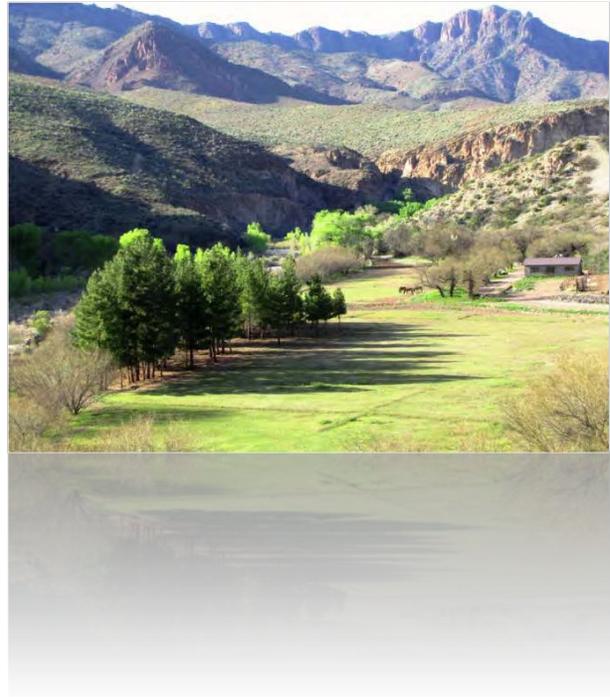


E. COLI REDUCTION ON THE SAN FRANCISCO RIVER THROUGH
ALTERNATIVE LIVESTOCK WATER ON THE KALER RANCH

FINAL REPORT



CONTRACT NUMBER 11-175WPF

May 31, 2013

Submitted to:
Arizona Water Protection Fund
By the Gila Watershed Partnership of Arizona
711 S. 14th Avenue
Safford, Arizona 85546



The Arizona Water Protection Fund Commission has funded all or a portion of this report or Project.

The views or findings presented are the Grantee's and do not necessarily represent those of the Commission, the State, or the Arizona Department of Water Resources.



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EXECUTIVE SUMMARY

The Kaler Ranch has been the location of numerous grant projects, supported or administered by The Gila Watershed Partnership of Arizona (GWP). With the alternative livestock water project covered in this report, our goal has been to continue the restoration and enhancement of the San Francisco River corridor and reduce *Escherichia coli* (*E.coli*) in the San Francisco River by installing four solar-powered, off-riparian wells with tanks and troughs for watering Kaler Ranch livestock.

The *E. coli* levels in the San Francisco River have been a concern since 2002, when the ADEQ listed the river with unsafe levels of *E. coli* in the 303(d) list of Impaired Waters.

The Kaler livestock were watering year-round in the riparian area of the San Francisco River, as livestock had done under previous owners for a century. The Kalers have water rights that give them the legal right to use the stream for livestock, and there were no alternative water sources.

The GWP worked with the Kalers, and wrote and received funding from ADEQ and ADA for the first well. Two years later, ADA funded the second well, with ADEQ funding number three. The fourth and last well was completed in this project with funding from the Arizona Water Protection Fund.

With the completion of the off-riparian watering system, the riparian area became completely free of livestock, sustaining only the more limited impacts of wildlife and recreation. Photos from the seven monitoring points used in this project, shown in the map below, confirm an extraordinary degree of vegetative recovery. This return of vegetative cover in streamside areas has multiple benefits for the miles of riparian corridor affected. It leads to more hospitable, shaded areas for sensitive aquatic life, more filtering of pollutants from recreation that are carried in surface flows toward the stream, and greater absorption of surface water into the water table.

The beneficial outcomes of this coordinated effort will expand over time, as the miles of river corridor on the Kaler Ranch grows rich with increasingly mature and complex plant communities, enhancing the vitality of innumerable wildlife communities. The quick recovery of this area, which was already attractive for recreation, provides inspiration for the growing community effort to care for and improve the San Francisco River environment.

The Gila Watershed Partnership will continue seeking grant funds for ongoing improvements to the San Francisco River. It also plans to continue supporting a sustained effort over time by volunteer groups, such as the Friends of the Frisco, which formed in 2010 with the guidance of GWP.

SITE BACKGROUND AND HISTORY

The Kaler Ranch has been the location of numerous grant projects, supported or administered by The Gila Watershed Partnership of Arizona (GWP). The Partnership supported the Kalers in a Natural Resource Conservation Service grant to level fields adjacent to the river to reduce livestock waste reaching the river. Following that, GWP secured grants from the Arizona Department of Environmental Quality (ADEQ), the Arizona Water Protection Fund (AWPF) and the Arizona Department of Agriculture (ADA) to address erosion and sediment deposition caused by huge culverts. These projects have made dramatic improvements in the San Francisco River and riparian area.

The *E. coli* levels in the San Francisco River have been a concern since 2002, when ADEQ listed the river from its confluence with the Blue River to Limestone Canyon just above Clifton as “impaired” for *E. coli*, with levels unsafe for the “full-body contact” that occurs with swimming, boating and other surface water recreation. In surface water quality science, two rules are at work here: 1) *E. coli* travels with and on sediments, so that elevated levels of *E. coli* often indicate increased suspended sediment, and 2) *E. coli* is regarded as an indicator that other waterborne pathogens are likely to be present, including some that may put wildlife as well as humans at risk. In addition, the erosion and excess sedimentation caused by the livestock in the riparian area negatively affect aquatic life, as sediment particles in the water can clog the gills of fish and decrease the amount of sunlight available to aquatic plants.

The Kaler livestock were watering year-round in the riparian area of the San Francisco River, as livestock had done under previous owners for a century. The Kalers have water rights that give them the legal right to use the stream for livestock, and until the solar wells were constructed, there were no alternative water sources on the steep mountainsides of the region.

In the course of working with GWP on improving the transport system for rainwater and sediments from the unpaved county road above them, the Kalers grew interested in reversing the impacts on the riparian corridor that were believed to have resulted from years of heavy use of the river by livestock.



Fig. 1 The landowner, Dick Kaler and his horse Licorice

The GWP worked with the Kalers, and wrote and received funding from ADEQ and ADA for the first well. Two years later, ADA funded the second well, with ADEQ funding number three. The fourth and last well was completed in this project with funding from the Arizona Water Protection Fund. AWPF, in funding the last of four facilities, would close the loop on a system that would allow a major section of an important Arizona surface water to return to robust, natural functionality, supporting fish and other wildlife in the region.

PROJECT NARRATIVE

This project came about because of the compromised environmental status of a major section of the San Francisco River in southeastern Arizona. The river is the largest tributary to the Gila River, once a major waterway to its confluence with the Colorado, and the target to this day of monumental water rights battles and legislation. The San Francisco's waters are critical to downstream agriculture and recreation but also to our community's water supplies.



Fig. 2 The San Francisco River at the Kaler Ranch

Remote by any measure with its rugged topography roughly evenly divided between Arizona and New Mexico, its sparse settlement concentrated mainly in Clifton and Morenci, the San Francisco River cuts through many areas of mountainous wilderness. It sustains richly diverse wildlife communities, which includes mountain lion, the recently re-introduced Mexican grey wolf, and the Big-horn

sheep. The river is also home to threatened and endangered aquatic species, which includes Gila trout, Gila chub, Loach minnow, Spikedace, Gila topminnow and Chiricahua leopard frog.

Many areas of the river are difficult for people to access. But the more accessible reaches have been significantly impacted by agricultural and recreation land uses in recent years. The San Francisco River above Clifton, up to its confluence with the Blue River some twenty miles north, was listed as impaired for *E.coli* in 2002 by ADEQ. The source of the elevated *E. coli* levels, which questioned the safety of some popular recreation areas, was suspected to be a combination of human and bovine fecal contamination. Subsequent research by GWP and University of Arizona microbiologists confirmed that humans and cattle were contributing to seasonal high levels of *E. coli* contamination in roughly equal measure.

Closely related to concerns about bacteria and other waterborne pathogens introduced into the stream, whether by grazing or recreation, was concern over the sedimentation of the stream. The reaches used by cattle for watering, more numerous and widespread than those accessible to people, have suffered stream bank erosion in all seasons, compounded the absence of stabilizing, shading vegetation. Many reaches of the San Francisco River were so degraded by livestock watering that there was no vegetation surviving along the water's edges.

GOALS AND OBJECTIVES

GWP's goal has been to continue the enhancement and restoration of the San Francisco River corridor. The objectives were to reduce *E.coli* in the San Francisco River by eliminating from the stream one of the primary sources, and to reduce unnatural sedimentation of the river water. A third and corollary objective was to make possible a regeneration of native plant communities in the river corridor used by the Kaler Ranch, providing food and shelter for fish and wildlife, and stabilizing soils.

These objectives have been met by installing a group of four solar-powered, off-riparian wells with tanks and troughs, for watering Kaler Ranch livestock. With the completion of this group of facilities, the Kaler cattle are now fully excluded from the riparian area. The watering facilities are also available for the use of wildlife on the uplands.

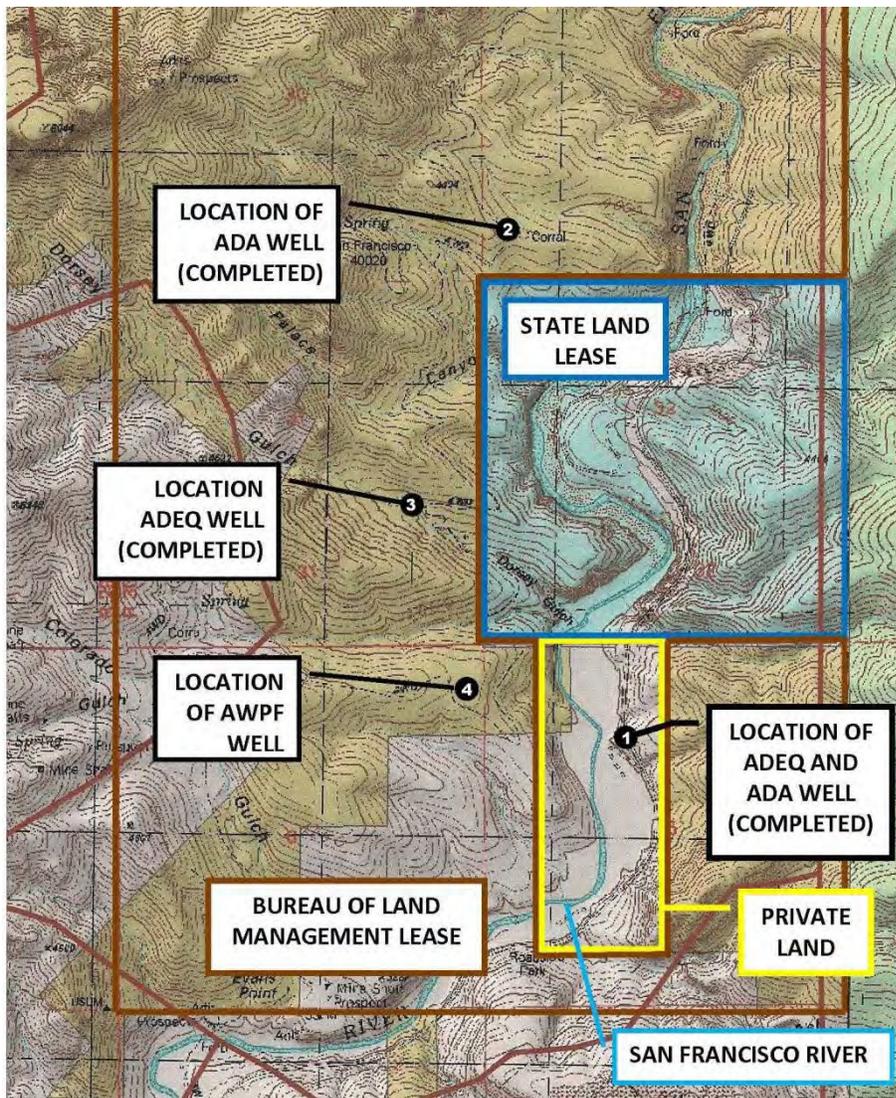


Fig. 3 Locations of the four wells.

The four wells have been calculated to produce a minimum of 5 gallons per minute. One well is currently located on the Kalers' private land, and three are located on Bureau of Land Management (BLM) property (see map). The wells have been planned to water the number of livestock the Kalers are permitted on their BLM allotment. The BLM has written their Biological Opinion that allowed for a fifth well, to allow for the possibility that the wells do not produce sufficient water to accommodate the landowner's permitted number of livestock.

Construction Phase

Mr. Kaler used his equipment and his ranch hands to repair and widen the steep, narrow road to the fourth well site, characterized by steep grades and hairpin turns, to permit safe passage for the well drilling equipment, and for future maintenance of the sites. In the final 3/4 mile, heavier equipment proved to be necessary, and the well contractor brought in their newer and larger Caterpillar, to complete the work. It was during this phase that the highway accident occurred that left Mr. Kaler widowed and severely injured. The contractor quickly stepped in to complete the job.

The well drilling went as planned, despite considerably rockier conditions than were anticipated. The sub-contractor drilled to a depth of approximately 750 feet. (The static water level at the site is 550 feet below ground surface.) A submersible pump was installed and set at 610 feet below ground level. The well is producing approximately five gallons per minute.



Fig. 4 Road preparation.



Fig. 5 The completed trough, with water tanks in the background.

The difficulties of construction on a steep upland site continued. Kaler's water truck was too damaged by the roughness of the road to complete the job, so the contractor brought in a military surplus truck to serve as a water truck for the last phase of road work, and for equipment mobilization and the drilling phase.

The following phase was the installation of the solar array, consisting of six Sharp 240 Watt Solar modules mounted to a fixed rack.

Next, two 3,000-gallon black plastic water storage tanks and one 718-gallon galvanized watering trough were installed. The galvanized water trough was surrounded by rock set in concrete, to minimize damage from livestock and wildlife.

FINAL MONITORING REPORT

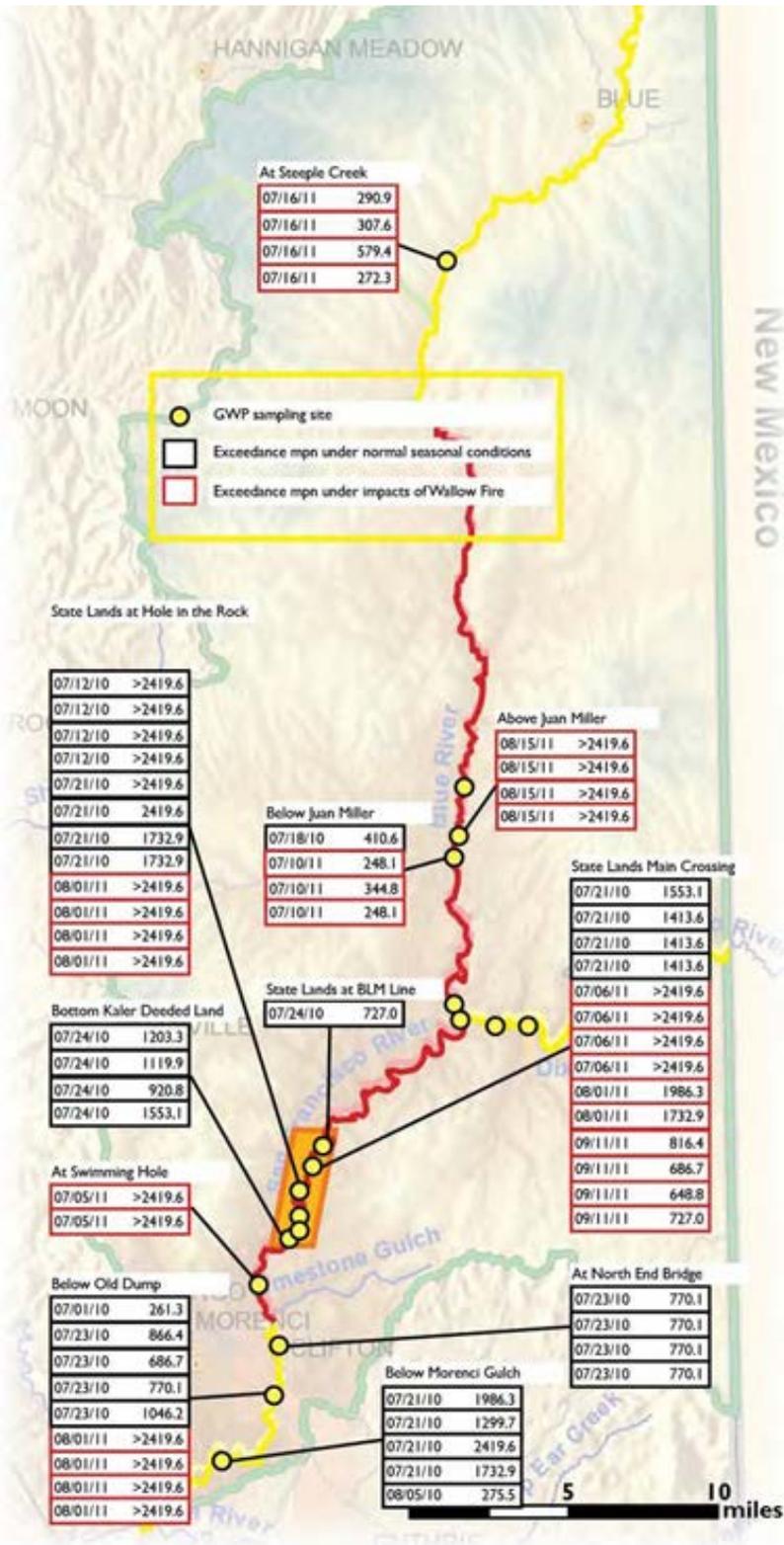


Fig. 5. Map of exceedances recorded by GWP 2010-11. The orange-shaded box is the area where Kaler ranch livestock graze.

To determine the success of the project, we decided on the following three methods of monitoring. First - photo monitoring was selected to detect the presence of any livestock in the area, and to document the before and after effects of the project on the vegetation in the riparian area. Second, *E.coli* monitoring would determine the level of *E.coli* in the river. Third, DNA testing would indicate whether the *E.coli* was the result of livestock or human waste.

For photo monitoring, GWP provided photos from seven sites on the Kaler Ranch and leases/allotments, which were collected as monitoring documents for an ADEQ grant that was completed in October of 2011.

For the *E.coli* monitoring, we would utilize the monitoring that was completed in a comprehensive research project that was funded by ADEQ to determine the source of the *E.coli* exceedance on the San Francisco River. We would be able to compare the *E.coli* levels and the microbial source tracking tests from before the off-riparian wells were implemented with the monitoring completed in May of 2013 in this project.

E.COLI MONITORING AND MICROBIAL SOURCE TRACKING TESTS

In June of 2012, GWP completed its ADEQ-funded study of *E.coli* levels and sources on the San Francisco and Blue Rivers, which included databases and other field records from numerous sites on and near the Kaler Ranch grazing areas. These studies confirmed that cattle, along with humans, were contributing *E. coli* to the San Francisco River waters in the reaches in question.

The results of the microbial source tracking tests at the University of Arizona Maricopa Agricultural Center showed consistent presence of *E. coli* originating from the intestines of both cattle and humans. “Exceedance” levels – at which time it is considered unsafe to have full-body contact with the water – occurred during the warmer months of the year. While it was not possible for U of A microbiologist Dr. Channah Rock and her staff to compare the bovine and human results exactly quantitatively – the tests currently in use do not permit exact comparisons – Dr. Rock and her colleagues at U of A devised a ranking system by which they were able to assign values indicated by one to three plus signs (+’s), which indicated whether the levels in question were of low, moderate or high significance. Table 1 below condenses the microbial source tracking results in 2011 for the sampling sites pertinent to the Kaler Ranch

Site name	Date Sampled	E. coli	Bacteroides molecular genes‡				
			All	Hu	Bov		
			Allbac296	HF183	CF128	Bac2	CowM2
SF Main Crossing 6 control	7/6/2011	NT	+++	-	-	-	++
SF Main Crossing 6 primary	7/6/2011	NT	+++	-	-	-	+
SFR @ State Lands main Crossing 7 control	8/1/2011	1986.3	+++	-	-	-	-
SFR @ State Lands main Crossing 7 primary	8/1/2011	1732.9	+++	-	-	-	-
SFR @ State Lands Hole in Rock 6 control	8/1/2011	>2419.6	+++	++	-	-	+++
SFR @ State Lands Hole in Rock 6 primary	8/1/2011	>2419.6	+++	+	-	-	+++
SFR State Lands @ main Crossing 8 control	9/11/2011	648.8	+++	-	-	-	++
SFR State Lands @ main Crossing 8 primary	9/11/2011	686.7	+++	+	-	-	-
SFR State Lands Main Crossing 9 control	11/19/2011	46.1	+++	-	-	-	-
SFR State Lands Main Crossing 9 primary	11/19/2011	37.6	+++	-	-	-	-
SFR State Lands @ Hole in Rock 8 control	11/19/2011	47.4	+++	+++	-	-	+++
SFR State Lands @ Hole in Rock 8 primary	11/19/2011	41.6	+++	+	-	-	+

Table 1. Summary of site information, indicator bacteria concentrations, and occurrence of Bacteroides and other bacterial molecular markers.

At the end of May of 2013, when Kaler cattle had been fully excluded from the San Francisco River for some months, and water temperatures had warmed sufficiently to provide significant results in tests for *E. coli* presence, GWP processed water samples from two sites: at the State Lands-BLM boundary above the Kaler Ranch, and the lower water gap that marks the southern boundary.

Tests performed were *E. coli*, flow, water temperature, and turbidity at each of the two locations. The final tests were only performed above and below the Kaler Ranch to determine the contribution of *E. coli* by the Kaler Ranch.

Date Tested	Site Name	CFU*	CFS	Water Temp	Turbidity
7/24/2010	State Lands at BLM Line	920.8	78.0	28.0	51.6
5/25/2013	State Lands at BLM Line	2.0	4.6	23.0	3.0
7/24/2010	Bottom Kaler Deeded Land	1199.3	79.0	28.0	46.0
5/25/2013	Bottom Kaler Deeded Land	3.0	4.6	23.0	3.0

These were the lowest test results ever seen for *E. coli* by GWP in the previous 200 samples. The *E. coli* presence test indicated 2.0 and 3.0 colony-forming units respectively. Since surface water is considered safe for full-body contact up to a result of 235, the *E. coli* test results indicate that the livestock have been completely excluded from the project area.

In addition, the following was reported by Channah Rock, Ph.D., Associate Professor and Water Quality Extension Specialist for the University of Arizona Water Quality Laboratory for the water samples we sent for testing for bovine and human genetic markers:

“Each submitted water sample was filtered for Bacteroidetes and the DNA was extracted and purified for DNA analysis. All reagents, chemicals, and instruments passed through quality assurance and quality control evaluations to ensure accurate results. All samples in this report were below the detection limit for real-time qPCR assay for Human Bacteroidetes. They were therefore classified as negative for the fecal Bacteroidetes Human gene biomarker. The Bovine Bacteroidetes biomarker was found in low levels for these samples indicating low levels of fecal contamination. This was confirmed by the low levels of *E. coli* (less than 235 CFU/100mL) also present in the samples you submitted for testing.”

MAC #	Client #	Analysis Requested	General Bovine Marker Quantified*	DNA Analytical Results
MAC SF1	SFR State Lands/BLM Line control	Bovine Bacteroidetes ID	7.44E+02	Positive for the Bovine biomarker
MAC SF2	SFR State Lands/BLM Line primary	Bovine Bacteroidetes ID	1.74E+02	Positive for the Bovine biomarker
MAC SF3	SFR bottom Kaler Deeded Land control	Bovine Bacteroidetes ID	3.67E+02	Positive for the Bovine biomarker
MAC SF4	SFR bottom Kaler Deeded Land primary	Bovine Bacteroidetes ID	5.27E+02	Positive for the Bovine biomarker

* Numbers reported as copy numbers per 100 mL of water

± Below Limit of Quantification (10 copies per reaction)

CONCLUSIONS

We believe that future monitoring will indicate that the work completed on the Kaler Ranch will lead to the removal of this section of the San Francisco River from the 303(d) list of impaired waters. However, the Gila Watershed Partnership needs to continue its work on the San Francisco River. This year, the Environmental Protection Agency and Arizona Department of Environmental Quality have added the reach of the San Francisco River between Clifton and the Gila River (which is the reach downstream of the Kaler Ranch) to the 303(d) list of waters impaired for *E.coli*. In addition, the Gila River is listed as impaired for *E. coli* as well. The GWP believes that the causes may be human, caused by recreation, outdated sewers, ranches and dairy operations.

PHOTO MONITORING

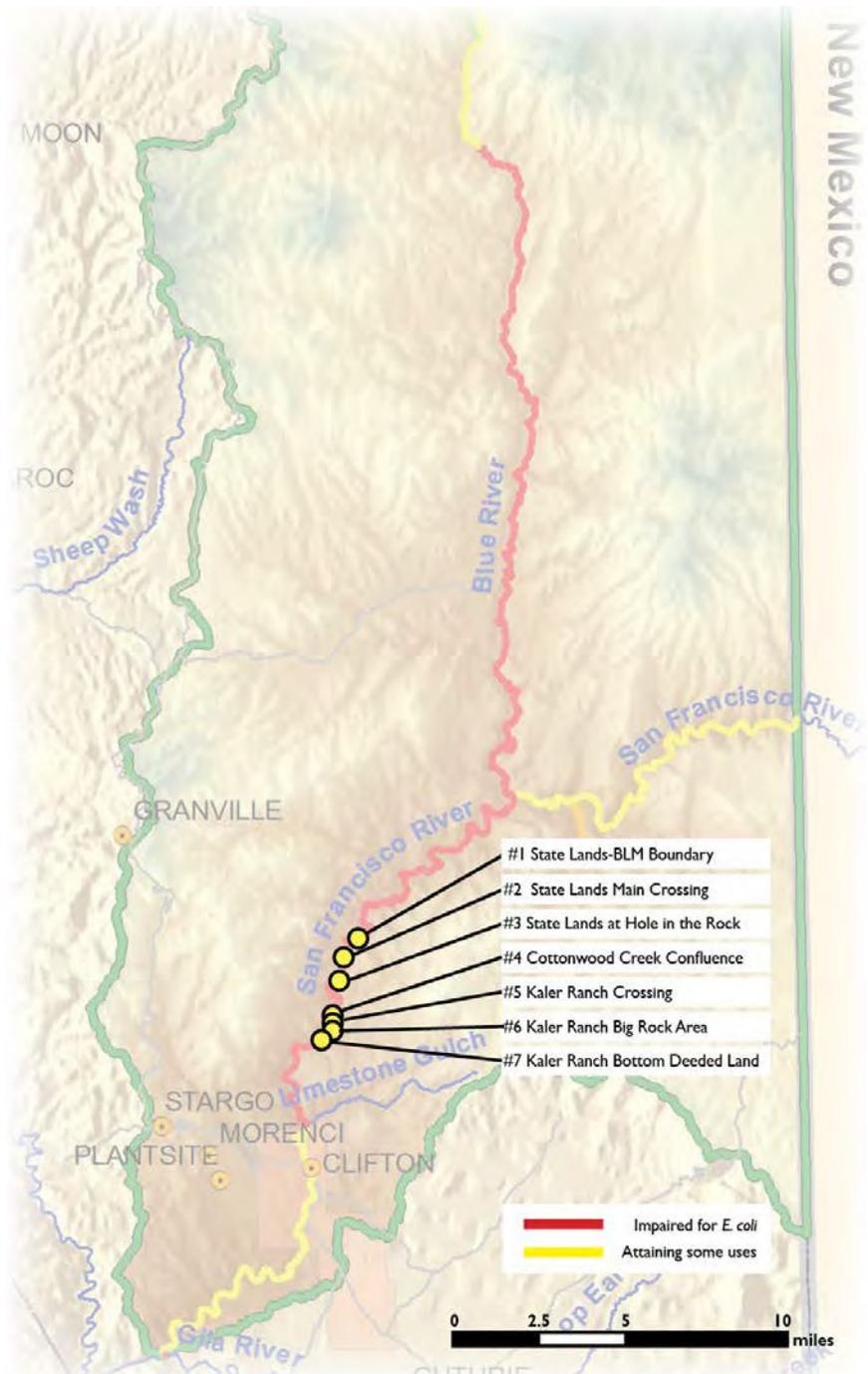
The photo monitoring crew returned to the sites that were previously monitored in the ADEQ E.coli research project completed in June of 2012. In June of 2012, the area still exhibited some evidence of livestock presence, and the riparian vegetation, although recovering, was still in only fair condition.

In conducting photo monitoring of seven Kaler Ranch sites at the end of May 2013, GWP observed no cattle sign except for a few very dry, aged manure piles at the edge of one site, left over from the previous year.

CONCLUSIONS

What is most conspicuous in our final photo monitoring is the vigorous growth of all kinds of riparian-corridor native plants. Assisted by the nutrient value of ash from the 2011 and 2012 fires in the upper watershed, plant communities – those essential buffers and wildlife habitats – have resurged in densities and species complexities not seen before in the memories of residents of the area.

There is a contrast between this riparian-corridor growth on the Kaler Ranch and the comparable growth downstream where cattle are not excluded. The arresting vigor of the new growth is visible downstream as well, but the effects of livestock are already seen there. The stream edges are disturbed and denuded of grasses, while on the Kaler Ranch grasses grow like thick carpets right to the water's edge. These observations are illustrated in the final photo monitoring beginning on the next page.



FINAL PHOTO MONITORING

PHOTO POINT #1

Site: Upper water gap at boundary of BLM and Arizona State Lands. Note: because of the dense growth of willows on the flat sandy bar on the east side, it was not possible to approach this site by land, or to access the exact point, about 8' to the east, from which photos were taken in the past. For this reason all photos were taken from the east side of the stream itself.

#1 – North, looking up the river (poor focus in this shot)

12S 0660527, UTM 3667609



5/29/13 11:55

Notes: densely vegetated bank on both sides of river and both sides of boundary fence. No cattle sign.

#1 – South, looking down into the east bank (river is out of the frame to the right, south)
GPS reading 12S 0660527, UTM 3667609



5/29/13 11:55

Notes: willows and other vegetation on the low, flat east bank are too dense to penetrate. A narrow ATV track still runs upriver behind this 10-20' green barrier.

#1 – East, looking into the east bank, where earlier photo point is located, now too densely vegetated to enter.

GPS reading 12S 0660527, UTM 3667609



5/29/13 11:55

Notes: vegetation barrier is up to 25' wide on this stretch of the east bank because table is low and flat.

#1 – West, looking across the river at the west bank.

GPS reading 12S 0660527, UTM 3667609



5/29/13 11:55

Notes: dense willow growth fills in around young cottonwoods at the bottom of a steep slope.

PHOTO POINT #2

Site: Arizona State Lands main river crossing. Note: This is a heavily used area for recreation and the site of constant river crossings by vehicles of various kinds when flows allow. For this reason, vegetation remains very thin in areas where vehicles operate. However there is no cattle sign of any kind and revegetation is strong outside of vehicle trails.

#2 – North, looking across the river

12S 0660233, UTM 3667336



5/29/13 12:12

Notes: densely vegetated bank on either side of vehicle trail. No cattle sign.

#2 – South, looking into a heavily used parking area for recreation, next to the crossing.
GPS reading 12S 0660233, UTM 3667336



5/29/13 12:12

Notes: no revegetation in this immediate area due to heavy vehicle use.

#2 – East, looking upriver.

GPS reading 12S 0660233, UTM 3667336



5/29/13 12:12

Notes: there is some vegetative recovery at the point where vehicle use drops off. In the past, this area was characterized by heavy cattle sign.

#2 – West, looking downriver.

GPS reading 12S 0660233, UTM 3667336



5/29/13 12:12

Notes: again, there is some vegetative recovery where vehicle use drops off.

PHOTO POINT #3

Site: Downstream of recreation area at Hole in the Rock, Arizona State Lands. Note: River meanders sharply in this reach, running north for about a quarter mile.

#3 – North, looking downriver

GPS reading 12S 0660054, UTM 3666643



5/29/13 12:20

Notes: densely vegetated bank downstream of parking area. No cattle sign.

#3 – South, looking upriver toward the feature that gives the site its name.

GPS reading 12S 0660054, UTM 3666643



5/29/13 12:20

Notes: willows and other low vegetation on the east bank (to the left), which previously was a rocky flat with no vegetation present.

#3 – East, looking across the river.

GPS reading 12S 0660054, UTM 3666643



5/29/13 12:20

Notes: this is another view of the rocky flat that previously had no vegetation on it.

#3 – West, looking at bank near parking area.

GPS reading 12S 0660054, UTM 3666643



5/29/13 12:20

Notes: this bank, just below a parking area, was previously free of vegetation.

PHOTO POINT #4

Site: east bank of river upstream of the confluence with Cottonwood Creek, on the Kaler Ranch. Note: in this narrow area, new vegetation had grown so dense and tall that it blocked views shown in earlier photos.

#4 – North, looking upriver

GPS reading 12S 0659994, UTM 3666071



5/29/13 12:40

Notes: the river is running downstream toward the photo point behind this densely vegetated bank. No cattle sign.

#4 – South, looking downriver toward the confluence with Cottonwood Creek.
GPS reading 12S 0659994, UTM 3666071



5/29/13 12:40

Notes: the river is running downstream away from the photo point behind this densely vegetated bank. No cattle sign.

#4 – East, looking into the dry floodplain.

GPS reading 12S 0659994, UTM 3666071



5/29/13 12:40

Notes: this looks out from the dense vegetative barrier at the river's edge.

#4 – West, looking across the river.

GPS reading 12S 0659994, UTM 3666071



5/29/13 12:40

Notes: there is equally dense vegetation on the other side of the river.

PHOTO POINT #5

Site: ranch crossing on the Kaler Ranch – the principal vehicle and horseback access to uplands pastures.

#5 – North, looking upriver

GPS reading 12S 0660147, UTM 3665583



5/29/13 12:55

Notes: vegetative recovery is strong on both sides of the vehicle/horse trail crossing the river to the uplands pastures, but is affected on the trail route itself. Prints are made by horses' hooves.

#5 – South, looking downriver below the crossing.

GPS reading 12S 0660147, UTM 3665583



5/29/13 12:55

Notes: same as previous.

#5 – East, vehicle/horse trail is on the right.
GPS reading 12S 0660147, UTM 3665583



5/29/13 12:55

Notes: strong vegetative recovery outside the trail itself.

#5 – West, looking across the river.

GPS reading 12S 0660147, UTM 3665583



5/29/13 12:55

Notes: on the other side of the river, the continuing trail cuts through new vegetation.

PHOTO POINT #6

Site: Big Rock area downstream of Kaler Ranch residential area.

#6 – North, looking upriver

GPS reading 12S 0660054, UTM 36649196



5/29/13 13:05

Notes: the big rock itself is not visible through new willow growth at the photo point used on previous monitoring occasions. New low vegetation is occurring across this often-scoured sandy bar.

#6 – South, looking downriver below the crossing.

GPS reading 12S 0660054, UTM 36649196



5/29/13 13:05

Notes: vegetation obscures the downstream view from the photo point.

#6 – East, looking up a small slope to the access road and parking area, heavily used in the past for recreation but closed to the public for the last few years.

GPS reading 12S 0660054, UTM 36649196



5/29/13 13:05

Notes: this shady area is higher than the main river channel, the boundary between the two marked by new willow growth.

#6 – West, looking across the river (barely visible through willow leaves on the left).
GPS reading 12S 0660054, UTM 36649196



5/29/13 13:05

Notes: as noted above, this sandy bar is frequently scoured but has a lot of new willow growth. There were a few piles of very dry, aged cattle manure at the entry to the flat area from the access road.

PHOTO POINT #7

Site: Water gap at southernmost boundary of Kaler deeded land (bordering property owned by Freeport McMoRan Copper & Gold, Inc., on which neighboring cattle often graze.

#7 – North, looking upriver

GPS reading 12S 0658842, UTM 3664266



5/29/13 13:31

Notes: dense grasses grow to within inches of the water's current edge.

#7 – South, looking downriver below the crossing, into Freeport McMoRan property.

GPS reading 12S 0658840 UTM 3664258



5/29/13 13:31

Notes: both river banks in this stretch of the neighboring property are disturbed by cattle hooves. There is fresh cattle manure present, and a strong odor of manure as one walks down the river. The river's edges are denuded of grasses.

#7 – East, looking across the river to the steep slope below the main river access road.

GPS reading 12S 0658840 UTM 3664258



5/29/13 13:31

Notes: grasses and willows fill the narrow border between the rocky slope and the water's current edge.

#7 – West, looking from mid-stream on Freeport McMoRan property just below the boundary and its water gap.

GPS reading 12S 0658840 UTM 3664258



5/29/13 13:35

Notes: footprints at right were left by the monitor when entering the stream to collect water samples. Grasses are less dense at the water's edge in this small triangle between the fence and a braided reach of the river on Freeport McMoRan property.

BEFORE AND AFTER SITE PHOTOGRAPHS

State Lands-BLM boundary looking east

July 2010



May 2013



Comparison of site before and after exclusion of Kaler Ranch cattle from the San Francisco River. The two photos above were taken of the same sites from points about 10' apart. The bottom photo could not be taken from exactly the same point because the wide vegetation buffer on the flat riverbank had grown too dense to enter.

Kaler Ranch, south end of deeded land looking north

July 2010



May 2013



Comparison of site before and after exclusion of Kaler Ranch cattle from the San Francisco River.



May 2013



Comparison of site before and after exclusion of Kaler Ranch cattle from the San Francisco River.

PROJECT RESULTS



The San Francisco River

The technical results of this project include a well producing approximately five gallons of water a minute, powered by solar cells, offering water year round in a trough designed for access by livestock and wildlife alike. Additionally there is a road to the site that makes ongoing maintenance relatively easy. This installation, the fourth in a series of four, completed a resource management plan that completely excludes livestock from a significant stretch of the San Francisco River.

Finally, the project has provided an example for an agricultural community facing challenges with prolonged drought, which is currently in its 18th year. The Kaler Ranch has hosted scores of visitors – Master Watershed Steward students, schoolchildren and others – so that the public may learn about the solar wells project, along with other innovations in the interest of riparian environment and wildlife habitat. Greenlee County’s weekly newspaper, *The Copper Era*, is a committed partner to GWP in educating the public on a wide range of water-related issues. *The Copper Era* is publishing a 1300-word article about the final solar well project, about twice the length of its more typical feature articles, as a front-page story. *The Copper Era* is the leading source of public information in Greenlee County. The story has also been submitted for publication in neighboring Graham County’s semi-weekly paper, *The Eastern Arizona Courier*.

PROJECT CONCLUSIONS

Exclusion of Kaler Ranch cattle from the San Francisco River, which occurred in stages over about four years, produced observable results in the health of native plant communities in the affected river reaches. However, now that the fourth well is complete, the impact after several months of complete exclusion is dramatically visible.

Natural conditions – rainfall and upstream fire – would have worked both for and against this recovery. While the nutrient value of ash carried downstream from forest fire areas will generally assist riparian plant recovery, the continuing sub-normal rainfall of the last two years would not have given plant recovery any extraordinary support. Comparing the Kaler Ranch to areas grazed by livestock year-round provides insights into the differences in this early stage of vegetation recovery. As noted above, the most vulnerable areas – the immediate edges of the stream – are markedly different in the grazed areas from those where the exclusion is complete.

The vegetation in some river reaches is so dense that experienced GWP field personnel could not walk to one long-established monitoring point – in fact it was only possible to access the edges of that area by walking upriver. These plant communities are now so robust and dense they offer sustenance and shelter to a great range of wildlife.

The San Francisco River as it travels through the Kaler Ranch now has vegetative buffers more dense than any in the memory of community members involved with GWP. The resurgence of riparian vegetation also offers some future hope for flood-prone Clifton, since the root systems will offer increasing bank stabilization over time, and greater and greater biomass slowing the flow of high waters and allowing more surface water to penetrate. That, in turn, benefits the region as a whole by recharging the water table.

We believe that future repeated monitoring will indicate that the work completed on the Kaler Ranch will lead to the removal of this section of the San Francisco River from the 303(d) list of impaired waters. However, the Gila Watershed Partnership needs to continue its work on the San Francisco River. This year, the Environmental Protection Agency and Arizona Department of



Environmental Quality have added the reach of the San Francisco River between Clifton and the Gila River (which is the reach downstream of the Kaler Ranch) to the 303(d) list of waters impaired for *E.coli*. In addition, the Gila River is listed as impaired for *E. coli* as well. The GWP believes that the causes may be human, caused by recreation and outdated sewers, and current ranches and dairy operations.

The landowner, Dick Kaler during a flood in 2002

RECOMMENDATIONS FOR FUTURE PROJECTS

The projects on the Kaler Ranch have served as unprecedented examples for others in the region to observe and follow. But that work will require ongoing outreach and assistance, as well as support from the local community. It is crucial to use the encouraging results of the work on the Kaler Ranch to inspire similar work in other parts of the watershed. We are working with many other agricultural producers in the Upper Gila Watershed on programs and projects that improve the watershed and particularly our rivers and riparian areas.

Through the Gila Watershed Partnership's community engagement efforts on the San Francisco River, a river cleanup and education group has emerged - the Friends of the Frisco. This group already has over 100 members, and is gaining support by the community. We need to find support for this group to further engage and educate the community on river and riparian health issues.

However, there are still large sections of the San Francisco River that are impaired for E.coli that is human caused. There are no restrooms available for people recreating on the San Francisco River. We were recently awarded a grant from ADEQ's Water Quality Improvement Grant Department for one restroom, which will alleviate a portion of the problem. However, the Freeport McMoRan mining company is working with the Arizona Department of Transportation to re-route highway 191 around the mine, to travel up the San Francisco River road. At that time, we will have an opportunity to construct restrooms near recreation access points that would be included in a public right-of-way.

The GWP is considering other projects that would further protect, enhance, and restore the San Francisco River, including fencing, signage, and education.



Fig. 10 *Riding the ranch with the landowner*

