

**PENNSYLVANIA SEA GRANT  
FINAL REPORT - 2014**

**TITLE: Innovative Tools for Groundwater Education in Pennsylvania**

**AUTHORS**

- Bryan Swistock, Senior Extension Associate, [brs@psu.edu](mailto:brs@psu.edu), 814-863-0194
- James A Clark, Extension Educator, [Jac20@psu.edu](mailto:Jac20@psu.edu), 814-887-5613
- Susan Boser, Extension Educator, [smw16@psu.edu](mailto:smw16@psu.edu), 727-774-3003
- Dana Rizzo, Extension Educator, [def18@psu.edu](mailto:def18@psu.edu), 724-837-1402
- Diane Oleson, Extension Educator, [djo13@psu.edu](mailto:djo13@psu.edu), 717-840-7429
- Lysle Sherwin, Extension Associate (retired), [lss9@psu.edu](mailto:lss9@psu.edu), 814-865-5736

**AFFILIATION**

Penn State University, 308 Forest Resources Building, University Park, PA 16802

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## EXECUTIVE SUMMARY

Over three-million rural residents of Pennsylvania rely on private wells and springs that utilize groundwater for drinking water and more than 50% fail at least one health based drinking water standard. Very few homeowners with contaminated water systems are familiar with the problem or have appropriate water treatment systems to provide safe drinking water. Real estate professionals are an important initial point of contact for rural homeowners in the evaluation of private drinking water supplies. Although Penn State Extension provides many written resources related to private water supplies, better mobile access to these resources is needed to meet the demands of private water supply owners and real estate professionals.

The Penn State Extension Water Resources Team worked with Skyward Apps in Columbia, MD to develop an innovative water APP to transfer groundwater-related extension resources to real estate agents, inspectors, and the general public. The *H2OSolutions* App was created in both Apple and Android platforms and released in 2014. A series of educational workshops for both real estate professionals and private water supply owners were conducted during this project to increase awareness of private water supply management and to market the new App as a mobile resource to assist in evaluating private groundwater supplies. A total of 55 real estate professionals and 412 homeowners attended a workshop with the vast majority reporting that they learned new information and planned on taking action to better manage private water supplies. Interestingly, real estate professionals reported that they interact with an average of 32 private water supply owners each year resulting in another 1,777 private water supply owners that were educated indirectly by this project.

Due to unforeseen delays in releasing the App caused by contract and Risk Management issues at Penn State University, the *H2OSolutions* App was not released to the public until the end of this grant. Based largely on initial marketing through Penn State news releases, 127 mobile device users downloaded the Apple version of the App in the first month since its release. Project staff will continue to measure downloads of both versions of the App over the coming months to better document the impact of the App. Based on the success of this initial App offering, Penn State Extension will continue to evaluate mobile Apps for more efficient delivery of educational resources to an increasingly technologically-driven public.

## REPORT

### INTRODUCTION

Over three-million rural residents of Pennsylvania rely on groundwater wells and springs for drinking water and nearly 20,000 new private groundwater wells are drilled each year. Numerous studies by the principal investigators have found that more than 50% of private water systems in the state fail to meet at least one health-based drinking water standard. Surveys have also shown that very few homeowners with contaminated water systems are aware of these problems or have appropriate water treatment systems to provide safe drinking water. In many cases, home inspectors or real estate agents are the only initial contact that rural homeowners have to discuss and evaluate their private water supply. Although Penn State Extension provides many written resources related to private water supplies, better mobile access to these resources is needed to meet the demands of private water supply owners and inspectors. Prior to this project, there were not mobile Apps specific to diagnosing issues with private drinking water supplies. The goal of this project was to provide specific educational resources needed for proper evaluation of private water supplies and drinking water quality via mobile technology.

### METHODOLOGY

#### App Development

At the beginning of the grant in May 2013 the principal investigators researched private contractors with experience in creating educational Apps. Skyward Apps ([www.skywardapps.com](http://www.skywardapps.com)) in Columbia, MD was identified as a qualified contractor with extensive experience working with mobile educational Apps within the budgetary restrictions of the project. A draft contract from Skyward Apps to complete the proposed App was received and forwarded to Penn State Risk Management in August 2013. Since Risk Management had never dealt with a contract to create an educational App, the project was delayed through November 2013 while appropriate language and contract language were negotiated. The draft App was published in a test mode on the Skyward Apps site in January 2014 for evaluation by testers. Based on naming restrictions and discussion with the water resources Extension team and Skyward Apps, the App was named *H2OSolutions* and the logo shown in Figure 1 was adopted.



**Figure 1. The *H2OSolutions* Logo.**

Penn State Information Technology Services provided an App webpage interface to allow for entry and editing of content for the App. Project staff entered content from existing Penn State Extension fact sheets along with extensive water test data (by county) based on thousands of private water supplies tested at Penn State's accredited water testing laboratory over the past seven years. The final Apple iOS version of the App was published to the Apple Store on May 7, 2014 and available for download by the public by searching for *H2OSolutions* on the Apple Store or direct download at: <https://itunes.apple.com/us/app/h2o-solutions/id872578421?mt=8>.

The Android version of the App required a separate contract and End User License Agreement (EULA) since, unlike Apple, no EULA existed between Penn State and Android devices. Even though the final Android version of the App was completed during this project, the additional EULA contract and negotiation through Penn State University is still ongoing (as of August 20, 2014) and has delayed final release of the Android version of the App. We anticipate that the final Android version will be available on the Google App store sometime in September 2014.

The overall delays in publishing the final versions of the App restricted our ability to collect evaluation data on the use of the App before the end date of this grant. Evaluation will continue and data can be provided to Sea Grant in fall 2014 if desired.



**Figure 2. The credit screen in the Android version of the *H2OSolutions* App.**

### Educational Workshops

During development of the *H2OSolutions* App, numerous workshops were planned and presented by project staff for both professional (real estate) and private water supply audiences. The intent of these workshops was to a) provide basic education on private water systems to professional and homeowner audiences; b) provide free or reduced rate water testing for private water supplies; c) increase awareness and potential use of the *H2OSolutions* App among these target audiences and d) provide a database of potential reviewers for early drafts of the App.

Real estate professionals including home inspectors and agents were an obvious target audience of the *H2OSolutions* App. Members of the App development team worked with regional real estate professional organizations to offer several three-hour training workshops that included basic information on inspecting and managing private water supplies and an introduction to the *H2OSolutions* App.

Homeowners with private water supplies were also targeted with numerous workshops throughout the state in 2013 and 2014. These workshops included two hours of education on private water system management and a short introduction to the *H2OSolutions* App. Homeowners could also take advantage of free or reduced cost water testing as part of these workshops.

## RESULTS

### H2OSolutions App Content

The final version of the *H2OSolutions* App includes four main sections shown in Figure 3.

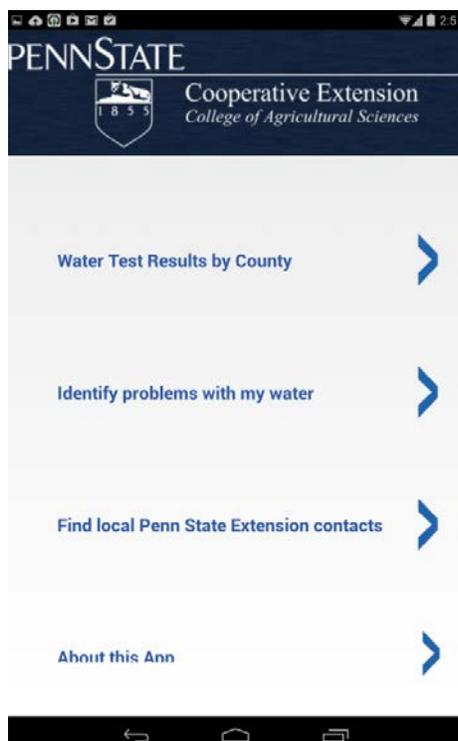
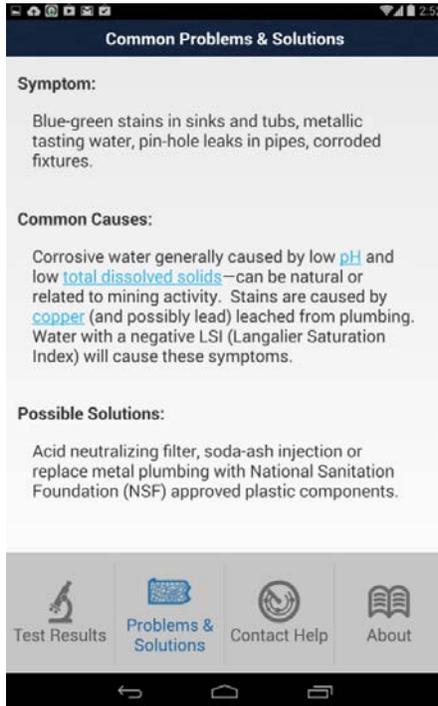


Figure 3. A screenshot of the main page of the *H2OSolutions* App showing the four sections.

- **Water test results by county**—Users can select a Pennsylvania county and see a summary of water quality for private water supplies tested from that county between 2007 and the present by the Penn State Agricultural Analytical Laboratory. Once a county is selected, a page is displayed with the drinking water standards and the percentage of samples that failed the standard for 25 inorganic and microbiological parameters. By selecting an individual test parameter, users can also view detailed statistics including the number of samples, median, minimum, and maximum concentrations for that county.
- **Identify problems with my water**—This section describes the causes of common water symptoms (stains, tastes, odors, etc.) in water and provides links to the water test parameters that may cause those symptoms. Once a water test parameter is selected, the county-based water test data can be accessed as described above. A screenshot of this part of the App is shown in Figure 4.
- **Find local Penn State Extension Contacts**—The App uses the location of the phone to provide a listing (organized from closest to furthest away in distance) of Penn State Extension educators and water specialists who specialize in private water system management. Information for the Penn State water testing laboratory is also provided. By selecting a person on the contact list, information including their phone number and email address are displayed.
- **About this App**—This icon provides information about Penn State Extension and the funding sources used to develop the App.

These sections allow a water supply owner, real estate agent or home inspector to evaluate an existing groundwater supply to determine if obvious water quality problems exist and also to guide water testing decisions. The unique, easy access to the existing database of several thousand water quality records from the state accredited laboratory at Penn State University also gives users the ability to view common problems in a given county. The development team also researched the possibility of including links in the App to existing Penn State web resources related to private water supplies but ultimately determined that this exceeded the needs of this App.



**Figure 4. A screenshot of “Common Problems and Solutions” page from the *H2OSolutions* App.**

### Real Estate Professional Workshops

A total of 55 real estate professionals attended one of three separate three-hour courses including:

- May 6, 2013, Grantville, PA (Dauphin County) – 27 real estate professionals
- March 13, 2014, York, PA (York County), 16 real estate professionals
- March 21, 2014, State College, PA (Centre County), 12 real estate professionals

Real estate professionals who attended one of the courses were able to receive required continuing education credits along with copies of a Penn State 80-page handbook (*A Guide to Private Water Systems in Pennsylvania*), various other Penn State Extension publications, and information on the *H2OSolutions* App.



**Penn State Water Resources Extension Educator Jim Clark conducts a workshop for real estate professionals in Dauphin County in May 2013.**



**Real estate professionals at a workshop in York, PA in March 2014 learn about water testing.**

On-site evaluations of the workshops for real estate professionals were conducted using TurningPoint response cards. The 55 attendees at these workshops indicated that they interact with 1,777 private water supply owners each year through real estate inspections or sales (32 private water supply owners per real estate professional). This represents a significant multiplying effect of the education and mobile App targeting this audience. All 55 (100%) of the attendees indicated that they learned some information at the workshops with 76% indicating that they learned a great deal of new information. Nearly all (94%) of the attendees indicated that they would take actions to help their clients as a result of the information presented in the workshop (4% were unsure and 2% did not plan to take any actions).

#### Private Water Supply Owner Workshops

Four workshops specifically targeting private water supply owners were conducted with funding from this project (see listing below). An additional 16 workshops were provided with support from other grants but still provided education about the *H2OSolutions* App. In total, these workshops were attended by 412 private water supply owners and free or reduced water testing was provided for 333 private water wells and springs. Specific information on each workshop is included below:

- Spring Mills, PA (Centre County), two workshops, October 10, 2013, 78 attendees, 77 free water tests, funded entirely by this grant
- Franklin, PA (Venango County), one workshop, March 24, 2014, 7 attendees, 7 reduced fee water tests, funded entirely by this grant
- New Castle, PA (Lawrence County), one workshop, February 27, 2014, 13 attendees, 5 reduced fee water tests, funded entirely by this grant
- Meadville, PA (Crawford County), two workshops, April 25, 2013, 18 attendees, 14 free water tests, funded by another grant but included information on *H2OSolutions* App
- Doylestown, PA (Bucks County), two workshops, May 14, 2013, 66 attendees, 51 free water tests, funded by another grant but included information on *H2OSolutions* App
- Greensburg, PA (Westmoreland County), two workshops, July 17, 2013, 31 attendees, 24 free water tests, funded by another grant but included information on *H2OSolutions* App
- Ebensburg, PA (Cambria County), one workshop, September 10, 2013, 30 attendees, 25 free water tests, funded by another grant but included information on *H2OSolutions* App
- York, PA (York County), November 14, 2013, two workshops, 36 attendees, 30 reduced fee water tests, funded by another grant but included information on *H2OSolutions* App
- Mercer, PA (Mercer County), January 14, 2014, two workshops, 39 attendees, 23 reduced fee water tests, funded by another grant but included information on *H2OSolutions* App

- Butler, PA (Butler County), March 27, 2014, one workshop, 5 attendees, 4 reduced fee water tests, funded by another grant but included information on *H2OSolutions* App
- Smethport, PA (McKean County), April 8, 2014, one workshop, 9 attendees, 8 reduced fee water tests, funded by another grant but included information on *H2OSolutions* App
- Brookville, PA (Jefferson County), April 15, 2014, one workshop, 11 attendees, 8 reduced fee water tests, funded by another grant but included information on *H2OSolutions* App
- Bloomsburg, PA (Columbia County), May 29, 2014, two workshops, 69 attendees, 57 free water tests, funded by another grant but included information on *H2OSolutions* App



**Private water supply owners listed to Penn State educator Diane Oleson discuss proper water supply management at a workshop in York, PA in November 2013.**

On-site evaluations were given to workshop attendees using TurningPoint response cards or paper evaluations. A total of 302 evaluations were received from the 412 attendees and 98% (296) indicated that they learned new information at the workshop. Eighty-four percent (254) planned on taking action to better manage their private water supply as a result of attending.

Email addresses were collected from attendees at all workshops to allow for later notification about the availability of the *H2OSolutions* App and to provide a list of potential reviewers for early drafts of the App. Evaluation of the first draft of the Apple version of the App was invited from 38 professionals including 27 real estate professionals, six water well experts who attended the January 2014 Pennsylvania Ground Water Association winter conference in Grantville, PA, and five Penn State Extension water resources educators. Many potential reviewers either did not have any mobile devices or had only Android devices. As a result, comments were received from only seven reviewers with Apple devices. Their comments were used to make edits and improvements to the App before its final release to the public.

After release of the final Apple iOS version of the App on May 7, 2014, project staff created a news release announcing the availability of the App which was publicized by Penn State University at: <http://news.psu.edu/story/317541/2014/06/04/campus-life/penn-state-extension-develops-new-water-quality-app>

## **CONCLUSIONS**

Trends in technology use clearly demonstrate that the public is more frequently using mobile devices to access information. The development of this App demonstrates the first attempt by the Penn State Water Resources Extension team to create a mobile portal for the wealth of private water supply and groundwater information available through our website.

Although development of the App was challenging due to delays from Penn State Risk Management, the final product creates a simple resource for mobile device users to evaluate private water supplies in Pennsylvania. Evaluation results from workshop attendees indicated a high level of learning and expected actions from both audiences with a significant multiplier effect (32X) for real estate professionals. In just the first month since its release, the Apple iOS version of *H2OSolutions* has been downloaded by 127 users and several clients have already contacted project staff using the “Find Local Penn State Extension Contacts” portion of the App. Similar tracking will occur for both Apple and Android device users over the next several months. Additional marketing of the App will occur over the next several months after release of the Android version. Direct marketing to all attendees at workshop conducted during this grant will occur by email along with newsletter articles to various audiences.

## **ADDITIONAL RESEARCH INDICATED**

The principal investigators have completed several research projects related to private water systems and have used innovative technology to deliver education to private water system owners in the past (Swistock et al., 2001). For example, recent projects have documented the occurrence of several health-related pollutants in private wells and correlated contaminants to nearby land use and water well construction. Other research has measured voluntary management practices implemented by well owners (including water testing strategies) along with their opinions of threats to their water supply and potential regulations for private systems. Past studies by the investigators have also documented the occurrence of pollutants in private systems (Swistock et al. 1993) and the relationship between well construction and bacterial contamination (Swistock et al., 2004, Swistock and Sharpe, 2005, Swistock et al., 2012). Another recent study documented the importance of well location relative to sources of contamination and land management practices in causing private well contamination (Center for Watershed Stewardship, 2005). Recently completed research also looked at relevant water quality issues adjacent to Marcellus gas drilling sites (Boyer et al., 2012). Basic information from these and other research projects were utilized to develop content for the *H2OSolutions* App developed in this project.

The APP can now be accessed through the Apple or Google App stores or through the Water Resources Extension web site (<http://water.cas.psu.edu>). Now that the App has been developed, it can be marketed at various extension water workshops for building inspectors and real estate agents, as well as, by extension educators at the district level. Evaluation of the App will continue through email surveys to attendees at various Extension water events to determine if additional Extension resources should be utilized for future App development.

## **Citations**

- Boyer, E., Swistock, B.R., Clark, J., Rizzo, D., & Madden, M. (2012). Impact of Marcellus Gas Drilling on Rural Drinking Water Supplies, Final report to the Center for Rural Pennsylvania, 26 pp. Report available online at: [http://www.rural.palegislature.us/documents/reports/Marcellus\\_and\\_drinking\\_water\\_2012.pdf](http://www.rural.palegislature.us/documents/reports/Marcellus_and_drinking_water_2012.pdf)

- Center for Watershed Stewardship. (2005). Spruce Creek Watershed Assessment and Stewardship Plan, Keystone Project 2004-2005, Phase II. p. 42-49.
- Swistock, B.R., Sharpe, W.E. & Robillard, P.D. (1993). A survey of lead, nitrate and radon contamination of private individual water systems in Pennsylvania. *Journal of Environmental Health*, 55(5), 6-12.
- Swistock, B.R., Sharpe, W.E. & Dickison, J. (2001). Educating Rural Private Water System Owners in Pennsylvania Using Satellite vs Traditional Programs. *Journal of Extension*. 39(3).
- Swistock, B.R., W.E. Sharpe and P.D. Robillard (2004). The Influence of Well Construction on Bacterial Contamination. Final Report to the Center for Rural Pennsylvania. May 2004. 14 pp.
- Swistock, B.R. & Sharpe, W.E. (2005). The influence of well construction on bacterial contamination of private water wells in Pennsylvania. *Journal of Environmental Health*, 2005.
- Swistock, B.R, S. Clemens, W.E. Sharpe and S. Rummel (2012), Water quality and management of private drinking water wells in Pennsylvania. *Journal of Environmental Health (in press)*.

## **Appendix A**

### Staff

1. Number of individuals – six total Penn State staff participated in this grant.
2. Number of full-time employees (as part of the grant) – one full time employee of Penn State was employed as part of this grant.
3. Number of full-time employees (as part of match) – five full times employees of Penn State participated in this project as matching resources.

### Students Supported

- i. Number of Undergraduate Students – zero
- ii. Number of Graduate Students - zero
- iii. Number of Ph.D. Students - zero
- iv. Degrees Awarded - none

### Outreach/Extension

- i. Number of meetings, workshops, or conferences and number of attendees – this project directly funded three workshops for real estate professionals and four workshops for private water supply owners for a total of 153 attendees. Based on an average multiplier for real estate professionals, we anticipate an additional 1,777 private water supply owners will benefit annually from this project. The App was further discussed at an additional 16 workshops attended by 314 private water supply owners.
- ii. Number of public or professional presentations and number of attendees – Each workshop involved three separate presentations for a total of 24 presentations for 467 private water supply professionals or owners.

**APPENDIX B - Impact Statement (<250 words)**

Over three-million rural residents of Pennsylvania rely on groundwater wells and springs for drinking water and more than 50% fail at least one health based drinking water standard. Private water supply owners and real estate professionals who routinely interact with them are often unaware of common problems and solutions for these drinking water problems. This project sought to more efficiently deliver unique Penn State Extension educational resources related to proper management of private water supplies to homeowners and real estate professionals using mobile technology.

An *H2OSolutions* mobile App was created in both Apple and Android platforms and released in 2014 to the general public. A series of educational workshops for both real estate professionals and private water supply owners were conducted to increase awareness of both private water supply management and the new mobile App. A total of 55 real estate professionals and 412 homeowners directly benefited from these workshops with another 1,777 homeowners indirectly benefiting through secondary interactions with real estate professionals.

The final version of the App was released at the end of the project but in its first month, 127 mobile users had already downloaded the App. Project staff will continue to measure downloads of both versions of the App over the coming months to better document the impact of the App.

Partners on this project included Penn State Extension, Pennsylvania Sea Grant, the Pennsylvania Water Resources Research Center and various regional real estate professional associations.