The Ground Water Research & Education Foundation
2013 Selects Research and/or Education Project for Funding

The Ground Water Research & Education Foundation (GWREF) has recently completed the necessary paperwork to award five projects are underway and will be completed by the end of 2014. Those awarded GWREF funding to complete the initiatives from proposals submitted in response to spring 2013 solicitation in the area of Groundwater Sustainability Research & Education projects.

National Research & Education Project Solicitation

In addition to the 5 general Categories of Eligible Research and/or Education Activities, the GWREF requested proposals in the following focus areas:

1. Groundwater Use & Availability
    - Deep Groundwater (What we know, what we don't know, what we need to know)
    - Brackish water treatment/reuse
    - Groundwater use studies (scope: local, state, national)
    - Aquifer Storage and Recovery
2. Induced Seismicity by Underground Injection and/or Hydraulic Fracturing
3. Groundwater and the Farm Bill/Farm Bill Programs

Title	*Submitted by*	*Funding Level*
Promoting Sustainable Groundwater Use by Advancing Methods for Determining Environmental Flows and Levels for Groundwater-Dependent Ecosystems	The Nature Conservancy - Emilie Blevins, Freshwater Program Coordinator	$46,446
Quantifying Water-use Requirements for the Variable Conditions and Processes Associated with Hydraulic Fracturing within the Williston Basin in North Dakota, South Dakota, and Montana	ND, MT, & SD Water Science Center - Kathleen Rowland, USGS ND Water Science Center	$35,000
The National Ground Water Association (NGWA) to orchestrate a conference on deep groundwater in 2014	National Ground Water Association - Bill Alley, NGWA	$6,000
Environmentally Friendly Drilling Systems Programs Development of Hydraulic Fracturing Virtual Site	Houston Advanced Research Center - Rich Haut	$50,000
Evaluation of Underground Injection Control Well Capacity for Class II-D Wells Near Major Shale Plays in the United States	Penn State University & Aqualith Technologies - David Yoxtheimer, Aqualith Technologies	$90,000
Total GWREF funding commitment for this round of projects		$227,446

Promoting Sustainable Groundwater Use by Advancing Methods for Determining Environmental Flows and Levels for Groundwater-Dependent Ecosystems

The Nature Conservancy

Groundwater is a vital source of water that sustains ecosystems, aquatic species, and human communities worldwide. To protect groundwater resources for both nature and people, The Nature Conservancy (TNC) and the U.S. Forest Service's (USFS) National Groundwater Team are developing a method for determining the amount of groundwater required to sustain groundwater-dependent ecosystems (GDEs), and that which is available for human uses. This method is called "Environmental Flows and Levels" (EFLs).

With financial assistance from the Groundwater Research and Education Foundation, we are developing and implementing the EFL method at pilot sites in National Forests and Grasslands in Oregon (Siuslaw NF; Ochoco NF) and North Dakota (Sheyenne NG). In all of these places, groundwater supports biologically diverse springs, wetlands, and streams, but it is also used for agriculture and municipal supply. To balance water use for nature and people, we establish threshold groundwater needs of GDEs, model groundwater flow, and define groundwater-ecology relationships. Using this information, the EFL method can be used to set groundwater management goals and objectives to serve multiple purposes.

The results of our work at these pilot sites will be incorporated into the EFL methods development. Our goal is to create an EFL method that is applicable across different hydrogeologic, climatic, and management contexts, and thus assure widespread relevance and adoption by water managers. By working with voluntary water users, we demonstrate that groundwater can be managed to satisfy multiple demands.

Quantifying Water-use Requirements for the Variable Conditions and Processes Associated with Hydraulic Fracturing within the Williston Basin in North Dakota, South Dakota, and Montana

ND, MT, & SD Water Science Center

Over the last decade, the rapid development of energy resources in the Upper Missouri River Basin, specifically in the Williston Basin, and the corresponding water resources needed to support energy development, has raised concerns of aquifer mining and water-level declines. Of particular concern is the amount of fresh water required to extract the oil and gas using hydraulic fracturing methods—in some cases, about three million gallons is needed to develop each well. Water is withdrawn from local aquifers and/or surface waters and then piped or trucked to the well pad. The withdrawal rate at many of these water sources can often exceed the sustainable recharge rate under current climatic conditions. The water that is returned to the surface after the fracturing process is often disposed in deep formations and effectively removed from the water cycle.

To date, there has been limited analysis of the amount of water used for hydraulic fracturing. Data that identify the factors (technological, geological, and geographic) that influence the amount of water used for hydraulic fracturing at each oil and gas site is particularly lacking in analysis. Additionally, little is known about the partitioning of disposal methods, including recycling. This lack of information prohibits fact-based management of the groundwater and surface water resources.

The objectives of this investigation are to (1) obtain and analyze water-use data at a well site (process) level, (2) identify the primary factors (predictor variables) controlling water use, and (3) identify the predictor variables controlling water recycling and disposal. Using available and surveyed water-use and disposal data, mathematical relations will be developed between the predictor variables and water-use and disposal quantities. These relations will then be used to estimate water-use requirements in the Williston Basin with respect to ongoing and future hydraulic fracturing and provide data for concurrent groundwater modeling studies to estimate groundwater availability under various development scenarios.

Evaluation of Underground Injection Control Well Disposal Capacity for Class II-D Wells Near Major Shale Plays in the United States

AquaLith Technologies & Penn State University

The United States' energy portfolio is changing dramatically as unconventional oil and gas development using horizontal drilling and large-volume hydraulic fracturing in shale formations increases. As a result of the growing domestic oil and gas production there has been a commensurate increase in use of Class II-D underground injection control (UIC) wells for disposal of brines in regions where shale energy development is occurring. The goal of this project will be to estimate the long-term capacity of Class II-D UIC well disposal reservoirs where extensive shale energy development is occurring, including Texas, Colorado, North Dakota, Pennsylvania, West Virginia and Ohio. Current energy development trends for each major shale play in these states will be considered, including volumes of produced fluids per unit of energy produced, reuse of produced fluids, current UIC well disposal volumes, projections of future energy development and associated produced fluids that may require disposal. This study will use published and other available geological and oil and gas production data to estimate long term injection well capacity and disposal requirements for these major shale basins. Distinct injection reservoirs currently used or proposed for use in each state will be included and available geologic data (depth, thickness, areal extent, permeability, injection rates, and injection pressures) will be gathered for each. The available oil and gas produced fluids records will also be gathered in order to estimate the volume of produced fluids generated per unit volume of oil and gas (per barrel of oil or thousand cubic feet of gas, respectively) for each state. This data will be analyzed to determine low, medium, and high estimates of available disposal capacity for each reservoir. This study will provide a basis upon which regulators, policy makers, industry representatives, and stakeholders can make decisions to facilitate long-term planning for safe disposal of oil and gas-related brines.

Environmentally Friendly Drilling Virtual Hydraulic Fracturing Site

Houston Advanced Research Center

The Environmentally Friendly Drilling (EFD) program, managed by the Houston Advanced Research Center (HARC), provides unbiased science to address environmental issues associated with petroleum drilling and production. The objective of the EFD workforce development program is to create a workforce skilled in environmental mitigation of exploration/production. Part of the effort is an innovative multimedia web-based training tool, a virtual rig, which engages the user to interact with cost-effective technologies that reduce the environmental footprint (www.efdvirtualsite.org).

Extending from the existing Virtual Rig site, the EFD team will create a conventional hydraulic fracturing site and underground formation. This Hydraulic Fracturing Virtual Site will be available on www.FracFocus.org as well as on www.efdvirtualsite.org. Users of this public educational website can choose to view an animation that would explain the traditional parts of a hydraulic fracturing site (both above and below ground) and how horizontal drilling and hydraulic fracturing processes are used to extract oil or gas from formations. By clicking on the technologies highlighted as hotspots, a new screen will appear that will allow viewers to learn more about the traditional technology as well as discover the latest environmentally friendly alternatives available.

Outcomes of this project will include:

- An easily accessible educational tool through an interactive virtual hydraulic fracturing site
- A ‘go to’ reference source for individuals responsible for submitting data into FracFocus
- Through the information presented on this site, increased understanding of groundwater protection measures taken in fracturing operations

Conference on Characterization of Deep Groundwater

National Groundwater Association

Gain insight on what is currently known and discuss what can be done to better understand and characterize deep groundwater — and the importance of doing so — during this one-day conference. The purpose of the conference is to bring together investigators from different segments of the hydrogeological community and the oil, gas, and mineral industry who have an interest in characterizing deep groundwater resources to share knowledge on how deep groundwater should be characterized — with particular focus on areas of the United States underlain by sedimentary basins.
Sessions on the hydrologic characterization of deep aquifers and tool, techniques and methods will explore:

- Methods of exploration and characterization of deep groundwater resources
- Drilling and monitoring techniques
- Geophysical techniques
- Determination of source waters and fluid migration
- Methods and information available from the oil, gas, and mineral industry to characterize deep groundwater resources
- Protection of deep groundwater
- Regulatory issues, concerns, and challenges.

View conference Web page.
Additional presentations on topics related to deep groundwater are scheduled in the Brine and Deep Aquifers session on May 7 at the NGWA Groundwater Summit — http://www.GroundwaterSummit.org.