on their own. This interpretation is supported by the Tribes’ and Earthjustice’s closing requests, both of which indicate that further action will be taken should the Attorney General deny their requests. Thus, regardless of the Attorney General’s decision with regard to either letter, a challenge to SESSHB 1338 is possible. ❧

Jessica Andrade is a third-year law student at the University of Michigan and a summer associate in the Seattle office of Preston Gates & Ellis LLP. Ms Andrade was the primary author of this article. Ken Gish is an associate in the environmental, land use and natural resources practice group at Preston Gates & Ellis LLP. ❧

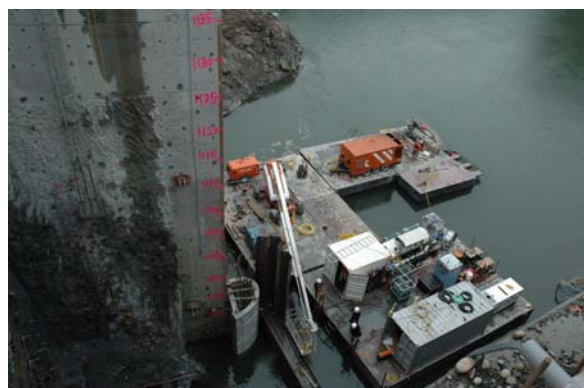
Future Past Comes To Howard Hanson Dam

Fish Facilities Constructed at Flood Control Dam

By Nola Leyde, U.S. Army Corp of Engineers

Jon Olson, Equipment Maintenance Leader at Howard A. Hanson Dam, has a saying. "It's just one dam project after another."

Said in all seriousness, construction is under way in earnest on a state-of-the-art fish passage facility at the dam. Contemplated decades ago, formulated years ago, the future is now here at this flood control facility.



Construction is under way on fish facilities at Howard Hanson Dam on the Green River. Originally designed for flood control and water storage, the fish facilities incorporate the latest design and biological information. (Photo by Ashlee Richie, Seattle District Public Affairs Office, U.S. Army Corps of Engineers)

When construction began on the dam in the 1950s, fish passage on the Green River had already been cut off by a diversion dam built downriver by the City of Tacoma early in the 1900s. The first construction of Howard A. Hanson Dam was completed in 1962.

"Before a shovel was turned for dam construction, over 13 miles of railroad that followed the river downstream from Stampede Pass, had to be relocated," said Olson. "The completion of Howard Hanson Dam fostered the start of industrial development from the lower Green River Valley to the Duwamish Waterway."

Howard A. Hanson Dam, located in the City of Tacoma watershed, is not open to the public and not very well known. The project serves a dual purpose by providing both flood control and water storage for fish flow enhancement.

Longtime residents talk of the massive flooding in the Kent Valley before the construction of the dam. Flood damages prevented by the dam totals more than half a billion dollars. In 1996 alone, the last large flood event, the dam prevented more than \$265 million dollars in damage. According to Olson, flood control in the Green-Duwamish River Basin is accomplished by impounding excessive water runoff from the upper drainage area of the

river and releasing the water under controlled conditions after downstream flooding has passed.



Forms poured in place stand ready to be lowered into the Howard Hanson Dam reservoir as part of the construction of fish facilities there. (Photo by Nola Leyde Seattle District Public Affairs, U.S. Army Corps of Engineers)

"If you don't hear about Hanson Dam or the Green River on the news during flood season, it pretty much shows we're doing our job."

"After the end of the annual winter flood season early in April, water is stored in a reservoir to augment the low natural summer river flow for the benefit of fisheries and other downstream water users," said Olson.



John Cantlon, far right, and Mike Wolleat, contractor field superintendents for Traylor Bros., discuss work at Howard Hanson Dam on the construction of the fish facilities. (Photo by Nola Leyde Seattle District Public Affairs, U.S. Army Corps of Engineers)

When the City of Tacoma began planning for the development of water supply to meet the needs of the growing regional population, it came to the Corps. Under the congressional authority entitled "Review of Completed Projects," the Seattle District evaluated the dam for the purposes of water supply storage, improved fish passage through the dam, and improvements to habitat. The review led to a feasibility study conducted in cooperation with Ta-

com Public Utilities, concluding it was feasible and in the federal interest to construct a project with ecosystem restoration and water supply features. The project was authorized by Congress for three new purposes: water supply, ecosystem restoration, and Endangered Species Act compliance, purposes that compliment the dam's primary purpose, flood control.

A key component of the Howard A. Hanson Dam Additional Water Storage Project is improved fish passage, says Mike Padilla, project manager. Tacoma Public Utilities Water Division is the local sponsor for the project.



Howard Hanson Dam before construction of the fish facility.

"The long-term goal is the reintroduction and survival of self sustaining runs of various anadromous fish – Chinook, coho, and steelhead — in the upper Green River watershed area," said Padilla.

This means there must be fish passage around the dam. This is being accomplished in two ways. For adult fish returning to the watershed from the sea, a trap and haul facility at Tacoma's headworks dam will transport the fish around both dams into the upper watershed.

For downstream passage, a state-of-the-art fish passage facility is being built for migrating juveniles and steelhead adults that have spawned and are returning downstream.

The fish passage features include a new intake tower with new fish collection and transport facilities, a wet-well, fish screens, fish well, discharge conduit, fish hoisting and hauling facilities, and a new monitoring station. The design of the facilities is incorporating the latest technology and biological data. Currently, the intake tower portion of the facility is under construction. The entire fish passage structure is scheduled to be completed by 2009.



Howard Hanson Dam after construction of the fish facility.

Engineered log jams, gravel nourishment facilities, and other fish habitat improvements on the Green River have already been constructed above and below the dam as part of the Additional Water Storage Project. Some of the new fish habitat construction is considered mitigation for the additional water storage. The new project will provide up to 20,000 acre-feet of additional water for the City of Tacoma and their project partners. Partial additional storage is expected to begin this year. ❧

North Puget Sound: Two pods of orcas - K and L - have been spotted recently in the San Juan Islands each with a baby. According to reports, K-pod's newborn is only a few weeks old, while L-pod's baby killer whale was probably born sometime during the spring. The two pods, along with J-pod, are part of a population of resident killer whales that reside in Puget Sound from early spring to late fall. Unlike transient killer whales, which occasionally wander into Puget Sound to feed on marine mammals, the resident population favors fish, such as salmon and steelhead.

South Sound/Olympic Peninsula: Eight areas of Puget Sound will open for crab fishing July 1, including marine areas 6 (eastern Strait of Juan de Fuca), 9 (Admiralty Inlet), 11 (Tacoma/Vashon) and 12 (Hood Canal) on the west side of the sound. Fishing in those areas will be open daily from July 1-8 before switching to a Wednesday-through-Saturday schedule.

(From: <http://wdfw.wa.gov/do/weekendr/weekendr.htm>) ❧.

Southwest Washington: The fish window at Bonneville Dam is still the best show in the region for anyone interested in fish migration up the Columbia River. More than 100,000 shad a day are currently moving up the fish ladder, occasionally eclipsed by summer Chinook salmon - sometimes known as "June hogs" - weighing 20, 30, 40 even 50 pounds. Summer steelhead can also be seen in increasing numbers, along with eel-like lamprey pressing against the viewing glass with their open-stretched mouths.

Eastern Washington: Summertime trout fishing is not a contradiction in terms, says WDFW district fish biologist Chris Donley. "Rainbows and cutthroats can still be found in the same places as in spring, but you have to fish in the early morning or late evening," he said. "They just won't be biting in the heat of the day now, and it's not very fun to sit in a boat or on a dock and bake in the sun without a bite."

Water, taken in moderation, cannot hurt anybody. Mark Twain (1835 - 1910)

Assessment of Three Categories of Stream Restoration Projects at the Reach Scale

Christopher S. James, WA-AWRA 2006 Scholarship Recipient

Declining anadromous fish populations in the Pacific Northwest have prompted state and federal agencies to fund projects focused on restoring aquatic habitat. In the State of Washington, the need for accountability of the funding spent on restoration of aquatic habitat has prompted monitoring of projects to assess the effectiveness of the restoration actions. The State of Washington Salmon Recovery Funding Board (SRFB) has funded more than 600 projects and contributed over \$200 million in state and federal funds toward salmon recovery since its creation in 1999. To ensure that the expenditures are improving aquatic habitat conditions, the SRFB approved funding for reach scale effectiveness monitoring in October 2003 to gauge the effectiveness of the funded projects. All projects funded by the SRFB are grouped into nine monitoring categories based on the type of project, and every year a random subset of projects from each category are selected for effectiveness monitoring. The nine effectiveness-monitoring categories in which projects are grouped include the following: fish passage, in-stream structures, riparian plantings, livestock exclusions, constrained channels, channel connectivity, gravel placement, diversion screening, and habitat protection. Effectiveness monitoring experimental designs and associated sampling protocols for each of the nine categories are intended to provide information about the probable effectiveness of projects in the same category. Although each category has its own specific experimental design and sampling protocol, in general, the intent of monitoring projects in the nine categories is to test if projects have improved local stream reach habitat conditions.

The focus of my research is to document preliminary changes – response conditions – at treatment reaches for in-stream structures, constrained channels, and channel connectivity projects based on the data from the SRFB effectiveness monitoring program. The SRFB effectiveness monitoring program employs a before after control impact (BACI) experimental design to test for changes associated with stream restoration projects, which entails sampling the control and treatment reaches simultaneously at both locations at selected times before and after a project has occurred. From the data collected for in-stream structures, constrained channels, and channel connectivity projects, the BACI design will be used to assess changes at a treatment reach relative to the changes at a control reach. In order to document preliminary changes at a treatment reach for each of the three categories, the data available from the monitoring program will be analyzed by comparing each available year of after data with before data and assessing differences between a treatment reach and its as-

sociated control reach. The following are the null hypotheses for the analysis of each of the three project categories:

- **For In-Stream Habitat Projects:**
 - Based on before data and available after data, each in-stream project being assessed has had **no** effect upon: (i) stream morphology and fish habitat, and (ii) juvenile abundance in the area where the in-stream project occurs.
- **For Constrained Channel Projects:**
 - Based on before data and available after data, each constrained channel project being assessed has had no significant effect upon: (i) channel capacity, and (ii) stream morphology and fish habitat.
- **For Channel Connectivity Projects:**
 - Based on before data and available after data, restoration of the disconnected channel to the stream for each project being assessed has had no significant effect upon: (i) stream morphology, fish habitat, riparian plant community characteristics, and (ii) juvenile abundance in the reach where the project occurs.

Although the ultimate goal of the SRFB effectiveness-monitoring program is to provide information about the probable effectiveness of projects in the same category, my research is intended to assess changes in conditions at a treatment reach for each individual project in a monitoring category through the above hypotheses.

In addition to documenting preliminary changes at each treatment reach by examining responses in fish density and habitat conditions at each project, further analysis will entail assessing the habitat data collected by the monitoring program for in-stream structures and channel connectivity projects, and evaluating the data for correlations with fish density. Specifically, through examination of microhabitat data at a spatial scale of each transect within a project reach, information about which variables influence fish density may be determined. Types of microhabitat data sampled at each transect before and after treatment includes depth, velocity, substrate, cover, large woody debris, and wetted width. The hypothesis being tested is that fish density varies with microhabitat attributes. The analysis is intended to focus on the distribution of fish and microhabitat attributes within a treatment reach, assess correlations between fish densities and the created microhabitat conditions, compare responses to intended conditions, and relate this information to the examination of differences between a treatment reach and its associated control reach in fish density, microhabitat, and stream

reach conditions. Additionally, this subset of my research provides the opportunity to look at a finer scale across the aggregate of implemented projects in each category. This level of detail is not only applicable for guidance in fish response and restoration design and construction, but also towards which elements of a project might be necessary for an intended response.

In summary, the objective of this study is to document and compare each stream restoration project being assessed in three SRFB monitoring categories versus each paired control reach before and after project implementation. Further investigation will focus on assessing correlations between fish density and microhabitat conditions before and after a project is implemented within the project monitoring categories of in-stream structures and channel connectivity. This research will contribute information regarding the evaluation of stream restoration projects, and the type of responses managers may expect after the first few years of project implementation. Attention will be given in the research towards describing the types of microhabitat attributes that correlate with fish density,

therefore providing information related to the elements that might be significant for the design and construction of a project. Additionally, my research will document the SRFB method used for data collection and evaluation of project effectiveness. Decision criteria used by the SRFB in analyzing the effectiveness of the nine project monitoring categories, project summaries, monitoring data and protocols, and general information related to the effectiveness monitoring program can be found at <http://www.iac.wa.gov/srfb/docs.htm>. ☺

This research is being conducted by Christopher S. James, a field technician with the effectiveness-monitoring program and a graduate student at the University of Washington in the College of Forest Resources Engineering and Hydrology department. Dr. Susan Bolton – University of Washington, Jennifer O’Neal – Tetra Tech EC, Inc., and Dr. Phil Roni – NOAA Northwest Fisheries Science Center, supervises this research. The SRFB, Tetra Tech EC, Inc., and the University of Washington made this study possible. All correspondence should be sent to Chris James via chrisja@u.washington.edu.

Special UW Student Social, Presentation by Dr. Derek Booth on Rivers and Cities

By Arden Thomas, UW Graduate Student

On June 1st, the state chapter hosted a joint meeting between AWRA members and University of Washington students. AWRA members joined students from Civil and Environmental Engineering, the College of Forest Resources, the School for Marine Affairs, and the School of Aquatic, Fishery Sciences at the South Campus Center and Earth and Space Sciences on the University of Washington campus.

Introductions from the 50 or so attendees revealed many U.W. alumni in the crowd, and memories of campus life were lightheartedly shared. Students and AWRA members alike quickly discovered refreshments, beverages, and much to talk about, and conversation filled the room from the start of the evening.

AWRA Washington State Chapter President Mona Thomason called the meeting to order and provided opening remarks. Student chapter President Chris James provided an overview of the year’s activities, which included restoration work on a cold rainy day along the Duwamish river estuary; a field trip to Roza dam where students observed the first spring Chinook of the year; demonstrating a watershed model at the Engineering department’s annual open house, a float trip down the Skagit river, and times to socialize when students could connect with the diversity of people at the U involved in water-related studies.

Dr. Derek Booth, professor of Civil and Environmental Engineering and Earth and Space Sciences shared his recent sabbatical travels to cities throughout the world. He reflected on peoples’ relationship with the rivers that many cities have been built upon. He revealed that sometimes the phrase “built upon” is a figurative one, rivers providing transportation crucial for commerce, but other times “built upon” is quite literal. In the case of Nice, France, the main river running through town disappears beneath the city all together. Views on the relationship between a river and its close inhabitants were brought back home with the observation that the Pacific Northwest has an interactive relationship with its larger rivers not commonly seen. Professor Booth’s entertaining and lively talk inspired many questions and comments from the audience. Enjoyment of food and drink then resumed, providing students the opportunity to connect with AWRA members.

Many thanks to Arden Thomas and Steve Foster for organizing this event, Dr. Booth for taking time to speak, and all in attendance for creating a successful joint meeting. Also thanks to the firms that sponsored and provided the refreshments: Bender Consulting, LLC; HDR Engineering Inc.; Preston Gates and Ellis LLP; and Brown and Caldwell Environmental Engineers & Consultants. We look forward to similar events in the future.☺

Hydrologic Connections: Surface-Groundwater Divide Thoughts and Lessons from an Experimental Plot Study

Stephanie K. Kampf, WA-AWRA 2006 Scholarship Recipient, Ph.D. Candidate, Department of Civil and Environmental Engineering, University of Washington

In research and in practice, hydrology and water resource studies are often compartmentalized. Surely many of us have heard the questions: Do you do groundwater or surface water? Management or policy? Engineering or science? Are you a modeler or a field person? As an example of fragmented perspectives, I recall a conversation once heard between two people who work in water. The first person, a visitor to the region, asked, "About how much rain do you get here?"; to which the next person responded, "Oh, I have no idea. I do groundwater." End of conversation.

When in the midst of a particular field of study, we are not often prone to question the divisions that exist. When meeting some of my graduate student companions once, my mother was highly amused at the dialogue about 'groundwater' versus 'surface water' people. After all, doesn't the hydrologic cycle connect the groundwater, surface water, and atmospheric water? Should they really be studied in isolation? Stuck in disciplinary niches, sometimes the connections are forgotten until they emerge as a promising new area of study such as 'groundwater-surface water interactions'.

In part, the divisions between groundwater and surface water can be attributed to practical barriers, some of which are revealed when we consider the different approaches in modeling the two domains. For example, many groundwater models treat surface water as a sort of 'black box' process that ends up being described using a 'recharge' term. In contrast, many surface water models treat the subsurface as a black box into which surface water may 'infiltrate'. In these approaches, both the groundwater and surface water models greatly simplify the hydrologic action that occurs in the subsurface under unsaturated conditions. Flow

processes in this domain are highly non-linear and can require some 98% of the computation time in a numerical model. Therefore, although physical links between flow processes on the land surface and in the subsurface are thought to be understood theoretically, functional models that fully couple surface and subsurface flow processes have only begun to emerge in the past decade.

A common distinction between groundwater and surface water modeling approaches is in their treatment of space. Groundwater models are designed to represent spatial distributions in head, so in calibrating a groundwater model, one might use measurements of groundwater levels at a number of different wells spread over an area of interest. Surface water models, in contrast, usually have the primary purpose of representing flow rates in a stream. Therefore, surface water models are usually calibrated to measurements of flow rates at one or more points in a channel. In other terms, this difference means that groundwater models are often calibrated to the spatially *distributed* hydrologic response, whereas surface water models are often calibrated to a hydrologic response that is *integrated* but measured at a single point in space.

Case study

The broad-brush perspective introduced so far suggests that connecting groundwater and surface water worlds in a model requires explicit representation of unsaturated flow and consideration of both distributed and integrated hydrologic response. We examine these connections using measurements at a small experimental plot located at the Center for Urban Horticulture on the University of Washington campus (Figure 1).

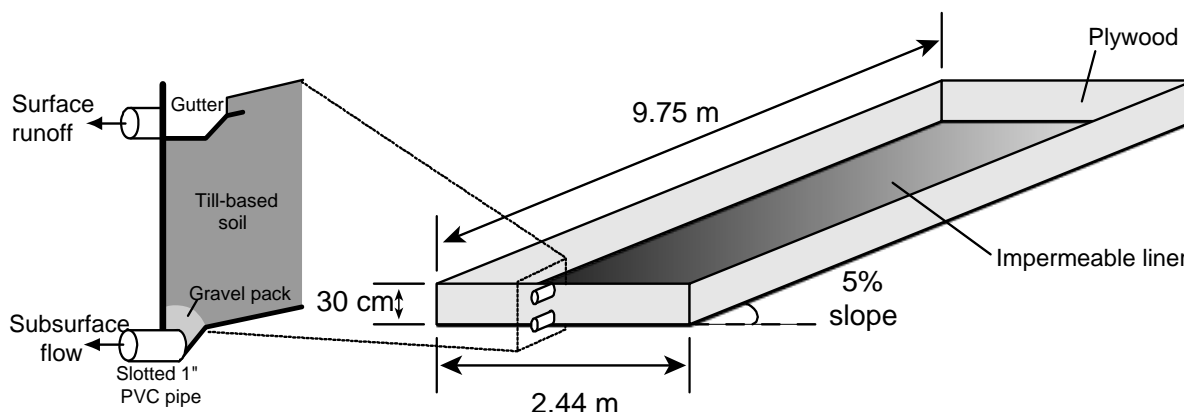


Figure 1: Experimental plot diagram

The plot is filed with grass-covered, till-based soil fills and tilted at a 5% slope. Surface runoff and subsurface flow are collected at the lower end in tipping buckets. We measure the input of water to the plot (rain), the energy budget to calculate evapotranspiration, and the distributed states of water (saturated groundwater levels, pressure heads, and water contents). Surface runoff rarely occurs at the plot, but saturated groundwater flow is common. The size of the saturated zone is highly variable, with most flow being unsaturated. To represent flow processes at the plot, we use Hydrus2D, which is a physically-based model that numerically solves the Richards' equation for variably saturated subsurface flow. Flow processes are simulated based on a two-dimensional vertical slice of the plot with no-flow boundaries on the bottom and sides, an atmospheric boundary on the top, and a seepage face boundary on the lower end. Given measured rain and evapotranspiration rates, the model simulates water flow through the 2D slice at 2-15 cm spatial resolution.

A simple scenario in which the plot begins at fully saturated conditions then drains for 24 hours is used to calibrate the model to different types of measurements, including both the distributed response (saturated groundwater levels) and the integrated response (subsurface flow rates). An inverse approach is used in which the model varies three soil hydraulic parameters until converging on the parameter combination that best meets the calibration objective.

Inverse simulation results show that calibrations to the distributed response (saturated water levels) converge on values of saturated hydraulic conductivity (K_s) that can be more than two orders of mag-

nitude lower than calibrations to the integrated response (subsurface flow rates). Figure 2 shows examples from two calibrations, one to an up-gradient saturated water level and the other to subsurface flow. The calibration to flow resulted in a high K_s with a small saturated area, whereas the calibration to water levels resulted in a low K_s with a large saturated area. Finding a parameter combination that can represent both the integrated and the distributed response is non-trivial and requires careful assignment of calibration objectives so that both the integrated and the distributed measurements are equally weighted.

Concluding remarks

To model flow systems where the size of the saturated area changes frequently, accurate simulation of unsaturated flow behavior is crucial. Finding accurate hillslope-scale soil hydraulic parameters for such a simulation, however, is a challenge even for a small, simple flow region. Although natural watersheds are much more complex than the experimental plot described here, the results highlight important lessons for setting up watershed models. In particular, a model calibrated to a single type of measurement (e.g. stream flow) can easily misrepresent hydrologic processes elsewhere. As we move into the next generation of fully coupled surface-subsurface models, we need to ensure that our modeling approaches accurately represent processes in both domains simultaneously. Results of this study provide preliminary guidance in designing strategies for measurement network design and multi-objective model calibrations that incorporate both integrated and distributed measurements. ☺

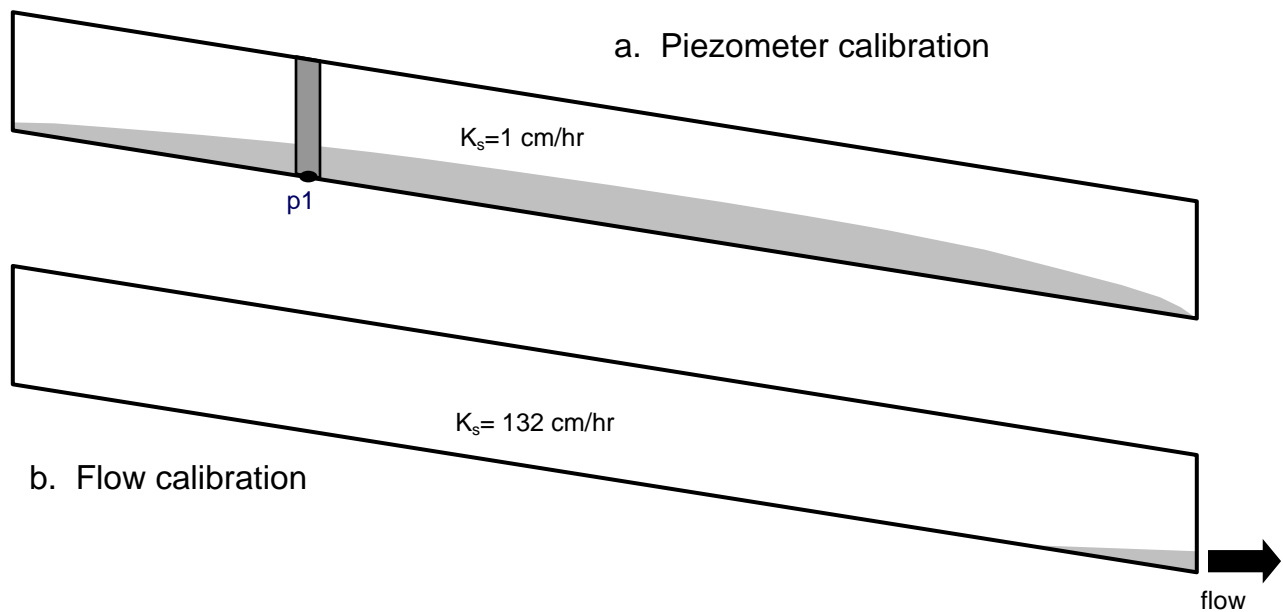


Figure 2: Simulated saturated area at 20 hours for two inverse simulations from a July 2005 drain from saturation experiment. (a) calibration to saturated water levels at a piezometer (p1); (b) calibration to subsurface flow rates. Grey shading indicates the predicted saturated area in each calibrated simulation.

Nominations for 2006 Water Resources Award for Outstanding Service

Each year the American Water Resources Association-Washington Section honors an individual at for outstanding contribution to the water resources profession in the State of Washington. In honor of the individual, the AWRA Board will make a donation in the amount of \$500 to a nonprofit organization that is related to individual's contribution.

The AWRA Board has adopted the following criteria to guide its selection.

- Outstanding contribution or achievement in the water resources field (broadly defined).
- Leadership, so that others are enabled, inspired or organized to advance the understanding, management or wise use of water resources.
- Degree of innovation.

- Interdisciplinary or bridge-building qualities.
- Acknowledgement of the outstanding contribution from a diversity of perspectives.

When nominating a person, please state specifically how that person meets the above criteria. An individual need not satisfy all of the criteria to win the award, and the Board may rely on other appropriate factors. The criteria are a non-exclusive list of factors to guide the Board's consideration.

Nominations will be accepted until September 1, 2006. The award will be presented at the Annual State Conference which will be held on November 16, 2006 at the Museum of Science and Industry. Please e-mail your nomination to Pete Sturtevant: psturtev@ch2m.com. ☺

2006 AWRA- Washington Section Annual Conference Water Resource Disasters in Washington: Risks and Recovery

During the past two years, the world has seen an a significant number of natural disasters. Tsunamis, earthquakes, and a series of devastating hurricanes have exposed our vulnerability to widespread destruction and its consequences on human lives, our infrastructure, and the environment. The enormous problems associated with failures in disaster response and long-term recovery have been have been equally disturbing. This year's AWRA State Conference, to be held on **November 16, 2006**, will focus on this timely topic with a conference titled "Water Resource Disasters in Washington: Risks and Recovery." In addition to the flood threat commonly faced by many regions, Washington State faces several other potentially severe water resource-related risks. Off our coast, the Cascadia Subduction Zone has historically produced earthquakes and tsunamis larger than the monster event that occurred off the coast of Sumatra a year and a half ago. Another active seismic feature, the Seattle Fault, is capable of producing equally destructive earthquakes, given it's shallow nature and proximity to a large metropolitan area. Washington State is also home to five active volcanoes that are capable of producing major melt water flood events and gigantic mud flows (lahars). Such events can travel tens of miles, obliterating everything in their path and represent a major threat to a number of valley communities.

Our 2006 State conference will discuss these sorts of catastrophic events relative to anticipated effects on our water resources. Experts from a diverse range of backgrounds will review these threats and the potential extent of damage and disruption that would result in our state. In a second session, the preparations federal, state, and local agencies have or need to have in place to deal with these disasters will be discussed. We anticipate that the conference will conclude with speakers from agencies such as FEMA and the State Department of Emergency Management who will review the recovery measures available to rebuild following a major disaster. At the end of the day, the attendee will walk away with an understanding of the risks associated with our water resources and the ability of the state to function and recover from a major disaster. The conference also may motivate some personal planning on the individual attendee's part to address the very local effects of a disaster on home, family, and friends.

This year the conference will be held at the Museum of History and Industry (MOHAI), located near the University of Washington at the edge of the Seattle Arboretum. Our Conference Committee is co-chaired this year by Carl Einberger and Ken Gish. Other members include Tom Ring, Steve Hughes and Pete Sturtevant. We have been working hard to assure that this will be a highly interesting and beneficial conference. Speakers are being arranged at this time, and you are welcome to contact Carl (206-342-1776) or Ken (206-370-6585) with any suggestions you may have. Mark November 16 on your calendar and plan to attend! ☺

Washington Section American Water Resources Association 2006-07 Fellowship Announcement

The Washington State Section of the American Water Resources Association (AWRA) is seeking nominations for its 2006–07 Fellowship Award. For the 2006–07 academic year, two fellowships of \$1,500 each will be awarded.

One award will be to a member of a Washington Section affiliated Student Chapter. The other award will go to a student enrolled in a graduate program at a college or university in Washington State. Both fellowships are for a full-time graduate student completing an advanced degree in an interdisciplinary water resources subject.

In addition to \$1,500 in cash, the award includes a one-year membership in both the State and National AWRA, a one-year subscription to the Journal of the American Water Resources Association, and admission to the Washington State Section Annual Conference.

Each department with qualified applicants may submit one nomination for the award. The application packet, limited to five pages, should include the following:

1. A brief letter of nomination from the department head;
2. Completed Application Form;
3. Statement of goals and objectives for graduate work;
4. Detailed description of research interest.

Qualified students need to fill out the application form and prepare the additional information requested above and mail it to the Fellowship Committee Chair, Stan Miller. The letter of nomination may be mailed under separate cover by the department head or included with the applicant's package.

Items two through four constitute the application package and must be prepared by the applicant. Nominations will be evaluated on:

1. The interdisciplinary nature of the course of study and research;

2. The effectiveness of the response in communicating research objectives;
3. The potential for application of the work to the current needs in water resources management; and,
4. The reviewers overall impression of the applicants qualifications and presentation.

Nominations will be accepted at any time between the date of this posting and September 30, 2006. Students not attending summer school, for which a September deadline would create a time crunch, are encouraged to submit applications in the spring or early summer.

In early October the Fellowship Committee will evaluate all applications received and will recommend recipients for the Open and Student Section winners to the Washington Section Board of Directors. The Board approves the selections at the October 2006 Board meeting.

The winners will be notified as soon as the board approves the award. Special recognition will be given to the fellowship recipients at the State Section's annual conference in November.

The recipients will prepare an article describing their research for the Section newsletter.

For additional information contact Stan Miller by email at samillerh2o@comcast.net or by phone at (509) 455-9988.

Send the completed Application Packet to the email address above (.PDF or MS Word format preferred) or mail to:

Stan Miller, Fellowship Committee Chair
AWRA Washington State Section
1329 S. Ferris Court
Spokane, WA 99202

For additional information, please see our website at: www.wa-awra.org

Article submissions are always welcome. Please let the editor Chris Pitre (cpitre@golder.com) know if you would like to contribute an article for the next newsletter.

WA-AWRA Dinner Meeting:
Water Resource Issues with Transportation Projects

Featuring: Allison Ray, Washington State Dept of Transportation

July 13, 2006

Pyramid Ale House

1201 First Avenue South, Seattle, WA (Across from Safeco Field)

5:30 - 8:00 PM

5:30 Social and Dinner, followed by the Dinner Program at 7:00 PM

Presentation Summary: AWRA WA is excited to have Allison Ray from the Washington State Department of Transportation speak to our section about water resource issues associated with transportation projects in our region. You won't want to miss this interesting presentation!

REGISTRATION

To register, please send registration fee (check made payable to AWRA, Washington Section) with the attached registration form.

-----detach & mail with registration -----

July 13, 2006 Dinner Meeting Registration

Registration is (please circle those that apply):

\$20 for members
\$35 for non-members (includes 2006 membership)
\$10 for student members
\$12 non-dinner option

Name _____ Total _____

Affiliation _____

Address _____

City _____ State _____ Zip _____

Phone:(____) _____ Fax (____) _____

E-mail _____ @ _____

Checks only. payable to: "AWRA Washington Section".

No credit cards or purchase orders, please. Please mail checks by **July 10, 2006 to:**

AWRA Washington Section, Dinner Meeting
P.O. Box 2102
Seattle, WA 98111

For questions about your membership or the dinner, please contact Jamie Morin by phone: (206) 493-2324 or email: morin@mentorlaw.com. Or contact Jacqueline Klug by phone: (425) 649-7124 or email: jklu461@ecy.wa.gov. ☺

NEW MEMBERS

Membership dues are a revenue source for the Washington Section of the American Water Resources Association (WA-AWRA). The most important use of this revenue is to fund the annual student scholarship awards which have grown from one scholarship per year worth \$1,000, to two scholarships worth \$1,500 each. We are also building a self-sustaining trust fund to expand the student scholarship program.

The primary means of recruiting membership to the Washington Section of the American Water Resources Association (WA-AWRA) is through attendance at the annual state fall conference. The annual national conference is also held at about the same time. Hosting the national conference is a privilege, which the Washington Section received in 2005. When the state section hosts the national conference, we reschedule our section's annual conference. This usually results in diminished recruitment for a number of reasons.

If you are not currently a member, we ask you to renew your membership using the last page of this newsletter. You hope that find the newsletters you receive as a benefit of membership to be interesting. New members will be listed in newsletters. Here are our newest members:

Tim Abbe, Herrera Environmental Consultants
Scott Bender, Bender Consulting, LLC
Lisa Dally Wilson, Golder & Assoc.
Craig Doberstein, Herrera Environmental Consultants
Tony Dubin, Brown and Caldwell
Bob Duffner, Port of Seattle
Clare Fogelsong, City of Bellingham
Steve Germiot, Aspect Consulting, LLC
Adam Gravley, Buck and Gordon LLP
Stephan Jilk, Whatcom County PUD #1
Kris Kauffman, Water Rights, Inc.
Andy Kindig, A.C. Kindig & Co.
William Kinsel, WSU-Tri Cities
Robert LaCroix, City of Port Townsend
Clay Landry, WestWater Research
Thomas Leschine, UW School of Marine Affairs
Carl Lunak, Northshore Utility District
James Mathieu, Northwest Land and Water
Joe Mentor, Jr., Mentor Law Group, PLLC
David Monthie, King County Dept. Natural Resources/Parks
Kathleen O'Neil
Rachel Paschal Osborn
Lisa Pelly, Washington Rivers Conservancy
Sue Perkins, Perkins Geosciences
Paul Pickett, Thurston PUD
Rebecca Ponzio, WA Dept. of Ecology
Craig Riley, WA Dept. of Health
Harry Seely, WestWater Research
Dan Smith, City of Tumwater, Dept. of Public Works
Judy Stockton, WOLF Environmental Group
Janet Thompson, JTL & Associates
Lance Vail
Tom vonSchrader, SVR Design Co.
Eric Weber, Landau Associates
Matt Wells, Preston Gates & Ellis LLP
Steve Winter, Adolfson Associates, Inc.
Wayne Wright, GeoEngineers, Inc.

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ardent@u.washington.edu

Faculty Advisor: **Anne Steinemann**
(206) 616-2661
acstein@u.washington.edu

2006 Membership / Change of Address Form

(⌂ please circle, as appropriate ↶)

Annual membership in the state chapter costs \$25.

Name _____ Position _____ Affiliation _____

Street Address _____ City _____ State _____ Zip _____

Phone(_____) _____ Fax(_____) _____ E-mail _____ @ _____

Please indicate if you prefer to receive your newsletter electronically.

Check if you would like to be actively involved on a committee.
You will be contacted by one of the board members.

2006 Membership Dues: \$25.00. **Checks only.** Please make check payable to
AWRA Washington Section.

Mail to: American Water Resources Assoc. WA. Section
P.O. Box 2102
Seattle, WA 98111-2102

The American Water Resources Association is a scientific and educational non-profit organization established to encourage and foster interdisciplinary communication among persons of diverse backgrounds working on any aspect of water resources disciplines. Individuals interested in water resources are encouraged to participate in the activities of the Washington Section.

Special Thanks!

To Golder Associates for word processing and graphics support on this newsletter.

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