Report as of FY2006 for 2006MI71B: "Protecting Critical Trout Streams Via a Water Quantity Cap and Trade Scheme"

Publications

Project 2006MI71B has resulted in no reported publications as of FY2006.

Report Follows

FY 2006 USGS 104(B) Annual Technical Report

Project Number: 2006MI71B
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Protecting Critical Trout Streams via a Water Quantity Cap and Trade Scheme

INTRODUCTION:

Our Great Lakes are the single largest source of freshwater on the planet with 21% of the world's surface freshwater supply. These magnificent 'sweet-water seas,' as they were called by their first European visitors, provide water to support the various uses of residents, agriculture, commercial businesses, industry, and plant, fish and aquatic wildlife. In spite of their vast size, the Great Lakes are vulnerable to a plethora of threats—invasive species, over use and depletion, pollution from point/non-point sources, poor and indiscriminate water and land use practices, and atmospheric deposition. Many regions outside the Great Lakes Basin are faced with or anticipate serious water shortages, and potentially look to Great Lakes waters to solve their water shortage problems. Contemplative and science-informed management has never been more important. Our goal was to design a W*ater Conservation Credit System* that sustains groundwater resources and related ecological functions while providing a flexible environment for the development and expansion of valuable economic enterprises.

RESEARCH PROGRAM

Project summary: We first established an *Advisory Committee* comprised of representatives from environmental and conservation groups; business/industry/utility; agricultural organizations; state planners; policy consultants; and citizens to help guide us in the development of the conservation credit and integrated water balance analysis systems. To obtain additional insights we surveyed ground water experts in 19 other riparian states about the successes of their revised regulations and the lessons that we could learn from them. We then developed a W*ater Balance Analysis System* based on integrating scientific knowledge of water resources and, using web-based models, to facilitate adoption of a water management system using market based water conservation

credits. Capitalizing on experiences from other parts of the country using credit trading and related mechanisms and instruments we developed a model water conservation credit system. The necessary conditions of a voluntary, cost-effective conservation "offset credit purchase program" were defined within an institutional context consistent with our knowledge of Great Lakes Basin policies and governance. This offset credit system can be used to "grow water", i.e., provide offsets for restoration of impaired watersheds to enhance flows and ecological functionality in critical areas. Development of this system required a solid foundation of hydrologic and ecological understanding of the impacts of withdrawals to quantify the appropriate values of conservation credits and corresponding values associated with specific conservation techniques.

The researchers integrated the results of a water balance analysis model (surface and groundwater models) into an ecological model (stream temperature and fish habitat models) to demonstrate the use of this integrated model results applied to a case study watershed and a hypothetical permitting process. Our researchers were able to evaluate the impacts of groundwater withdrawals on stream flow, water temperature, and fish habitat, and established criteria for setting threshold impacts on trout populations. In addition, we recommended conservation activities that could receive credit in the permitting requirements. The potential offset actions derived from the study model scenarios involve management and changes of land uses and characteristics (for example, alternate crop production or a change from impervious residential surface to forest growth or crop production). In addition, when various management actions are insufficient to reduce or offset flow impact, well locations can to be moved to areas further removed from streams to reduce negative impacts on trout populations and habitat. Our survey respondents suggested permitting fee structures that would allow for additional modeling to be done on a case by case basis to determine better locations without placing undue burden upon the state.

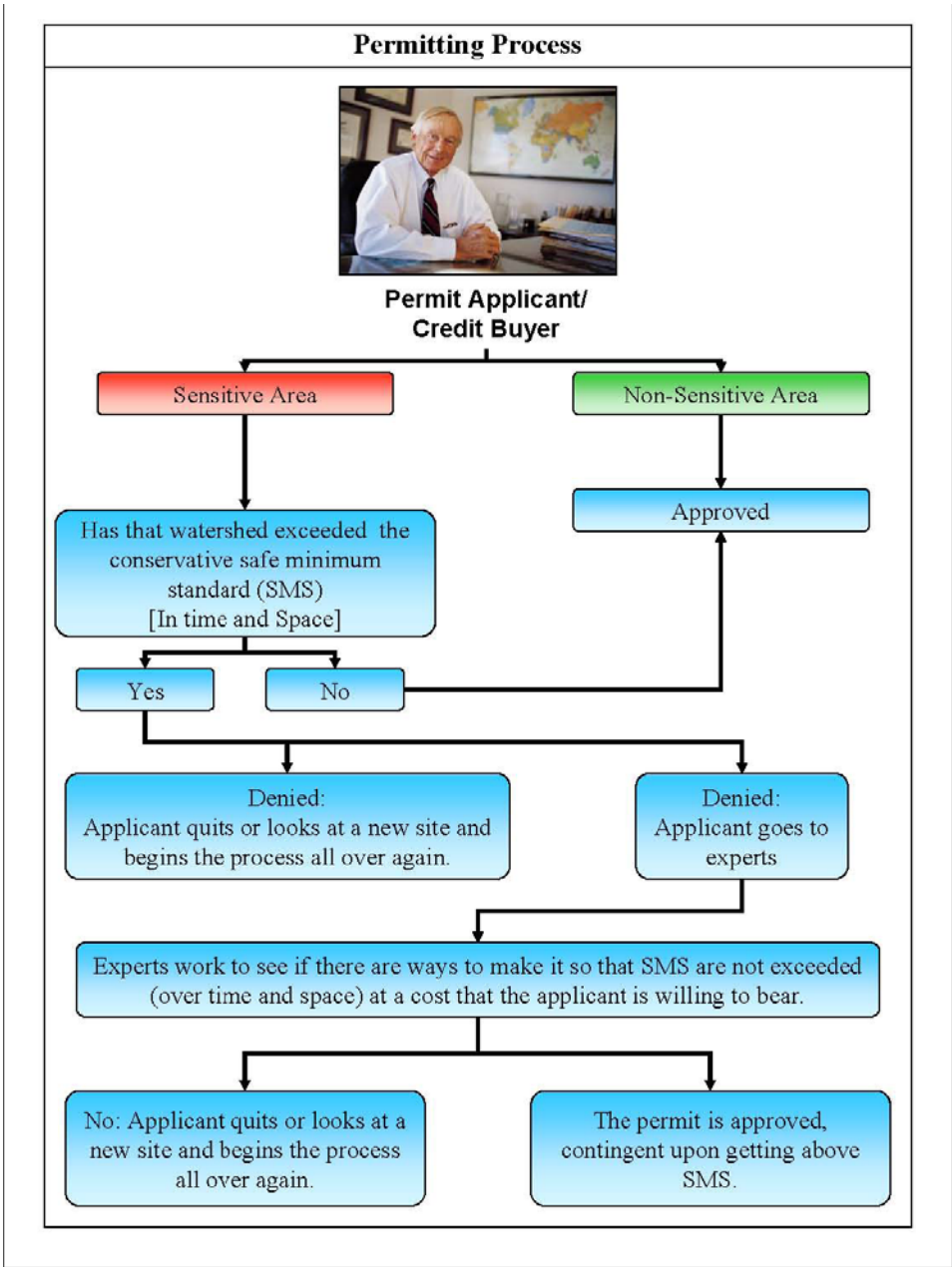
Development of this suite of models and analysis tools to produce a watershed balance analysis system was the cornerstone of the project. This water balance analysis system integrated modeling of the hydrologic partitioning of precipitation at the earth's surface, the static water table and horizontal flow to nearby streams, and the impacts on the affected aquatic ecosystem. Our work used a fishery model related to trout survival as a key component of an integrated assessment tool that was the basis for developing policy relevant economics that will be valuable for policy discussions. The pilot demonstration of a potential web-accessible user assistance interface shows promise as a way to lower transaction costs, and provide buyers and sellers with immediate access to geospatial information for simple and uncomplicated analysis of all the components of the conservation credit system and the water balance analysis system. The system was developed for statewide and Basin-wide application. System feasibility was demonstrated in a high-risk watershed for which extensive hydrologic data was available. A hypothetical market-based purchase of conservation credit offsets was demonstrated with a hypothetical case study of a proposed groundwater withdrawal. In our case study, a proposed new groundwater withdrawal that was expected to cause an adverse impact on the ecological functions of an adjacent trout stream was allowed to go forward by purchasing offset conservation credits from sellers in the watershed. We will continue to seek and take advantage of opportunities to apply project findings and provide the broadest possible dissemination of

this new knowledge and technology to support the sustainability of water resources across the Great Lakes Basin.

Problem and Research Objectives

Our goal was to provide an economic framework that uses the newly created surface and groundwater modules to demonstrate how a market-based trading system can assist in protecting critical watersheds as demonstrated in a real world case study of the Augusta Creek, Michigan, watershed. We achieved that goal. We created a water allocation framework (i.e. trading system) that can be applied throughout the state (and the nation) that protects the surface water conditions favorable for trout survival while minimizing the negative impacts on development and current water users.

The diagram below illustrates the process that we developed to implement our proposed water allocation framework.



Methodology

We began by reviewing existing literature while paying special attention to the following issues: mitigation and offsets, safe minimum standards, market based incentives, and necessary conditions for a working market. We then developed the criteria for critical watersheds based on SMS for trout as trout are an indicator species of water based ecosystem health. Some of our survey respondents emphasized the importance of defining a cap based on both time and location and using scientific models we did exactly that. We developed a table of potentially desirable outcomes and the recommended policies that would help achieve these outcomes. We suggested politically viable option(s) for the creation of a trading scheme and we developed a matrix of potential mitigations and offsets for the market. To make this unique case study useful to the entire state of Michigan, we outlined the necessary variables that must be measured for each watershed. We used a case study method focusing on the Augusta Creek watershed to demonstrate the applicability of our work.

Principal Findings

Our proposed policy includes the following characteristics:

1) The market-like policy functions only in sensitive watersheds or sub-watersheds where increased groundwater pumping may have negative impacts on the stated environmental policy objective. By remaining within a specific boundary, such as an environmentally critical sub-watershed, it simplifies the management of potentially adverse pumping activities and focuses scarce agency time and resources strictly on those areas viewed as sensitive and valuable.
2) We defined the environmental policy objective as preserving, restoring, and maintaining high-quality, unique and special cold water ecosystems suitable as trout habitat.
3) The hypothetical permit system, as applied to our case study, requires permit applicants in these sensitive watersheds to bear the costs of the permit scheme and the identification, design, and enforcement of any contracts to implement conservation credits purchased to offset the potential ecosystem damages from pumping. Thus, because these costs are borne by the applicants, those applicants who propose withdrawals with either low-value uses or do not have to locate their proposed wells in a sensitive watershed or sub-watershed have incentives to consider other less sensitive areas for locating their wells.
4) Allowances can be allocated at no cost (e.g. grandfathering) and/or by using an auction. In terms of environmental effectiveness, there is no appreciable difference between these two methods
5) Anyone pumping a significant amount of groundwater within the identified groundwater-shed boundaries must obtain a withdrawal permit. The significant level of pumping will be determined via groundwater modeling so that the minimum uses of water will not require permits. Although existing uses may be grandfathered, they still require a permit. As a result, all groundwater uses are recorded; total use of the groundwater in the sensitive watersheds or sub

watersheds are “capped” at a level that meets the environmental policy objective with due attention given to spatial and temporal variability. The permit, once obtained, will also be subject to periodic reviews at agreed to intervals such as every 5 years.

6) As designed for this hypothetical case study, the total number of allowances will not allow pumping of volumes that would exceed the ‘cap” (i.e., the amount that would have a negative impact on the policy objective), taking into account temporal and spatial variations. The impacts of pumping on trout habitat and populations can be predicted via groundwater and fish habitat and survival models.

7) The selection of appropriate actions for conservation credits will depend on the responsible agency's policy objective.

8) The allowances of groundwater available for pumping with any permit in a sensitive watershed are transferable to others, and thus holding a permit in a sensitive watershed or sub-watershed is the equivalent to holding a market asset that can be sold to others, subject to regulatory review. An applicant needing more groundwater pumping allowances than allowed in his or her proposed permit may obtain additional allowances by purchasing them from others—with regulatory oversight as well as with the recording of the sale.

9) Conservation credits are certified credits given by the state agency to those landowners who adopt practices or techniques that conserve or reduce groundwater use. These credits can be bought by a groundwater user to expand his or her pumping beyond the allowance indicated in the original permit. If so used, these credits will be incorporated into the applicant’s permit. Offset credits can be environmental suspect if not monitored and assessed well. The offsets need to result in equivalent improvements in either water quality and/or temperature to what would have occurred with a reduction in pumping by the permit applicant. There needs to be adequate baseline accounting for those holding permits that wish to sell those or reduce their permit to provide an offset credit for sale. While this requirement involves a regulatory oversight, the costs of such oversight can be paid by the applicant. For this research, the researchers assumed that the applicant will bear these costs and must enlist third parties to conduct such monitoring, albeit overseen by the regulatory agency.

10) Liability issues—who holds liability and how liability is determined—often pose significant challenges to the implementation of environmental trading programs. Liability for credit malfeasance could potentially rest with either the credit buyer or the seller. This case study assumes that the buyer bears liability and must bear the costs of assuring that permit requirements are met. This placement of liability thus discourages location of high volume wells in sensitive watersheds.

11) Because the use of conservation credits (and the changes in activities that they represent) may have various levels of uncertainty associated with them as to how much their implementation will ameliorate potential damages from increases in groundwater pumping, there may be requirements in a permit that sufficient

credits must be purchased to cover more than 100 percent of potential damages. For example, an applicant may have to purchase sufficient conservation credits and/or permits to account for 120% of the potential damages as predicted by expert modelers. The extra quantity, called the "trading ratio" can be changed if real monitoring data is acquired and the certainty of the credits can be verified. The verification of the efficacy of the applicant's proposed offsets or allowance transfers would be the responsibility of the applicant, but with third party verification by an agency. This "trading ratio" is a strategy often employed in water quality trading markets to overcome uncertainty associated with nutrient reduction from best management practices as well as to provide a net water quality benefit.

12) The buying and selling of allowances and conservation credits will be overseen and facilitated by an agency or certified broker. Third party verification of the use of permits will be required. Modeling and analysis by experts of the impacts of proposed activities and of use of permits will be required of and paid for by the applicant.

Significance for Project

Utilizing advice supplied by both our advisory committee and our survey respondents we explored a hypothetical groundwater withdrawal permit system supplemented with the use of conservation credits--and illustrated this approach with our case study. This type of a market-like structure, particularly when compared with outright prohibitions or restricted use regulations, affords significant advantages. If this program approach is well designed and effectively enforced, this market-like structure discourages low- value uses of groundwater in sensitive watersheds and sub-watersheds when there are competing needs for the use of the groundwater resources. At the same time, this market-like structure allows for new or expanded high-value uses which require location in a critical area; and compensates those groundwater users who reduce their groundwater withdrawals to offset a new or expanded use. This type of market-like structure can be cost-effective in achieving the objective of protecting the natural resources (e.g., trout populations) provided that administrative and enforcement costs are not excessive.

Publication citations associated with the research project

USGS is acknowledged in the credits of the GLPF final report available at:
http://www.hydra.iwr.msu.edu/iwr/glpf/FinalPublic/GLPF-Final%20Report.asp

NOTABLE AWARDS AND ACHIEVEMENTS.

Funding from USGS (2006-104b) has supported a graduate student's, Mariah Branch, efforts. Her accomplishments during the funding period will be presented at the AAEA 2007 Annual Conference in July 2007.

PUBLICATIONS FROM PRIOR PROJECTS

NONE