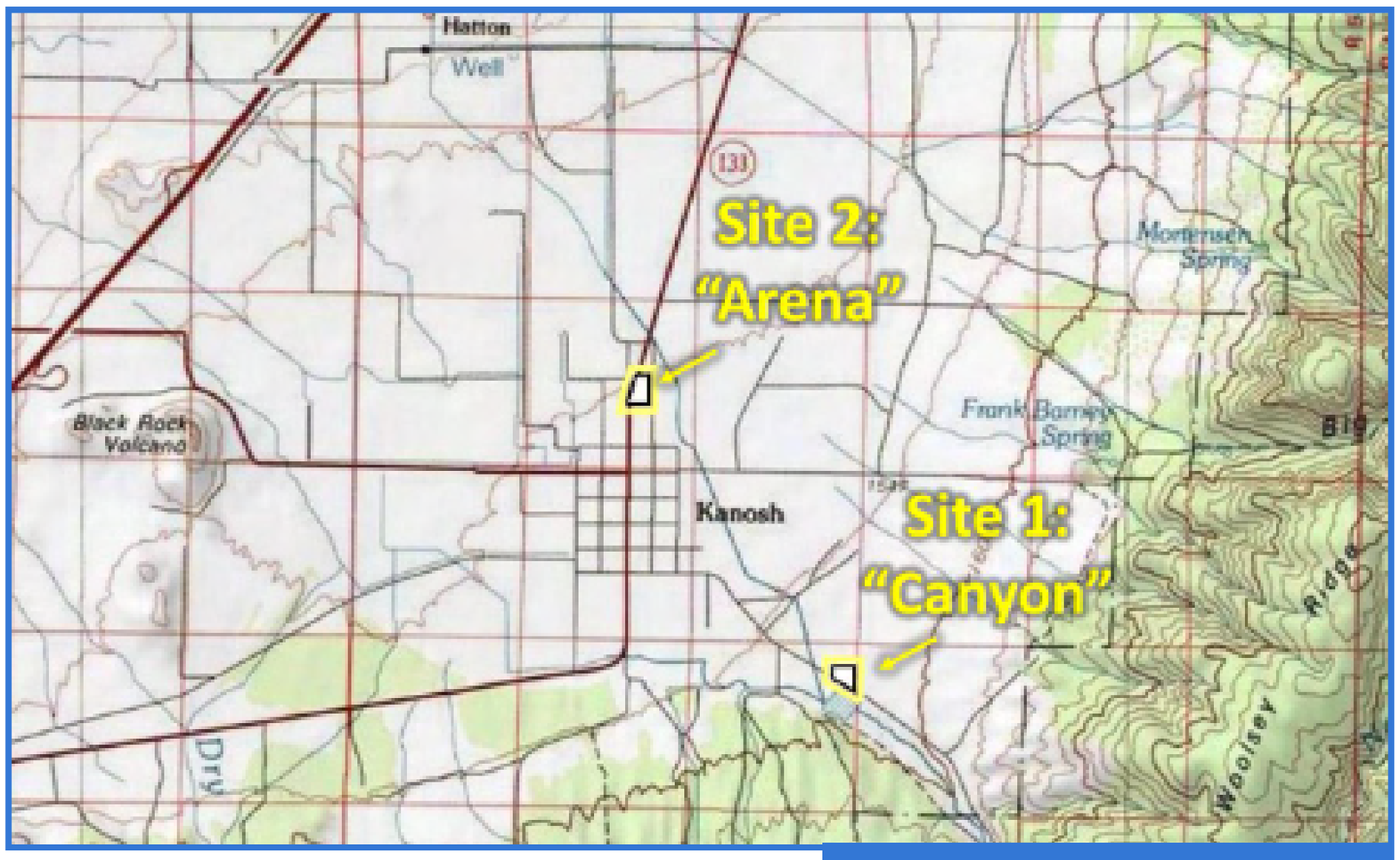
CASE STUDY: Groundwater Well Siting Study - Kanosh, Utah (Arena, Canyon)

GEOPHYSICAL INVESTIGATION TO LOCATE WELL DRILLING TARGETS ON FRACTURED ROCK

Willowstick LLC



Site Locations of “Arena” and “Canyon”

Introduction

In Kanosh, Utah, a comprehensive geophysical survey was conducted to identify optimal water well drilling locations across the "Canyon Area" and "Arena Area," each approximately 10 acres. Grounded in extensive hydrogeologic research, the survey emphasizes the crucial role of fractured rock zones in achieving optimal well yields. A 2013 study examining over 90 well logs in Utah revealed that wells drilled into "highly fractured" volcanic rocks yielded notably higher outputs, highlighting the significance of faulted zones for efficient water movement (Iron Springs Corporation, 2013). This approach is supported by findings from the PennState Extension, advocating for precise targeting of fracture zones to enhance well productivity (Swistock and Sharpe, 2015).

To fulfill its objectives, the survey integrates advanced geophysical methodologies, including Micro Seismic Resonance (MSR) and Radiometric Gamma analysis, tailored for detecting geomechanical weaknesses and water presence indicators within fracture zones. While Willowstick's AquaTrack method offers valuable insights for groundwater mapping, its applicability to well siting remains somewhat limited. Instead, the survey capitalizes on MSR's precision measurements, capable of detecting fractures at depths of up to 3000 ft, and the Radiometric Gamma system's prowess in identifying highly permeable fracture zones with elevated water content. By synergizing these methodologies, the survey aims to efficiently scout and pinpoint high-yield well sites, thereby fostering informed decision-making for water management in Kanosh, Utah.

SUMMARY

LOCATION

Kanosh, Utah - USA

CHALLENGE

well siting faces challenges with inconsistent flows due to debated fractured rock effects. Prioritizing fractured zones for higher yields tends to be a daunting process for most sites.

SOLUTION

The survey integrates MSR & Radiometric Gamma techniques to pinpoint optimal well sites accurately, enabling informed decision-making for efficient selection.

BENEFIT

Allows for a more optimal step by step path to getting to available water, ultimately resulting in the ability to drill with peace of mind that you’re in the right area.

CONTACT US TODAY

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Investigative Approach

Fieldwork took place on December 15th and 16th, 2021. In the Intermountain West, shallow aquifers may yield limited water, highlighting the importance of precise drilling to access deeper water sources. For cleaner boreholes and optimal water yield, we recommend air rotary drilling in hard or fractured rock. Mud rotary drilling, less preferable due to pore blockage, is advisable only under specific circumstances.

The Gamma system, working alongside MSR, delves into gamma emissions from rocks and soil. When these emissions diminish, it suggests water might be present. Picture it as our diligent scout, pinpointing super permeable zones for further scrutiny with MSR or other methods. This rapid assessment helps us swiftly identify potential drilling sites - it's like the initial survey before diving deep (refer to Figure 1).

Following meticulous data processing, we've assembled a comprehensive GIS file set for thorough examination. Radiometric gamma data, illustrated in Figure 2, unveils groundwater potential vividly. Notably, the low gamma signals, particularly in the southern regions of both sites, indicate promising groundwater prospects. However, the real game-changer lies in selecting sites boasting both high permeability and low gamma readings, ideally within close proximity (see Figures 1 and 2 for detailed insights). This combined criterion ensures optimal drilling locations with superior water extraction potential.

The Micro Seismic Resonance (MSR) method utilizes passive seismic measurements, known as "shots," to detect geo-mechanical weaknesses in rocks. These measurements, akin to laser precision, facilitate the accurate location of fracture zones for drilling. MSR operates effectively at depths ranging from 3000 ft to 6000 ft under ideal conditions, leveraging the continuous micro-seismic energy generated by natural earth movements. The method integrates Radiometric Gamma data to identify highly permeable zones, crucial for pinpointing prospective drill targets.

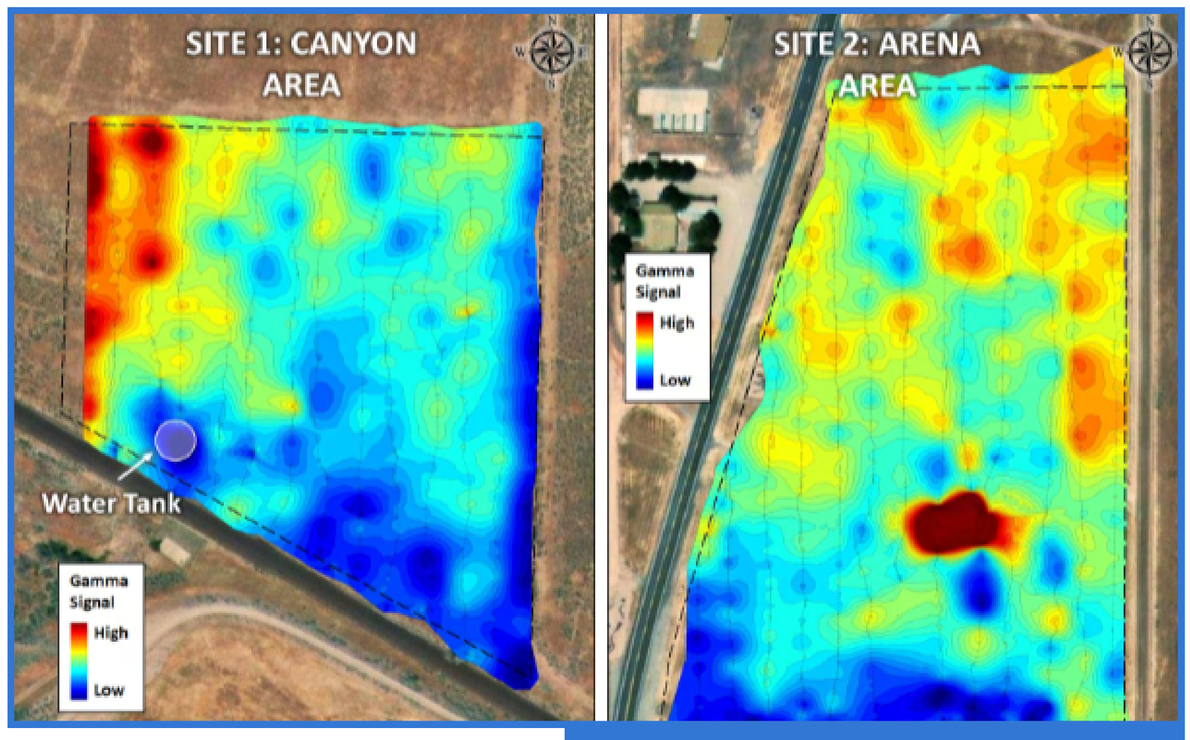

Fig. 1 - Gamma Maps At Sites 1 And 2

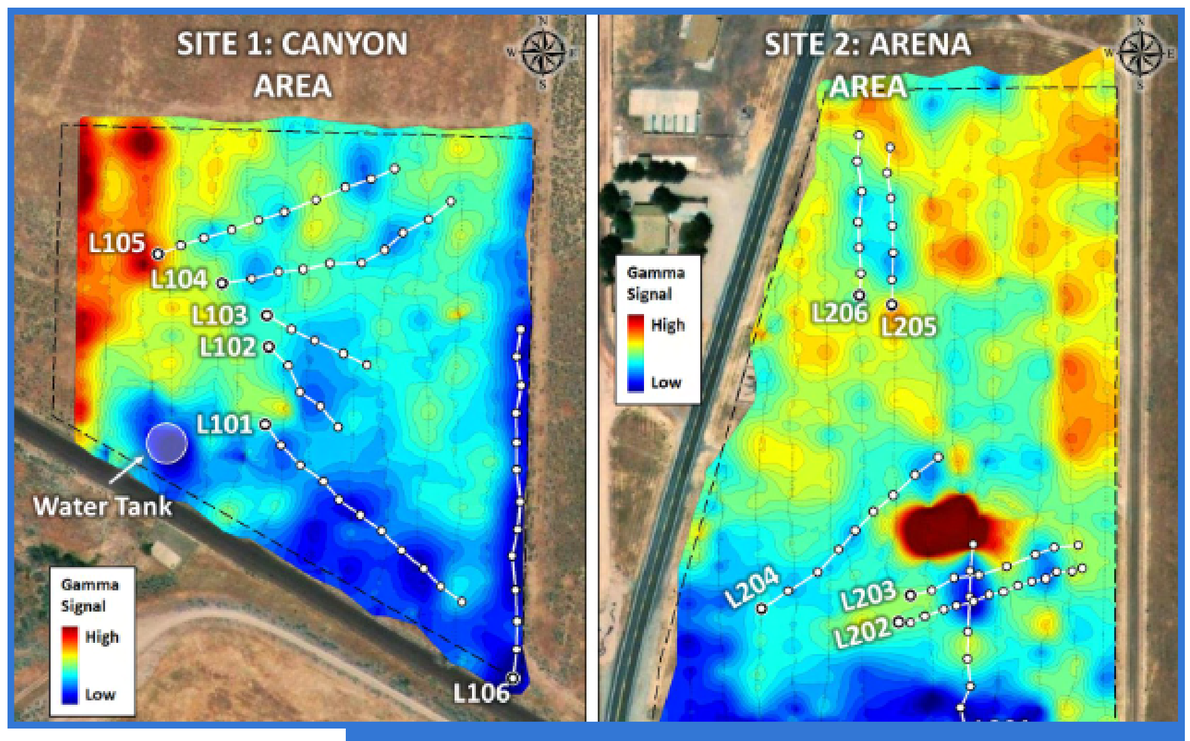

Fig. 2 - Location Of Various MSR Lines At Both Sites

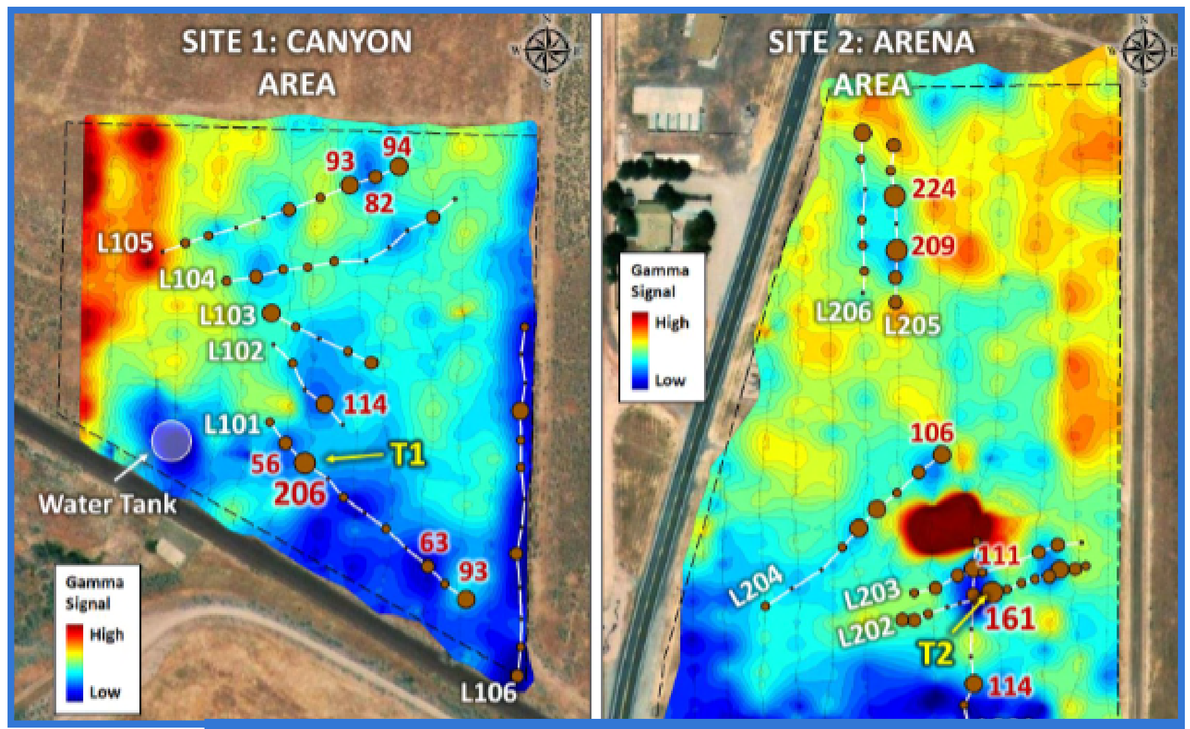

Fig. 3 - MSR Intensity Aggregate per shot, (200-900 ft depth)

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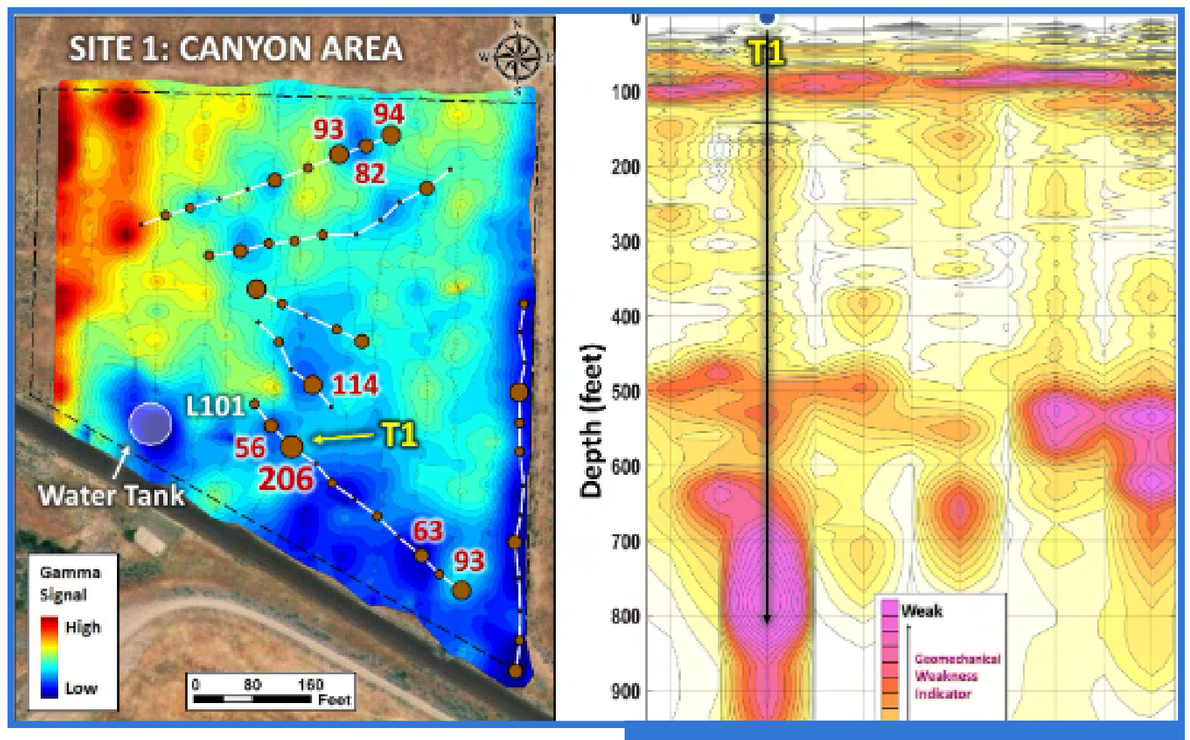
Investigative Approach Cont.

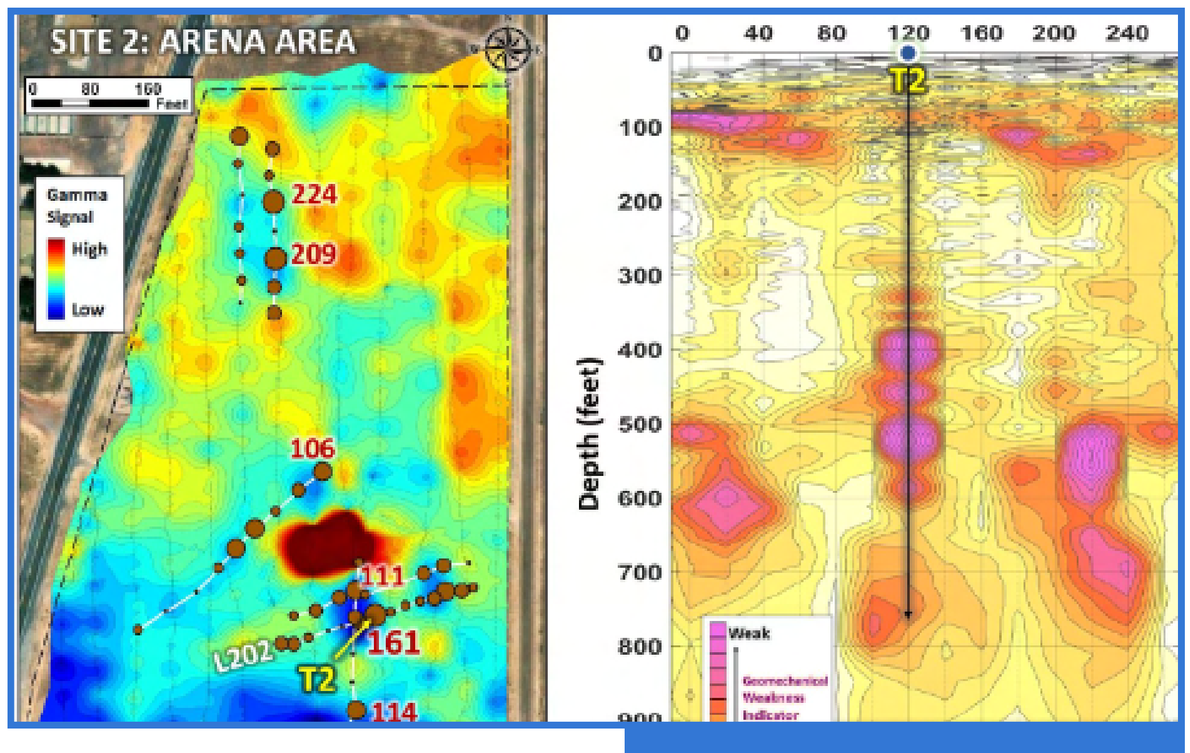
In the analysis, MSR data focused on identifying fracture systems corresponding to ideal gamma patterns.

At Site 1, the top recommended drill target (T1), located at the third shot (Station 80) on Line 101, boasts a remarkable MSR score of 206. This spot demonstrates significant potential, with projections indicating a broad reach en-compassing the southern half of the property and the "blue gamma" area. Additionally, T1 adheres to the ideal well placement criteria, positioned 114 feet from the property boundary and 165 feet east of the water tank.



MSR Profile Line of Site 1, Target 1

Conversely, at Site 2, Target T2 emerges as a secondary option, ranking below T1. Detailed MSR profiles, such as Line 101, reveal crucial fracture system information, with T1 showcasing the strongest MSR intensity between 700 to 800 ft bgs, indicating substantial porosity and permeability. Another viable drilling option at Site 1 is the fourth shot on Line 102, with a respectable MSR score of 114. This choice promises significant water capture potential and robust permeability around the borehole, essential for ensuring high flow rates.

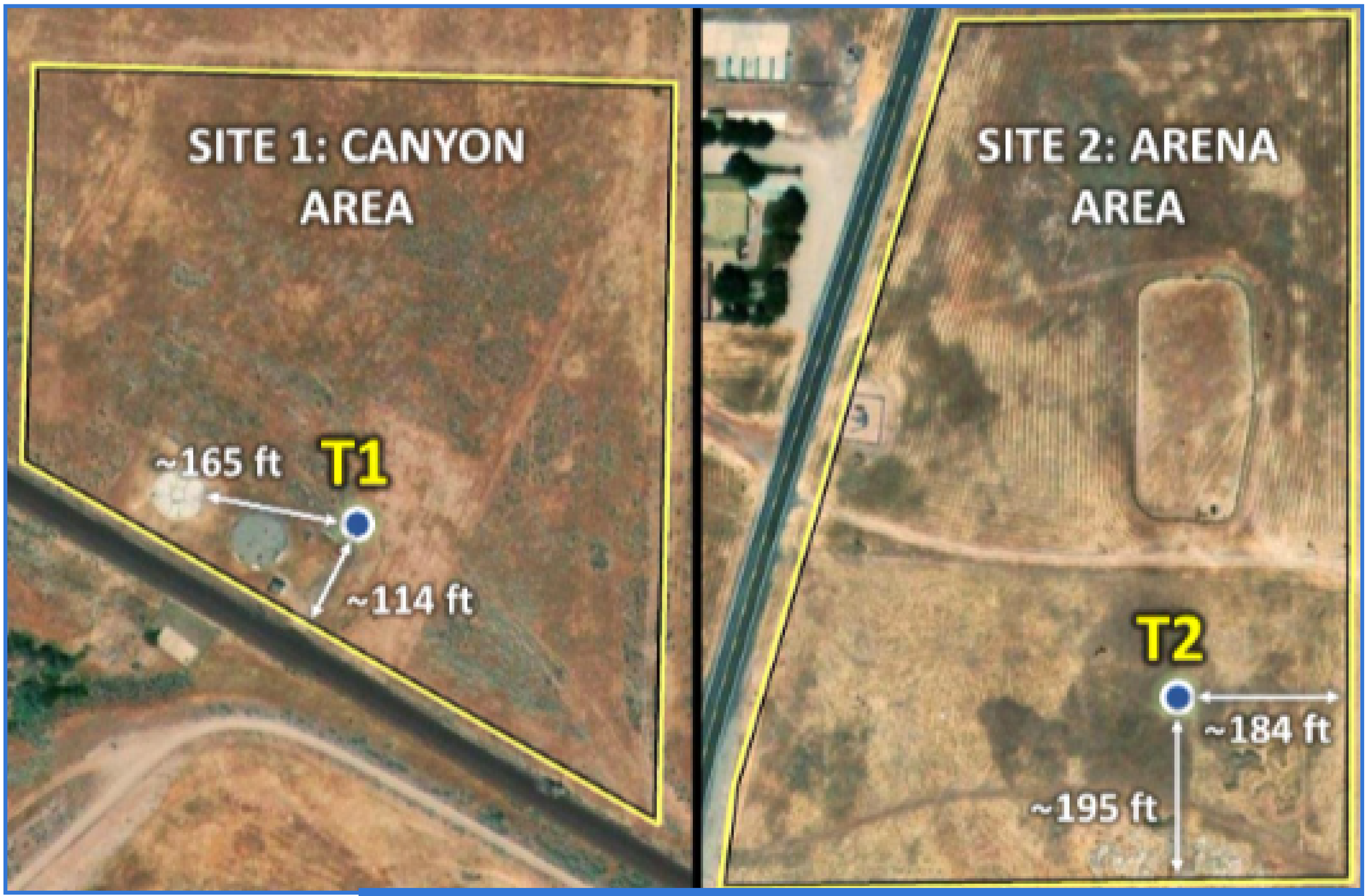


MSR Profile Line of Site 2, Target 2

CONCLUSION ON NEXT PAGE

Conclusion

This study combined Micro Seismic Resonance (MSR) with the Radiometric Gamma method to identify fracture zones at depth with high water extraction potential. By employing these techniques, we systematically scouted and refined drilling targets within Site 1 and Site 2. Among the prospects, T1 and T2 emerged as primary candidates. MSR and Gamma data, along with GPS coordinates, guided precise target selection. Although recommended drill depths for T1 and T2 were determined, it's important to note the limitations in predicting production capacity and flow rates solely based on collected data. Additionally, MSR sections provide estimations with an approximate accuracy of 10%, acknowledging inherent uncertainties in geological exploration. We at Willowstick are at the top of our field and only further refining our patented systems.



Recommended Drill targets T1 and T2, based on data collected we can be sure of our accuracy of about ±50 ft.

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Quotes

"I thought you might enjoy hearing from us. Our driller started the hole with mud rotary. He was in fairly competent formation until about 600 ft when he hit fractures and lost all circulation. He tried twice to restore circulation but ended up losing ~20,000 gal of mud very quickly. He switched to air last night and the fun began. I've attached a link with some drone footage when he got his bit back on the bottom of the hole around 605 feet. The slugs of water coming from the hole were consistently timed about 2 min apart."

- Project Manager of Kanosh Well

"The depth of the fracture zone is correlating very well with your MSR survey.

Thanks again for your help. "

- Project Manager of Kanosh Well

" Kanosh was a smashing success. We tested the well capacity last week. We sustained a 1,000 gpm flow with only 14 ft of drawdown. Based on the step test, Dao is estimating the specific capacity of the well to be north of 3,000 gpm. I couldn't be happier with how things turned out. The town is very pleased."

- Project Manager of Kanosh Well