

WARM MINERAL SPRINGS, SARASOTA COUNTY, FLORIDA: A SUMMARY OF RETROSPECTIVE DATA

BACKGROUND

Warm Mineral Springs, located in southern Sarasota County (fig. 1), is the only warm (87° F), highly-mineralized spring in Florida. This unique geothermal spring has hydrologic importance, ecological and archeological significance, and economic value for Sarasota County. Since 1946, a day spa has operated at the spring, attracting vacationers and health enthusiasts. In addition, the warm water from the spring attracts manatees to the adjoining spring run during the winter months, and provides vital habitat for these mammals as well as an opportunity for environmental education. Archeological evidence indicates that the spring has long been an attraction for humans. Well-preserved human bones, artifacts, and Pleistocene age animal bones and plant remains have been found in and around the spring (Rupert, 1994). Clearly, Warm Mineral Springs is a multi-use resource, with numerous stakeholders involved in its development, management and sustainable use.

Conditions that led to the formation of Warm Mineral Springs and the source(s) of the spring water are uncertain. The primary warm-water conduit of the spring is developed in carbonate unit belonging to the Arcadia Formation of the Hawthorn Group which resides within the intermediate aquifer system (Rupert, 1994). The spring water is highly mineralized with chloride and sulfate concentrations ranging from 9,200-10,000 mg/L and 1,600-1,700 mg/L, respectively (Ferguson and others, 1947; Rosenau and others, 1977; Scott and others, 2004).

The temperature of the spring has long been of scientific interest. Temperatures range from 84.02-86.38 °F at the surface to 97 °F at the bottom vent located at 209 ft (Bowen, 2010). Using an estimate of the geothermal gradient with depth in Florida of 0.86 °F per 100 feet (Griffin and others, 1969) and an estimated mean surface temperature of 72 °F, implies a *minimum* source depth for Warm Mineral Springs of about 3,000 feet. Kohout

and others (1977) suggested that the source was deep geothermally heated seawater flowing at the base of the Floridan aquifer system at depths of 3,000 feet, then rising to the surface through fractures in the overlying carbonates. In contrast, Hutchinson (1992) and Sacks and Tihansky (1996) suggested that the water from Warm Mineral Springs is from the Ocala-Avon Park permeable zone of the Upper Floridan aquifer. Archeological evidence suggests that this spring was a source of freshwater for primitive humans when sea-level was lower some 5,200 to 12,000 years ago (Clausen and others, 1979) and these findings may provide further support for a shallow Upper Floridan aquifer source for Warm Mineral Springs.

The main area of discharge in Warm Mineral Spring is through a conduit located near the bottom of the spring shaft. A discharge of about 31 ft³/s (20 Mgal/d) has been estimated through this conduit (Cockrell and Murphy, 1978). Several cool-water vents occur in other locations along the formational walls of the sink (Bowen, 2010). Historical discharge measurements (1942-1981) made at Warm Mineral Springs ranged from 7 to 12 ft³/s (5 to 8 Mgal/d) (Ferguson and others, 1947; Rosenau and others, 1977). More recent discharge measurements (2003-2012) ranged from 5 to 8 ft³/s (3 to 5 Mgal/d) (Scott and others, 2004; Cliff Harrison, Sarasota County, written commun., 2012; Dave DeWitt, Southwest Florida Water Management District, written commun., 2012). If the flow estimate of Cockrell and Murphy (1978) made at the vent of 31 ft³/s (20 Mgal/d) is correct, a large amount of the mineralized water from the main spring vent could be flowing into shallower aquifer zones exposed within the sink.

PROBLEM

Hydrologic conditions have changed over time in the area surrounding Warm Mineral Springs. As development expanded in this region, the need for the groundwater resources has increased. In southeastern Sarasota County, the increase in groundwater withdrawals has coincided with about a 10 to 20 foot decline in the potentiometric surface of the Upper Florida aquifer (Metz and Lewelling, 2009) along with a decline in Warm Mineral Springs discharge (fig. 2).

Because the origin of the source water to Warm Mineral Springs is unknown, it is difficult to ascertain the effect of increased withdrawals on spring flow. Using a regional groundwater flow model of the study area (Sepulveda, 2002), the projected groundwater withdrawals in 2020 could result in an 11 percent decrease in spring flow for Warm Mineral Springs (estimated to decrease from 6.6 to 5.3 Mgal/d). However, estimates of spring flow decline may be very approximate given the coarse conceptualization of this flow model relative to the local scale of Warm Mineral Springs and, in particular, the uncertainty of the origin of the source water.

As demands for water in southwest Florida and use of the intermediate aquifer system and the Upper Floridan aquifers increases, a greater understanding of spring and aquifer hydrogeology is necessary to arrive at reliable estimates of the impact (flow, temperature, and mineral content) of current and future changes in anthropogenic (e.g., groundwater withdrawals) and climatic stresses. This understanding could provide water managers with the necessary information to preserve Warm Mineral Springs for future generations.

OBJECTIVES AND SCOPE

This project will accomplish the first step in a comprehensive long-term study of Warm Mineral Springs. The objective of this project is to provide a review, compilation, and objective summary of existing data, including published data and all data available in the public domain, pertinent to the hydrology of the area. The data review and summary will bring the questions that remain unanswered by previous studies into objective focus. This review and summary will facilitate the design of a comprehensive study needed to help local, regional, and state water resources professionals better understand and sustainably manage Warm Mineral Springs.

The long-term objectives of a comprehensive study of Warm Mineral Springs are to: 1) identify the source(s) of water and the boundaries and/or the extent of the springshed for Warm Mineral Springs; 2) characterize any changes in water quality with depth and source; 3) characterize flow by measuring the change in water quantity with depth and source; 4) determine the total and net daily discharge of Warm Mineral Springs; 5)

assess the potential for water-quality degradation within the spring/aquifer complex; and
6) assess the potential for changes in spring hydrology resulting from human activities within the springshed area.

RELEVANCE AND BENEFITS

The proposed work addresses several priority water-resource issues identified in the strategic plan of the USGS Water Resources Discipline. The proposed investigation will increase understanding of subsurface flow processes, which will help in addressing issues of water quality and supply to ecosystems downgradient of the spring. Studies of groundwater and surface-water interactions are essential for the sound development and management of the area's water resources, especially as demand for water resources increases. Groundwater and surface-water interactions are poorly understood, but their understanding is of vital importance if available water resources are to be quantified. This study will provide information that could be used by regional water managers to safeguard the flow at Warm Mineral Springs and water levels in the Upper Floridan aquifer as development of the groundwater supply continues.

Results from this project also will address one of the five key science issues identified in the "Florida Water Science Center Science Plan": *Advance Understanding of Hydrologic Information for Ecological and Urban Concerns* -- identification of the processes that affect the movement of water within and through a watershed. Basic hydrologic and water quality data are needed to provide baseline information for increased understanding of watershed processes, for evaluating causes of problems, and for detecting and predicting trends.

Specific benefits to the USGS that will be provided by the proposed project are opportunities to:

- Improve understanding of the flow processes and the geochemistry of different zones in the aquifer system and how they influence the hydrology of springs in southwest Florida.
- Expand monitoring techniques for determining flow in complex spring systems.

APPROACH

The study will summarize existing data pertinent to the hydrologic conditions and hydrogeology in the study and surrounding area, which is the first step in any subsequent comprehensive analysis of Warm Mineral Springs.

1. Project planning, meetings, and reviews— this task involves project schedule development and reviews. Project documentation and public outreach will take place throughout the project via periodic project status updates on the Sarasota County Water Atlas web page.

2. Retrospective analysis—The principal activity of this project will be to summarize existing data. A literature and file search will be conducted and all data pertinent to the hydrology of the area will be reviewed, compiled, and summarized.

- An inventory of historical and current streamflow, groundwater levels, and water use will be performed.
- Data from driller's completion reports, existing core data from ROMP wells in the area, and lithologic and geologic logs will be compiled.
- Water levels from existing wells will be evaluated and summarized.
- A water-quality inventory will be completed and data will be summarized.

3. Summary of recent monitoring data at an existing surface site – Sarasota County has been collecting hourly water-level and water temperature data since May 1, 2012 at a site 75 ft upstream of the Ortiz Road culvert. The County will continue to monitor water level and temperature at this existing site for the duration of the study. The County also has measured discharge monthly at a discharge station on the spring run. These measurements also will continue for the duration of the study.

4. Preparation, review, and publication of an Open-File Report –A draft report will provide a comprehensive summary of existing data pertinent to the hydrologic conditions and hydrogeology in the study area and surrounding areas. In addition, data gaps will

be defined, and a design for a comprehensive study of Warm Mineral Springs that will address those data gaps will be completed in consultation with the cooperators and stakeholders. The draft report, a USGS Open-File Report, will be reviewed, approved, and published. Data will be shared informally with the cooperators during the project, and a final draft will be provided to the cooperators for editorial review prior to publishing.

PRODUCTS

The primary product of this investigation will be a USGS Open-File Report titled “Warm Mineral Springs, FL: Summary of Retrospective Data”. Digital data sets of retrospective data also will be compiled and summarized. In addition, a technical presentation will be conducted to describe the study’s findings to the County and City at publicly noticed meetings.

TIMELINE

The project will be conducted over a 1-year period from July 1, 2014 through June 30, 2015.

ESTIMATED FUNDING

The proposed project will be conducted under a USGS Joint Funding Agreement. The agreement will be between the U.S. Geological Survey, Sarasota County, FL, and City of North Port, FL. The duration of the project is 1 year and the cost is estimated to be \$ 50,000, distributed as follows:

Estimated Funding Summary By Cooperator

<u>Agency</u>	<u>FY14</u>
USGS FL WSC	20,000
Sarasota County	15,000
City of North Port	15,000
Total	50,000

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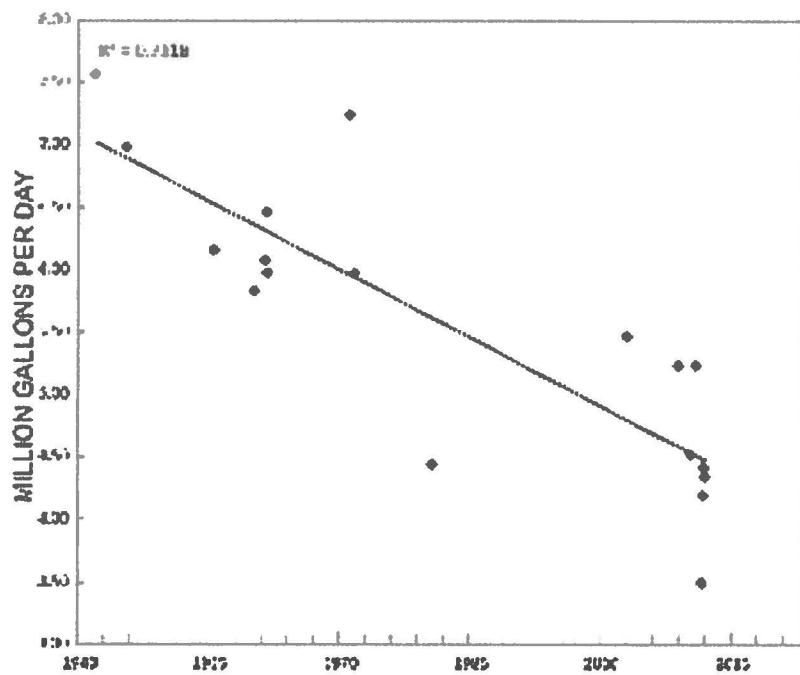


Figure 2. Long-term discharge from Warm Mineral Springs (1942-2012), and a trend line indicating a decline in spring discharge.