**The Declining Aquifers of the Palouse Basin:**

**An Attempt at the Interdisciplinary Process**

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**Introduction to this Interdisciplinary Project**

Complex physical and social problems cannot be adequately addressed from a single disciplinary perspective. The importance of interdisciplinarity for such complex issues has been identified in recent decades (Newell 2001; Repko 2008). Rather than simply looking at the problem from different disciplinary perspectives, an interdisciplinary method integrates each discipline’s approach to the problem to form a new, more complete perspective. In this paper, we address the complex problem of declining aquifer levels in the Palouse Basin, the communities that rely upon them, and the scientific and social barriers to securing a long-term viable water supply well into the future. In order to fully understand the problem and identify possible solutions to these barriers, we integrated perspectives from the natural sciences, social sciences and public policy.

Section I is a chronological report of the interdisciplinary steps taken and the processes used in this integrative experience. Section II explores the problem from the integrated perspective we gained and includes recommendations for moving forward with this issue.

**Section I: Methods of Integration: A Journal of the Interdisciplinary Process**

Week 1:

In our initial meeting and as a part of a workshop/guest lecture from Professor Maureen Laflin, we introduced ourselves and established a basic framework for the way our group wanted to operate. We discussed and agreed upon the ground rules listed in Table 1.

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| **Table 1.** Team Ronde House Ground Rules | |
| **Challenge** | **Decision to address challenge** |
| Decision making style | Consensus, with focus on efficiency of time |
| Where/how often to meet | One time per week, until we feel the need for more frequent meetings |
| How to schedule meetings | Doodle polls online |
| How to meet with people in remote locations | Skype, using Liza and John’s accounts |
| How to share documents | Dropbox |
| How to deal with group dynamic problems if they arise | Focus on open communication and early warnings about personal conflicts with meetings, deadlines, etc. Use group meetings as a time/place to deal with issues when appropriate. |

Week 2:

This was in many ways the formative stage of our group. We established connections within the group and grew into a team with a common goal. We even chose a group name - Team Ronde House - to build camaraderie and foster a unique sense of ownership of the project. Following the general steps outlined by Allen F. Repko (2008) in his book, we spent the majority of this meeting identifying relevant disciplines and discussing which would be worthwhile and appropriate to include in this project.

To begin the process each individual shared past educational and academic training, job history, relevant past experiences and current research. Everyone also shared what interested them the most about the declining aquifer problem based on its brief introduction. We wrote key words from these answers on a white board, which made it relatively easy to identify emergent themes and common areas of experience and interests within our group. Collectively, we had a good deal of background in the natural sciences (environmental sciences, hydrology, biology) and some in public policy and law. Notably, everyone had a relatively high level of interest in social and natural science intersection (land use planning, conservation, and water engineering).

We decided to break up into working groups to develop disciplinary adequacy, pairing up into teams of two based on academic interest, experience, and expertise. Group member backgrounds were generally known from the initial introductions in class, but we also went through a more formal process to determine the roles. Ross and Allison accepted the policy component, Liza and Audrey accepted the community education component, while Heidi and John accepted the hydrologic component. Forming these disciplinary pairs turned out to be very effective in the integration process. Drawing on the analogy of interdisciplinarity as a fruit smoothie (Nissani, 1995) in which disciplines are seamlessly blended together, the formation of these working groups was like making hybrid fruits even before attempting to blend them together. It made the final product much easier to integrate.

During this introductory meeting we set valuable standards for ourselves by establishing clear goals for the upcoming week. We also established goals for the end of our next meeting: to leave with an understanding of what each individual would do to move beyond exploratory research and begin the writing process. We left the meeting with a generally defined, but flexible idea of the scope and structure our report would take.

Week 3:

In our group meeting during class time we focused on the integrative process. We followed the steps to integration as suggested by Repko (2008) and defined the following for our group:

1. Problem: The uncertainty of a long-term, viable source of water for the community of the Palouse Basin given current population growth and rates of aquifer decline
2. Common Ground—all members agreed on these three aspects of the problem:
   1. Given the uncertainty of the water supply, there is a need for action to minimize the potential severity of a water crisis in the future.
   2. The two primary ways to address the issue are to:
      1. Increase the water *supply* by acquiring an additional water source.
      2. Decrease the *demand* of water through behavioral changes.
   3. We will focus on the demand side of the water balance equation.
      1. We all agreed that the supply question is highly limited by current science and technology with regards to aquifer research.
3. Integrating Question: While uncertain of our future water supply, how might we increase community willingness to minimize demand on the aquifers using education, conservation, and political solutions?

This was a somewhat rushed process given the time constraint we had, but by directly and respectfully asking for each other’s opinions, and giving frank answers, we were able to create an initial integrating question. As reported in some of the individual meeting summaries (explained below) not everybody was fully satisfied with this question, but all agreed that it was a good starting point and would evolve and change to our satisfaction. The mutual trust we had built up by this point helped facilitate this speedy process because *everybody* spoke up and contributed. Nobody was afraid of their ideas being ‘wrong,’ as Professor Laflin warned can happen in groups.

This week each pair glanced briefly at all the existing material, but focused on their sphere of disciplines (broadly defined by the working pair titles). During this meeting each pair reported their findings to the rest of the group in order to help develop disciplinary adequacy and ensure that we were not biased for or against other relevant disciplines. A lot of ground was gained during this time discussing what each pair could contribute to answer the integrating question we had developed during class. It involved a lot of “talking things out” with each other, and giving suggestions to other pairs about how we could each contribute. We also spent some of this time developing common terminology and language that we could work from. We discussed how we could distinguish communication, education, outreach, and policy implementation to avoid overlap in our report and avoid different usages of the same terms. Retrospectively, this was a helpful discussion to have at this point in the process, but the editing process and passing around the final product was another notable iteration of developing and using common language.

We left the meeting with a major consensus reached (listed above as 2c), a clear understanding of our status on the project, clear goals for the next meeting, and a clear process for deciding the time of the next meeting through a Doodle poll. We aimed to arrive at the next meeting with a distinct product from each working pair: an outline for the specific component they would write about. We also looked at our long term goals during this meeting and agreed we were on track to have a draft done one week prior to the due date to allow ourselves time for reading, editing, and further integration. In order to track our process in the interdisciplinary process and provide a means for individual and group reflection, everyone agreed to post individual summaries of meetings into our shared Dropbox folder.

Members of the group noted in their personal statements that they felt much better about the project after this meeting. Each person was able to share his/her unique perspective on the issue. Through that process we all gained a better understanding of how we could shape the report to integrate it all together. Narrowing the scope of the project helped make it more manageable. Similarly, understanding that a major group goal was to identify the steps that we could take to move forward in finding solutions to this problem as opposed to actually defining specific solutions helped make the project more manageable.

Week 4:

In this meeting we revisited the group outline that had been compiled after each working pair posted its outline in Dropbox. We further discussed what we each wished to contribute to the project. Each person discussed an aspect of the declining aquifer problem that they found significant. We all then discussed the relationship between those aspects and how we might represent those relationships in a paper form. Additionally, each disciplinary group made suggestions for the content of the other groups’ sections that would aid in the overarching interdisciplinary goals. For example, Allison wrote about the views of Palouse Basin policy-makers: John and Heidi would use this information in their efforts to provide a background of hydrological uncertainty in which the policy-makers’ views would be adequately explained.  The outline produced from this meeting was subsequently improved and can be found in Appendix A. This outline provides an interesting snapshot into the integration process. The group goals for the next week included a revised conceptual model and completed rough drafts from each working pair.

After the class session with Professor Jan Boll on conceptual models, we created our own model that identified the major physical and social systems pertinent to the integrating question and scope of our project. Importantly, our model included potential connections and flows related to these systems.

We began creating this model by focusing on the aspects of the issue that interested all of us and had been captured in our integrating question. We then identified factors related to our question. The hydrologic communication pair noted significant uncertainties that surround the aquifer itself, including the rate of recharge, the rate of leakage, and the actual volume of the aquifer system. The policy pair noted that the level of interest in an alternate water supply is not known and the rate of demand is dependent on uncertain factors like population growth and public interest in conservation. The education/outreach pair noted that education can facilitate interaction between advisory groups, policy-makers and members of the public. They also noted that this education can promote behavioral changes that affect the demand for water from the aquifer and can create a foundation of awareness and understanding that may be helpful in mobilizing action in the future.

Together, we created a preliminary model to begin representing all of our ideas on paper. Then, this model was transferred to a PowerPoint slide and saved to Dropbox. Group members individually viewed and edited the model to accurately reflect their understanding of the problem. Similar to the development of our integrating question, the initial model was revisited later. When we revisited the model, we noted the value of the creation process itself. By working together to create a final product, we collectively clarified our ideas. The visual nature of the model forced us to narrow our thoughts on the issues and their interconnectedness (see Appendix B).

Week 5:

This Ronde House meeting focused on defining needs to complete the project successfully. As with most meetings, we began with a few minutes for everyone to put items on the agenda that they would like to address. The issues addressed were the final integration of the sections written by each working pair, division of work for completing and compiling the methods section, and a plan for final editing and reflection on the best methods for writing with interdisciplinarity. We came up with an exciting and creative idea to include a brochure explaining the declining aquifer problem, its scientific uncertainty, and the need for action as an example product for educational purposes (see Appendix C). Our goal looking forward was for all of the writing to be completed by the following Monday, at which point we would compile everything into one document.

Week 6:

The process of interdisciplinary writing really began with our group discussions and identification of important components of our paper in preceding weeks. As mentioned above, we decided that our paper would be addressed to community members and policy-makers, and our message focused on demand reduction and conservation measures through education and outreach. The decision to speak to this audience affected the way we wrote our sections. For instance, in the educational brochure, we present enough science to ensure a basic comprehension of the Palouse Basin hydrology and to convey an explanation for the uncertainties of the water supply. However, our goal was not to explain complex science that would be unnecessary to convey our main message of uncertainty in the supply. Establishing which audiences we were addressing as an interdisciplinary group also facilitated smooth integration in the final product.

We started the editing process exchanging section between the individuals within each working pair. This was an effort to ensure quality within each discipline, so the material was presented clearly and accurately. Next, we exchanged papers across disciplines so each paper could be reviewed from a different perspective to ensure the focus of the main goal of the paper. This step in our methodology was important because it refocused each section so that they were not overemphasizing their information or going too far in depth into each discipline. This was a reflective step, and we assessed ourselves for appropriate levels of disciplinary depth and breadth as well as an interdisciplinary synthesis (Repko 2008). Additionally, it became apparent in the arguments made that each discipline had underlying assumptions about what were the most important elements. This was addressed in one of our final meetings and we explained to each other why certain components were critical in the presentation of the information. The process of editing across disciplines was a challenge because we have all been trained to write in a specific style that is appropriate for our discipline. We each adjusted our writing styles for the sake of this interdisciplinary paper throughout the entire editing process. This paper grew and changed along with the group. We began as individual parts coming from different perspectives and through communication and understanding, we became one integrated whole.

**Section II: “The Declining Aquifer Problem”**

**Introduction**

The Palouse Basin declining aquifer problem is ultimately a physical problem best defined by the discipline of hydrology. The Palouse Basin region includes land east and west of the Washington-Idaho border near Pullman, Washington and Moscow, Idaho. The majority of water consumed in this region is extracted from the underlying Wanapum and Grande Ronde aquifers. Data show that for the past 100 years, the water table is declining (Robischon 2011). Studies have attempted to determine whether this rate of water use is sustainable. However, due to the convoluted geology of these aquifers, there is uncertainty in the total volume of water storage, the rate of recharge, and discharge. Many models have been used to perform trend analysis on declining aquifer levels in the Grande Ronde and suggest a range of potential outcomes for the future, including a scenario in which the aquifers cease to provide sufficient water to supply the region at the current demand (Beall et al. 2010). This possible scenario means that at some date, water users would cease to be able to extract water at the current rate and have to find an alternative supply of water and/or find ways to decrease consumption.

In addition to human consumption of water from this aquifer system and the uncertain hydrology, social problems (best defined by the discipline of political science) confound the declining aquifer problem. Palouse Basin policy-makers have indicated a reluctance to act to address the declining aquifer because of a lack of community will (Richartz 2010). We define “act” and “action” as: 1) implementing conservation measures generally, 2) tiered water rates, where water users who use less water are charged less money per unit of water, or 3) paying for supplemental water sources. Furthermore, willingness to act is correlated to knowledge of local water resources (Bilodeau 2009). This paper proposes a plan of action to educate residents about the declining aquifer levels with the end goal of fostering community willingness to act. This paper examines the policy barrier, outlines education and outreach efforts in the past with future recommendations, and distills the hydrologic information down to a brochure that will help community members understand the declining aquifer problem. By conveying simplified versions of complex hydrologic information through targeted outreach, we hope that community will toward decreasing water demand is fostered so that policy-makers can act.

**An Argument for Action in the Palouse River Basin**

Policy-makers point to the lack of community will as a barrier to action, therefore increasing community willingness may trigger policy-maker action. Furthermore, community knowledge of local water resources correlates to individual will for action. It then follows that focusing on educating the community may increase the number of individuals willing to act and, thus, affecting the collective community will. Through the use of education and outreach to increase knowledge, the plan of action developed here is intended to foster community will and make action politically feasible.

The plan of action is based on three related assumptions and is intended to mitigate the potential effects of the declining aquifers in the Palouse Basin. First, the plan of action assumes that the factors correlated to willingness to act are causally linked. In other words, increasing individual education will make individuals willing to act. Second, the plan assumes there is a progression from: 1) individual knowledge of the declining aquifer to, 2) individual concern to, 3) individual willingness to act to, 4) community will for action. Third, it is assumed that the educational recommendations can influence enough individuals to be willing to act in order to surpass a tipping point, thus compelling policy-makers to follow the new community will. It is important to note that these assumptions are made by this group alone and not the referenced sources. While these assumptions may seem tenuous, it is believed that a plan of action was preferable to waiting for more certainty. Again, we argue that acting according to the plan of action is important, even if some of these assumptions are not yet verified, because increased knowledge lays the foundation for *any* future action.

In Bilodeau (2009), results of a survey were compiled and analyzed that asked Palouse Basin residents several questions related to local water resources. The study found a “higher level of knowledge, concern, and perception of water resource problems as well as the respondent being a municipal water user were correlated with a greater likelihood to indicate a willingness to pay for water conservation.” (Bilodeau 2009, iii). “Willingness to pay” is generalized here as the willingness to act or acceptance of conservation measures.

Bilodeau (2009) admits that this correlation does not prove causality, however, community campaigns are not inhibited by the statistical convention of correlation versus causality. It is therefore appropriate to design a plan of action based on an assumption that there is an underlying causation between the correlated knowledge and willingness to act. Virtually no community campaigns are sure to work and it would be unduly stifling to impose such a burden on the use of community campaigns.

An additional assumption is that increasing education will lead to concern and willingness to act, which will be followed by political action. This assumption is also unproven, but it is logical to design a community campaign that relies on this assumption. Residents unaware of a problem or the extent of a problem are unlikely to be concerned about it or willing to act. Furthermore, policy-makers are apparently unwilling to act without community will (Richartz 2010). By making residents aware, it is at least possible to trigger eventual political action. Thus, a strong basis for a plan of action exists while the potential consequences of the alternative of inaction are great.

It is necessary to assume that the recommended plan of action of targeted outreach and education can make enough individuals willing to act that the policy-makers will follow. By educating and hopefully making enough individuals willing to act, it is hoped that the policy-makers will follow through and implement conservation measures in accordance with the wishes of their constituents. If the plan of action does not reach this threshold of community will, due to the incorrectness of any of these assumptions, the plan may fail. However, the failure will be the result of inherent and unchangeable community values rather than a lack of community knowledge regarding the future of their water supply.

**Policy Making in the Palouse Basin**

Policy in the Palouse Basin is decided and implemented by representatives from two universities, individuals from multiple communities, and several levels of government including elected city and county officials and state agencies. These entities must communicate with one another and come to agreement in order to implement any policies addressing water use in the region.

Currently, the Palouse Basin Aquifer Committee (PBAC), a cooperative group of entity representatives, works across jurisdictional lines. Under the PBAC umbrella, representatives from basin universities, cities, and counties work to develop solutions to the declining aquifer problem (PBAC 2011). There have been attempts to implement solutions to this problem in the past. For example, in the 1970s, the Army Corps of Engineers, a federal entity, proposed to the United States Congress the creation of a storage and pump system to supplement diminishing groundwater with surface water (Robischon 2011). Palouse Basin locals did not approve of this proposal. Farmers feared losing land to the project and their protestations forced the Corps to abandon the effort. Experiences like this suggest that any change must come from the community level, rather than being implemented by outsiders.

Policy-makers familiar with local stakeholders may be able to identify ways in which change can be made at a community level. In a 2010 study, Opportunities for Collaboration: A Situational Assessment of the Palouse, Saundra Richartz interviewed fifteen policy-makers in the Basin. To account for the area’s unique multijurisdictional components, Richartz interviewed policy-makers involved in the problem from city, county, state and university levels. Interviewees were asked to identify important Basin issues, their opinions about these issues, and potential management solutions.

Those interviewed suggested that their primary goal was to secure “A long term, reliable, sustainable, quality, clean water source …” and consistently identified the annual decline in aquifer water levels as the overarching problem in the Basin (Richartz 2010). Additionally, the interviewees expressed concern over the relationship between current water usage and water recharge. Despite uncertainties, policy-makers think the current rate of water use is greater than the rate of recharge and some policy-makers believe that the level of current water usage is not sustainable (Richartz 2010).

While policy-makers believe that current use is unsustainable and are interested in implementing policies to address water availability, they also believe that people are unwilling to change their behavior until they believe a problem exists. Those interviewed consistently suggested that the “primary question … is how to get people to care before the tap runs dry,” and as one interviewee said, “‘Until someone’s tap goes dry, the public isn’t going to show up’” (Richartz 2010). Without public involvement, policy-makers have little power to implement solutions. As one policy-maker said, “It’s hard to be visionary when we are limited by money and lack of cooperation” (Richartz 2010).

Some policy-makers suggest that increased inter-entity communication and the promotion of conservation ideals could be one solution to the community interest problem. Specifically, some policy-makers believe that the exchange of information in the Basin is limited and are interested in increased communication between PBAC, entities represented by PBAC members, and the general community (Richartz 2010). Increased communication could serve the important goals of changing behavior and promoting conservation (Richartz 2010). Some interviewees also believe “it is necessary to get community leaders engaged more than they already are with PBAC and with the community to promote” a change in community culture and support for finding solutions to the declining aquifer problem (Richartz 2010). Those interviewees also wish to bolster cooperation in PBAC and the community to combine existing knowledge, future research, and policy implementation (Richartz 2010).

Additionally, policy-makers suggested that outreach focusing on the benefits of conservation, like “saving time and money with unique irrigation design,” would be more effective than a negative campaign with messages like “green lawns and irrigation are bad” (Richartz 2010). Developing an interest in conservation may not only slow down the rate of consumption, but may also help achieve the goal of building support for an alternate source of water. By promoting conservation, individuals in the community may become more aware of the need for a sustainable water source and therefore more willing to shoulder the expense of an alternative. Some interviewees even suggested that support for the eventual expense of an alternate source of water must be built (Richartz 2010).

Policy-makers believe that the individuals within the community at large need more information about the problem at hand in order to willingly change their behavior. It has been explicitly suggested that a way to gather public support for conservation efforts might be “a public information campaign to get the public on board with further conservation efforts” (Richartz 2010).

**Education and Outreach Efforts**

If water demands in the Palouse Basin are to be met for current and future needs, it is important that knowledge and understanding of the situation within all sectors of the population increase. Promoting changes in natural resource consumption can be challenging and is often met with resistance unless clear reasons for change are presented. Education and outreach are effective tools that could be used to minimize resistance and encourage increased water conservation. Given the uncertainty of the aquifer supply and the feasibility of alternative sources, reducing demand on the aquifer is a prudent measure to take.

Education efforts regarding water resources within the Palouse Basin date back to 1992 with the formation of the Palouse Basin Aquifer Committee (formerly the Pullman-Moscow Water Resources Committee, PMWRC) and its objective to promote “public education and awareness regarding basin ground water management issues” (PBAC 1992). The establishment of this committee and its desire to educate the community shows a change in perspective about the water supply and how to sustain its viability. In 1995, the Palouse-Clearwater Environmental Institute produced a conservation handbook for PMWRC that targeted domestic water conservation measures. While it provides some very simple yet effective methods for reducing water use, the level of distribution that it experienced is unclear (PCEI 1995).

Although education was identified as an important part of water conservation efforts, activities have been somewhat limited. The City of Moscow Water Conservation Plan (2004), a summary of conservation activities from 1997 – 2003, shows a focus on the installation and distribution of water-saving devices rather than education. Education was limited to tours of the water treatment plant. Despite initial shortcomings, the plan outlines a strategy for more involved education and outreach measures for future implementation. The City of Moscow’s Public Information and Education Programs (PIE) show great promise with effective methods of educating the community and encouraging behavioral change regarding water use (City of Moscow 2004).

The key to achieving greater conservation is to successfully communicate to various stakeholders why conservation is important and how it may be achieved. Several PIE vehicles for outreach and education have been identified, such as media/advertisements (print, radio, television and internet), awareness-generating giveaways, school programs and community events, and outreach to industry groups. These methods have the potential to inspire increased conservation efforts across broader sectors of the population. Moreover, if these education and outreach efforts are coordinated with the City of Moscow and other institutions, such as the local universities, the City of Pullman, Latah County, and Whitman County, the potential impact is much greater (City of Moscow 2004).

In 2007, the University of Idaho Waters of the West (WoW) program began to design a participatory systems model, the Palouse Basin Water Resource Visioning Tool, which better defines the water resource problem and can be used as an interactive educational tool. In 2009 PBAC started collaborations with WoW on this project and together they encouraged individuals from the Washington Department of Ecology, the Idaho Department of Water Resources, University of Idaho and Washington State University hydrologists, and a handful of community members to participate in the development process. The model has great potential to reach community members and policy-makers and elucidate the problem and possible solutions. The model could be used in classrooms with students of all ages and the website could be made available to interested community members at large (Beall et al. 2010; Beall et al. 2011)

**Plan of Action: Education/Outreach Implementation Recommendations**

Past efforts to increase awareness and knowledge on the status of water resources in the Palouse Basin can also help direct future education and outreach projects. Before implementation of further educational programs two things must be considered: 1) where to aim these efforts and 2) how to communicate complex scientific/social issues to community groups with a wide range of educational background and knowledge regarding the issue.

Given the limited resources for outreach efforts such as time, human power and funding, it is prudent to define where these efforts will have the most influence. Identifying target audiences and focusing education and outreach on them will increase the probability of seeing responses and action by the community. Once target audiences have been defined, we can turn to the second question, recognizing that different audiences may benefit from different methods of communicating the dilemma of declining aquifers in the Palouse Basin.

The first step in identifying target audiences is to identify all the possible audiences that exist in the community. This is a challenging undertaking, especially considering the socially and politically charged task of “grouping” people together, but the value of a participatory process discussed earlier demands identification of relevant stakeholders. For the purposes of this paper, we performed a community diagnostic (a method to identify stakeholders and pre-existing community groups) by reviewing the existing literature that relates to water use in the Palouse Basin. Drawing on information from UI Masters’ theses, city water plans, PBAC publications and presentations given by professionals to the Water Resources 506 course, we identified the groups listed in Table 2. The primary criterion used for selection of the potential audiences was their inclusion as separate entities in existing documents (Tidwell et al. 2003; City of Moscow Water Conservation Plan 2004).

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| **Table 2.** Existing community groups to consider for targeted education and outreach efforts |
| Primary & Secondary Schools |
| Universities: University of Idaho, Washington State University, New Saint Andrews |
| Cities of Moscow & Pullman |
| Government Agencies (County, State, Federal) |
| Commercial Entities (service industry, healthcare, etc.) |
| Agricultural Entities |
| Non-profits/Community Action Groups: PCEI, PBAC |
| Individuals/Family Households |
| \*Note: This list is not comprehensive, and we recognize that there are many people that may fit into more than one category, or perhaps none at all, but this is a functional list that does identify the major potential audiences for education and outreach efforts. |

Defining the criteria to *prioritize* these groups for targeted education and outreach efforts was more complex, but again relied heavily on preexisting research and information available on the Palouse Basin Community Water Information System website. Through this analysis and discussion within our group we developed questions (Table 3) to guide the process and select audiences to target.

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| **Table 3.** Guiding questions for identification of target audiences |
| Which groups would be most receptive to learning about the declining aquifers and water resource issues confronting the region? |
| Where is there the most ground to be gained? Which audiences have not yet been exposed to the problem? |
| Where is there the greatest potential for water and/or monetary savings? |
| Which groups have the most elasticity of water use? |
| Which groups are most likely to respond with behavioral changes? |
| Where will the effort gain followers for future participatory processes? |
| How many people/groups are realistic to reach given current resource constraints? |

Ideally, for each group given priority as a target audience, we would identify the level of knowledge and familiarity with the problem, determine the best method to communicate the issue, and come up with ways that they can be a part of the solution. This approach to implementation can ensure that future education and outreach efforts are both efficient and effective. It also re-emphasizes the importance of community willingness in achieving the goal of a long term, viable water supply through demand reduction, while simultaneously laying the groundwork and understanding for alternative water sources in the future.

Maintaining the momentum of ongoing efforts is also important and we must take advantage of the interdisciplinary and cross-community networks for the flow of information that have already been created. For example, PBAC is a community organization that has already gained some notable ground and clout within the community, and even carries some legal weight. It is a resource that must be capitalized on to reach a diversity of stakeholders. The Palouse Basin Summit – an event planned for later in the year – may be a great opportunity to reach out to target audiences. An effort should be made to include targeted groups through invitations, activities that engage them in the process, inclusion of presentations that use the methods described in this paper for communicating scientific uncertainty, and other creative efforts such as a symposium featuring presentations of school projects from students of all ages or research presentations on various aspects of the issue.

There are innumerable ways to educate and engage target audiences of the Palouse Basin community. Integrating existing structure with creativity promises to increase attention on the uncertainty of a future water source for the area. Through increased attention and education on possible conservation measures, the hope is that the region can decrease per capita demand, thus minimizing pumping outflow from the aquifer, and simultaneously gain momentum towards future alternative water sources through public awareness.

**Conclusion**

An educational outreach program that accessibly conveys complex scientific information to the layperson may increase individual knowledge of the declining aquifer problem and result in increased community will for action. Because policy-makers are limited by community will to act, increased public interest will allow them to implement policies encouraging conservation of the existing water resource.

Given the scale of the problem, an appropriate approach utilized multiple disciplines including hydrology, education, and public policy. From an interdisciplinary examination of the problem and focused dialogue about potential solutions, a brochure resulted that presents the hydrology of the basin in an easily digestible manner as one example of how to better increase community members’ knowledge of local water resources and the uncertainty surrounding future water supply.

**Appendix A:** Final Outline for the Interdisciplinary Paper

1. Problem Statement
   1. Brief introduction to aquifer
   2. Brief introduction to management
      1. Policy makers and community leaders believe that the declining aquifer problem needs to be addressed but cannot implement programs until community members recognize that there is a problem and it needs to be addressed.
      2. Education could overcome that lack of recognition and make action politically feasible.
   3. Brief introduction to education
2. Interdisciplinary Methods Section
3. Interdisciplinary process during weekly meetings LIZA
   1. Group meeting summaries
   2. Identifying important disciplines in the problem
      1. Which ones we identified (including the ones we’re not using)
      2. Why we chose the ones we did
   3. Clarifying terms across disciplines
4. Defining our question ROSS
   1. Focus on demand of water
5. Describing the uncertainty of water supply JOHN
   1. Social meets Hydrology: Information needed to convince community to change consumption
6. Creating our conceptual model ALLISON
   1. How is our system structured?
      1. Structured around our question
7. Writing with interdisciplinarity… HEIDI
8. Integration into a final product AUDREY
9. Policy
   1. Management structure
      1. Policy Makers
         1. Information from PBAC
         2. Leader interest, lack of community will
            1. “‘Until someone’s tap goes dry, the public isn’t going to show up’”
   2. Management Priorities
      1. “A long term, reliable, sustainable, quality, clean water source is paramount.” (iii)
   3. Lack of community interest.
      1. Without community interest, policy makers hands are tied
         1. ““It‟s hard to be visionary when we are limited by money and lack of cooperation.””
            1. People are unwilling to pay for solutions until they believe a problem exists.
      2. Management believes that community needs more information to come to a point where it is interested in changing their behavior.
         1. Better conversations with community and within pbac.
         2. Promote conservation
            1. “change the culture to be more cognizant of the importance of a sustainable aquifer”

“start building support for the future expense of an alternate supply of water.”

* + - 1. Issue: how to present this information in a way that is not alarming but still relays the urgency of the issue.
  1. How raising community interest will help.

i. Define knowledge gap.

1. Introduce Katie’s thesis but later fleshed out in Liza’s section.

2. Foundation of knowledge is the simple fact that the aquifer is declining.

ii. Other factors correlated to community interest.

1. Demographics.

2. Sense of community.

ii. Progression towards action- knowledge > concern > political will/action.

1. Knowledgeable citizens are more willing to pay.

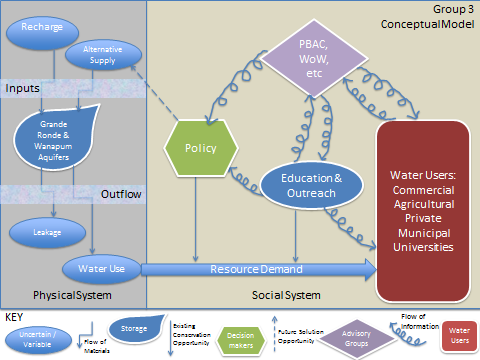
2. Recognition that knowledge may not create “enough” political will.

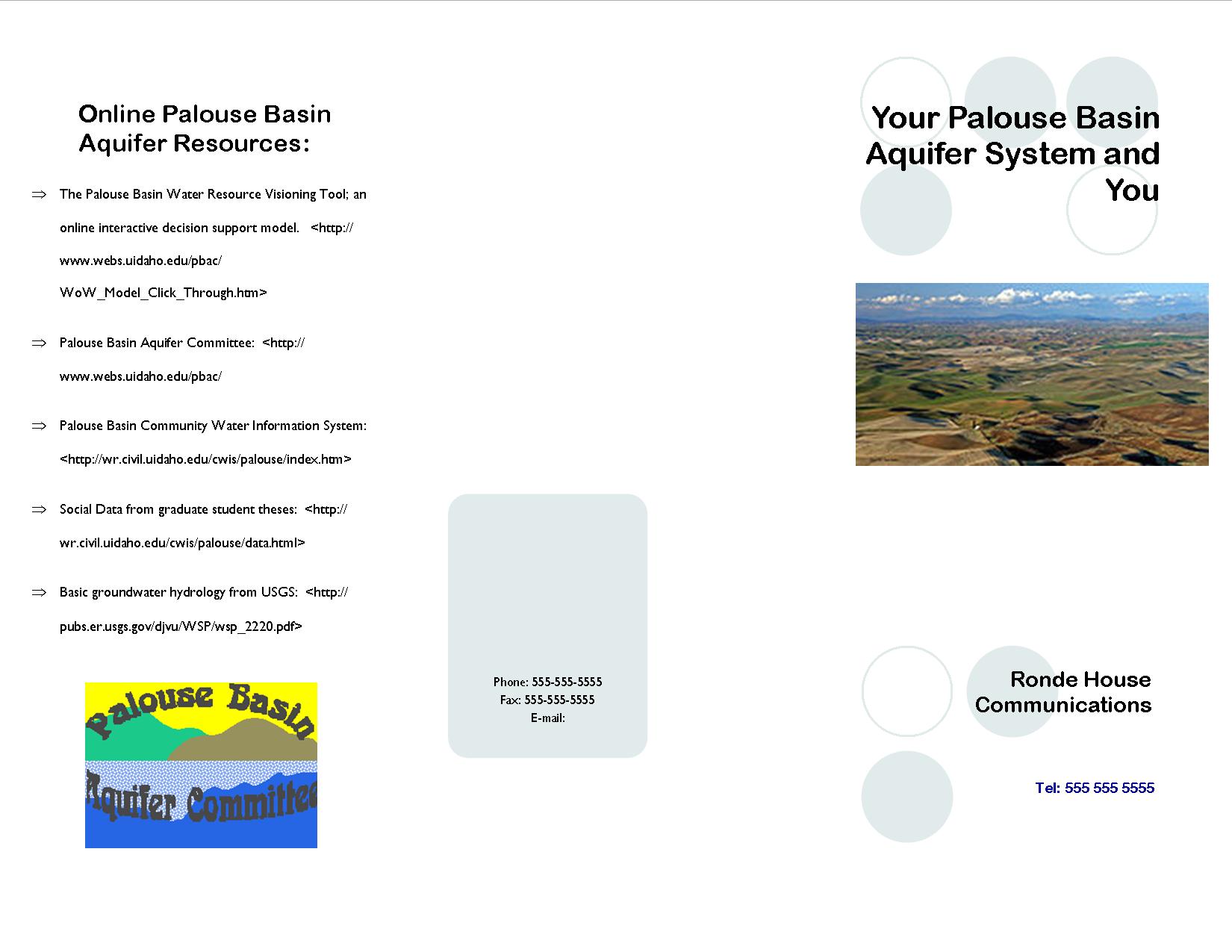
iii. If political will is created, policy makers should follow through.

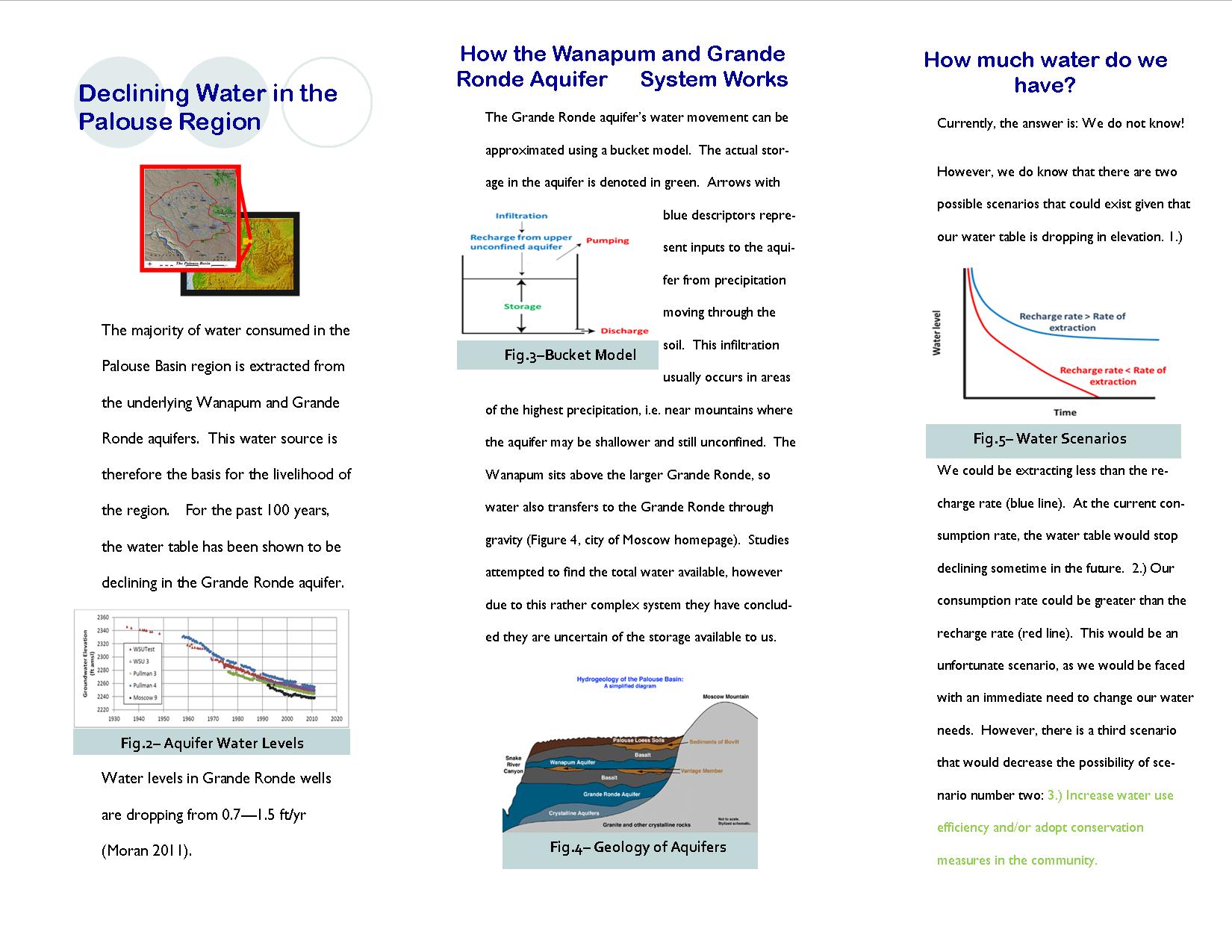
* 1. Strategies
     1. Conservation
        1. Conservation alone isn’t enough, but is a start
        2. We can’t conserve our way out of this – it’s a finite resource.”
     2. Alternate Water Source

1. Education
   1. Summary of what’s been done in education and outreach
      1. Systems model
      2. Conservation literature
      3. Public Information and Education (PIE) programs
         1. What has been done with it?
   2. How to implement more education and what needs to be done
      1. What needs to be done before implementation
         1. Community diagnostic
         2. Identify potential audiences
            1. List them, explain criteria used
         3. Determine target audiences --Which groups should be targeted?
            1. List them, explain criteria used
            2. Explain exclusion of certain groups?
      2. Audiences to education
         1. For each target audience
            1. Identify level of knowledge/familiarity with problem
            2. determine best method to communicate the problem
            3. how they can be part of the solution
      3. Return briefly to ongoing efforts
         1. Palouse basin summit
         2. Highlight PBAC as a resource (with some clout) to be capitalized on to reach a diversity of stakeholders?
         3. Other examples?
   3. Possible conservation measures
2. Hydrology
   1. How to provide enough information regarding aquifer to reach a tipping point where people are willing to change their own behavior.
   2. Bucket model of aquifer
      1. This is what we know.
         1. Summarize a few studies
         2. Turns out, if you take out more than you put in, level will go down.
      2. This is why studies are limited regarding fate of water.
         1. We don’t know how big the bucket is.
   3. Scenarios
      1. Empty bucket
      2. Reach equilibrium
   4. If the above is short and you need more to talk about/more ways to integrate the hydrology into the social, consider this: discuss the variability in ways to communicate these scientific concepts to the different target audiences! (Just thought of this over the weekend and maybe you guys have developed a different focus but I think it would be an awesome integration opportunity)
      1. For example:
         1. K-8 can learn about aquifers by real bucket experiments in classrooms,
         2. 9-12 will be more able to understand hydrology,
         3. Universities can hold symposiums/guest speakers like PBAC man to educate its population (even different ways of framing the issue in different disciplines/colleges)
         4. Etc…and b/c you are fulfilling the “hard science” portion it would be good to prove we incorporated scientists/created common language that can be used across the community/social spectrum (by you guys explicitly saying what info is needed for each target group)
3. Conclusion

**Appendix B:** Conceptual Model of the Declining Aquifer Problem

**Appendix C:** Educational Brochure

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**References**

1. Beall, Allyson, and Andrew Ford. 2009. “Reports from the Field: Assessing the art and science of participatory environmental modeling.” *Journal of Information Systems and Social Change* (June): 1-21.
2. Beall, Allyson, Fritz Fiedler, Jan Boll, and Barbara Cosens and. 2010. “The Palouse Basin Water Resource Visioning Tool.” *University of Idaho Waters of the West and Palouse Basin Aquifer Committee.* Accessed August 30, 2011. http://forio.com/simulation/ns/allysonbeall/palouse\_basin\_model/.
3. Beall, Allyson, Fritz Fiedler, Jan Boll, and Barbara Cosens. 2011. “Sustainable Water Resource Management and Participatory System Dynamics. Case Study: Developing the Palouse Basin Participatory Model.” *Sustainability* 3 (5): 720-742.
4. Bilodeau, Katheryn Anne. 2009. Pooling our water resource knowledge: Public knowledge, concerns, opinions, and dynamics related to Palouse Basin water resource issues. University of Idaho.
5. City of Moscow. 2004. “City of Moscow Water Conservation Plan.” Prepared by EES and JUB Engineers.
6. Heemskerk, Marieke, Karen Wilson, and Mitchell Pavao-Zuckerman. 2003. “Conceptual Models as Tools for Communication Across Disciplines.” *Conservation Ecology* 7 (3).
7. Laflin, Maureen. 2011. “Cross Disciplinary Communication/Group Dynamics.” Presentation to the UI Water Resources 506 class, Moscow, ID, August 30, 2011.
8. Moran, Katie. 2011. Evaluation of the relationship between pumping and water level declines in the Grande Ronde Aquifer of the Palouse Basin. Technical Report for PBAC.
9. Newell, William H. 2001. “A Theory of Interdisciplinary Studies.” *Issues in Integrative Studies* (19): 1-25.
10. Nissani, Moti. 1995. “Fruits , Salads , and Smoothies : A Working Definition of Interdisciplinarity.” *English* 29: 119-126.
11. Palouse Basin Aquifer Committee. 1992. “PBAC Goals, 1992 – 2005.” Accessed September 21, 2011. http://www.webs.uidaho.edu/pbac/Presentations/2006/PBAC\_Robischon\_April\_20\_2006.pdf.
12. Palouse Basin Aquifer Committee. 2011. Accessed September 1-27. http://www.webs.uidaho.edu/pbac/.
13. Palouse-Clearwater Environmental Institute. 1995. “Water Conservation Opportunities for the Palouse: A Water Conservation Handbook.” Edited by Tom Lamar and Sarah Weppner.
14. Repko, A.F. 2008. *Interdisciplinary Research: Process and Theory.* Thousand Oaks, CA: Sage Publications.
15. Richartz, Saundra. 2010. Opportunities for collaboration: A situational assessment of the Palouse Basin. MS thesis, University of Idaho.
16. Robischon, Steve. 2011. Presentation to the UI Water Resources 506 class, Moscow, ID, August 25, 2011.
17. Tidwell, Vincent C., Howard D. Passell, Stephen H. Conrad, and Richard P. Thomas. 2004. “System dynamics modeling for community-based water planning: Application to the Middle Rio Grande.” *Aquatic Sciences* 66 (4): 357-372.