

The Art of Building a Citizen Science Program: Empowering Volunteers to Collect Credible Scientific Data



Meghan Smart, Scientist III
September 4th, 2018





ADEQ MISSION

**TO PROTECT AND ENHANCE
PUBLIC HEALTH AND THE
ENVIRONMENT**

Arizona Waterbody Statistics



Streams

- ~100.000 Miles



Lakes

- ~257



Wetlands

- ~870 Square Miles



ADEQ Staff

- ~8 Monitoring Unit
- ~6 Watershed Protection Unit





**CITIZEN SCIENCE
TO THE RESCUE!**



- Citizen Science: volunteers collecting and analyzing data pertaining to the natural world



"Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has."

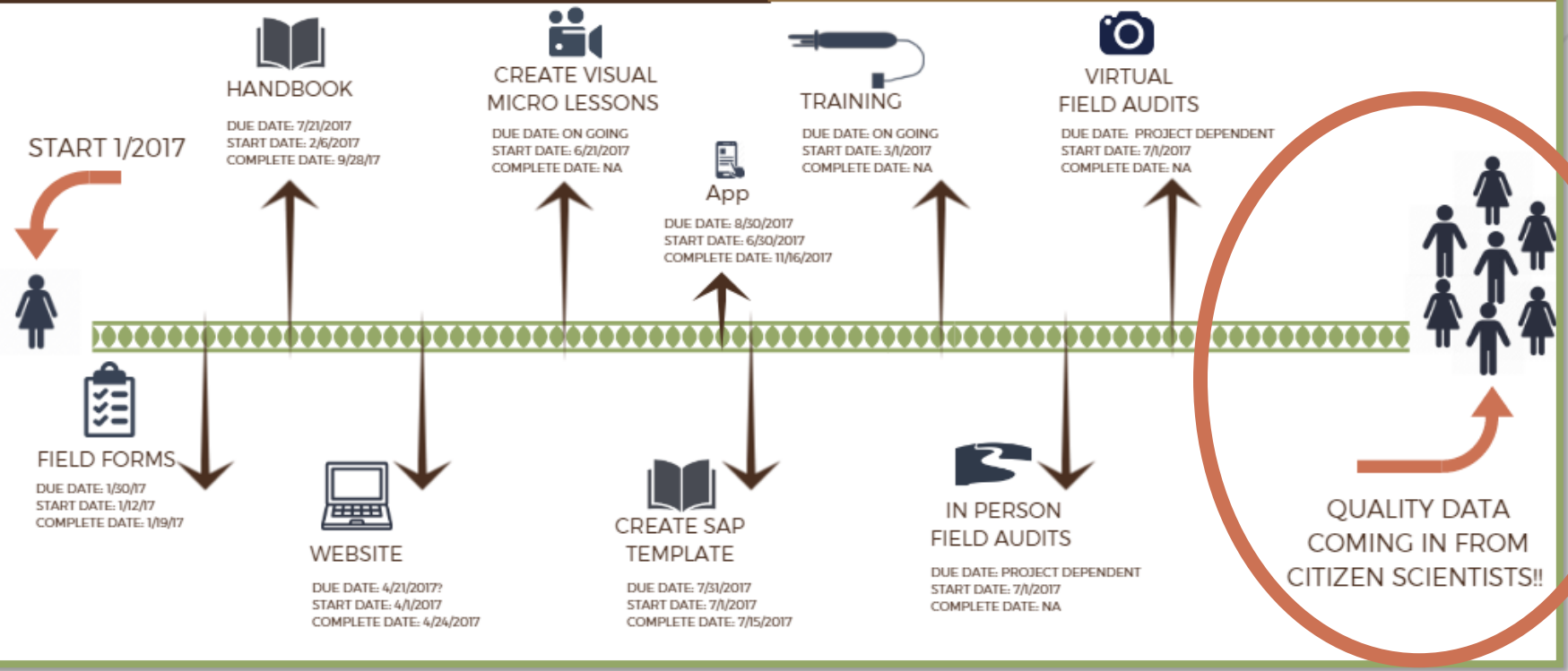
Margaret Mead

ARIZONA WATER WATCH CITIZEN SCIENCE PROGRAM

PROVIDE RESOURCES AND GUIDANCE TO VOLUNTEERS IN ARIZONA. ALIGN ADEQ MONITORING GOALS WITH LOCAL GROUPS' NEEDS AND COLLECT DEFENSIBLE HIGH QUALITY DATA!

“ NEVER DOUBT THAT A SMALL GROUP OF THOUGHTFUL CITIZENS CAN CHANGE THE WORLD. INDEED, IT'S THE ONLY THING THAT EVER HAS. ”

-MARGARET MEAD



ADEQ SURFACE WATER MONITORING

WATER QUALITY



Field Conditions



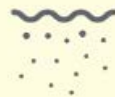
E. coli



Metals



Nutrients



Sediment

FLOW



CFS



Time Lapse

ECOSYSTEM



Riparian



Pebble
Count



Reach
Habitat



Channel Structure

LIVING ORGANISMS



Macroinvertebrates



Algae

IMPLEMENTATIONS



Vegetation



Erosion



Mine

WET DRY MAPPING



Desktop



GPS

CREDIBLE DATA



SAP/QAPP



Annual
Training

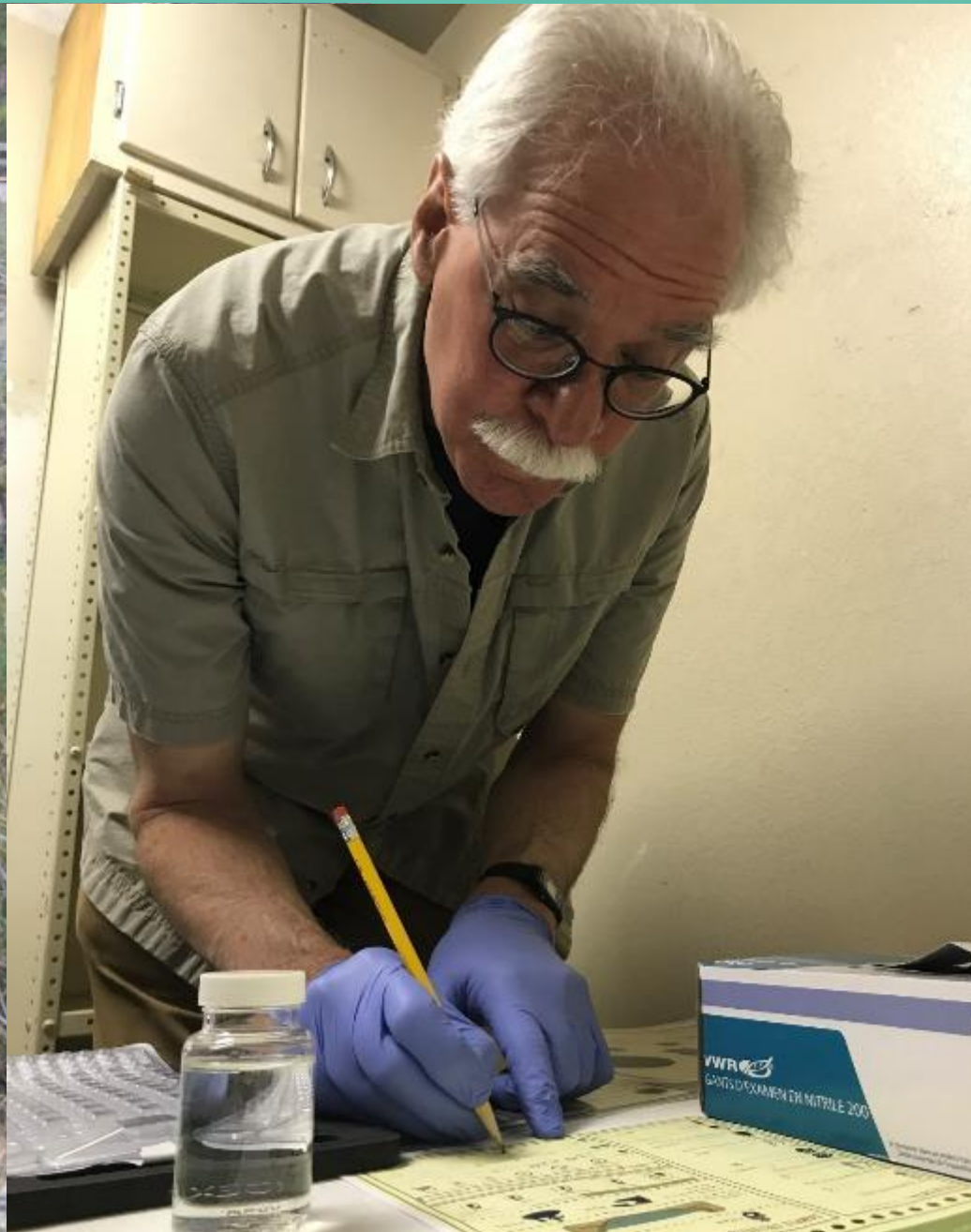


Audit

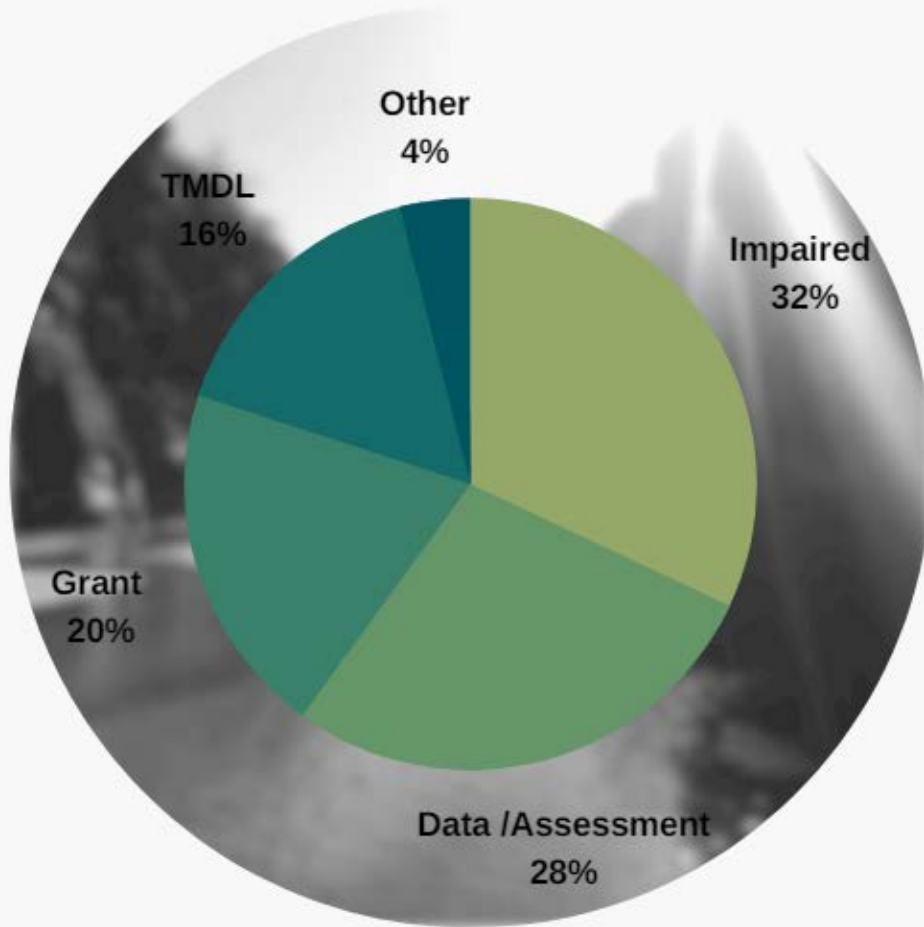
Volunteer Needs:

- Training
 - Handbook, micro-video lessons, etc.
- Scientific Equipment and Supplies
 - Loaner Library
- Study Design Assistance

If You Build It, They Will Come!



Sampling Purpose Breakdown



Resources: Visually Friendly Field Forms

THEN

NOW



CITIZEN SCIENTISTS FIELD DATA FORM

PROJECT NAME: _____

ADEQ Number _____

ADEQ Site Code _____ Date _____ Water Sample Time _____

Site Name _____ Field Crew _____

GPS Coordinates _____ GPS Projection _____

FIELD DATA

Air Temp.	°C	Sp. Cond.	μS/cm	Weather Conditions:	
Water Temp.	°C	ORP	mV		
D.O.	mg/L	Turbidity	Avg= NTU	Sample 1=	NTU
D.O. %	%	Standard Range (e.g., 0-10)		Sample 2=	NTU
pH	SU	Calibration	Cal= NTU Read= NTU	Sample 3=	NTU

FIELD CALIBRATIONS

% D.O.	Barometric Pressure (mm Hg) =	Post-cal. Reading =	%
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SAMPLE COLLECTION INFORMATION

Grab Reach pole

Circle where sample taken LEW-----¼-----½-----¾-----REW Riffle Run Pool

E. COLI

Reagent	Colilert 18 (incubation time = 18-22 hrs) <input type="checkbox"/>	Colilert 24 (incubation time = 24-28 hrs) <input type="checkbox"/>			
Dilutions	None <input type="checkbox"/> 1:10 <input type="checkbox"/> 1:100 <input type="checkbox"/>				
Collection Time	Regular	Incubation Time-in	Regular	Enumeration Time	Regular
	Duplicate		Duplicate		Duplicate
	Blank		Blank		Blank
Number Positive Large Wells	Regular	Number of Positive Small Wells	Regular	Most Probable Number (see table)	Regular
	Duplicate		Duplicate		
	Blank		Blank		
Flag (incubation/holding time exceeded?) <input type="checkbox"/>	Holding time is 6 hrs from collection.				

FIELD NOTES

NOTE ANY DEVIATIONS FROM SOPs, CHANGE IN SAMPLE LOCATION, AND ANY OTHER USEFUL INFORMATION REGARDING DATA COLLECTED AT THIS SITE.



ADEQ CITIZEN SCIENCE DATA FORM

AWW # _____

PROJECT NAME: _____ FIELD CREW: _____

SITE NAME: _____ ADEQ SITE ID: _____

___/___/2017



AM
PM



LATITUDE: _____

LONGITUDE: _____

NAD 83

FIELD DATA: FILL IN THE BLANKS

AIR TEMPERATURE: _____ °C

WATER TEMPERATURE: _____ °C

DISSOLVED OXYGEN: _____ mg/L
_____ %

pH: _____ SU

SPECIFIC CONDUCTIVITY: _____ uS/cm

TOTAL DISSOLVED SOLIDS: _____ mg/L

TURBIDITY: _____ NTU

SAMPLE COLLECTION INFO: CIRCLE ALL APPLICABLE INFORMATION IN EACH SECTION

GRAB POLE

LOOKING DOWNSTREAM LEW---¾---½---¼---REW

RIFFLE RUN POOL

Samples Collected: _____ QC SAMPLE NAME: _____

E. COLI METALS NUTRIENTS SSC INORGANICS

CIRCLE IF APPLICABLE B=BLANK D=DUPLICATE

E. COLI: CIRCLE AND FILL IN APPLICABLE INFORMATION

DILUTION: NONE 1:10 1:100 MEDIA: COLILERT 18 COLILERT 24

	COLLECTED	INCUBATED	COUNTED	LRG. WELL	SM. WELL	MPN
REGULAR:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	AM PM	AM PM	AM PM			
DUPLICATE:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	AM PM	AM PM	AM PM			
DI BLANK:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	NA	AM PM	AM PM			

Handbook Snippets:

- Increase Visuals
- Breakdown Form Details
- Label Equipment
 - Calibration Details Step by Step
- Updated Annually
 - Change Is Inevitable!

APPENDIX C: INSITU SMARTROLL CALIBRATION GUIDE



PREPARATION

1. Remove Stainless Steel Restrictor.
2. Take the orange pH port plug out of the sonde unit.
3. Locate the pH probe in the sensor storage bottle and remove.
4. Insert probe into unit.
5. Reattach Stainless Steel Restrictor.
6. Store sensor storage bottle in safe location.
7. Put batteries into battery pack.
8. Attach cable to battery pack and sonde.
9. Turn on Battery Pack and Ipad.



ADEQ Arizona Department of Environmental Quality

SEARCH GO >

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ARIZONA WATER WATCH MOBILE APP
Submit waterbody photos and data and become a Citizen Scientist in less than three minutes!

ARIZONA WATER WATCH

Download the Mobile App >

< RETURN TO LEARN MORE ABOUT THE WATER QUALITY DIVISION

Arizona Water Watch

Revised on: 2017-11-16 19:55

As a desert state, water is one Arizona's most precious resources that people and animals rely on to live and vital to our recreational enjoyment as well. To enhance statewide surface water protection efforts, ADEQ established Arizona Water Watch, offering Arizonan residents and visitors ages 10 through retirement the opportunity to help ADEQ monitor the health of our waters and inform measures to protect it for future generations. Anyone can become a Citizen Scientist by collaborating with professionals in scientific research, which Arizona Water Watch provides several ways to do!

Download the Free Mobile App

Smartphone users can easily submit photos and data for any stream, wash, river or lake in the state within a few minutes | [Learn more >](#)

App users who have made submissions can check here to see their photos and data plotted on a GIS map of Arizona (updated quarterly) | [Go to Map >](#)

Join the Citizen Science Water Monitoring Program

Citizen Science Water Monitoring is a volunteer program for children (age 10+), teens, college students, adults, retirees and ADEQ scientists to work together on scientific research and environmental protection of Arizona's waterways.

As a Citizen Science volunteer, you will:

- Receive training so you can collect and prepare water samples for testing

CONTACT
Program Coordinator
Ph: 602.771.4506
Email >

CALENDAR
Upcoming Training - Coming Soon

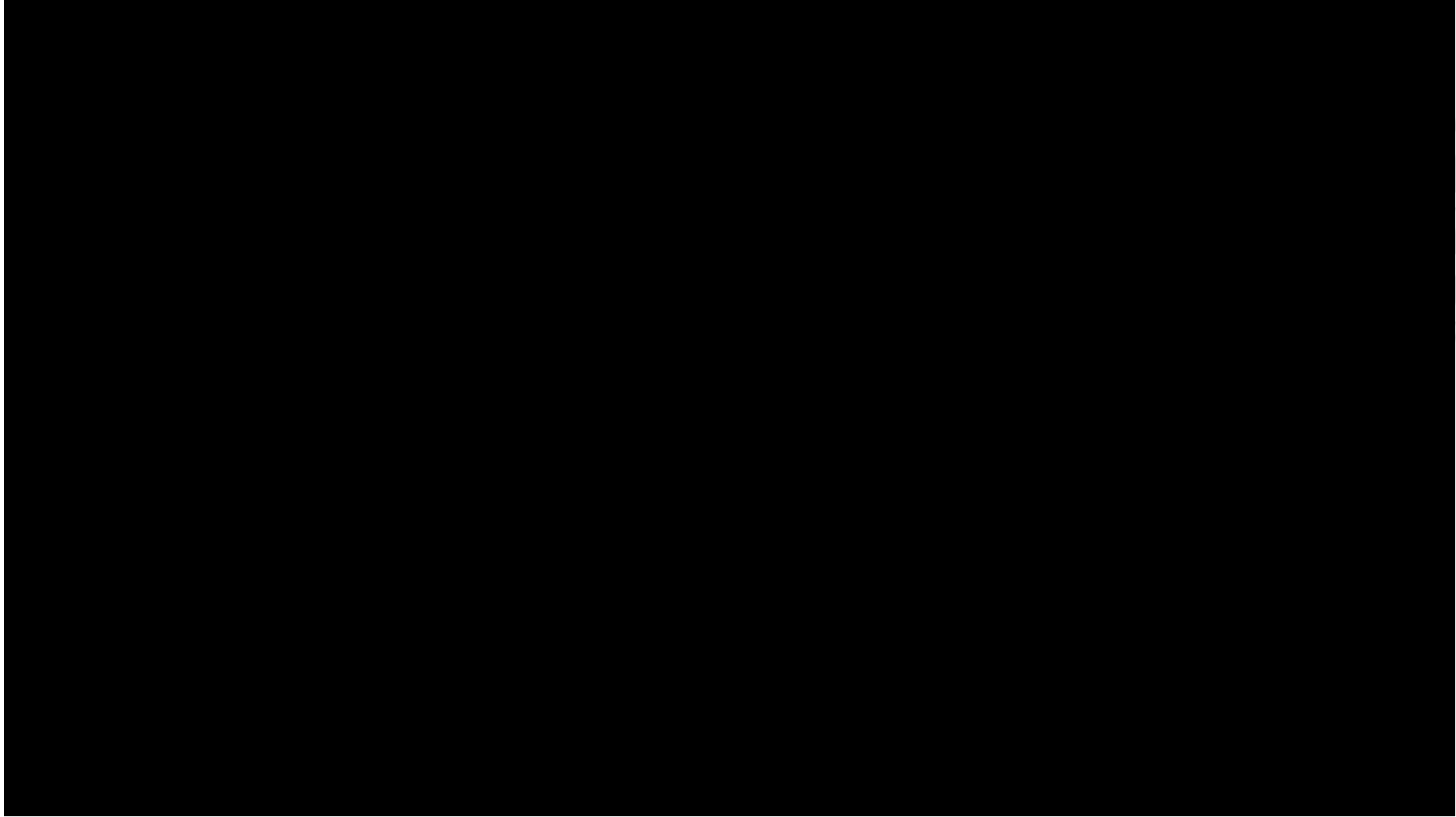
RESOURCES
[Download the Free Mobile App >](#)
[Subscribe to Receive Updates >](#)
[Arizona Water Quality Map >](#)
[Citizen Science Handbook >](#)
[E. coli Processing Mat >](#)
[Stream Vital Signs Guide >](#)
[Tips to Help Protect AZ Waters >](#)

FORMS
[Field Data >](#)
[Flow Measurement >](#)
[Volunteer Monthly Timesheet >](#)
[Volunteer Registration | Photo Release >](#)



AWW Website:

- Access to resources
 - Download handbook, forms, Etc.
 - Visual Equipment Loaner Library (coming soon)
 - Listserv Signup
 - Training Calendar



Short “how to” videos that are under 2 minutes in length and go over procedures.
Example: Measuring Flow

FY17 Sampling and Analysis & Quality Assurance Program Plan for Verde River Institute



Verde River

Institute
Verde River Institute
Arizona Water Watch
Sampling and Analysis & Quality Assurance
The Verde River

Ambient Water Quality
Fiscal Year 2017
Sampling Season March through December

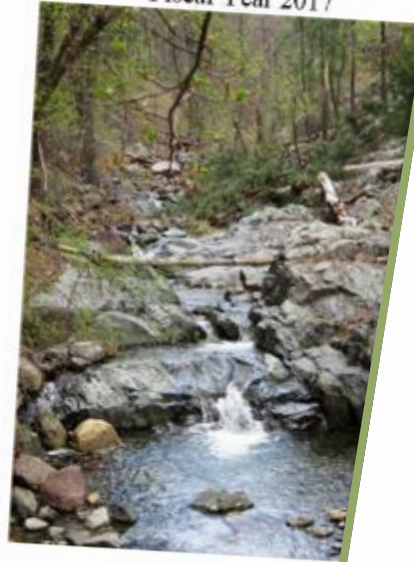


FY17 Sampling and Analysis Plan for Butte Creek

Butte Creek Restoration Project at Prescott College

Butte Creek Restoration Council
Sampling and Analysis Plan for Butte C

Ambient Water Quality
Fiscal Year 2017



FY17 Sampling and Analysis & Quality Assurance Program Plan for Friends of the Tonto and Tonto NF



Friends of the Tonto and Tonto NF
Arizona Water Watch
Sampling and Analysis & Quality Assurance Plan for
Butcher Jones, Saguaro Lake

Ambient Water Quality
Fiscal Year 2017 & 2018
Sampling Season June-September 2017



- **Annual Training!**
- Volunteers prefer to learn where they are sampling
- Do best with inside watch and learn. **THEN** outside practice
- Probes are difficult
- Notebooks provided
- Cheat sheets help



Resources: E. coli Processing Mat

CITIZEN SCIENCE
ARIZONA WATER WATCH
E. coli
Processing Mat

Wipe down mat, place equipment on images below and follow step by step instructions.

1 Turn on sealer and incubator
Incubator should be turned on 4 hours prior to sampling
Set Incubator Temp to:
35 °C
Temperature Range +/- 0.5°C

2 Put gloves on

3 Add information to E. coli sampling tray:
-Site ID
-Date
-Time added to incubator
-Time out (to be filled in after 24 hours incubation)

4 Add media to E. coli bottle

5 Invert E. coli bottle until media is completely dissolved

the tray
e rubber
mat

feed the
mat into the
small cells
(e side up)

the tray
e rubber
mat and place
the tray into the
preheated
incubator

Turn the sealer off

ARIZONA WATER WATCH

Not to scale

Not to scale

3 of 3

Reduce errors by following the steps

Resources: Stream Vital Signs

ARIZONA WATER WATCH

TEMPERATURE

TEMPERATURE: IS THE MEASURE OF

WE COLLECT: AIR TEMPERATURE & WATER TEMPERATURE

METRIC UNITS USED: °C

THE METRIC SYSTEM IS USED BY SCIENTISTS ALL AROUND THE WORLD AND ALLOWS FOR EASY COMPARISON.

TEMPERATURE AFFECTS:

- OXYGEN IN WATER
- RATE OF PHOTOSYNTHESIS
- WATERBORNE DISEASES

HOW WE MEASURE: WE USE A SCIENTIFIC PIECE OF EQUIPMENT CALLED A MULTIPROBE, THAT DISPLAYS AIR TEMPERATURE, WATER TEMPERATURE, AND OTHER WATER RELATED DATA.

RANGE: BASED ON HISTORICAL DATA FOR ARIZONA

- AIR TEMPERATURE: 0 to 40 °C
- WATER TEMPERATURE: 0 to 30 °C

ARIZONA WATER WATCH

pH

pH: IS THE MEASURE OF HYDROGEN ION CONCENTRATION ON A LOGARITHMIC SCALE FROM 0 (ACIDIC) TO 14 (BASIC).

pH SCALE:



HOW WE MEASURE: WE USE A SCIENTIFIC PIECE OF EQUIPMENT CALLED A MULTIPROBE, THAT DISPLAYS pH AND OTHER WATER RELATED DATA.

RANGE: BASED ON HISTORICAL DATA FOR ARIZONA

1.53 to 9.7 SU

ARIZONA WATER WATCH

DISSOLVED OXYGEN

DISSOLVED OXYGEN: IS THE AMOUNT OF OXYGEN DISSOLVED IN WATER

DEPENDENT ON:

- TIME OF DAY
- BAROMETRIC PRESSURE
- TEMPERATURE

METRIC UNITS USED: mg/L

THE METRIC SYSTEM IS USED BY SCIENTISTS ALL AROUND THE WORLD AND ALLOWS FOR EASY COMPARISON.

DISSOLVED OXYGEN: LIVING ORGANISMS NEED OXYGEN



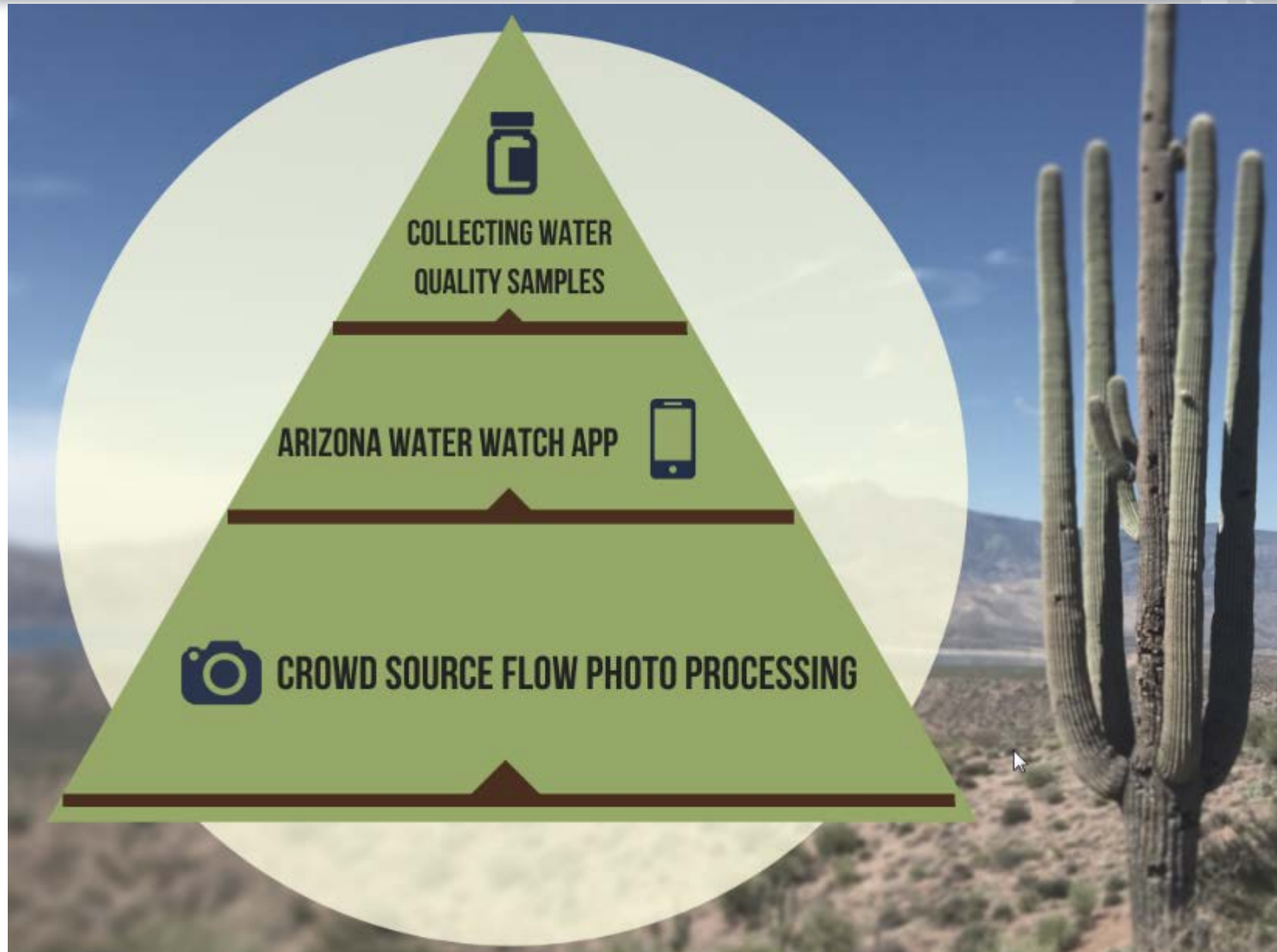
OXYGEN ENTERS A STREAM FROM THE ATMOSPHERE (DISSOLVED OXYGEN IS ESSENTIAL TO SUPPORT AQUATIC LIFE).

HOW WE MEASURE: WE USE A SCIENTIFIC PIECE OF EQUIPMENT CALLED A MULTIPROBE, THAT DISPLAYS DISSOLVED OXYGEN IN MG/L AND AS PERCENT SATURATION ALONG WITH OTHER WATER RELATED DATA.

RANGE: BASED ON HISTORICAL DATA FOR ARIZONA

- DISSOLVED OXYGEN: 0 to 20 mg/L
- PERCENT SATURATION: 0 to 150 %

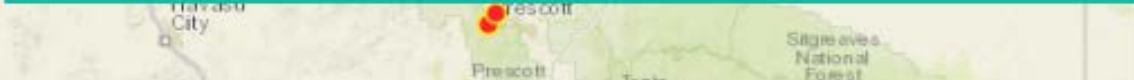
Multi-Level Volunteer Opportunities



Arizona Water Watch APP



Is this a lake or a stream? •
 Lake Stream



Arizona Water Watch App

- Survey Takes 3 minutes
- Uses Survey 123 platform
- Built in house
- ~300 observations since January



Download the free mobile app and instantly help protect AZ waters

- 1 Download **Survey123 for ArcGIS** (iPhone or Android) free from your app store 
- 2 Open the app, sign in—
username: adeqaww
password: adeqaww2
—and press **Get Surveys**
- 3 Select **Arizona Water Watch** and start submitting data!
- 4 Visit azdeq.gov/programs/azww for other volunteer opportunities



Go to a waterbody, take photos, make observations and submit. It only takes a few minutes!

Data will be interpreted, approved and posted to an online data map for analysis and research. Your contributions allow ADEQ scientists to better discover and analyze water quality issues at the source.



AWW APP

- Legal disclaimer before survey
- Geo-locates observation
- Deep dives into Questions if “Yes”
- Notifies HAB’s coordinator if algal bloom
- Complaint form button
- Picture submittal



Arizona Water Watch

Map showing location: W Van Buren St, W Washington St, W Jefferson St, Madison St, Pho

© Esri contributors

Is this a lake or a stream? *

Lake Stream

Is water present?

Yes No

Has it rained in the last 48 hours?

Yes No

Is the length of the water more than 30 feet?

Yes No

What color is the water?

Green Brown
 Clear Other

Is there trash?

Yes No

✓

Arizona Water Watch

Yes No

What kind of trash?

Shopping Carts Paper/Plastic wrappers/bags
 Tires Metal
 Cans or Bottles Clothing/backpacks
 Other

Is the amount of trash more than a 5-gallon bucketful?

Yes No

Are there signs of animals?

Yes No

What kind of signs?

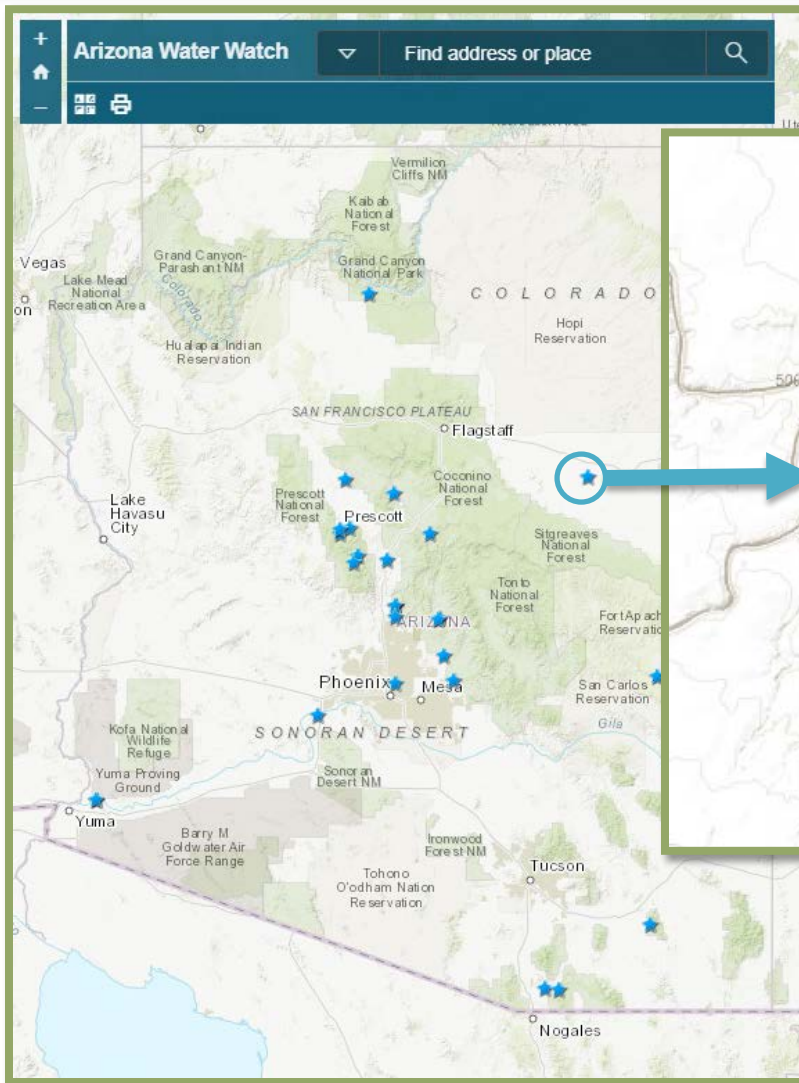
Live Animal Scat
 Tracks Dead Animals
 Den or Nest Fur or Feathers
 Gnaw or Rubbings Other

Is there algal bloom present?

Yes No

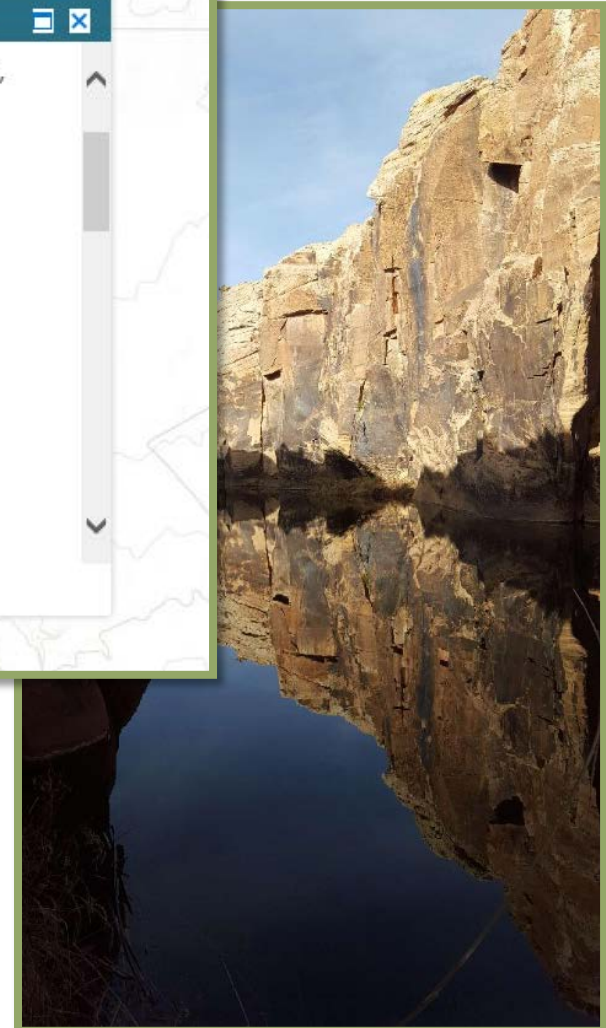
✓

Public View

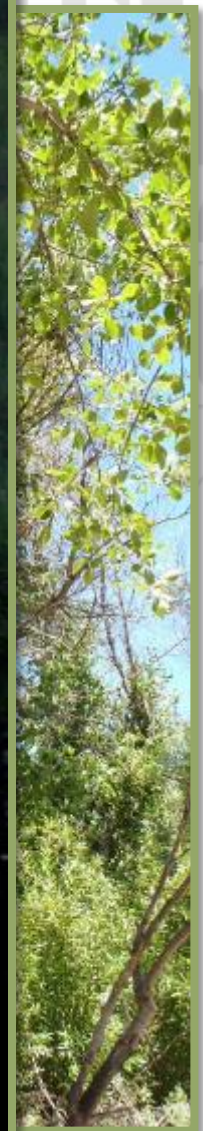


Date	1/15/2018, 12:00 AM
Time	10:37
Is this a lake or a stream?	Stream
Is water present?	Yes
Has it rained in the last 48 hours?	No
Is the length of the water more than 30 feet?	Yes
What color is the water?	Brown

Zoom to



Intermittent Stream Study at ADEQ



Solution Zooniverse: Flow Finder!

Help scientists from the comfort of your own home by viewing our intermittent stream camera images and answering questions!



FLOW FINDER: ARIZONA WATER WATCH ABOUT **CLASSIFY** TALK COLLECT RECENTS LAB ARIZONA WATER WATCH HOMEPAGE

Flow Observation?

- Flowing
- Pooled
- Dry
- Not Sure

Back Next

Show the project tutorial

FIELD GUIDE

MOULTRIE 73°F PILOT INSPK 15 AUG 2015 01:34 pm

AVAILABLE SOON!

Verde Valley: *E. coli* Drone Sampling



AWESOME CITIZEN SCIENTIST! DOUG VON GAUSIG

- Uses a drone to collect *E. coli* and field data
- “Ship and Sniff” sampling event
 - canines are used to smell samples and alert if human sewage present.

Wet Dry Mapping

- Wet Dry Mapping Field Form
- Wet Dry Mapping App (coming soon)
- Scientific Equipment and Supplies
 - GPS Units
 - Cameras
 - Multiparameter Probes
 - Turbidity Meters



APP COMING SOON!

A sample of the ADEQ Citizen Science Wet Dry Mapping field form. The form is titled "ADEQ CITIZEN SCIENCE WET DRY MAPPING" and features the "ARIZONA WATER WATCH" logo. It includes fields for "STREAM:" and "TEAM:", "SECTION:" and "DATE: __/__/20__". The form is divided into sections for "LOCATION DETAILS" (with "DECIMAL DEGREES - NAD 83" noted), "FIELD DATA", and "NOTES". Each section contains multiple rows for "START" and "STOP" measurements, with fields for "LATITUDE:" and "LONGITUDE:". The "FIELD DATA" section includes fields for "AIR TEMP (C)", "DO (MG/L)", "pH (S)", "TDS (MG/L)", "WATER TEMP (C)", "DO %", "SPC. COND. (US/CM)", and "TURBIDITY (NTU)". The "LOCATION DETAILS" section includes fields for "DOMINANT HABITAT:" (with icons for RIFFLE, RUN, POOL) and "WEATHER:" (with icons for SUN, RAIN). The form is repeated five times, indicating it is a multi-page document.

City of Buckeye: MS4 Time Lapse Photography



MOULTRIE



66°F

APOLLO-COB

27 SEP 2017 11:27 pm



★ ★ ★
2017 SAMPLING SEASON ★ ★ ★

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

CITIZEN SCIENTIST

CERTIFICATE OF APPRECIATION

MENELIK HUME

for an outstanding season collecting over **200** water quality data records and aiding in the protection of Arizona's streams!

Given this 10th of November, 2017



MEGHAN SMART

ADEQ Citizen Science
Coordinator

*Thank
You*

How Can Citizen Science Help You?



- **Equation for success!**
- **Think outside the box!**
- **How can citizen science help you?**



Meghan Smart

602-771-4506

ms14@azdeq.gov

Arizona Water Watch Website:

<http://www.azdeq.gov/programs/azww>

