Ricks Spring

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Utah Geosites
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Utah Geological Association Publication 48

M. Milligan, R.F. Biek, P. Inkenbrandt, and P. Nielsen, editors

Cover Image: *Ricks Spring rises along a nearly vertical normal fault in the Ordovician Garden City Formation.*

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Utah Geosites showcases some of Utah's spectacular geology, both little-known localities and sites seen by visitors to Utah's many national and state parks and monuments. The geosites reflect the interests of the many volunteers who wrote to share some of their favorite geologic sites. The list is eclectic and far from complete, and we hope that additional geosites will be added in the coming years. The Utah Geological Survey also maintains a list of geosites https://geology.utah.gov/apps/geosights/index.htm.

We thank the many authors for their geosite contributions, Utah Geological Association members who make annual UGA publications possible, and the American Association of Petroleum Geologists—Rocky Mountain Section Foundation for a generous grant for desktop publishing of these geosite papers.

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PRESIDENTS MESSAGE

I have had the pleasure of working with many different geologists from all around the world. As I have traveled around Utah for work and pleasure, many times I have observed vehicles parked alongside the road with many people climbing around an outcrop or walking up a trail in a canyon. Whether these people are from Utah or from another state or country, they all are quick to mention to me how wonderful our geology is here in Utah.

Utah is at the junction of several different geological provinces. We have the Basin and Range to the west and the Central Utah Hingeline and Thrust Belt down the middle. The Uinta Mountains have outcrops of some of the oldest sedimentary rock in Utah. Utah also has its share of young cinder cones and basaltic lava flows, and ancient laccoliths, stratovolcanoes, and plutonic rocks. The general public comes to Utah to experience our wonderful scenic geology throughout our state and national parks. Driving between our national and state parks is a breathtaking experience.

The "Utah Geosites" has been a great undertaking by many people. I wanted to involve as many people as we could in preparing this guidebook. We have had great response from authors that visit or work here in the state. Several authors have more than one site that they consider unique and want to share with the rest of us. I wanted to make the guidebook usable by geologists wanting to see outcrops and to the informed general public. The articles are well written and the editorial work on this guidebook has been top quality.

I would like to personally thank Mark Milligan, Bob Biek, and Paul Inkenbrandt for their editorial work on this guidebook. This guidebook could not have happened without their support. I would like to thank Jenny Erickson for doing the great desktop publishing and the many authors and reviewers that helped prepare the articles. Your work has been outstanding and will certainly showcase the many great places and geology of Utah. Last, but not least, Thank you to the American Association of Petroleum Geologists, Rocky Mountain Section Foundation for their financial support for this publication.

Guidebook 48 will hopefully be a dynamic document with the potential to add additional "geosites" in the future. I hope more authors will volunteer articles on their favorite sites. I would like to fill the map with locations so that a person or family looking at the map or articles will see a great location to read about and visit. Enjoy Guidebook 48 and enjoy the geology of Utah.

Peter J. Nielsen
2019 UGA President

INTRODUCTION

Ricks Spring is one of several major karst springs that discharge along the Logan River in the Bear River Range in Cache County, Utah. The spring is located along U.S. Highway 89 in Logan Canyon about 17 miles (27.4 kilometers) northeast of (up-canyon from) the city of Logan, at mile marker 477. It lies within Uinta-Wasatch-Cache National Forest at an elevation of 5880 feet (1792 meters). Situated at the base of a hillside, the spring is one of the largest and most scenic along the Logan River (figure 1). Water from the spring flows out of a large alcove, under Highway 89, and into the Logan River, about 150 feet (45 meters) from the spring. Pullouts on both sides of the highway provide parking for visitors to the spring, and a boardwalk crosses the spring run, which allows access to the rise pool in the alcove. Several signs at the spring provide information about its history and hydrology. Ricks Spring typically flows during the spring, summer, and fall months, but can have periods of no flow during the winter months, particularly during extended periods of cold weather. During these times, the water in the rise pit recedes to a small pool of standing water that can contain fish, which presumably originate from the nearby Logan River. During the last 10 years, cave divers have explored the conduit that feeds the spring for about 2300 feet (700 meters) into the mountainside. **Coordinates:** 41° 50' 24.55" N, 111° 35' 19.15" W (NAD 83)

Figure 1. *Ricks Spring rises along a nearly vertical normal fault (dashed red line) in the Ordovician Garden City Formation. Bedding dips to the southeast at about 36° near the fault. The small cave on left side of photo could have been a former spring outlet. Photograph by Larry Spangler, August 2011.*

HISTORY

Ricks Spring is named for Thomas E. Ricks, a Mormon pioneer who settled in Cache Valley in 1859. A colonel in the Utah Militia, Ricks was commissioned by Brigham Young to locate a better route from Cache Valley over the mountains to Bear Lake Valley. Consequently, Ricks and others in the community began constructing a road to Bear Lake Valley up Logan Canyon. The road to Ricks Spring was the first section to be completed. Ricks' explorations of Logan Canyon were some of the first documentations of the area, and it was during this time that he discovered a "natural spring flowing from the cavity of a large rock" (web page accessed December 27, 2018, at https://en.wikipedia.org/wiki/Thomas_E._Ricks_(Mormon)). Since its discovery, people visiting the spring have often drank from it, bringing home jugs and barrels of the "fresh spring water" under the assumption it came from a deep aquifer. They often became sick with *Giardia*, indicating the water was not from an artesian source (web page accessed December 27, 2018, at https://en.wikipedia.org/wiki/Ricks_Spring). Early 1900s postcards showed visitors in their Sunday best dipping water from the spring, unaware that part of the water from the spring came from the Logan River just upstream. At one time a water fountain was present at the spring; however, this water was sourced from a different spring nearby. That, along with an outhouse, were removed in the 1980s (Scott Bushman, U.S. Forest Service, retired, verbal communication, June 7, 2019). In the 1990s, a sign was still posted at the spring advising visitors that *Giardia* was present in the water.

GEOLOGY

Ricks Spring discharges from the Ordovician Garden City Formation, a thin-bedded, cherty, dolomitic, argillaceous (clay-bearing) limestone about 1250 feet (380 meters) thick in the vicinity of the spring (Dover, 1995). The Garden City crops out in the area surrounding and immediately to the north of Ricks Spring, but farther north, the formation is covered by (1) the Tertiary (Eocene) Wasatch Formation, a reddish conglomeratic siltstone with interbedded limestone and marl, (2) Quaternary and (or) upper Tertiary unconsolidated conglomerate (diamictite), and (3) Pleistocene glacial moraine deposits consisting of poorly sorted boulder till (Dover, 1995; figure 2). Regionally, the Garden City Formation crops out on the eastern flank of the Logan Peak syncline, as indicated by mapped bedrock dips of 10 to 20 degrees to the southwest in the vicinity of the spring (Dover, 1995; figures 2 and 3). Overlying Silurian dolomites and Devonian carbonate and clastic (shales and sandstones) rocks crop out west of the Garden City and form the core of the syncline (figures 2 and 3).

Ricks Spring rises along a northeast-trending normal fault (herein termed the Ricks Spring fault) that is unmapped but roughly parallels the Logan River. The fault appears to extend to the northeast from the alcove where it presumably intersects the Logan River upstream of the spring and could act to divert water from the river to the spring. A mapped fault that also trends northeast and parallels the Rick Springs fault, lies just north of the spring and is shown to intersect the Logan River (figure 2). Dip along this fault is about 80 degrees to the southeast, with about 200 feet (60 meters) or less of displacement within the Garden City Formation, based on a geologic cross section that traverses the fault southwest

Explanation of Geologic Units (for figures 2 and 3)

- **Qa** — **Quaternary (Holocene)**—Main-stream alluvium
- **Qaf** — **Quaternary**—Side-stream alluvium and fan deposits
- **Ql** — **Quaternary**—Landslide deposits
- **Qm** — **Quaternary (Pleistocene)**—Moraine deposits
- **QTd** — **Quaternary/Tertiary**—Diamictite deposits
- **Tw** — **Tertiary (Eocene)**—Wasatch Formation
- **Db** — **Devonian**—Beirdneau Formation
- **Dh** — **Devonian**—Hyrum Dolomite
- **Dw** — **Devonian**—Water Canyon Formation
- **Sl** — **Silurian**—Laketown Dolomite
- **SOf** — **Silurian/Ordovician**—Fish Haven Dolomite
- **Os** — **Ordovician**—Swan Peak Quartzite
- **Og** — **Ordovician**—Garden City Formation

Contact between geologic units, dashed where approximate

? **Geologic unit uncertain**

80 **High-angle normal fault**—Dashed where approximately located; dotted where concealed. Bar and ball on downthrown side. Arrow shows direction and amount of dip, in degrees

25 **Strike and dip (in degrees) of inclined bedding**

Inclined bedding—Estimated from aerial photographs or distant obser

Landslide scarp—Hachures point down dip

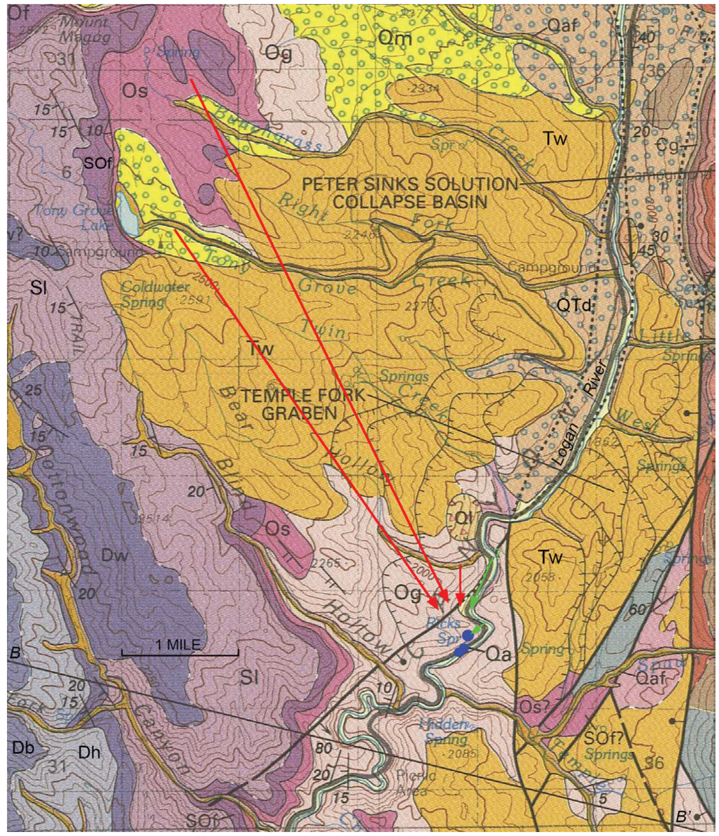

Figure 2. Geologic map of the area surrounding Ricks Spring. Much of the outcrop area of the Ordovician Garden City Formation is covered by the Tertiary Wasatch Formation and Quaternary unconsolidated deposits. Note the northeast-trending fault near the spring. Map modified from Dover (1995), with dye-tracing results (red arrows) from Spangler (1991). Green arrows indicate possible flow paths based on information from U.S. Forest Service and fault projections. Blue dots represent spring discharge points.

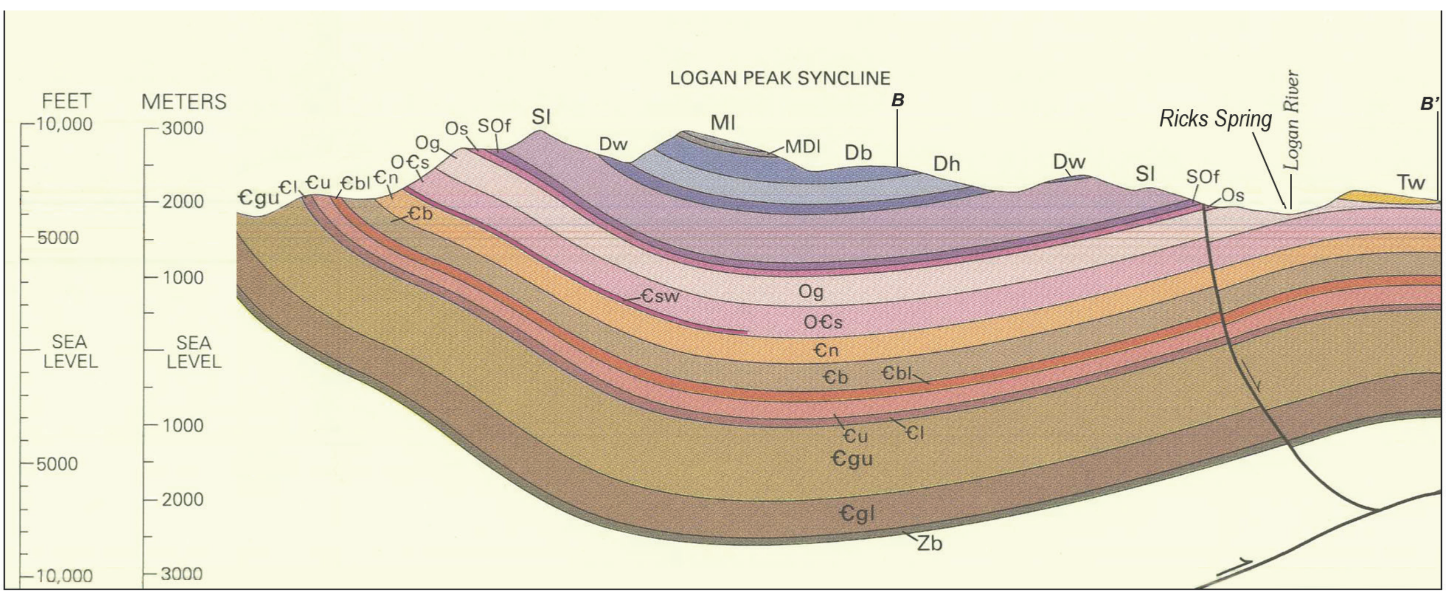

Figure 3. Generalized geologic cross section showing the location of Ricks Spring in relation to the Logan Peak syncline and the mapped fault near the spring (arrow shows relative direction of movement). Cross section modified from Dover (1995). Refer to figure 2 for location of cross section B–B' and to Explanation for geologic units and symbols.

Figure 4. Flow from Ricks Spring often ceases during the winter, leaving only a standing pool of water in the rise pit (not visible). Spring rises along normal fault (dashed red line) in alcove. Photograph by Larry Spangler, March 2002.

of the spring (Dover, 1995, section *B-B′*; figures 2 and 3). The Ricks Spring fault could be a branch off the mapped fault or a localized separate fault. Displacement along the Ricks Spring fault is unknown but is also within the Garden City Formation, appearing to phase out to the southwest. Bedding along the fault in the spring alcove where it is dramatically exposed (figure 4), strikes about N 28° E and dips to the southeast at about 36 degrees.

HYDROLOGY

Ricks Spring discharges primarily from a prominent alcove as well as from three additional outlets: one along the base of the hillside on the north side of the highway, about 380 feet (115 meters) southwest of the main spring, and two along the river on the south side of the highway, about 560 feet (170 meters) and 740 feet (225 meters) from, and at a slightly lower elevation than, the main spring (figure 2). Flow in the alcove is from a funnel-shaped rise pit that is about 13 to 14 feet (4 meters) deep. During the winter months water may not rise high enough to flow from the rise pit. Throughout the rest of the year water fills the rise pit and overflows into a channel that conveys the water from the alcove to the Logan River. A small cave adjacent to the alcove, but higher than the spring (figure 1) can be explored for about 25 feet (7.5 meters). The cave is always dry but could have been a former spring discharge point or outlet at some point in the geologic past when groundwater levels and the Logan River were higher.

Discharge and Temperature

Discharge of Ricks Spring is highly variable like most karst springs in snowmelt-dominated terrains, with low flow (base flow) during the winter months and peak flow during the snowmelt runoff period from May to June. Discharge of the spring normally ranges from less than 1 cubic foot per second (ft^3/s) or about 450 gallons per minute (0.028 cubic meter per second [m^3/s]) to 75 ft^3/s (2.1 m^3/s) (Mundorff, 1971), although estimates as high as 150 ft^3/s (4.25 m^3/s) have been reported (Wilson, 1976). In a thesis completed at Utah State University in 2018, Skyler Sorsby (written communication, December 2018) reported monthly measurements of springflow from the alcove ranging from 1.77 ft^3/s (0.05 m^3/s) in November 2016 and March 2017, to a peak flow of 109.5 ft^3/s (3.1 m^3/s) in June 2017, during the snowmelt runoff. During high flow, a boil as much as 1-foot (0.3 meter) high forms on the surface of the pool from the upwelling water (figure 5). Clarity of the water at high flow is exceptionally good, reflecting the input of snowmelt into the aquifer that supplies the spring. During snowmelt runoff, most water discharges from the alcove (figure 6), and the estimated combined flow from the other springs appears to be no more than 2 to 3 ft^3/s (0.057 to 0.085 m^3/s). During winter, when little or no flow occurs from the alcove (figure 4), base flow of the spring is maintained by the lower elevation or underflow springs, which discharge less than 1 ft^3/s (0.028 m^3/s).

Figure 5. Boil on surface of rise pool during the snowmelt runoff period in May–June. Water is typically very clear. Photograph by Larry Spangler, June 2017.

Figure 6. Ricks Spring at high flow during the spring runoff of 2017. Estimated discharge is about 100 ft^3/s (2.8 m^3/s). Photograph by Larry Spangler, June 2017.

Temperature of water from Ricks Spring is higher during low-flow conditions and lower during high flow. On the basis of periodic measurements made over a 3-year period (May 1994 to July 1997), and likely representative of the annual cycle, the temperature of water discharging from the main alcove spring ranged from 5.5 degrees Celsius (°C) (41.9 °F) during the snowmelt runoff (May–June) when discharge is highest, to about 7.0 °C (44.6 °F) during low-flow conditions (late fall to late winter) (Spangler, 2001). The lower temperature during high flow results from the input of snowmelt into the aquifer from losing streams and possibly from the snowmelt-fed river water. The snowmelt moves rapidly through the aquifer along solution-enlarged joints, faults, and (or) bedding planes to the spring. During low-flow conditions, groundwater stored in the aquifer matrix (tighter fractures) that has had a longer residence time dominates spring discharge, and water temperatures are slightly warmer.

Sources of Water

In the 1950s hydrogeologists noticed a pattern between the flows of the Logan River and Ricks Spring, and theorized a connection between them. During the winter of 1972, severe cold weather froze the river, resulting in ice jams in some locations, which caused the water to back upstream. Subsequently, Ricks Spring began to flow and then subsided when the river level dropped again, suggesting a link between the river and the spring. Later that summer, dye was added to the Logan River and was subsequently observed in Ricks Spring, confirming the connection between the river and the spring (U.S. Forest Service, Logan District Ranger, verbal communication, 2010; web page accessed December 27, 2018, at https://en.wikipedia.org/wiki/Ricks_Spring). Morgan (1992, p. 17) in a geological road guide of northern Utah, recognized that the river may not be the only source of springflow and stated that "there is a direct relationship between the spring's increased discharge and snowmelt in the spring; therefore, the source of the water is most likely local spring runoff which probably seeps into the ground in the Tony Grove Basin area to the northwest. It is possible that some of the spring's water may also come from the Logan River, since a fault intersects the river upstream from the spring and trends directly toward the spring."

Beginning in 1991, Spangler (2001) began further investigations into the source of water for Ricks Spring. Results of these investigations, based on dye-tracer tests, showed that in addition to the river, water also originated from Bear Hollow, northeast of the spring, Tony Grove Creek near Tony Grove Lake, and from Bunchgrass Creek, north of the spring (figure 2). Results of the dye tracing indicated that the source area or groundwater basin for Ricks Spring extends more than 5 miles (8 kilometers) to the northwest in the Tony Grove Lake area and 2600 feet (790 meters) higher than the spring. Maximum groundwater travel time from the dye-injection points to the spring was about 4 weeks during low-flow conditions. Because the recharge area for the spring is largely underlain by the Garden City Formation, groundwater movement appears to be confined within and is generally to the southeast through this formation to the spring. Although these results indicate that water originates from higher on the mountain as well as from the river, the ratio or proportion of these sources to the total flow is unknown and could be highly variable depending on flow in the river. In addition, the location of the input point(s) along the Logan River is unknown. Both faults appear to intersect the river upstream of the spring and either or both could act to divert river water into the Ricks Spring flow system.

Figure 7. Richard Lamb (left) and Wendell Nope rising from the depths of Ricks Spring. Photograph by Larry Spangler.

EXPLORATION OF THE SPRING

The submerged conduit feeding Ricks Spring was first accessed by a team of Utah-based cave divers (Wendell Nope, Richard Lamb, and Tibby Petrescu) in 2007 (figure 7). Since that time, dozens of dives have pushed the known length of the underwater cave to about 2300 feet (700 meters) (figure 8). Along the way, several air-filled rooms were encountered, including one at the end of the explored cave that contains a 28-foot-high (8.5 meters) waterfall cascading from an upper level passage. The largest dry room encountered in the cave is about 260 feet (79 meters) long, 40 to 50 feet (15 meters) wide, and 50 to 70 feet (20 meters) high (figure 8). Although it has been documented that the river provides part of the flow to the spring, the overall trend of the underwater passage is due north (away from the river) for almost 500 feet (150 meters) before turning and heading generally southwest and west. The remaining part of the cave heads northwest for approximately 400 feet (120 meters), then abruptly turns to the northeast for the last 270 feet (82 meters) of the known cave. Observations made by the cave divers indicate a side passage off the main passage about 500 feet (150 meters) from the entrance rise pool that could be the infeeder from the Logan River (figure 8, "River Intrusion Tunnel").

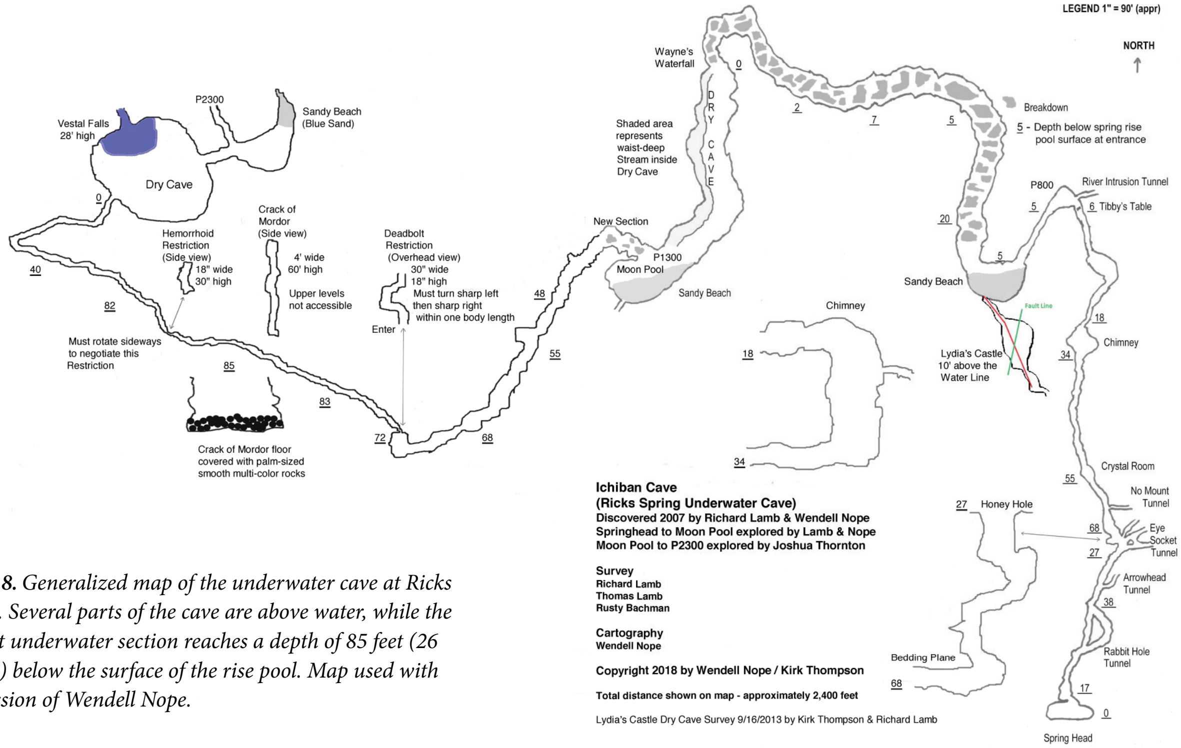

Figure 8. Generalized map of the underwater cave at Ricks Spring. Several parts of the cave are above water, while the deepest underwater section reaches a depth of 85 feet (26 meters) below the surface of the rise pool. Map used with permission of Wendell Nope.

Warmer water temperatures in the side passage (more than 1°C; 1.8 °F) in comparison with water in the main passage along with an increase in sediment, also indicate a possible connection with the Logan River. For much of the mapped portion of the cave, the passage lies below the surface of the rise pool in the spring alcove, with a maximum surveyed depth of 85 feet (26 meters) (figure 8). In addition, underwater surveying has shown that before rising to the surface in the alcove, the water descends to a depth of about 68 feet (21 meters) below the rise pool, and thus, below the level of the adjacent Logan River. The initial discovery and exploration of Ricks Spring Cave are summarized in an article published in the National Speleological Society (NSS) Cave Diving Section's Underwater Speleology newsletter in May/June 2008. This article as well as the history of Ricks Spring exploration and videos of the underwater cave can be accessed at the website [www.wendell-nope.com/scuba3.htm.](www.wendellnope.com/scuba3.htm)

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