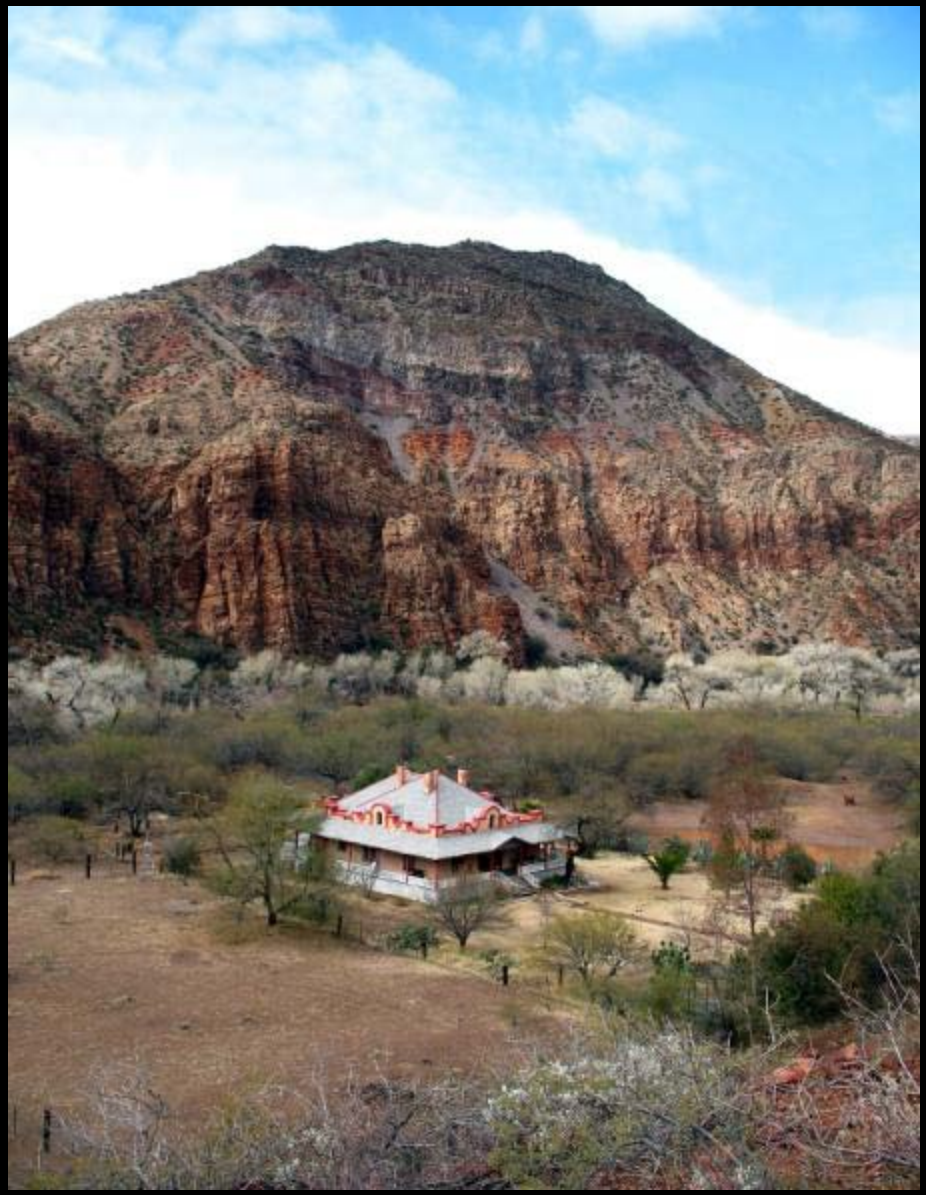
E. coli Reduction
on the
San Francisco and Blue Rivers

Project update
May 12, 2010



Potter Ranch house, San Francisco river above Clifton, January 2010
Photo courtesy of project volunteer Gerry Allen, American West Travel

The San Francisco-Blue River Watershed

The largest tributary to the Gila River

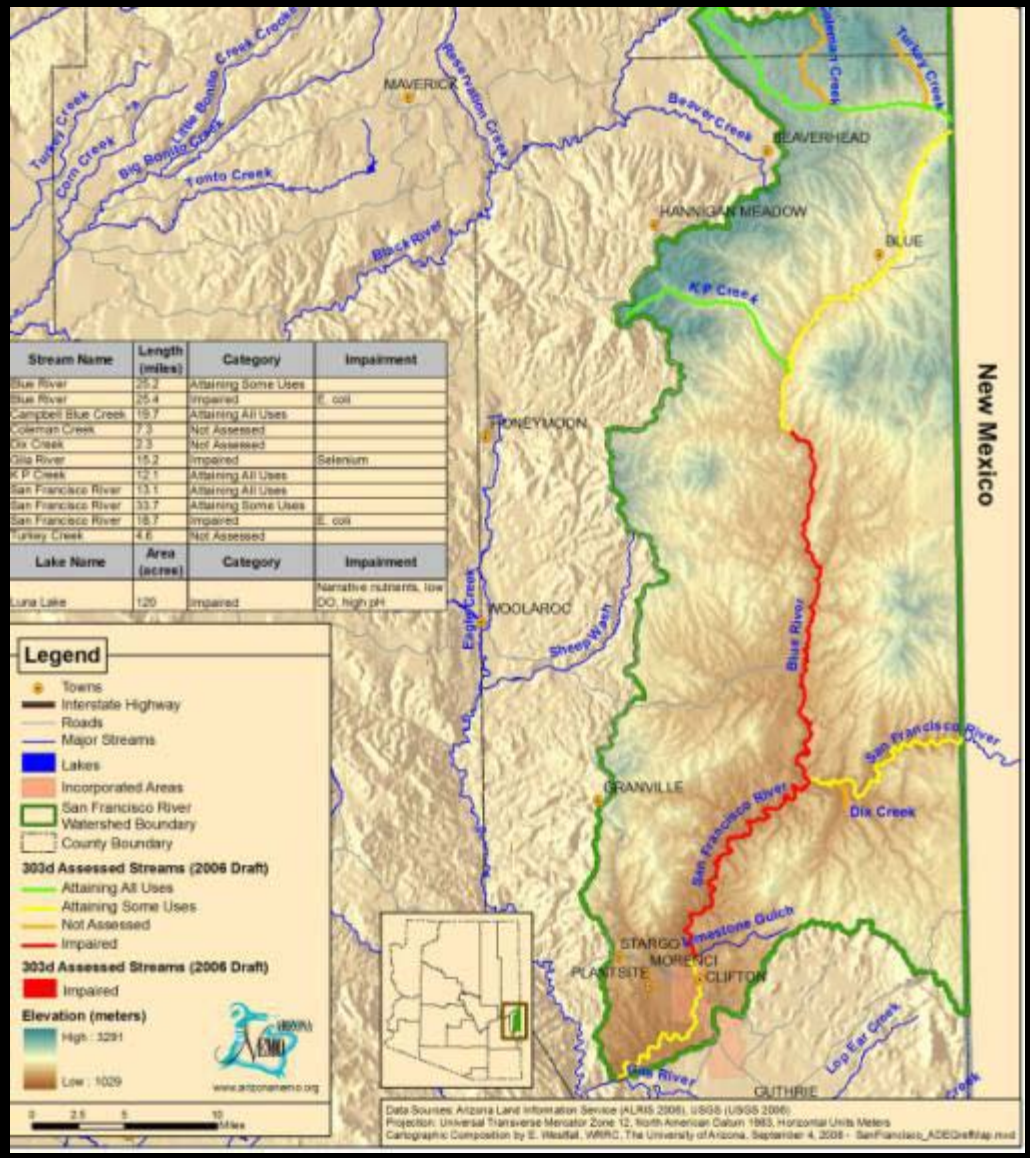
Vast: 2,800 square miles

Thinly populated: under 3,000

Difficult to access, especially during rain or snow

Diverse land uses: ranching and farming, hunting and camping, fishing, swimming and boating, urban parks and RV sites

High-value potential land uses: eco-tourism; productive urban forest



Stream Name	Length (miles)	Category	Impairment
Blue River	25.2	Attaining Some Uses	
Blue River	25.4	Impaired	E. coli
Campbell Blue Creek	19.7	Attaining All Uses	
Coleman Creek	7.3	Not Assessed	
Dix Creek	2.3	Not Assessed	
Gila River	15.2	Impaired	Selenium
KP Creek	12.1	Attaining All Uses	
San Francisco River	13.1	Attaining All Uses	
San Francisco River	33.7	Attaining Some Uses	
San Francisco River	18.7	Impaired	E. coli
Turkey Creek	4.6	Not Assessed	

Lake Name	Area (acres)	Category	Impairment
Luna Lake	120	Impaired	Narrative nutrients, low DO, high pH

Map produced for ADEQ by Arizona NEMO, 2009

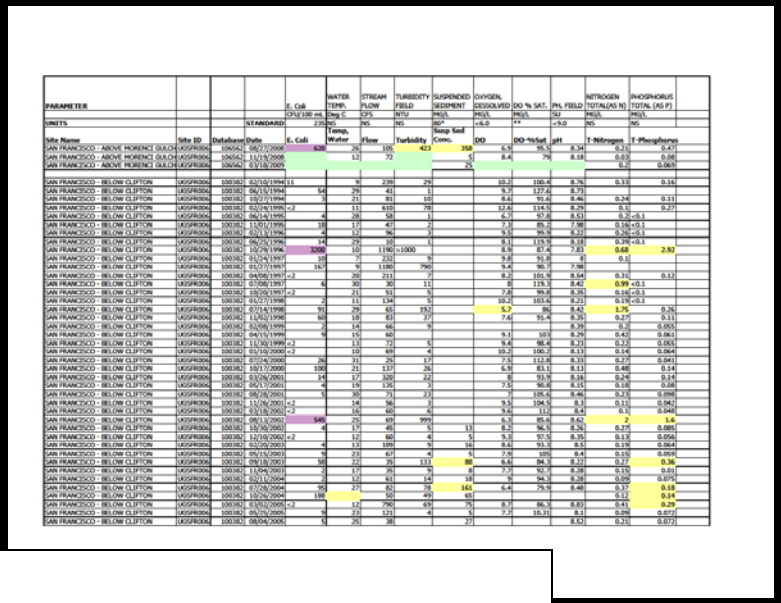
What is the problem?

ADEQ has listed portions of both rivers as “impaired for *E. coli*” — the bacterium *Escherichia coli.*

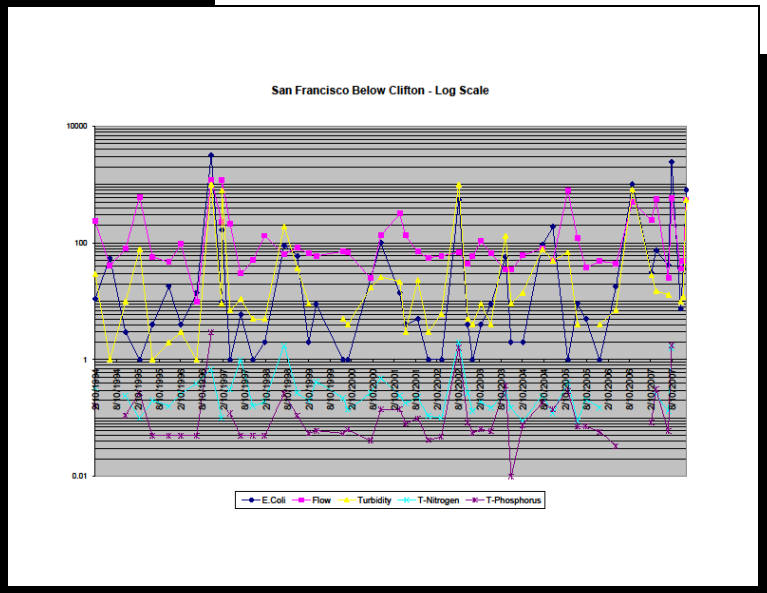
Occasionally, levels of *E. coli* have far exceeded safe ranges for partial or full body contact with stream water.

E. coli is an “indicator” pathogen. Where it is found, there are sure to be other pathogens, potentially more dangerous to humans.

Tracking down the sources of *E. coli* is complex and requires the consent and the involvement of land owners on the rivers.



PARAMETER				E. Coli	WATER TEMP.	STREAM FLOW	TURBIDITY FIELD	SUSPENDED SEDIMENT	OXYGEN, DISSOLVED	DO % SAT.	PH, FIELD	NITROGEN TOTAL(AS N)	PHOSPHORUS TOTAL (AS P)	
				CFU/100 mL	Deg C	CFS	NTU	MG/L	MG/L		SU	MG/L	MG/L	
UNITS			STANDARD	235	NS	NS	NS	80*	<6.0	**	<9.0	NS	NS	
Site Name	Site ID	Database	Date	E. Coli	Temp, Water	Flow	Turbidity	Susp Sed Conc.	DO	DO-%Sat	pH	T-Nitrogen	T-Phosphorus	
SAN FRANCISCO - ABOVE MORENCI GULCH	UGSFR006	10656J	06/27/2006	620		26	105	423	358	6.9	95.5	8.34	0.21	0.47
SAN FRANCISCO - ABOVE MORENCI GULCH	UGSFR006	10656J	11/19/2008			12	72		51	8.4	79	8.18	0.03	0.08
SAN FRANCISCO - ABOVE MORENCI GULCH	UGSFR006	10656J	03/18/2009						25				0.2	0.069
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	02/10/1994	11		9	239	29		10.2	100.4	8.76	0.33	0.16
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	06/15/1994	54		29	41	1		9.7	127.6	8.73		
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	10/27/1994	3		21	83	10		8.6	93.6	8.46	0.24	0.11
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	02/24/1995	<2		11	610	78		12.6	114.5	8.29	0.51	0.27
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	06/14/1995	4		28	58	1		6.7	97.8	8.53	0.2	<0.1
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	11/01/1995	18		17	47	2		7.5	85.1	7.96	0.16	<0.1
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	02/13/1996	4		12	96	3		9.5	99.9	8.22	0.25	<0.1
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	06/25/1996	14		29	10	1		8.1	115.9	8.18	0.19	<0.1
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	10/29/1996	3200		10	1190	>1000		8.9	87.4	7.83	0.68	2.92
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	01/24/1997	10		7	232	9		9.8	91.8	8	0.1	
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	01/27/1997	167		9	1180	790		9.4	90.7	7.98		
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	04/08/1997	<2		20	211	7		8.2	101.9	8.54	0.31	0.12
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	07/08/1997	6		30	30	11		8	119.3	8.42	0.99	<0.1
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	10/20/1997	<2		21	51	5		7.8	99.8	8.35	0.16	<0.1
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	01/27/1998	2		11	134	5		10.2	103.6	8.23	0.19	<0.1
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	07/14/1998	95		29	65	19		5.7	86	8.42	1.35	0.26
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	11/02/1998	60		18	83	37		7.6	91.4	8.35	0.27	0.11
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	02/08/1999	2		14	66	5				8.29	0.2	0.053
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	04/19/1999	9		15	60			9.1	103	8.29	0.42	0.061
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	11/30/1999	<2		13	72	5		9.4	98.4	8.23	0.22	0.053
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	01/10/2000	<2		12	69	4		10.2	100.2	8.13	0.14	0.064
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	07/24/2000	26		31	25	17		7.5	112.8	8.33	0.27	0.041
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	10/17/2000	100		21	137	26		6.9	83.1	8.13	0.48	0.14
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	03/26/2001	14		17	320	22		8	93.9	8.16	0.24	0.14
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	05/17/2001	4		19	136	3		7.5	90.8	8.15	0.18	0.08
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	08/28/2001	5		30	71	23		7	105.6	8.46	0.23	0.098
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	11/26/2001	<2		14	56	3		9.5	104.5	8.3	0.11	0.042
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	01/18/2002	<2		14	60	6		9.6	113	8.4	0.1	0.048
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	08/13/2002	545		25	69	999		6.3	85.6	8.62	2	1.6
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	10/30/2002	4		17	45	5	13	8.2	96.5	8.26	0.27	0.085
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	12/10/2002	<2		12	60	4	5	9.3	97.5	8.35	0.13	0.056
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	02/20/2003	4		13	109	9	16	8.6	93.3	8.5	0.19	0.064
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	05/15/2003	5		22	62	5	5	7.9	109	8.4	0.15	0.069
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	09/18/2003	58		22	35	133	38	6.6	94.3	8.32	0.27	0.36
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	11/04/2003	2		17	35	9	8	7.7	92.7	8.28	0.15	0.01
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	02/11/2004	2		17	61	14	14	9	94.3	8.28	0.09	0.075
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	07/28/2004	95		27	82	78	161	6.4	79.9	8.48	0.37	0.18
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	10/26/2004	188			58	491	65				0.17	0.14
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	03/02/2005	<2		12	790	69	75	8.7	86.3	8.83	0.41	0.29
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	05/25/2005	9		23	121	4	5	7.7	10.31	8.1	0.09	0.072
SAN FRANCISCO - BELOW CLIFTON	UGSFR006	10018J	08/04/2005	5		25	38		27			8.52	0.21	0.072



From 1993-2009 data, as summarized by ADEQ

What are the big questions?

What are the sources of the *E. coli* "exceedances?"

Wildlife?

- *Which wildlife?*
- *Is there a threat to humans or not?*

Livestock?

- *Is there really an E. coli problem?*
- *If so, can we create more off-stream watering facilities?*

Human ?

- *From recreation? Locals? Outsiders? Pets?*
- *From faulty old septics?*

The solution: an overview

REWRITE THIS SLIDE

Land owners and others from the watershed have come together to talk, and have begun training in key skills, in order to assume this responsibility.

Now, as conditions for sampling improve, local volunteers are beginning the process of sampling and observation.

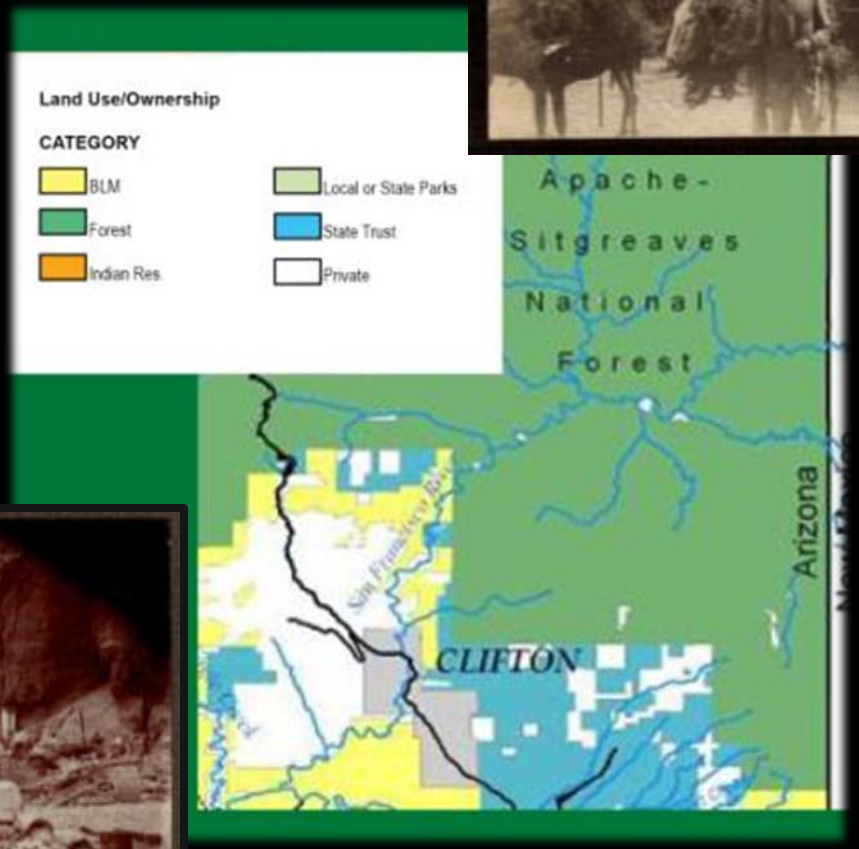
Understanding the region

Land ownership

Land use issues past and present

Social and economic histories of the different communities

Relations among communities



Old Coronado Inn in Clifton after the 1900 flood

Photos courtesy of Joanne Spoon

Building interest and trust in our project out in the communities

Understanding the unique pressures that ranchers, farmers and others live with in relationship to their river.

Creating project protocols that build confidence and trust in what we are doing.

E. coli project advisors listen very carefully to Kristine Uhlman of Arizona NEMO.

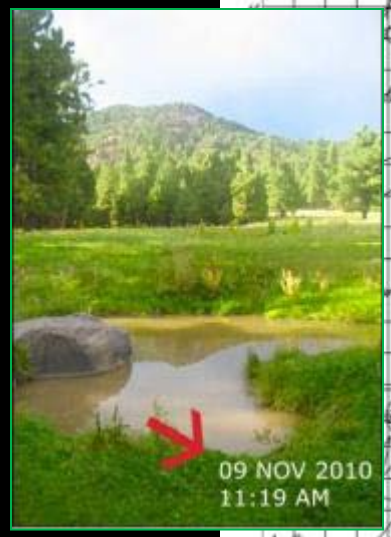
Trainings of volunteers

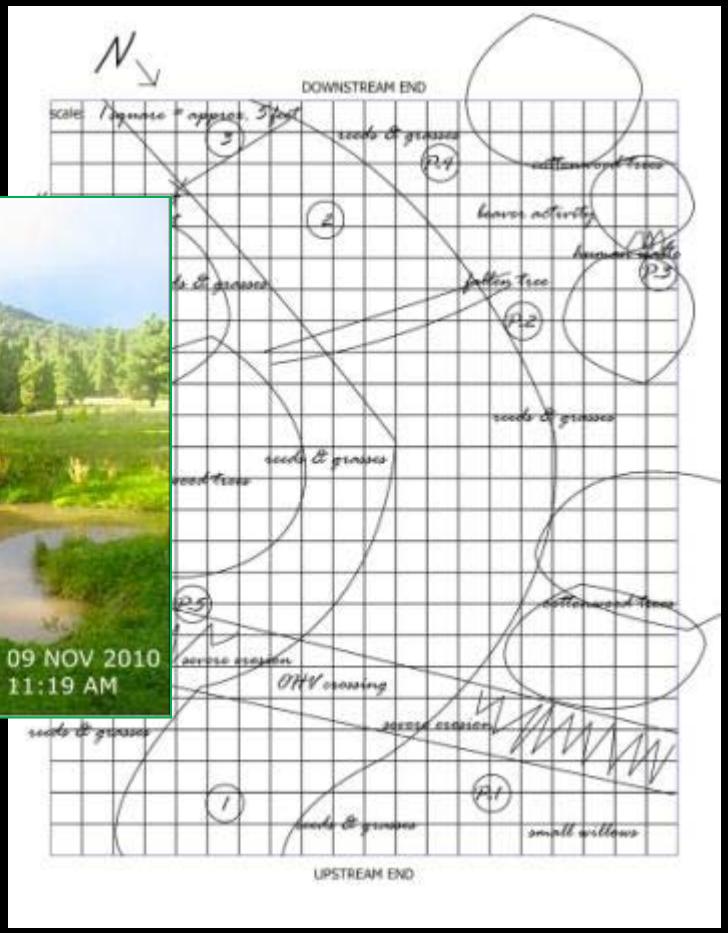
- Overview of geo-fluvial, meteorological, land use, socio-economic and other key perspectives on our watershed
- Overview of water-borne pathogens and potential dangers to humans through partial or full body contact
- Field safety in wilderness conditions
- Taking water samples for testing

Dr. Channah Rock of the University of Arizona Maricopa Agricultural Center and lab director Kelley Riley train San Francisco and Blue River volunteers.

Trainings of volunteers, continued

- Measuring: cubic feet per second *(cfs)*, pH, air and water temperature, and other environmental conditions
- Use of GPS and GIS in field work
- Notating multiple non-quantifiable site observations
- Taking proper photographic records
- Incubating samples and reading results
- Interpreting results



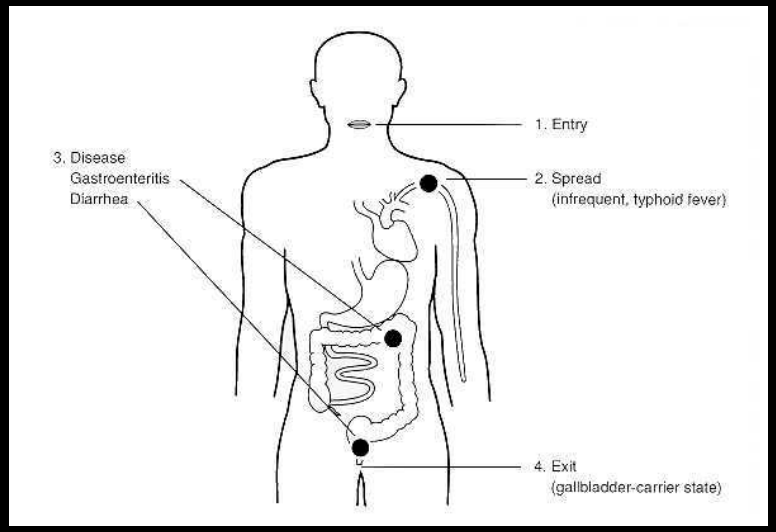


A crash course in water-borne *E. coli*

- *Escherichia coli* (*E.coli*) is a bacterium naturally found in the intestines and the feces of warm-blooded animals.
- It is a commonly used indicator of fecal pollution of water.
- There are many different types of *E. coli*, most harmless, but some may cause illness.

Slide content courtesy of Dr. Channah Rock, University of Arizona Maricopa Agricultural Center

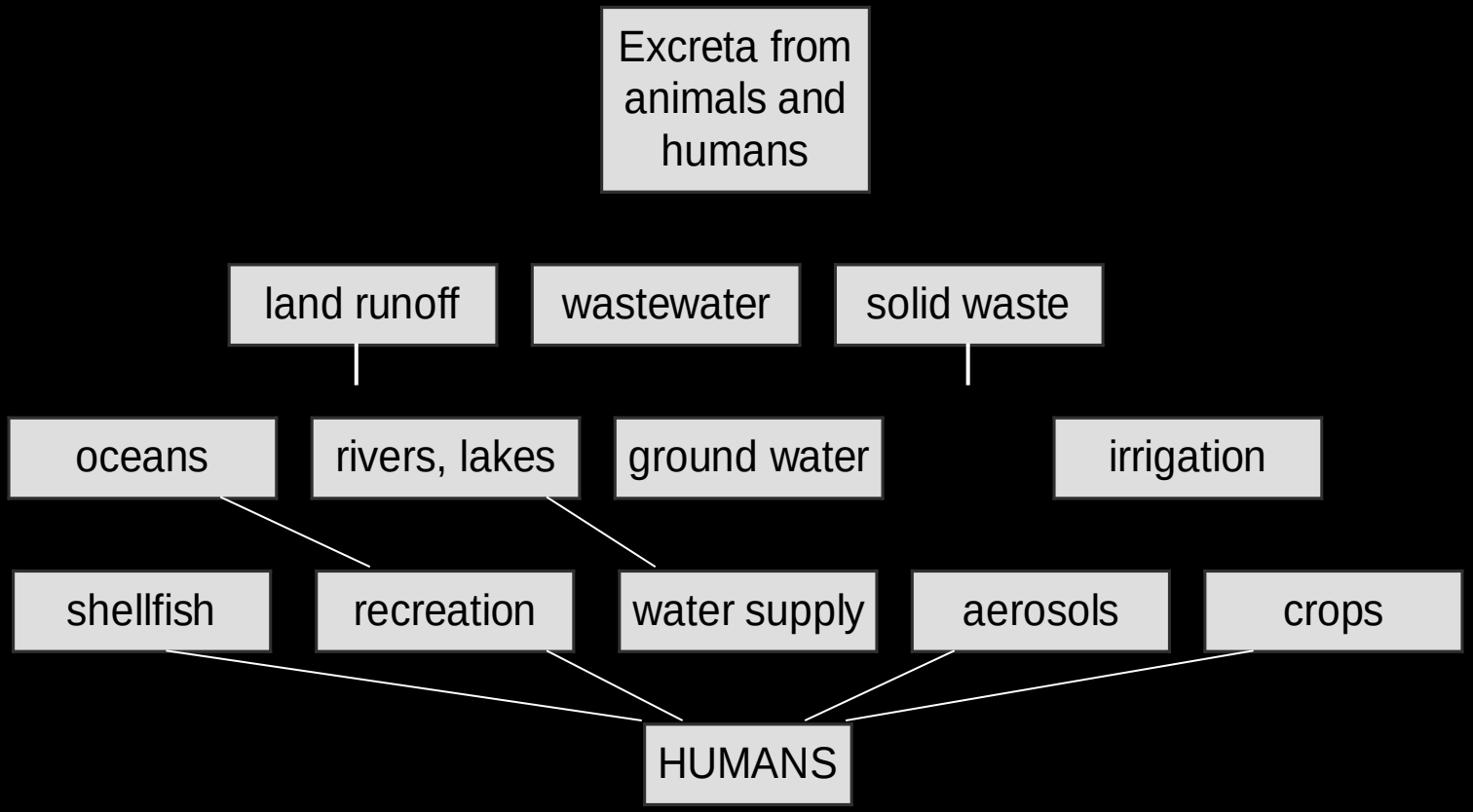
Enteric Pathogens



- Exposure is via ingestion
- Primary site of infection is gastrointestinal tract
- Gastroenteritis symptoms
  - nausea
  - vomiting
  - diarrhea
  - fever
- May spread to other sites (blood, liver, nervous system)
- Shed in fecal material
- “Fecal-oral” route of transmission

Slide content courtesy of Dr. Channah Rock, University of Arizona Maricopa Agricultural Center

Waterborne Transmission of Organic Pollutants



Slide content courtesy of Dr. Channah Rock, University of Arizona Maricopa Agricultural Center

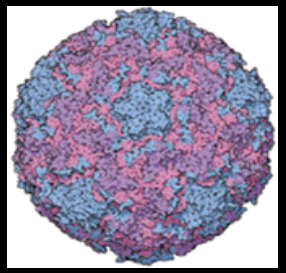
Water-borne pathogens

Some of the types we worry about:

- Bacteria – *Escherichia coli (E. coli), Salmonella*
- Viruses – Rotavirus, Adenovirus
- Parasites – *Cryptosporidium, Giardia*

- Pathogens cause disease. These microorganisms can be shed in the feces of humans and animals.

Escherichia coli



Rotavirus

Giardia

Slide content courtesy of Dr. Channah Rock, University of Arizona Maricopa Agricultural Center

E.coli are used as indicators because:

- They indicate fecal contamination
- They suggest the presence of pathogens
- They are easy to collect and analyze
- They are relatively safe to handle and generally harmless

Slide content courtesy of Dr. Channah Rock, University of Arizona Maricopa Agricultural Center