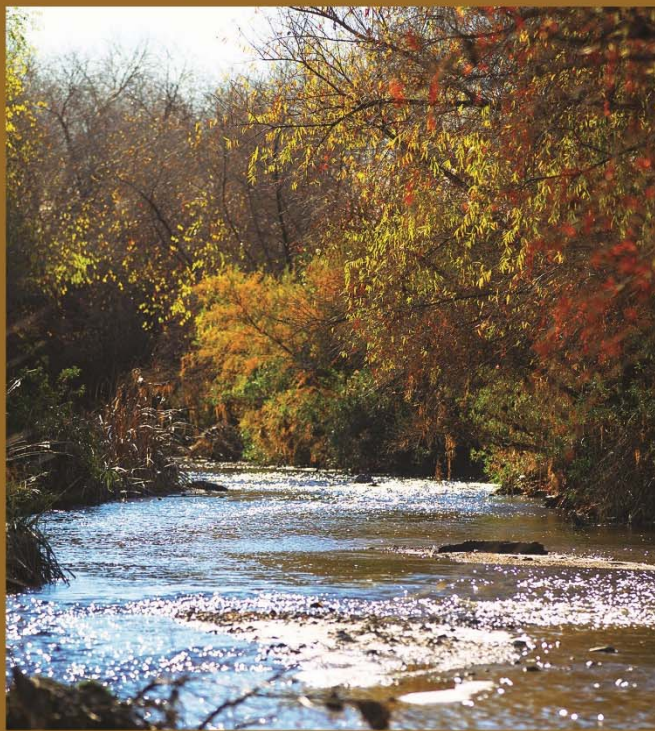
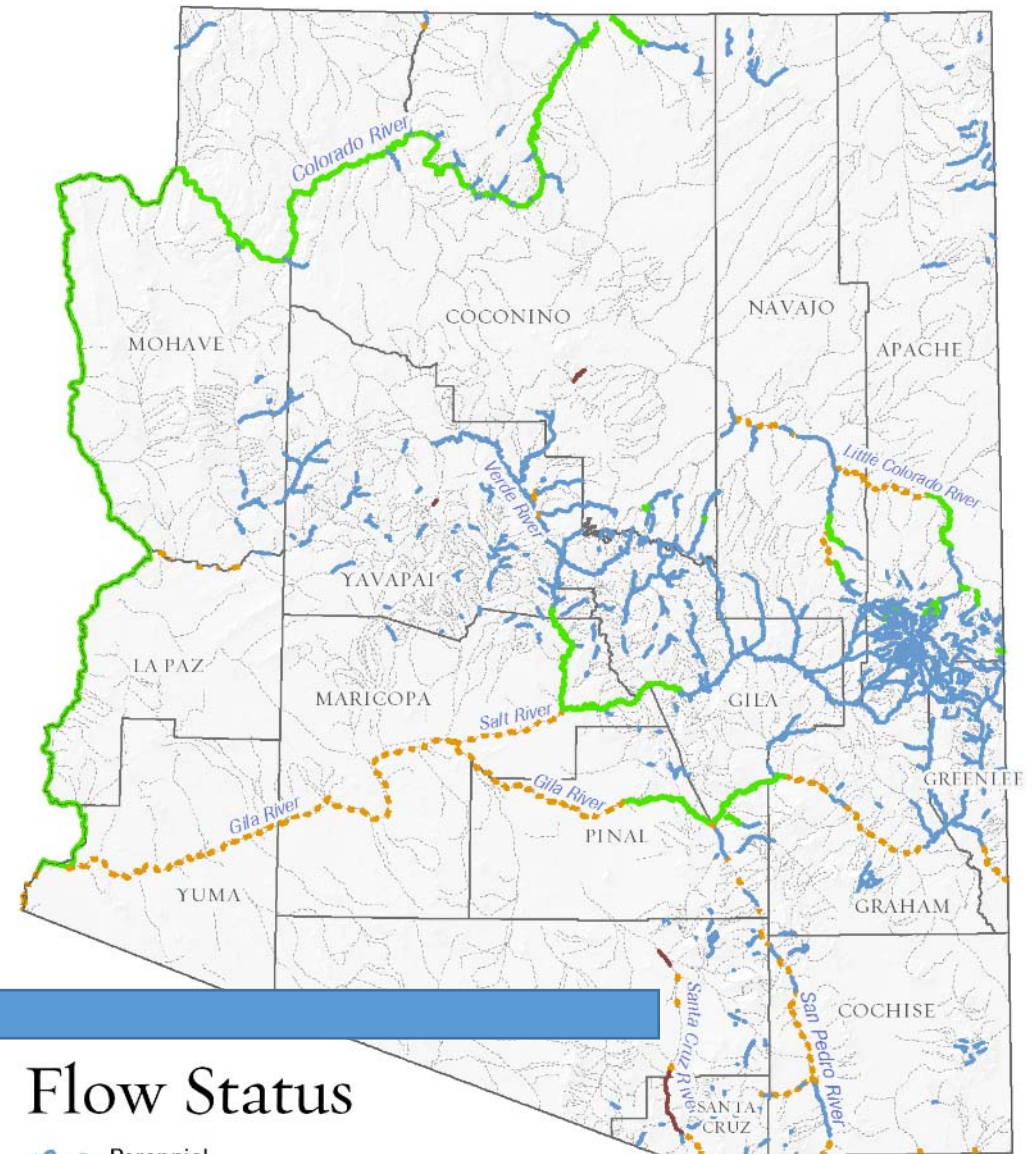
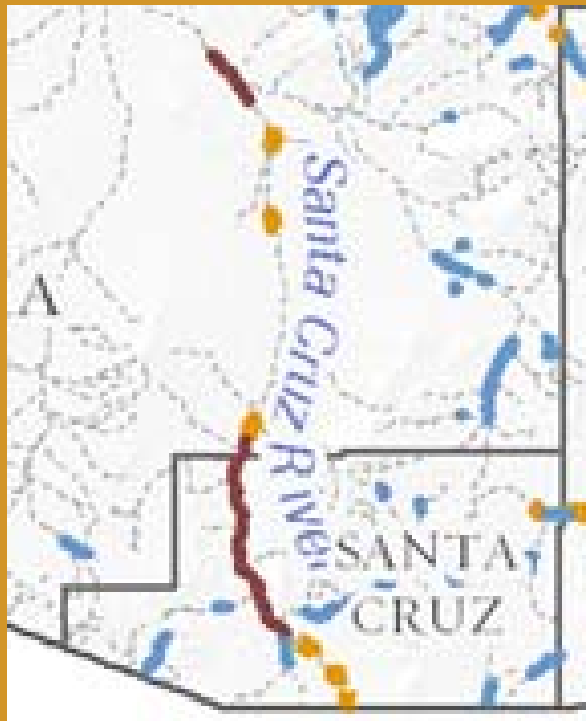







# a living river

TRACKING CHANGING CONDITIONS ALONG THE  
EFFLUENT STRETCHES OF THE SANTA CRUZ RIVER





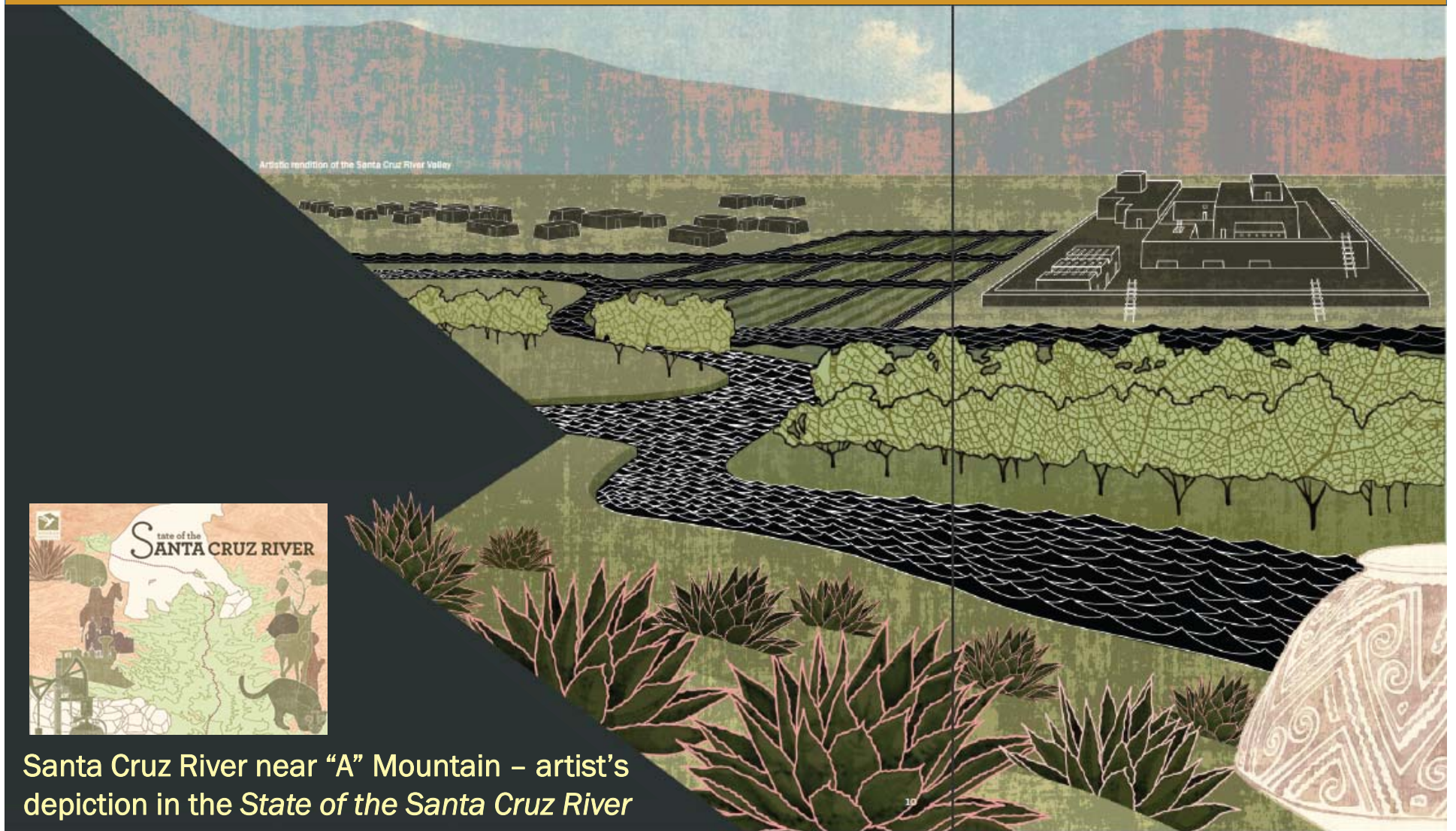
## Flow Status

-  Perennial
-  Formerly Perennial
-  Regulated
-  Effluent Dominated (May Be Formerly Perennial)
-  Intermittent or Ephemeral

The Nature Conservancy   
Protecting nature. Preserving life.™

Flow status data created from TNC Freshwater Assessment, available from [azconservation.org](http://azconservation.org)

# 12,000 years of rich history



Santa Cruz River near "A" Mountain – artist's depiction in the *State of the Santa Cruz River*



Santa Cruz River near "A" Mountain, 1904



Santa Cruz River near  
Tumacácori, 2015



Santa Cruz River near Ina Road, 2014

T. Moody



# How do we document changes?



Pima County

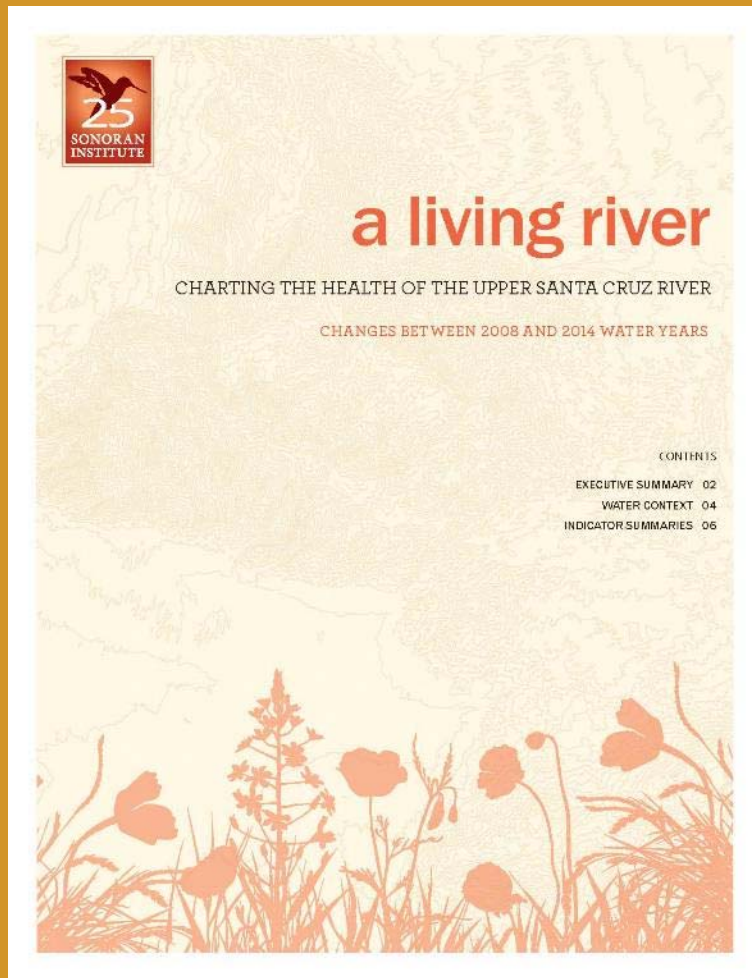
# Living River report series tracks improvements on Upper Santa Cruz River



- Effluent stretch in Santa Cruz County
- 2008-2010 water years



# Changes over last 7 years



# Changes over last 7 years



## a living

CHARTING THE HEALTH OF THE UPPER SANTA CRUZ RIVER

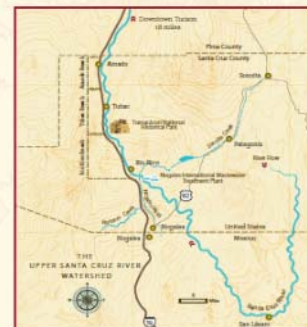
CHANGES BETWEEN 2008 AND 2014

## THE UPPER SANTA CRUZ RIVER: A LIVING ECOSYSTEM

The Upper Santa Cruz River in Santa Cruz County flows year-round from a biologically diverse region. River flows are sustained by effluent discharge from the Nogales International Wastewater Treatment Plant (NIWTP) which treats and reclaims water from sewage in Nogales, Sonora. In the last seven years, two important changes in waste

• **Upgraded Treatment Plant:** In 2009 the NIWTP completed significant upgrades that reduced levels of nitrogen in the released effluent.

• **Wastewater Diversions:** In 2013 Nogales, Sonora completed construction of a wastewater diversion system that treats some of the wastewater that would otherwise be sent to NIWTP. Effluent from this system flows south into Sonora.



2



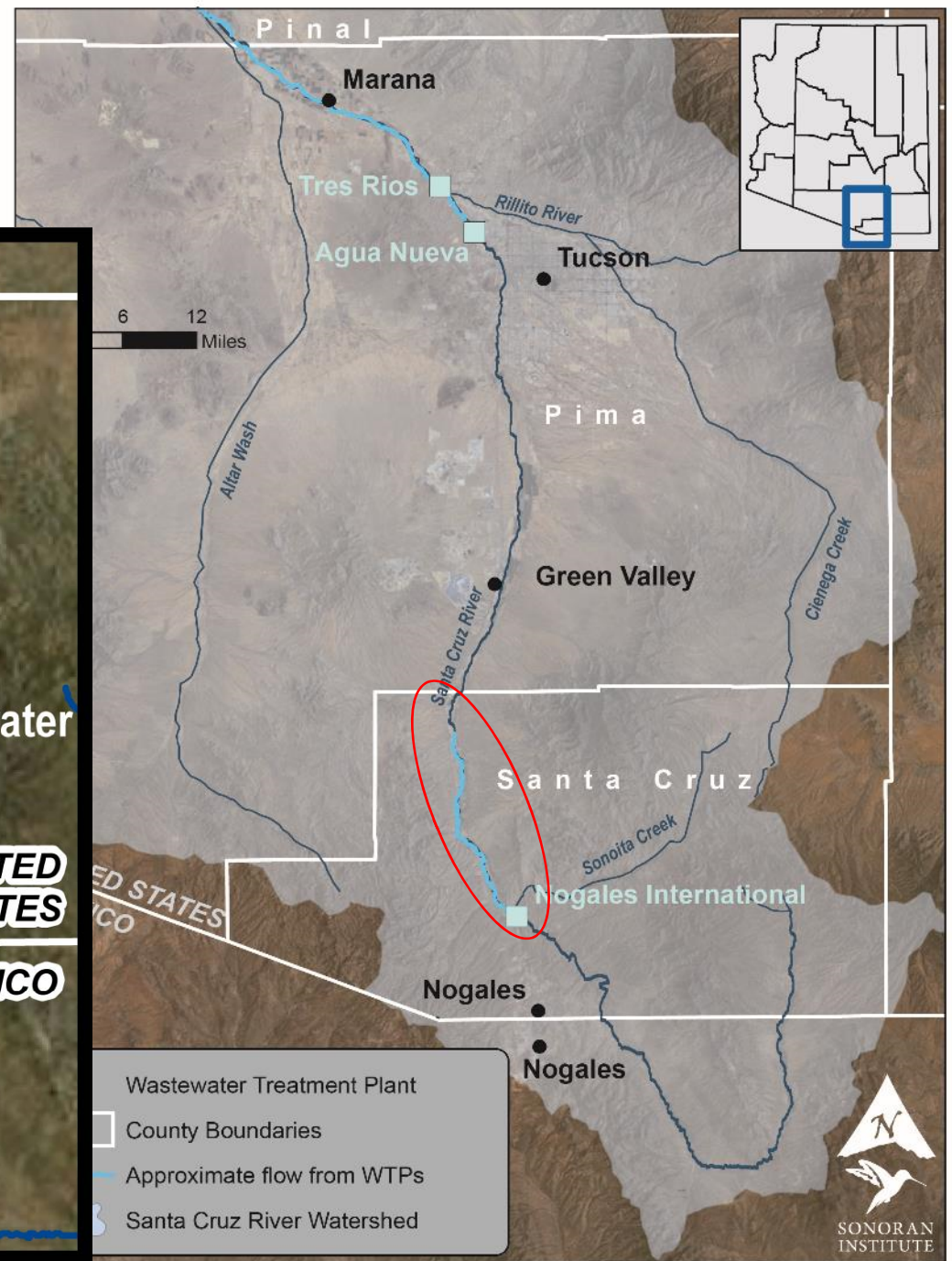
## E. COLI

*Escherichia coli* (*E. coli*) is one of the common species of bacteria living in the lower intestines of mammals, and its presence in water is an indication of fecal contamination. The discovery of *E. coli* indicates the potential presence of other pathogenic microorganisms such as bacteria and viruses that might be a health risk to people swimming or wading in the river. The ADEQ standard for a single sample maximum for full body contact (swimming) is 235 colony-forming units per 100 milliliters of water (CFU/100mL). For partial body contact (wading), the single sample maximum is 578 CFU/100mL. The results are compared to the stricter standard, thus samples with greater than 235 CFU/100mL do not meet the standard.

### 2008-2014 Summary

*E. coli* levels varied seasonally and were similar in all three reaches. The Nogales International Wastewater Treatment Plant has always removed bacteria prior to release of effluent in the river, thus levels of *E. coli* did not change after the upgrades were complete. Levels of *E. coli* exceeded the standard most often during the rainy seasons. High levels during the rainy season suggest that rain is washing fecal contamination into the river from multiple sources within the watershed. Preliminary research identifies humans, livestock, and wildlife among the sources of contamination.

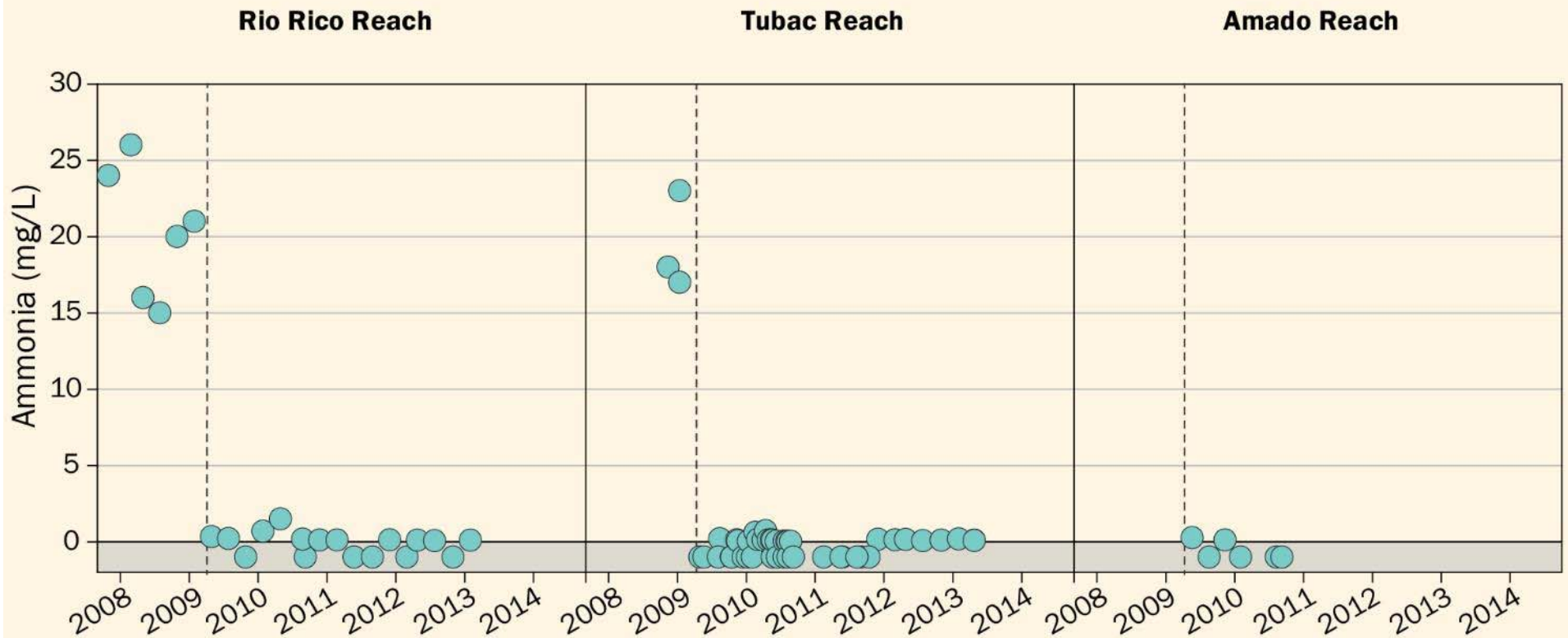






# Ammonia decreases

Direction of Flow >>>>



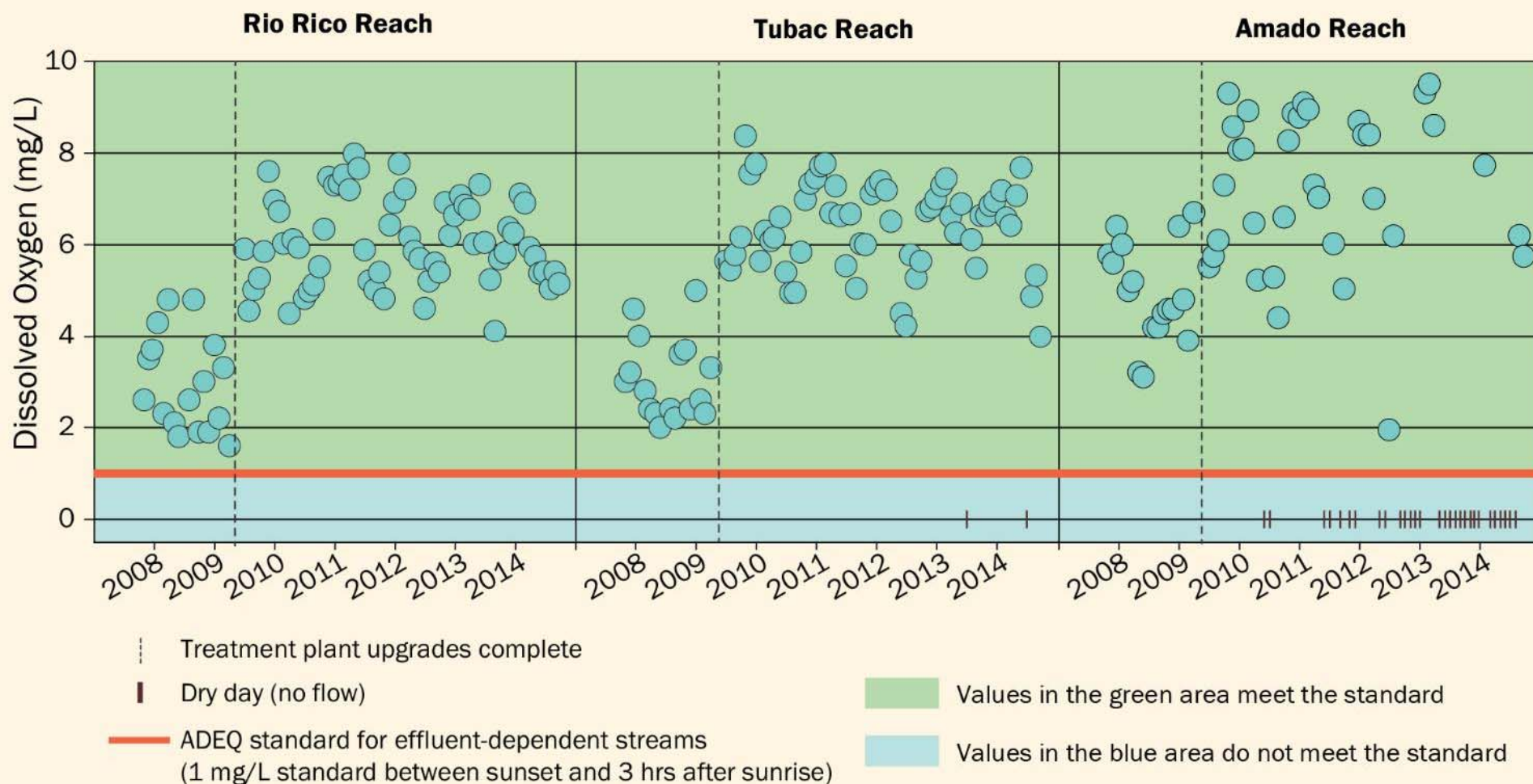
Note - Ammonia standards vary with temperature and pH and can't be graphed as a single line

--- Treatment plant upgrades complete  
Ammonia not detected for points in the gray area



# Oxygen increases

Direction of Flow >>>>

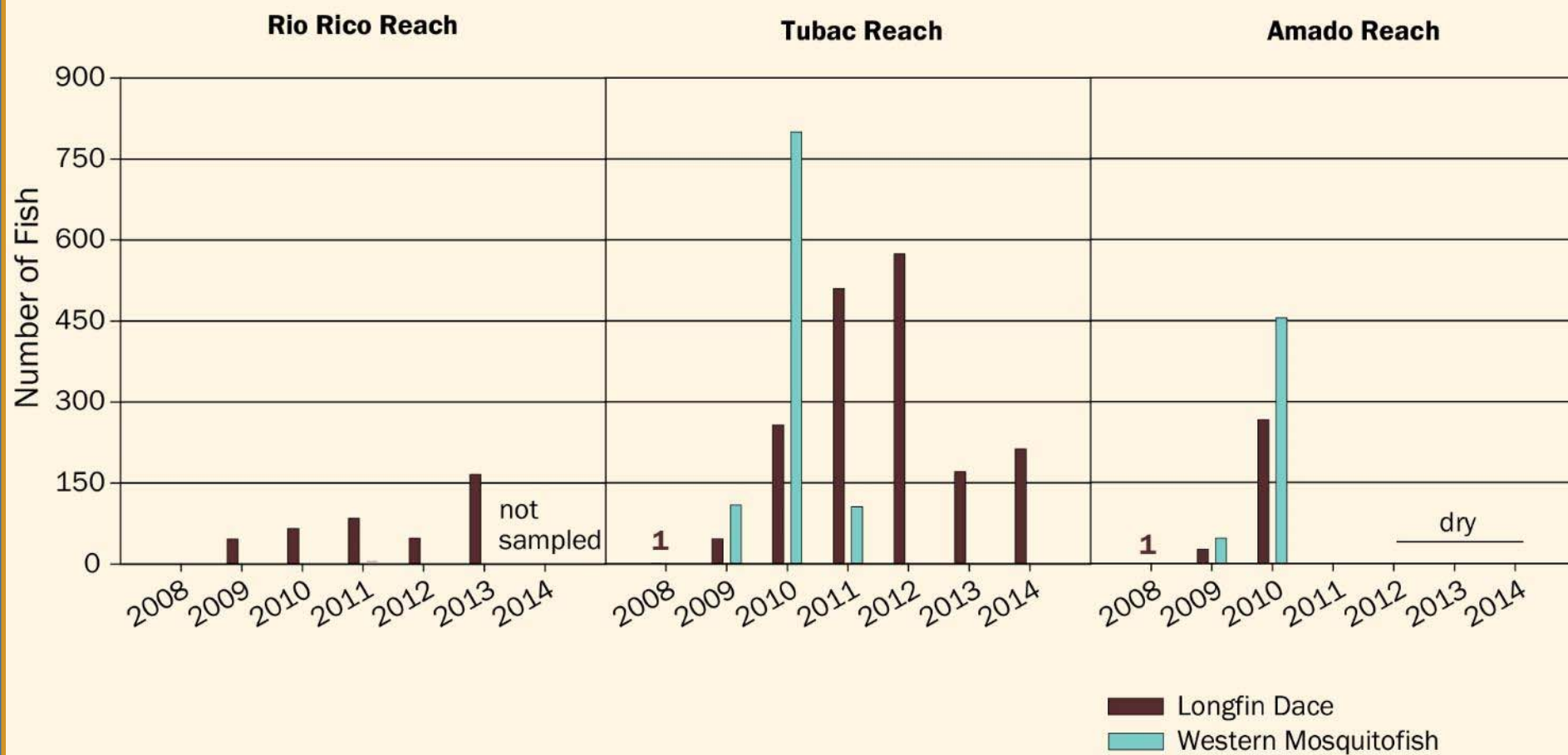






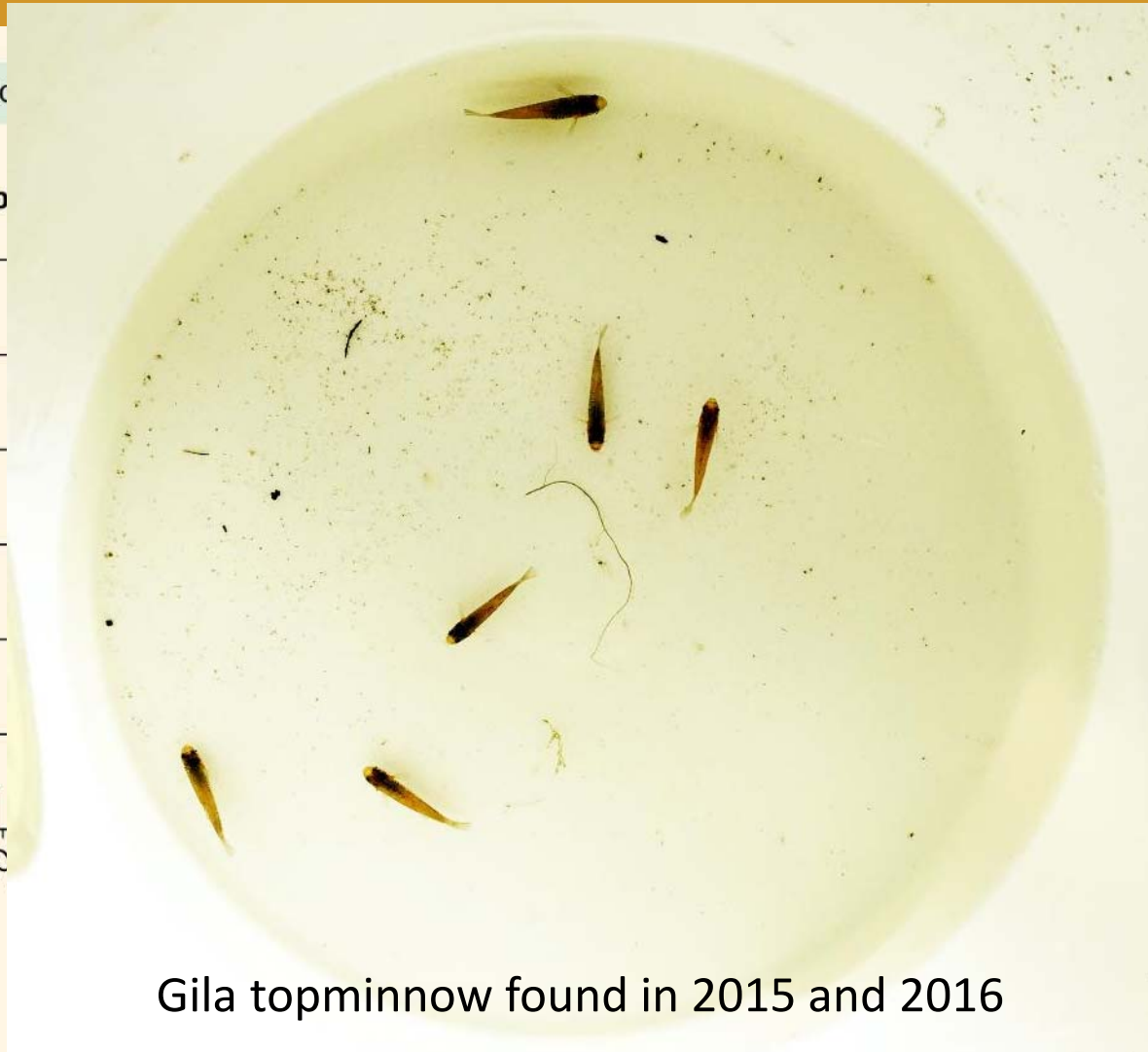
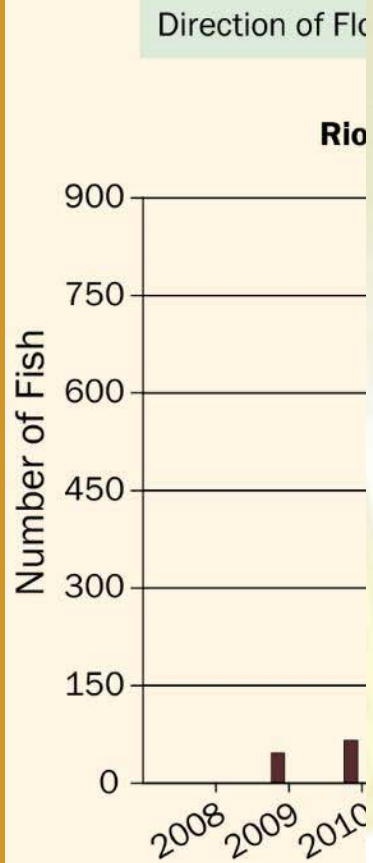
# Fish return!

Direction of Flow >>>>



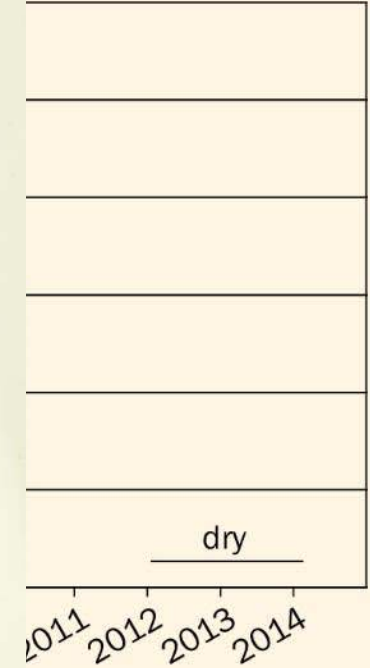


# Fish return!



Gila topminnow found in 2015 and 2016

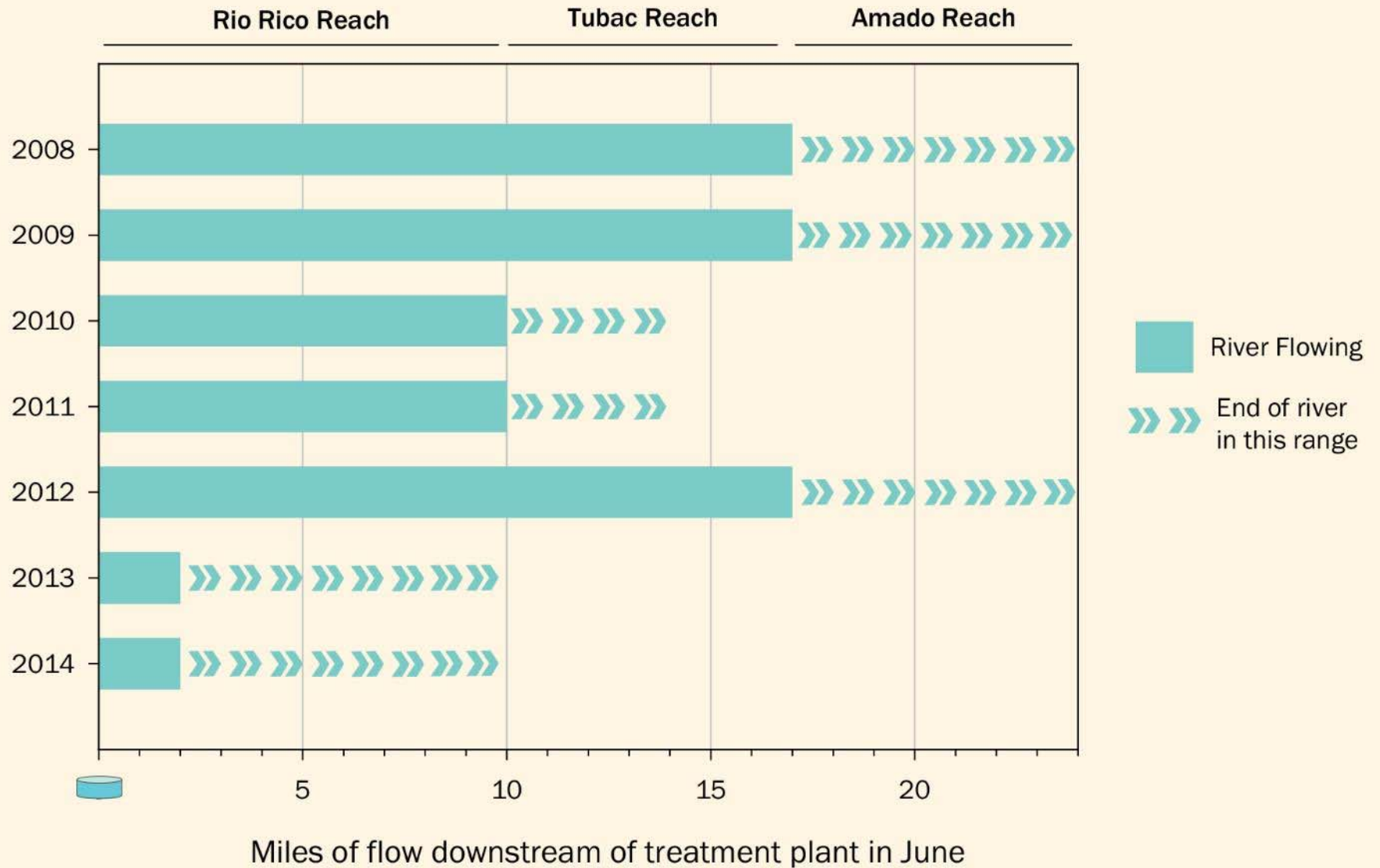
nado Reach

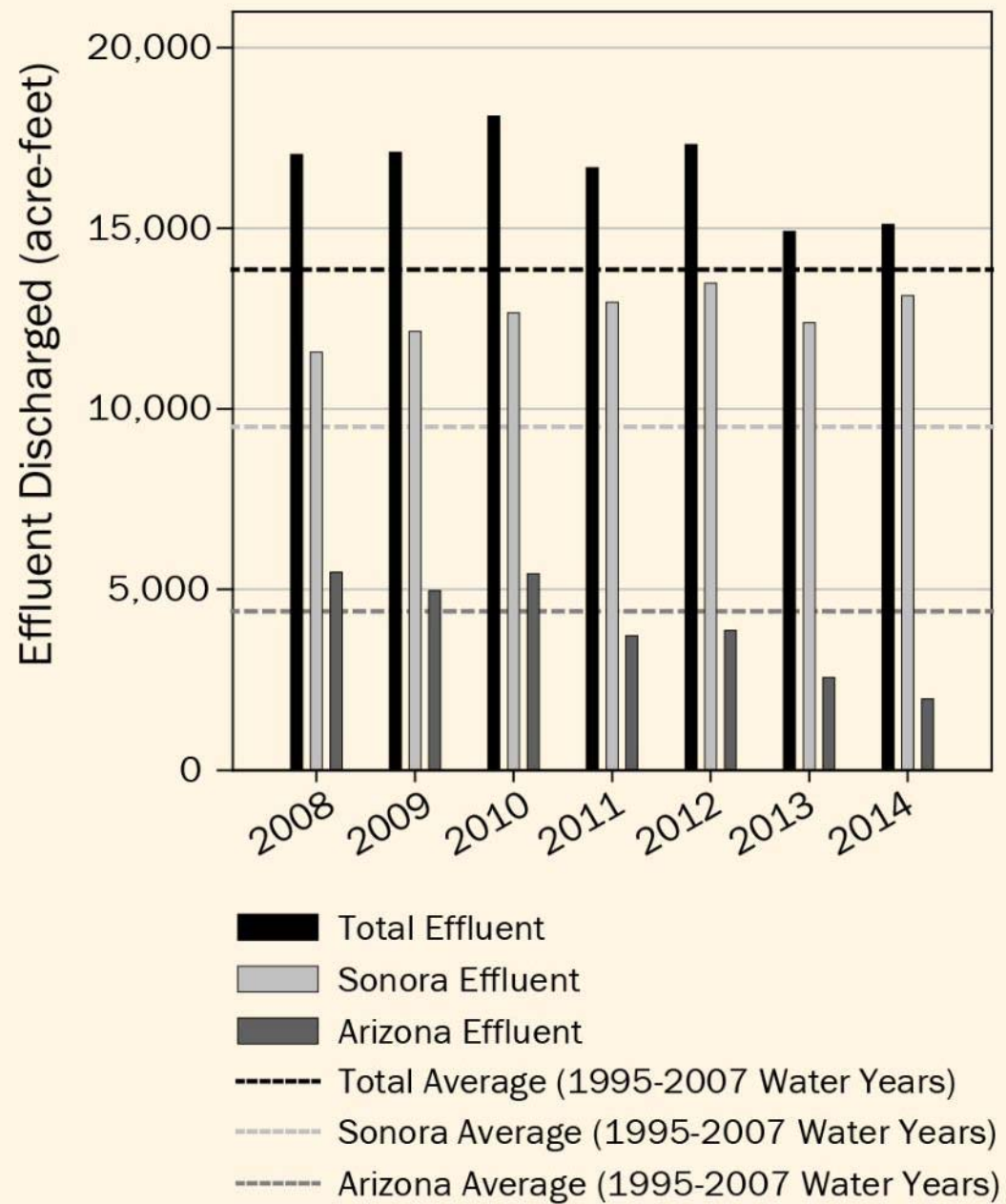


ace  
Mosquitofish



# Fewer miles of flow in June







# Trees stressed at end of reach

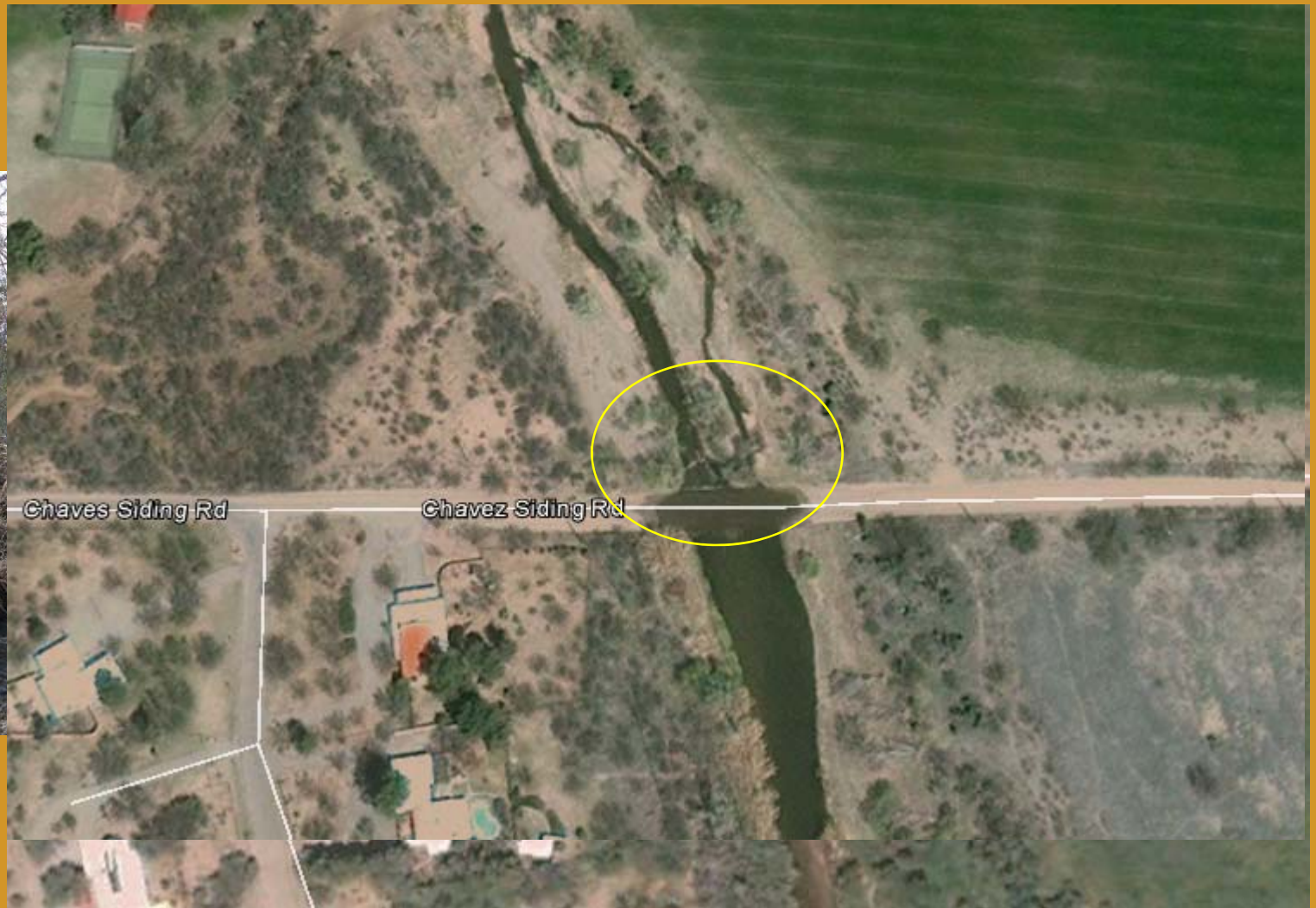


August 2010



# Trees stressed at end of reach

March 2010





# Trees stressed at end of reach

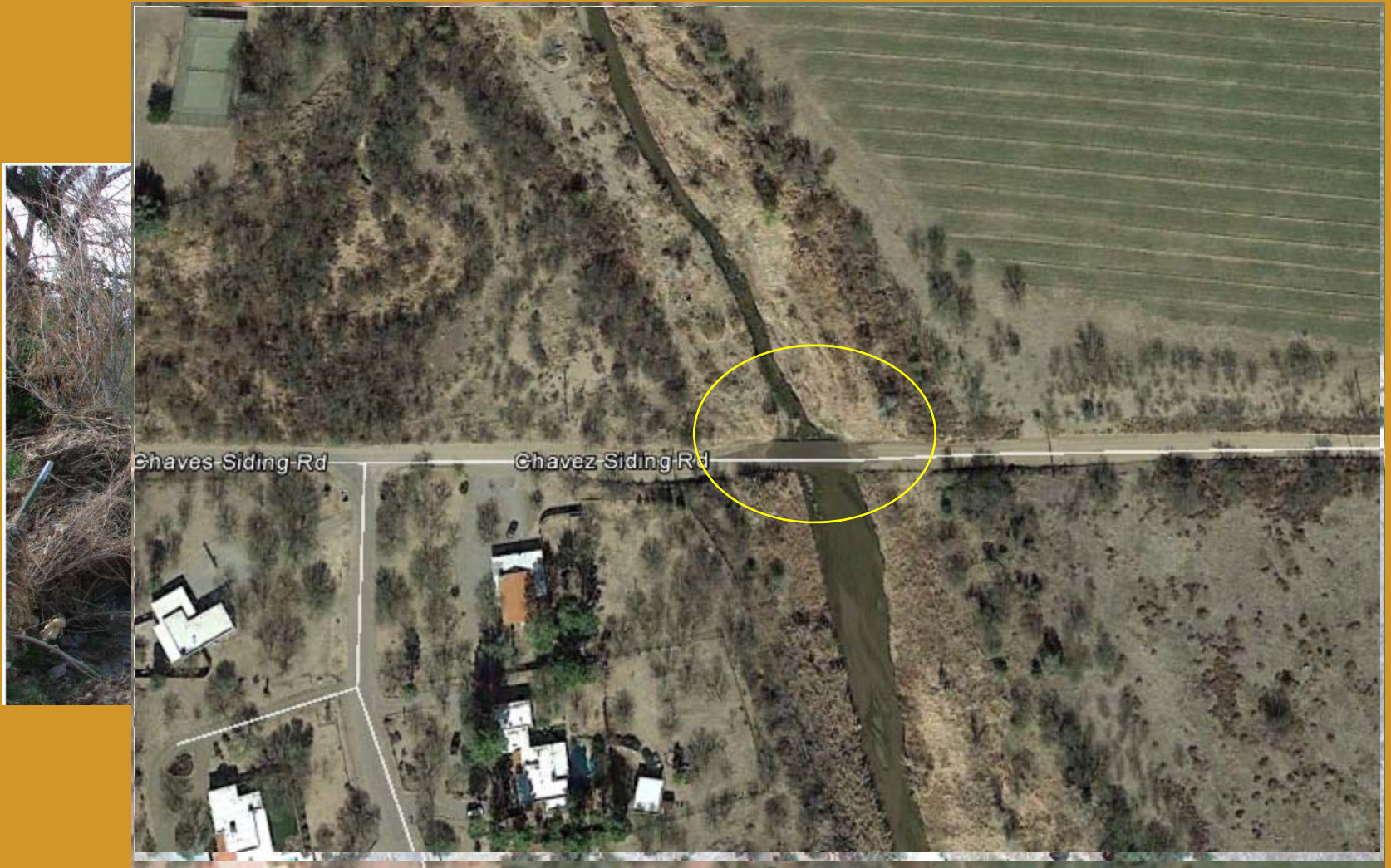
June 2011





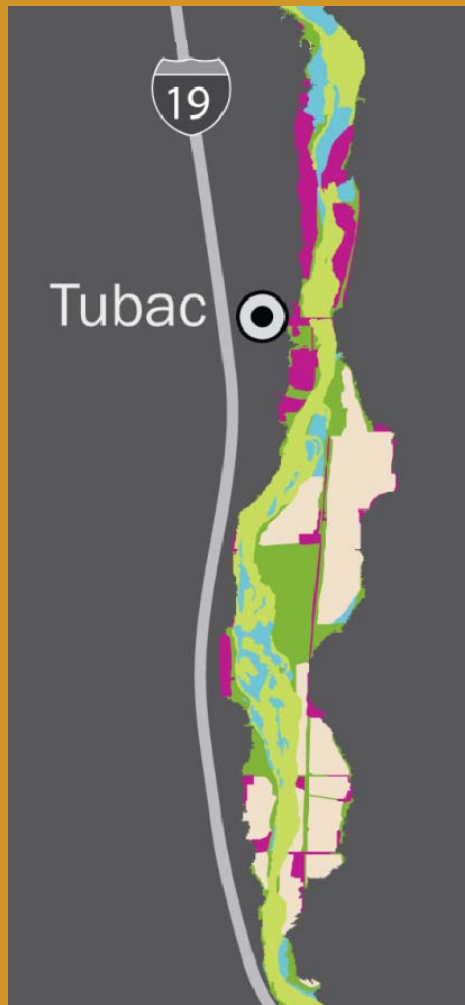
# Trees stressed at end of reach

Jan 2016





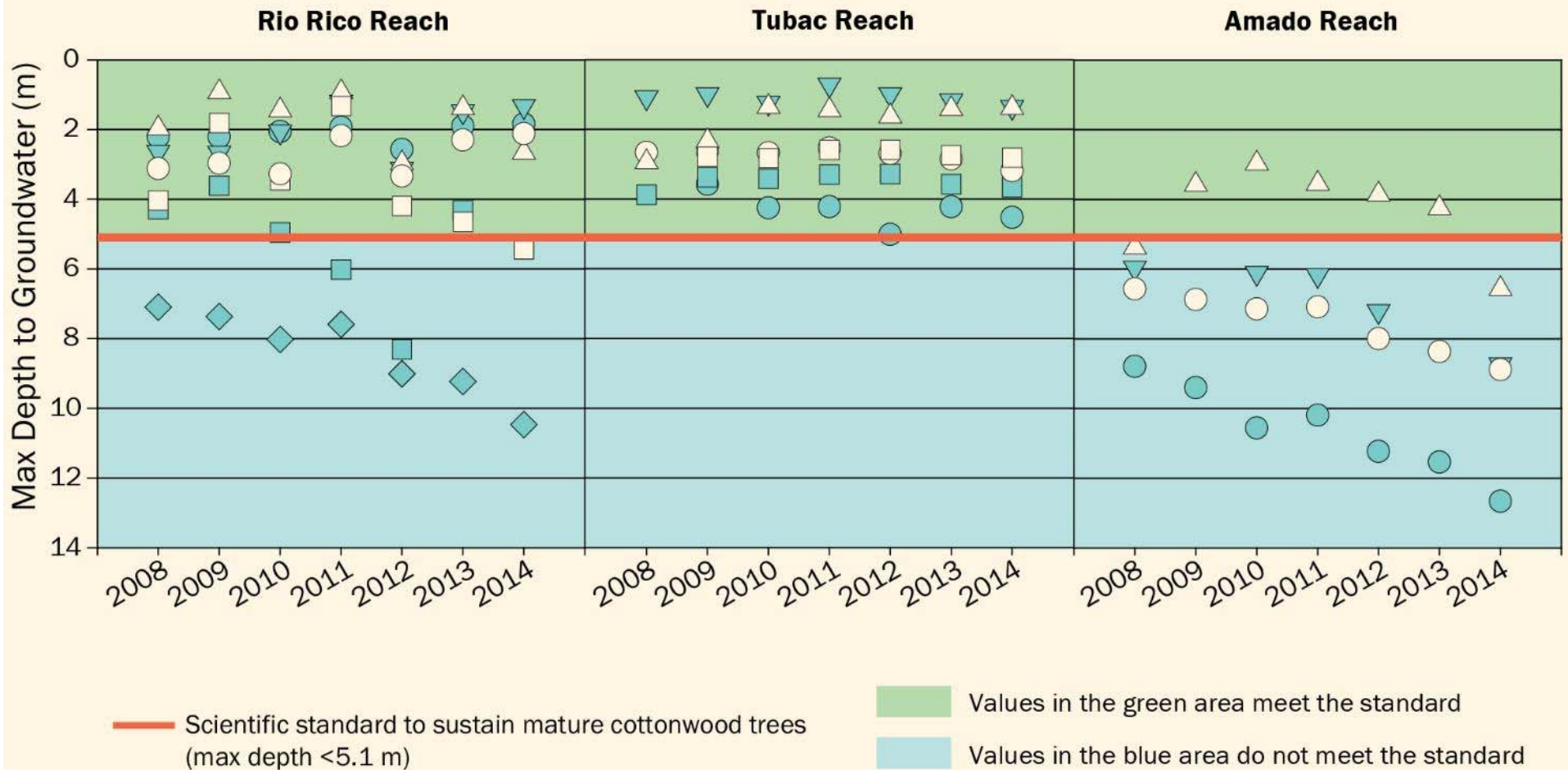
# Trees likely stable in Tubac reach





# Groundwater stable in Tubac

Direction of Flow >>>>



# Upper Santa Cruz Summary

- River health improves
- Flow extent reduced
- Effluent not secure
- Allocating water for the river
  - Community values
  - Conservation priorities
  - Binational solutions
- Opportunities for the Lower Santa Cruz



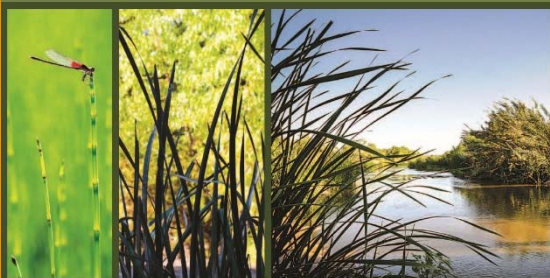
# Lower Santa Cruz





# a living river

CHARTING WETLAND CONDITIONS OF THE LOWER SANTA CRUZ RIVER  
2013 Water Year



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2013 Water Year  
*Baseline*

# a living river

CHARTING WETLAND CONDITIONS OF THE LOWER SANTA CRUZ RIVER  
2014 Water Year



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2014 Water Year

# a living river

CHARTING WETLAND CONDITIONS OF THE LOWER SANTA CRUZ RIVER  
2015 Water Year



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| GET INVOLVED                               | 24 |



2015 Water Year

# Water quality and clarity improved



Cloudy water, May 2013



Clear water, June 2014

# Little to no ammonia



Ammonia, average mg/L

# Increased Fish Diversity



Western Mosquitofish



Black Bullhead



Common Carp



Green Sunfish

# High infiltration and greater recharge reduces flow extent



|      | Flow In June | Dry Days At Trico Rd |
|------|--------------|----------------------|
| 2013 | 23 miles     | 0                    |
| 2015 | 16 miles     | 244                  |

# Effluent supports wetland species



# Effluent supports wetland species



# Wetland plant cover reduced in drying sections



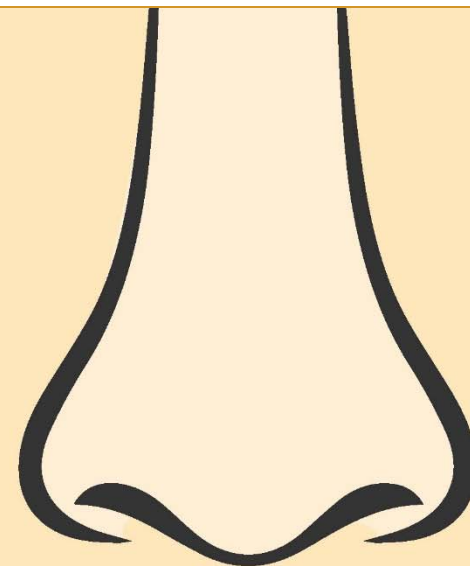
**2013**  
**2015**



Live  
Dead  
Goodding's Willow Cover



# Minimal odor leaving the facility



LEVEL OF "ROTTEN EGG" SMELL (HYDROGEN SULFIDE, OR  $H_2S$ , IN PARTS PER BILLION) ASSOCIATED WITH RECLAMATION PROCESS

**10**  
Concentration  
(ppb) allowed by  
facility permit

**0.5**  
Actual  
concentration (ppb)  
for 99% of measures



# Lower Santa Cruz Summary

- River health improves
- Flow extent reduced
- Effluent not secure
- Allocating water for the river
  - Community values
  - Conservation priorities
  - Balanced solutions



# Questions?

Claire Zugmeyer  
czugmeyer@sonoraninstitute.org



## OUR FUNDERS

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US Environmental Protection Agency

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National Park Service Desert Southwest Cooperative Ecosystems Studies Unit

Pima County

Southwestern Foundation for Education and Historical Preservation

Tohono O'odham 12% Gaming Distribution Funds



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