REQUEST FOR PROPOSALS
University of Wyoming
Water Research Program
FY2009

The Water Research Program (WRP) invites faculty members and affiliates of the University to submit research proposals under the National Institutes for Water Resources (NIWR) annual allotment program funded jointly through the U.S. Geological Survey and the State of Wyoming Water Development Commission. Proposals responding to the priority areas described below are sought. It is also acceptable to address multiple research priorities within a single proposal. The available funds for new FY09 projects are estimated at approximately $100,000, dependent upon the level of the USGS appropriation.

Proposals for research projects of one to three years in duration will be accepted, but can only be funded on a year-by-year basis. Thus, annual plans of activity and budgets must be submitted in addition to a total budget for all years. The WRP Priority and Selection Committee will monitor progress and act on continuation annually. Annual and final reports on all projects are required. Also, results of research under the WRP are expected to be published in peer reviewed publications.

Proposals must include University faculty or affiliates as Principal Investigators. Student training is a high priority of the WRP, thus student participation is expected. In addition, most projects are expected to include personnel from a State Sponsoring Agency as a coordinator and/or participant.

Selection will be based on the results of peer reviews and the decision of the WRP Priority and Selection Committee. Final approval must be obtained through the NIWR annual allotment program. All proposals must be submitted for review in both hard copy (10 copies required) and electronic format. Final submission of selected projects to the NIWR program will be in electronic format.

PROPOSAL DEADLINE: Tuesday, October 7, 2008, by 5:00 P.M.

Tentative Timeline for Project Selection and Start-up:

Proposal submission due date: Tuesday, October 7, 2008, by 5:00 P.M.

Project selection by Priority and Selection Committee: December 2, 2008

Submission of FY09 application to USGS in electronic format: Mid-January, 2009*

Tentative project start date, pending USGS approval: March 1, 2009*

*These dates, along with the dollar amount available for supporting new projects, are dependent upon approval of the FY09 Federal Interior Appropriations Bill

All researchers interested in submitting proposals must contact the Director of the WRP for formatting requirements (e.g., the narrative portion of the proposals is limited to 6 pages single spaced, Times New Roman 12 font, Microsoft Word), budget preparation including an Excel template for preparing budgets, submission guidelines, selection criteria, reporting requirements, and other information. A minimum of 20% direct matching funds (e.g. PI time) is required on all proposals.

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WRP Research Priorities for FY2009

(Priorities are listed randomly and not in any particular order of interest or importance)

1. **Conveyance Losses on the Mainstem of the Green River**

The flows in the Colorado River system have diminished with long-term regional drought. The water levels in Lake Powell have fallen nearly to the point where interstate regulation would be triggered. The State of Wyoming is gathering information to be able to regulate in the Green River Basin should interstate regulation be triggered. Regulation would cause a number of junior water rights to be shut off. These junior water rights may purchase water from senior direct flow users or stored water. Stored water may be mixed with natural flows leading to uncertainties as to the true quantities of each. Proper accounting of stored and natural flows becomes an important component in the administration and enforcement of Wyoming water laws. Conveyance loss is an important quantity to measure in order to understand the distinction of natural and stored flows. Conveyance losses may be affected by length of reach, natural flow in the river, size of flow increase, bank storage, channel storage, precipitation, elevation and slope of the water table, stream channel characteristics, evaporation, evapotranspiration, hydraulic characteristics of the aquifer, irrigation return flows, inadvertent diversion and valley cross sections. Conveyance losses on the mainstem of the Green River are vital to any regulation that may occur in the Green River Basin.

2. **Irrigation Efficiency Improvements Through Irrigation System Operations Management Opportunities**

Improving the efficiencies of large canals to better match on farm efficiencies is desired. Most of the large irrigation projects in Wyoming were constructed by the Department of the Interior, Bureau of Reclamation. These canals were designed to accommodate flood irrigation practices. Due to labor savings, flood irrigation practices are yielding to the use of center-pivots, side-roll irrigation systems, gated pipe, installation of piped laterals and surge valves, which have drastically improved on farm efficiencies. The purpose of the research project would be to determine whether delivery system efficiencies could be improved by using mechanical automated checks in combination with lower canal flows to discourage operational waste due to filling canals to an elevation to service farm turnouts and irrigation laterals. Other issues include seepage losses versus canal head and whether opportunities may exist within canal reaches to lower operating levels to discourage seep and to determine whether the "checked" canal may be used as a re-regulation facility. With respect to seep, this may require installation of some pumped turnouts or laterals to service those facilities residing at a respective higher elevation with other similar facilities within a specified canal reach residing at a lower elevation with respect to the canal's surface water elevation. Economics (benefit vs. cost), quantitative impacts to groundwater re-charge, effects on water quality and aquatic communities in associated streams, and other related issues also should be addressed.

3. **Effects on Stream Flows from Flood Irrigation of Riparian Hay Meadows and Pastures**

One of the presumed benefits of flood irrigation of hay meadows and riparian pastures is that these riparian areas store significant quantities of water when they are being irrigated in early summer and this water is slowly released back to the stream during the following months, supplementing late summer flows to the benefit of aquatic communities. Research is needed to quantify this process, identify the conditions under which these kinds of return flows occur, assess the benefit to biotic communities in associated streams and provide guidance for implementing irrigation procedures which could create or increase such benefits.

4. Glaciogenic Cloud Seeding Efficacy Through Remote Sensing

Additional information is desired regarding cloud processes resulting from glaciogenic cloud seeding and the potential for enhanced precipitation. More specifically, investigations should focus on an assessment of snow crystal growth at the expense of supercooled liquid water (SLW) in regions seeded with silver iodide (AgI), using vertical transects of remotely-sensed snow and SLW concentrations. Such mapping of both snow crystal concentrations and SLW concentrations in orographic clouds in a vertical plane below an aircraft can be derived from a combination of cloud radar and a cloud lidar. While not providing any quantitative estimates of surface precipitation enhancement, the results of the proposed study would greatly expand our knowledge of microphysical cloud processes resulting from glaciogenic cloud seeding and will also provide further insight into basic orographic precipitation processes.

5. Relationship Between Watershed Management and Water Yield

There is a substantial body of scientific research and anecdotal evidence that supports the concept of manipulation of forest vegetation for augmentation of water yield. It is well documented and accepted that the management of dense timber stands in high elevation regions with greater snow precipitation will create an increase to stream flows, at least on a localized basis. This is due to physical, environmental and biological responses within the system such as reduction of precipitation interception, reduction of evapo-transpiration, reduction of evaporation of trapped blowing snow, and also a reduction of consumption by forest vegetation during the growing season.

Water yield improvement can be evident not only in stream flow increases but also in ground water increases. This can be achieved by reduction of stand densities, conversion to a less water consuming cover type, creating openings that are conducive to concentrating snow fall, or establishing trees or artificial snow fences in treeless areas to initiate snow drifting. These methodologies have the potential to increase water yield on selected sites by the manipulation of drifting snow to reduce sublimation loss and promote redistribution of snow.

Within the body of evidence supporting the relationships between vegetation management and water yield, there are two predominant unanswered questions. One is concerned with the fate of the water yield, specifically what is the amount of overland flow and what is the amount of aquifer yield. Another is concerned with the fate of overland flow, specifically what is the impact of increased flow and where can increased yield be collected and stored.

Along with those salient questions, what is the potential to systematically design a management scheme for a watershed, in accord with the objectives established in a watershed plan? Is there potential to create a symbiotic relationship between vegetation management, weather modification, snow farming, conveyance loss reduction, and efficient cost effective storage? Proposals are sought to address the statements of interest within a three year maximum time frame, rather than a long term monitoring program.

6. Enhanced Drought Prediction Throughout Wyoming's Major River Basins

Building upon the recently completed study: "Predicting Drought in the Green River Basin" by Tootle, et al. additional information regarding drought prediction tools is desired to help water managers and water users in the Green River and Upper Wind River Basins judge by late fall what kind of water year may be coming and allow them to plan accordingly. The previous study pointed to reliable predictors, but also called for follow up investigations to further hone in and sharpen these predictive tools. Specifically, investigations which extend existing records with more tree-ring reconstructions (i.e. streamflow, SWE, and temp); and evaluate Pacific and Atlantic Ocean sea surface temperature influences are desired. Similarly, investigations into Wyoming's other major river basins (Platte, Bighorn, etc.) with respect to determining drought prediction tools through tree ring reconstructions, etc. by replicating the baseline work completed by Tootle, et al. in these new basins is highly desirable. As before, identifying predictors that can help water users and managers in these additional basins know what kind of water year to expect with enough lead time to plan their activities for that year would be crucial.

7. Water Quality Associated with Flood Irrigation

There is evidence that irrigation return flows have water quality impacts on receiving streams in some situations that can have significant negative effects on biotic communities in those waters. Impacts may include increases in temperature, sediment, nutrients, and salinity. In addition some return flows may carry elevated levels of pesticides and herbicides. Research is needed to define the conditions under which these suspected water quality impacts occur, quantify the range of differences between the quality of return flows from riparian hay meadows and pastures vs. row crops, and identify effective practices for managing water resources to minimize or avoid adverse water quality impacts associated with flood irrigation of different types of agricultural crops while maintaining or improving agricultural productivity.

8. Coalbed Methane

Coalbed methane (CBM) development in Wyoming is continuing at a rapid rate. Perhaps the most difficult issue associated with the development is the disposal of the water pumped out of the coal seams to facilitate production of the gas.

Needed areas of research include:

- Methods of gas removal which require no (or reduced) water pumping.
- Enhanced and economically feasible methods for re-injection of CBM produced water.
- Water treatment technologies for reduction of total dissolved solids, sodium adsorption ratio, barium, iron, and whole effluent toxicity in CBM produced water surface discharges.
- Changes to native vegetation due to increased water flow from CBM produced water discharges.
- Changes to the hydrology and habitat of naturally intermittent and ephemeral streams by perennial CBM water discharges.
- Reclamation of CBM water holding ponds once they are abandoned.
- Surface water contamination caused by the subsurface horizontal movement of CBM water out of holding reservoirs into the downstream natural drainage.
- Water quality requirements for the irrigation of naturally occurring vegetation in NE Wyoming.
- The geochemistry and fate of CBM water discharged via subsurface drip irrigation systems.

9. E. Coliform

Currently (2008), 62 stream reaches are listed on the DEQ's 303(d) list of impaired water bodies, with coliform bacteria as the impairment. Several groups are working to implement best management practices (BMPs) to reduce coliform counts in listed waters; however, it is not known to what extent the source of the coliform contamination is a predictor of human health effects. Areas of research needed include:

- Identification of the sources of e. coliform contamination in high altitude streams in Wyoming.
- Evaluation of various grazing and land management practices on e. coliform contamination of high altitude streams in Wyoming.
- Fate and transport of "x"–coliform bacteria in Wyoming streams. "X"–coliform bacteria appear to be over-wintering in Wyoming streams and showing up in samples collected during the spring runoff. This research would help in design of BMP's to reduce contamination levels in streams.

10. Oxbow Storage Properties/Opportunities

Information is desired on the potential benefits/costs of diverting high river flows for storage in old river channel and oxbow features. Potential benefits to examine should include, but not be limited to: supplemental water supply, fish and wildlife habitat, recreation and flood control; while costs evaluated could include not simply the possible expense of the diversion and storage, but the impact of this new use on the functions the old channels and oxbow features already perform, including flood control. Ideally, the investigation should look at the use of old river channel and oxbow features on Wyoming rivers that include at least one river with a major dam or dams and one that has not been significantly dammed.

11. <u>"Open" Category</u>

The Priority and Selection Committee welcomes research proposals related to other issues concerning Wyoming's water. As is the case for researchers intending to submit proposals under the above priority areas, those submitting proposals under this "open" category must contact the WRP Director indicating their intentions. Potential proposers will be provided information concerning formatting requirements, budget preparation (including an Excel template), and submission guidelines.