Arizona Water Company

Leak Detection Equipment

Replacement Project

Phoenix AMA
Cover Page
WMAP Groundwater Conservation Grant Application Cover Page

**Program/Project Title AND Brief Description:** Echologic Leakfinder-ST Equipment Purchase and Employee Training Program. Purchase and implement new Echologic Leak Detection Equipment to our field operations staff at our Apache Junction, Town of Superior, and White Tank service areas for the purpose of finding and repairing main and service leaks. Finding and repairing leaks results in less system loss and greater groundwater savings.

**Type of Program or Project:**
- ☑ Water Innovation & Technology
- ☑ Infrastructure Water Efficiency
- ☑ Ecological Enhancement
- ☑ Public Outreach & Engagement

**Your level of commitment to maintenance of project benefits and capital improvements:**
- ☐ < 5 years
- ☑ 5-10 years
- ☐ 11-15 years
- ☑ 16-20 years

**Applicant Information:**

- **Name/Organization:** Arizona Water Company
- **Address:** 3805 N Black Canyon Highway
- **City:** Phoenix
- **State:** AZ
- **ZIP Code:** 85015-5351
- **Phone:** 602-240-6860
- **Tax ID No.:**

**AMA:**
- ☑ Phoenix
- ☐ Tucson
- ☐ Prescott
- ☐ Pinal
- ☐ Santa Cruz

If the project is located outside of an AMA, it is not eligible for funding.

**Contact Person:**

- **Name:** Deron Allen
- **Title:** Vice President Operations
- **Phone:** 602-240-6860
- **e-mail:** dallen@azwater.com

**Does this project meet any of our priority criteria? If so, which?**
- ☑ Additional contribution
- ☑ Innovative qualities
- ☑ Demonstrate high impact
- ☑ Demonstrate multiple benefits

**Water Management Assistance Program Grant Amount Requested:**

- $ 120,311.50

**Additional Contribution Obtained and Secured:**

<table>
<thead>
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<th>Applicant/Agency/Organization</th>
<th>Amount ($)</th>
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<tr>
<td>1. Applicant</td>
<td>$120,311.50</td>
</tr>
<tr>
<td>2.</td>
<td></td>
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<tr>
<td>3.</td>
<td></td>
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<tr>
<td><strong>Total:</strong> $120,311.50</td>
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Signature of the undersigned certifies understanding and compliance with all terms, conditions and specifications in the application. Additionally, signature certifies that all information provided by the applicant is true and accurate. The undersigned acknowledges that intentional presentation of any false or fraudulent information, or knowingly concealing a material fact regarding this application is subject to criminal penalties as provided in A.R.S. Title 13. The ADWR Director may approve Grant Awards with modifications to scope items, methodology, schedule, final products and/or budget.

<table>
<thead>
<tr>
<th>Arizona Water Company / Deron Allen</th>
<th>Vice President, Operations</th>
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<tr>
<td><strong>Name of Applicant / Authorized Representative</strong></td>
<td><strong>Title</strong></td>
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<tr>
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<tr>
<th><strong>Telephone Number</strong></th>
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Project Map
Disclaimer: This map is for general reference only. It does not replace a land survey and Arizona Water Company does not guarantee its thematic or spatial accuracy.

2-6-2020
R:\08- Water Resources Master Plan - PINAL VALLEY\Task - GIS Data\Maps\Arizona CCN's Inside AMA for Melinda

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), OpenStreetMap contributors, and the GIS User Community

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<td>Falcon Valley</td>
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<td>837816</td>
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<tr>
<td>Superior</td>
<td>831060</td>
<td>926094</td>
</tr>
<tr>
<td>White Tank</td>
<td>899962</td>
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Arizona Water Company (Company) operates 22 water systems in the State of Arizona and serves a population of approximately 250,000. In the Phoenix Active Management Area (AMA), the Company has 3 water systems: Apache Junction, Superior, and White Tanks. In the Pinal AMA, the Company operates 4 water systems: Pinal Valley East and West, which includes the Cities of Coolidge and Casa Grande; Stanfield, Tierra Grande, and Coolidge Airport. In the Tucson AMA, the Company has 1 system: Falcon Valley which includes Saddlebroke Ranch. Arizona Water Company is requesting a grant to purchase new leak detection equipment to replace its current equipment which has reached the end of its useful life.

The WMAP cost share if the grant is awarded is: $120,311.50

In a water distribution system that has never used leak detection equipment, the water loss can easily exceed 30 percent of the water pumped from its production wells. The water lost from each non-surfacing leak will increase with time and new leaks from aging pipelines occur continually. Typical non-surfacing water leaks range in size from one-half gallon per minute to 20 gallons per minute. To grasp the amount of water lost by these leaks, consider that a small leak of just one-half gallon per minute will lose 260,000 gallons per year. A ten gallon per minute leak is equal to 5,184,000 gallons of lost water in a year. Locating and repairing the non-surfacing water leaks in a distribution system is a vitally important conservation endeavor.

Identifying non-surfacing water leaks is very challenging and requires a considerable number of experienced staff, plus the use of advanced leak detection equipment. Arizona Water Company has a proven track record of finding non-surfacing leaks using portable correlators, loggers, and geophones to progress across the entire distribution system to search for pipeline leaks. The equipment is attached to contact points along the way, such as curb stop valves, mainline valves, and fire hydrants. In any water distribution system, this is a daunting task because the entire distribution system of one hundred miles of pipe (in most cases more) must be covered from beginning to end, over-and-over. The process can take many months or even exceed a year’s time and then it must be repeated. In order to effectively find and identify non-surfacing leaks, modern equipment must be used.
Project Overview
Executive Summary:
Arizona Water Company (Company) operates 22 water systems in the State of Arizona and serves a population of approximately 250,000. In the Phoenix Active Management Area (AMA), the Company has 3 water systems: Apache Junction, Superior, and White Tanks. In the Pinal AMA, the Company operates 4 water systems: Pinal Valley East and West, which includes the Cities of Coolidge and Casa Grande; Stanfield, Tierra Grande, and Coolidge Airport. In the Tucson AMA, the Company has 1 system: Falcon Valley which includes Saddlebrooke Ranch. Arizona Water Company is requesting a grant to purchase new leak detection equipment to replace its current equipment which has reached the end of its useful life.

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Background:
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Project Overview:
As part of the Third and Fourth Management Plans for AMAs in Arizona, a comprehensive leak detection program is listed in Category 4 of Best Management Practices for Physical System Evaluation and Improvement. Arizona Water Company has consistently been working to expand the effectiveness of its leak detection programs, not only in the AMA systems, but across all of its systems in Arizona. This grant will allow the Company to purchase new sets of equipment for the Phoenix AMA systems. The equipment sets consist of correlators, loggers, and ground microphones.
Arizona Water Company reports its well production and conservation efforts annually for each of its systems. The lost and unaccounted for water is also reported. It will be clear to see pre-project implementation and post-project implementation groundwater savings based on repaired or replaced pipe. While it is unrealistic to anticipate that unaccounted for water loss will be 0%, it is realistic to anticipate a 2%-3% reduction in unaccounted for lost water. The example of groundwater savings using a conservative 2% savings below shows that the Company can plan to save 2,060 acre-feet over a 4-year term.

<table>
<thead>
<tr>
<th>AMA</th>
<th>2019 Demand AF</th>
<th>2% Annual Groundwater Savings AF</th>
<th>Total Groundwater Savings AF After 4 Years</th>
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<tr>
<td>Phoenix</td>
<td>9,756</td>
<td>195</td>
<td>780</td>
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<tr>
<td>Pinal</td>
<td>15,372</td>
<td>307</td>
<td>1,228</td>
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<tr>
<td>Tucson</td>
<td>644</td>
<td>13</td>
<td>52</td>
</tr>
<tr>
<td>Total</td>
<td>25,772</td>
<td>515</td>
<td>2,060</td>
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As an example of the effectiveness of new leak finding equipment, the Apache Junction system implemented one new Echologic Leakfinder RT Correlator set in 2016 and found that the equipment helped it reduce its lost and unaccounted water to 6.8% in 2017 which was down from 10.64% in 2014. (Source: ADWR AMA Municipal Conservation Program – 2019 Progress Report) Other systems in Arizona Water Company AMA service areas are using old equipment that has come to the end of its useful life and it is clear that lost and unaccounted for percentages have been climbing for the past couple of years with the Pinal Valley System being the highest loss at 12.1% in 2017. (Source: ADWR AMA Municipal Conservation Program – 2019 Progress Report)

Groundwater pumping and demand in Apache Junction have been declining over the past 3 years while the overall connections have been rising.
Arizona Water Company plans to leverage this project with its ESRI ArcGIS Field Rollout Project. The two projects work together to provide the most effective and comprehensive leak detection programs for Arizona Water Company water systems. Additionally, Arizona Water Company has project plans in place to replace aging mains, service lines, and valves that have been found to be leaking with leak detection equipment. Arizona Water Company reports its well production and conservation efforts annually for each of its systems. The lost and unaccounted for water is also reported. It will be clear to see pre-project implementation and post-project implementation groundwater savings based on repaired or replaced pipe.
Scope of Work
Scope of Work:
Arizona Water Company has leak detection processes embedded into distribution system crew workdays. As technology has evolved, it is important for the Company to replace expired equipment with new products to help combat leaks in the field which cause lost water and increased groundwater pumping.

The new equipment needs to be approved and purchased, received, and training scheduled. The purpose of the grant proposal is to purchase this new equipment and continue with the existing leak detection and reporting program. The evidence of lost water reduction and groundwater savings will be viewed in the annual well production and conservation reporting. The time span for implementing the project is six weeks after funding. The 50% cost share requested will go toward the purchase of equipment. The other 50% of the equipment cost, subsequent use of the equipment and monitoring of the leak detection program will be borne by Arizona Water Company.

There are three main tasks for the project itself based on the requirements of the grant process:

**Task One:** Procurement - $120,311.50
Confirm the prices for the requested equipment to be used for field leak detection. Order equipment in the quantity specified on the purchase order. Deliver equipment to the field staff for use in daily operation.

**Task Two:** Monitor Use of Equipment
The current leak detection program has a set of forms and procedures that are utilized in the field and sent to the main office for recording and tracking on a monthly basis. Work Orders are generated for a specific location. Employees place equipment and monitor for leaks. Employees fill in leak detection form and submit to supervisors with findings. If a leak is detected, the service crew is dispatched for repair. Service crew members notes the size of leak and gallon per minute loss along with other information regarding the pipe and condition. Leak and repair information are sent into main office and data is added to system database and mapping system.

**Task Three:** Monitor Leak Detection Program for Reduction of Groundwater Pumping
Field management analyze the locations and severity of leaks encountered to determine if larger capital projects are in order to replace failing infrastructure. Operations analysts track the leak discovery and repairs on a monthly basis by system. Employees also track well production on a monthly basis. Lost water is often a direct result of leaks on the system. Employees track lost and unaccounted for water on a monthly basis. The tracking of repaired leaks, well production, and loss volumes will provide the necessary data to determine whether the program is successful in reducing groundwater pumping. Reporting of the findings is submitted to management monthly and to the Arizona Department of Water Resources, annually.
Everything Else Seems Old School
SUPERIOR LEAK RESOLUTION AND ACCURACY ACROSS ALL MATERIALS INCLUDING PVC.

It began when Severn Trent Water (STW) in their drive to innovation in the science of leak detection commissioned fundamental research into leakage within plastic pipes. Collaborating with Loughborough University led to the development of a prototype leak noise correlator which demonstrated a marked improvement in performance. Results demonstrated that the new correlator out-performed all commercially available equipment. Following extensive university research, STW approached us to commercialise this correlator. We are globally recognised for our innovative research into leak detection in plastic pipes and were the ideal partner. Further development led to a commercial prototype, complete with active trials using STW leak detection field crews since. These trials have proved so successful that we have launched this as our next generation correlator. Branded LeakFinder-ST™, it’s now commercially available.

With the LeakFinder-ST™ correlator, we introduce a whole new level of speed and accuracy in locating leaks. Until now, leak noise correlators have had limitations in pinpointing leaks in mains. Speed and accuracy were just relative measures.

SUPERIOR LEAK RESOLUTION

The LeakFinder-ST™ correlator enables customers to locate “quiet” narrow band, low frequency leaks and leaks previously identified as background leakage on water mains, with a wide range of materials such as:

- Plastic (PVC, PE, MDPE, HMDPE)
- Pre-Stressed Concrete Cylinder Pipe (PCCP)
- Asbestos Cement (AC)
- Ductile & Cast Iron (DI, CI)
- Steel

RAPID CORRELATION TIME

As an advanced Windows-based leak noise correlator, the LeakFinder-ST™ correlator can quickly and cost-effectively locate leaks that other correlators cannot. Its enhanced correlation function accurately identifies narrow-band leak noise – making it ideal for PVC pipes, small leaks, multiple leak situations, and testing environments where there is high background noise.

EASY TO USE

The LeakFinder-ST™ correlator has been lab and field tested. It was designed and developed by acoustic engineers and the interface perfected in the field, through collaboration with end users, to provide an accurate, non-invasive leak detection system that is simple to operate. Anyone that has ever used Microsoft Windows can easily and confidently learn how to operate the LeakFinder-ST™ correlator.

DIMENSIONS

A. Receivers / Transmitters: 6.6” x 4.3” x 2.7” (16.8cm x 10.8cm x 6.9cm)
B. Sensor: 6.8” x 0.6” (17.3cm x 1.5cm)
C. Pelican case: 22” x 18” x 10 (56.0cm x 45.5cm x 26.5cm)
GREAT ACCURACY ON PVC
There was a suspected leak on 3” PVC pipe in Clungunford, Shropshire area in UK. The LeakFinder-ST™ correlator was utilised to identify the precise leak location by bracketing the leak over 420’ (128 m). The field technicians accurately correlated the exact leak location, which was confirmed by ground sounding over main. Excavation team was dispatched and the leak was found as pinpointed by the LeakFinder-ST™ correlator and the flow rate of the leak was 3.5 gpm (0.8 m³/hr).

A SINGLE CORRELATION IN SHROPSHIRE, UK
There was a suspected leak on a 3” Asbestos Cement pipe on Meole Brace, Shropshire area. The LeakFinder-ST™ correlator was used to identify the precise leak location by bracketing the area of the suspected leak over 92 metres. The leak was found in a single correlation. There was no correction or adjustments needed. The leak location that was pin-pointed by the LeakFinder-ST™ correlator was confirmed with the surface noise and noise on stop-tap, 2 metres away from the leak location. Excavation team was dispatched and the leak was found as pinpointed by the LeakFinder-ST™ correlator. The leak size of 4.4 gpm (1.0 m³/hr) was confirmed.

OVERCOMING NOISE INTERFERENCE IN LEOICESTERSHIRE, UK
A difficult leak was detected at Wing in Leicestershire. The night-line for the area had risen and a resultant step test indicated a leak was likely in an area just downstream of Wing Reservoir on a 150 mm AC Pipe with an operating pressure of only 1.2 Bar. There was the additional issue of pump noise at the reservoir that interfered with the leak noise. Investigations by an alternative correlator had resulted in two dry holes and an unsuccessful leak detect. The LeakFinder-ST™ correlator was then utilised and the area of the suspected leak was bracketed by extending the correlation to a distance of 298 m. The resultant peak was accurate and successful excavation / repair followed. The resulting drop on the area flow graph established that the leak had a volumetric flow of 22 gpm (5 m³/hr).

LEAKFINDER-ST™ GIVES YOU:
Feature: Automatic noise filter and velocity calculator
Advantage: Highly accurate pinpointing of leaks on any material of pipe or multiple pipe types
Benefit: Saves money and effort through the avoidance of dry holes

Feature: Advanced engineering of sensor acoustics and signal processing
Advantage: Finds low-acoustic-frequency leaks, such as in PVC or other quiet leaks, that other correlators miss
Benefit: Saves water and money from the discovery of long-running and previously undetectable leaks

Feature: PC-based software platform with streamlined user interface
Advantage: Easy to determine leak position, frequency levels and filter settings
Benefit: Saves time and effort of field operators

OUTSTANDING INNOVATION AWARD
MOST INNOVATIVE NEW TECHNOLOGY AWARD

These awards are a unique demonstration of what can be achieved with collaboration between a top research university, a leading water utility, and commercial enterprise.
### OPERATIONAL PARAMETERS

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<th>Feature</th>
<th>Specification</th>
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<td>Ambient Temperature</td>
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<tr>
<td>Liquid Temperature</td>
<td>33°F to 100°F (0.5°C to 38°C)</td>
</tr>
<tr>
<td>Liquid Flow Velocity</td>
<td>&lt; 5 ft/s (1.5 m/s)*</td>
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<tr>
<td>Pressure</td>
<td>15 psi - 150 psi (100 kPa - 1000 kPa)</td>
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<tr>
<td>Pipe Material</td>
<td>Cast Iron, Steel, Ductile Iron, Asbestos Cement, PCCP, PVC, PE, and other plastics</td>
</tr>
<tr>
<td>Pipe Diameter</td>
<td>1/2&quot; to 16&quot; diameter (13 mm to 406 mm)**</td>
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<tr>
<td>Maximum Sensor Spacing</td>
<td>Contact Sensor: Up to 600' (183 m)</td>
</tr>
<tr>
<td></td>
<td>Hydrophone: Up to 1000' (305 m)</td>
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</table>

* Higher velocities may result in turbulent flow introducing noise into the pipeline. Measurements can be performed at higher velocities, however sensitivity may be limited.
** Dependent on pipe material and site condition. Please contact Echologics specialists for more info.

### SPECIFICATIONS

#### Features
- Enhanced correlation function
- Built-in noise reduction
- Selectable frequency range (automatic or manual)
- Propagation velocity calculator
- Support multiple pipe materials
- Support mixed pipe sections
- Playback of recorded leak sounds
- Volume-controlled 3.5 mm stereo output
- Available in languages other than English

#### Sensors
- 2 x Accelerometers with High-sensitivity piezoelectric sensing element
- Built-in amplifier with Automatic Gain Control (AGC)
- Operating frequency range from 0.5 - 1500 Hz.
- Low pressure operation up to 150 psi (1,000 kPa), or
- High pressure operation up to 400 psi (2,700 kPa).
- Frequency response: 0.5 to 3000 Hz
- 32-lb (14.5 kg) pull base magnet
- 10' (3 m) cable having -40 to +194°F (-40 to +90°C) temperature rating

#### Optional Sensors
- 2 high sensitivity hydrophones
- Operating frequency range from 0.5 - 1500 Hz.
- Low pressure operation up to 150 psi (1,000 kPa), or
- High pressure operation up to 400 psi (2,700 kPa).
- Operating range: 1.2 mi (2 km)

#### Communication
- Wireless radios operating in the Low Power Frequency Bands:
  - Industrial/Business Pool Group A1 (450 to 470 MHz)
  - Industrial/Business Pool Group A1 (450 to 470 MHz)
- Frequency response: 0.5 to 20,000 Hz
- Time resolution: 25-microsecond (44.1 kHz sampling rate)
- Signal-to-Noise Ratio (SNR) = 84 dB (44.1 kHz, Gain = 0 dB)
- Adjustable gain: -31 dB to 24 dB
- Plug and Play Driver

#### Power Supply
- Input Voltage: 15V DC
- Rechargeable high-capacity NiMH batteries
- Low-battery indicator
- Battery charge indicator
- 15 hours of operation on fully charged battery @ 20 C (68 F)

#### Enclosure
- Conforms to Waterproof IP68
- Rugged aluminum case
- Protective rubber boots for durability and shock resistance
- Foil switches

#### Warranty
- Two-year limited warranty.
- Hardware protection plans covering extended warranty or accidental damage are available. Warranty covers manufacturing defects only. It does not cover failure resulting from misuse, accident, modification, field maintenance and unsuitable physical or operating environment. The warranty does not cover the sensors except for dead-on-arrival cases.

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For more information about us or to view our full line of water products, please visit www.echologics.com or call Echologics® customer service at 800.423.1323.
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1.0 INTRODUCTION

The FCS S30 SURVEYOR is a precision leak detection/location instrument incorporating several unique and advanced features, including:

- Low Noise Design: To help the operator detect the minimum signal level possible.
- Manual Volume Control: To provide great versatility.
- Analog Meter: To ensure consistent and accurate sound intensity measurements.
- Adjustable Meter Control: To ensure accurate readings in a variety of environments.
- Lightweight, compact, rugged and weather resistant to withstand daily field use.

The S30 is designed as a survey instrument for use with the AX80 transducers.

2.0 SYSTEM COMPONENTS

2.1 TRANSDUCERS
   2.1.1 AX-80 (standard) with replaceable 6’ cable or 10’ cable

2.2 S30 CONSOLE

2.3 HEADPHONES

2.4 GEOPHONE ADAPTOR PLATE (GROUND MICROPHONE)

2.5 PROBE ROD SET (3 PIECE)

2.6 BELT-MOUNTED CARRY CASE

2.7 PROTECTIVE STORAGE CASE
3.0 CONNECTIONS, CONTROLS AND INDICATIONS

Rear Panel

![Diagram I – Rear Panel](image)

3.1 SENSOR CONNECTOR: Accepts the male LEMO plug from the AX80 transducer.

3.2 TRANSDUCER (SENSOR) CABLE: The AX80 transducer is provided with a rugged 10 ft. cable. This cable is mounted to the transducer by means of a screw-on type connector. This allows for replacement of the cable in case of damage to a connector or the cable itself. Under typical day-to-day use, the cable should remain attached to the transducer. The connector assembly has been mounted to the transducer and packed with a special purpose silicone grease to waterproof the sensor and to prevent corrosion of the terminals.

Note: WHENEVER THE CONNECTOR/CABLE ASSEMBLY IS DISCONNECTED FROM THE TRANSDUCER, REPACK THE CONNECTOR WITH A DAB OF G.E. #661 SILICONE GREASE. DO NOT USE ANY OTHER SUBSTANCE.

3.3 BACKLIGHT SWITCH: Controls the backlight mode of the unit. To enable the meter backlight, press the switch into the “ON” position. To turn the backlight off, select the “OFF” position.

3.4 HEADPHONE/CABLE JACK: Used to provide the audio output to the operator. For survey, insert the headphone plug into the jack to monitor the output.
FRONT PANEL

Diagram II - Front Panel

3.5  **ON/OFF BUTTON:** Depressing and hold down on the ON/OFF BUTTON to keep the S30 on and active. The red light will come on to indicate that the S30 is operating. Release the ON/OFF button and the S30 will turn off indicated by the on/off light going out.

3.6  **ANALOG METER:** Indicates signal level. The meter reads between 0 and 10 typically, depending on the intensity of the leak signal input. The meter can provide valuable assistance to the operator in determining the approximate location of a leak.

3.7  **METER GAIN:** Allows the operator to adjust the sensitivity of the meter when the noise level is too high or too low for the present setting. Turn the meter clockwise one click if the meter is reading 0. Turn the meter counterclockwise one click if the meter is reading above 10. Please note, though, that meter readings can only be compared when the gain setting remains the same.

3.8  **VOLUME CONTROL:** Rotating this inner knob allows the user to control the volume level of the headphones (Each headphone also has a control on the ear piece.) Turn the inner knob clockwise to increase the volume and counterclockwise to decrease the volume. Note that the meter reading is completely independent of the volume control.
4.0 LEAK SOUND WAVES

The characteristic sound produced by a leak is a form of energy that results from fluid escaping under pressure. This sound energy travels as sound waves down the pipe in both directions from the leak site. These waves are carried through the piping fluid and through the walls of the pipe. Therefore, in order to detect leak sound, a device must be able to detect the leak sound vibrations in the pipe wall or alternatively on pipe fittings (valves, hydrants, etc.).

5.0 TRANSDUCER

Sound Pick-Up Transducers are the devices used to detect the leak sound by generating an electrical signal in response to a mechanical vibration. The standard transducer available for use with the S30 is:

AX-80 Transducer (accelerometer)
Accelerometers are transducers designed to be placed in physical contact with the pipe. The vibration that results from the sound waves is sensed by a piezoelectric crystal in the accelerometer that generates a small electrical signal proportional to the vibration. The amount of signal in volts is determined by the intensity of the vibration as measured in units of gravity, or "g's". Therefore, the sensitivity of an accelerometer can be measured in Volts/g.

Because they use sensitive crystals to produce the electrical signal, these accelerometers are susceptible to damage by mechanical shock. They are rated for a shock of approximately 5000 g's; dropping the accelerometer onto a hard surface from 3.5 feet results in a shock of approximately 50,000 g's. HANDLE THE ACCELEROMETERS WITH CARE, AS THEY ARE SENSITIVE PIECES OF EQUIPMENT.

6.0 LEAK DETECTION WITH THE S30

To utilize the S30 for detecting unknown leaks, a leak survey must be conducted. A leak survey is the process of monitoring the distribution system for the sound of leaks.

6.1 ACCESS POINTS AND SURVEY FREQUENCY

The typical access points that are used when conducting a leak survey are: Main Line Valves, Fire Hydrant Valves, Fire Hydrants and Service Connections. The number of access points to be monitored will vary depending on how thorough a survey you wish to conduct.

There are some rules of thumb that are helpful in determining "how much is enough" with respect to leak surveys. These rules are based on extensive field experience, but should still be used only as guidelines. The predominant factor in determining the distance between listening points is the type of pipe. For the distances listed below, the most significant leaks in a system will be monitored.

METALLIC (Iron, Steel, Copper) - sound on access points at least every 500 ft.

ASBESTOS-CEMENT (Transite, etc.) - sound on access points at least every 250 ft.

PLASTIC (PVC, Polyethylene) - sound all available access points (i.e. services, gate valves, hydrants, etc.).
From the information listed above, it should be clear that leak sound travels well in metallic pipe and not very well in plastic pipe. Once leak sound is detected, treat the leak as a "known leak" and listen at several access points to determine the approximate location and where to place the transducers for pinpointing with the correlator.

6.2 TRANSDUCER CONTACTING METHODS

The S30 provides two different methods of contacting these access points.

1. Magnet - to attach the transducer to iron or steel access points (e.g., valve operating nut).

2. Extendable Probe Rod - The rod can be made up for 17", 33" or 49" length to reach valves or curb stops below which may be buried or under water. Simply attach the magnet to the Wave Guide, followed by the rods to make up the desired length. See diagram below.
SOUNDING FOR LEAK NOISE

Once the transducer is properly positioned on the access point, turn the S30 on. Use the VOLUME CONTROL to set the S30 to a comfortable level for your ears. At this time the operator must determine two things:

1. Do you hear leak sound?
2. What is the intensity of that leak sound?

If leak sound is monitored, note the location and relative signal level for reference.

When this has been completed the operator advances to the next access point. The operator uses the intensity of the leak sounds to determine the approximate location of the leak. The stronger or greater the leak sound intensity, the closer to the leak.
7.0 LEAK PINPOINTING WITH THE S30

The S30 can also be used as a leak pinpointing device. Leak sounds being emitted from a pressurized pipe can transfer through the ground and be detected on the surface above the leak. This technique is called "Surface Sounding" or "Ground Miking". The success of this method varies from leak site to leak site. The variables that dictate your effectiveness are: Depth of Pipe, Size of Leak, System Pressure, Soil Conditions, Surface Material, Traffic and Wind.

In order to effectively utilize this method, the operator must already know that there is a leak in the vicinity and he must know where the water main is located.

7.1 SET-UP: To properly use the S30 for pinpointing, the ground microphone plate should be attached to the bottom of the transducer magnet. See diagram below.

7.2 PINPOINTING: Place the transducer assembly on the ground above the water main. Press the “ON/OFF” BUTTON to activate the S30. Determine whether or not you hear the leak at this location. Use your ears and the meter to determine the intensity of the sound and make a notation of it. Move the transducer assembly about 3’ and repeat the process. Continue this process every few feet until you have discovered the loudest
point on the surface. Mark the location. If possible confirm this location by using a leak correlator or by repeated soundings.

Sounding for leaks requires patience and acquired listening skills. The operator using the S30 must be prepared to practice with the instrument and to learn by experience.

8.0 **BATTERY REPLACEMENT**

To replace the batteries, remove the two screws from the back plate. To access the batteries slide the top Black cover on the S30 back away from the removed screws. The batteries are immediately accessible and removable, replace batteries and replace black cover and screws.

For optimum battery life, use high-quality alkaline batteries (2 9-Volt type). Do not use rechargeable batteries as their lower cell voltage will impair the operation of the unit.
9.0 **WARRANTY**

The S30 SURVEYOR, AX-80 Transducer and Interconnect Cables are warranted on parts and labor for 12 months from date of shipment to customer. Headphones are warranted separately under the manufacturer's own warranty. If your FCS product should prove defective in material or workmanship within the prescribed period, FCS will repair or replace the product, at its sole discretion, without charge, upon presentation of satisfactory proof of purchase. This warranty applies only for normal, reasonable use of the equipment and does not cover damage which occurs in shipment, or failure which results from alteration, accident, misuse, abuse, neglect or improper maintenance.

This warranty is void if the serial number has been altered or removed from a serialized product; if the product is modified in any manner which FCS concludes, after inspection, affects the reliability of the product; if the product has been repaired or serviced by anyone other than an AUTHORIZED FCS Service Technician; if the product is damaged due to improper installation, maintenance or operation in accordance with the instructions which accompany the product.

THIS IS NOT A SERVICE CONTRACT. THIS WARRANTY DOES NOT INCLUDE MAINTENANCE, CLEANING, PERIODIC CHECK-UP OR CHARGES INCURRED FOR REMOVAL OR REINSTALLATION OF PRODUCT.
ZCorr Digital Correlating Loggers

Advantages of ZCorr Correlating Loggers

• Performs correlations exactly like a correlator
  – Pinpoints exact distance to leak
• Can operate at night in “Overnight Survey”
  – Less traffic and usage noise
• Multiple loggers survey large areas for leaks
  – 8, 16, or 32 loggers over miles of pipe
• Can turn “ON” multiple times with hours between recordings
  – Best chance to get leak sounds without usage noises
• Can find smaller leaks at night
  – less traffic and usage noise
• Even more sensitive than human ear
• User can listen to the actual leak sounds for 60 seconds for each recording (unfiltered)

Advantages of Automatic Leak Frequency Analysis (ALFA)

• Accurate registration and pinpointing of each leak sound occurs automatically with every recording
• Tracks the patterns of the leak sound over time to “tune in” to the true leak sound signal
• Digital signal processing isolates (multiple) leak sounds individually at each logger, statistically optimizing their correlation at each possible value of time delay
• No fixed high or low filters are needed for matching the audio frequencies at two correlating loggers
• Can extract the true leak sounds from each recording even when louder noises are present at the same audio frequencies
The Solution is in the ZCorr Software

Analysis of All Correlations Found

Click a Thumbnail, See the 8 Best Correlations.

Correlation for Z2 and Z3

Above: Many correlations at many loggers. One leak or many?

Click Listen. Logger No. 4 much louder (below).

Click Play and listen to the leak for 60 seconds.

Correlation at 2:15 AM but not at 1:15 AM or 3:15 AM. Answer: Usage at service.
Technical Specifications
ZCorr Digital Correlating Loggers

Logger

- Enclosure: Aluminum, cylindrical
- Protection: IP68, fully submersible
- Dimensions: 2.25” diameter x 4.5” (5.7 cm x 11.4 cm)
- Weight: 1 lb (450 g)
- Mounting: Magnet, 40 lbs (18 kg) pull force
- Operating temperature range: -20 to +140°F (-30 to +60°C)
- Power source: Lithium battery, 5-year life, factory-replaceable, non-rechargeable
- Sensor:
  - High-resolution electronic accelerometer
  - Shockproof to 6,000 g
  - Sensitivity: 1 V/g
  - Resolution: 0.25 μg /√Hz
- Data Acquisition:
  - Frequency range: 1-3,000 Hz
  - Signal range: sub 1 μg – 20 mg
  - Digital resolution: 20 bits

Docking Station

- Enclosure: Rugged ABS carrying case
- Protection: IP68 - closed; IP65 - open
- Weight: 15 lbs (6.8 kg) without DCLs
- Dimensions: 20.5” x 16.75” x 8.5” (52 cm x 42 cm x 22 cm)
- Operating temperature range: +20 to +140°F (-5 to +60°C)
- Capacity: 3 to 8 DCLs
- PC link: USB 2.0

Manufactured by:
SubSurface Leak Detection™
P.O. Box 5490
Incline Village, NV 89450
office: (775) 298-2701
Internet: www.subsurfaceleak.com
E-mail: subsurfacelocators@gmail.com

Distributed by:
Budget Breakdown
Arizona Water Company

Leak Detection Equipment Replacement Project

BUDGET NARRATIVE

FY2020
Budget Breakdown:
The project being proposed is to purchase a suite of new leak detection equipment that will enable Arizona Water Company to expand its leak detection program. By identifying leaks and repairing them, the Company will be able to lower its lost and unaccounted for water percentage. Additionally, the reduction in lost water should result in a reduction in groundwater pumping. The equipment sets consist of correlators, loggers, and ground microphones. The total award is proposed to be spent on Task #1 – Procurement/Purchasing the equipment listed in the breakdown below. Costs associated with Tasks #2 and #3 listed on the scope of work page will be borne by Arizona Water Company as part of normal operations.

The total cost of the project is $240,623.00 as per the breakdown below:

Total amount requested - Phoenix AMA - $120,311.50

The total award is proposed to be spent on the following items as follows:
1) Echologics Leakfinder ST – with Software & Training - $27,773.00 per unit
2) Fluid Conservation Systems – S30 Surveyor Geophone - $4,200.00 per unit
3) Subsurface Leak Detection – ZCorr Logger – $15,995.00 per unit
4) Apple – Cellular Enabled 1TB storage Ipad Pro - $1,000.00 per unit

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<thead>
<tr>
<th>Item</th>
<th>Price</th>
<th>Quantity</th>
<th>Total</th>
<th>Arizona Water Company Cost Share</th>
<th>ADWR WMAP Cost Share</th>
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<tr>
<td>Echologics Leakfinder ST with Training PHX AMA</td>
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<td>166,638.00</td>
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Budget Narrative
Arizona Water Company

Leak Detection Equipment Replacement Project

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Supplemental Information:

Evidence of Physical and Legal Availability of Water
Evidence of Control and Tenure of Land
Supplemental Information:

**Evidence of Physical and Legal Availability of Water** – The project that Arizona Water Company has proposed for the purpose of this grant will not be using water to accomplish the goals of the project. For this reason, Arizona Water Company will only be providing the Department of Water Resources with a map of its service area CCN as they appear inside each of the AMAs the Arizona Water Company serves.

**Evidence of Control and Tenure of Land** – The project that Arizona Water Company has proposed for the purpose of this grant will not be breaking ground on land to accomplish the goals of the project. For this reason, Arizona Water Company will only be providing the Department of Water Resources with a map of its service area CCN as they appear inside each of the AMAs the Arizona Water Company serves.
State Historic Preservation Office
(SHPO) Review Form
STATE HISTORIC PRESERVATION OFFICE
Review Form

In accordance with the State Historic Preservation Act (SHPO), A.R.S. 41-861 et seq, effective July 24, 1982, each State agency must consider the potential of activities or projects to impact significant cultural resources. Also, each State agency is required to consult with the State Historic Preservation Officer with regard to those activities or projects that may impact cultural resources. Therefore, it is understood that recipients of state funds are required to comply with this law throughout the project period. All projects that affect the ground-surface that are funded by AWPF require SHPO clearance, including those on private and federal lands.

The State Historic Preservation Office (SHPO) must review each grant application recommended for funding in order to determine the effect, if any, a proposed project may have on archaeological or cultural resources. To assist the SHPO in this review, the following information MUST be submitted with each application for funding assistance:

• A completed copy of this form, and
• A United States Geological Survey (USGS) 7.5-minute map
• A copy of the cultural resources survey report if a survey of the property has been conducted, and
• A copy of any comments of the land managing agency/landowner (i.e., state, federal, county, municipal) on potential impacts of the project on historic properties.

NOTE: If a federal agency is involved, the agency must consult with SHPO pursuant to the National Historic Preservation Act (NHPA); a state agency must consult with SHPO pursuant to the State Historic Preservation Act (SHPA),

OR
• A copy of SHPO comments if the survey report has already been reviewed by SHPO.

Please answer the following questions:

1. Grant Program: WMAP Groundwater Conservation Grant
2. Project Title: Leak Detection Equipment Replacement Project
3. Applicant Name and Address: Arizona Water Company
4. Current Landowner/Manager(s): n/a
5. Project Location, including Township, Range, Section: Phoenix AMA
6. Total Project Area in Acres (or total miles if trail): n/a
7. Does the proposed project have the potential to disturb the surface and/or subsurface of the ground?
   □ YES  ☒ NO
8. Please provide a brief description of the proposed project and specifically identify any surface or subsurface impacts that are expected: This project is a request to help pay for the cost of replacing expired leak detection equipment for use on existing infrastructure. Any leaks found with the equipment after purchase will be found in existing rights of way and easements.
9. Describe the condition of the current ground surface within the entire project boundary area (for example, is the ground in a natural undisturbed condition, or has it been bladed, paved, graded, etc.). Estimate horizontal and vertical extent of existing disturbance. Also, attach photographs of project area to document condition: There will be no new ground surface impact with this project.
10. Are there any known prehistoric and/or historic archaeological sites in or near the project area?  □ YES  □ NO

11. Has the project area been previously surveyed for cultural resources by a qualified archaeologist?  □ YES  □ NO  □ UNKNOWN

   If YES, submit a copy of the survey report. Please attach any comments on the survey report made by the managing agency and/or SHPO.

12. Are there any buildings or structures (including mines, bridges, dams, canals, etc.), which are 50-years or older in or adjacent to the project area?  □ YES  □ NO

   If YES, complete an Arizona Historic Property Inventory Form for each building or structure, attach it to this form and submit it with your application.

13. Is your project area within or near a historic district?  □ YES  □ NO

   If YES, name of the district:

Please sign on the line below certifying all information provided for this application is accurate to the best of your knowledge.

[Signature] / Date

Applicant Signature / Date

Applicant Printed Name

---

FOR SHPO USE ONLY

SHPO Finding:
□ Funding this project will not affect historic properties.
□ Survey necessary – further GRANTS/SHPO consultation required (grant funds will not be released until consultation has been completed)
□ Cultural resources present – further GRANTS/SHPO consultation required (grant funds will not be released until consultation has been completed)

SHPO Comments:

For State Historic Preservation Office: Date:
STATE OF ARIZONA
HISTORIC PROPERTY INVENTORY FORM

Please type or print clearly. Fill out each applicable space accurately and with as much information as is known about the property.

PROPERTY IDENTIFICATION
For properties identified through survey: Site No. n/a  Survey Area: n/a

Historic Names (enter the name(s), if any that best reflect the property’s historic importance): n/a

Address: n/a

City or Town: n/a  □ Vicinity  County: n/a  Tax Parcel No.: n/a

Township: n/a  Range: n/a  Section: n/a  Quarters: n/a  Acreage: n/a

Block: n/a  Lot(s): n/a  Plat (Addition): n/a  Year of plat (addition): n/a

UTM Reference – Zone: n/a  Easting: n/a  Northing: n/a

USGS 7.5’ quadrangle map: n/a

ARCHITECT: n/a  □ not determined  □ known  Source: _____

BUILDER: n/a  □ not determined  □ known  Source: _____

CONSTRUCTION DATE: n/a  □ known  □ estimated  Source: _____

STRUCTURAL CONDITION
□ Good (well maintained; no serious problems apparent)
□ Fair (some problems apparent)  Describe: _____
□ Poor (major problems; imminent threat)  Describe: _____
□ Ruin/Uninhabitable

USES/FUNCTIONS
Describe how the property has been used over time, beginning with the original use: n/a

Sources: _____

PHOTO INFORMATION
Date of photo: n/a
View Direction (looking towards): _____

Attach a recent photograph of property in this space. Additional photographs may be appended.

SIGNIFICANCE
To be eligible for the National Register, a property must represent an important part of the history or architecture of an area. The significance of a property is evaluated within its historic context, which are those patterns, themes, or trends in history by which a property occurred or gained importance. Describe the historic and architectural contexts of the property that may make it worthy of preservation.

A. HISTORIC EVENTS/TRENDS – Describe any historic events/trends associated with the property: n/a

B. PERSONS – List and describe persons with an important association with the building: n/a

C. ARCHITECTURE – Style: n/a □ no style

Stories: _____ □ Basement □ Roof Form: _____

Describe other character-defining features of its massing, size and scale: _____

INTEGRITY
To be eligible for the National Register, a property must have integrity (i.e. it must be able to visually convey its importance). The outline below lists some important aspects of integrity. Fill in the blanks with as detailed a description of the property as possible.

Location - □ Original Site □ Moved: Date: _____ Original Site: _____

DESIGN
Describe alterations from the original design, including dates: n/a

MATERIALS
Describe the materials used in the following elements of the property:

Walls (structure): n/a

Walls (sheathing): _____

Windows: _____

Roof: _____

Foundation: _____

SETTING
Describe the natural and/or built environment around the property: _____

How has the environment changed since the property was constructed? _____

WORKMANSHIP
Describe the distinctive elements, if any, of craftsmanship or method of construction: _____

NATIONAL REGISTER STATUS (if listed, check the appropriate box)
□ Individually Listed; □ Contributor; □ Non-contributor to _____ Historic District

Date Listed: _____ □ Determined eligible by Keeper of National Register (date: _____)
RECOMMENDATIONS ON NATIONAL REGISTER ELIGIBILITY (opinion of SHPO staff or survey consultant)

Property □ is □ is not eligible individually.

Property □ is □ is not eligible as a contributor to a listed or potential historic district.

☐ More information needed to evaluate.

If not considered eligible, state reason: This project will not impact any land or buildings
Application Checklist
ARIZONA DEPARTMENT OF WATER RESOURCES
WMAP Groundwater Conservation Grant Application Checklist

☒ Project Proposal
  ☒ Cover Letter
  ☒ Executive Summary
  ☒ Project Overview
  ☒ Scope of Work
  ☒ Budget Breakdown & Narrative
  ☒ Additional Contribution Breakdown (if applicable)
  ☒ Project Map

☒ Supplemental Information
  ☒ Evidence of physical and legal availability of water
  ☒ Evidence of Control and Tenure of Land
  ☒ State Historic Preservation Office Review Form