



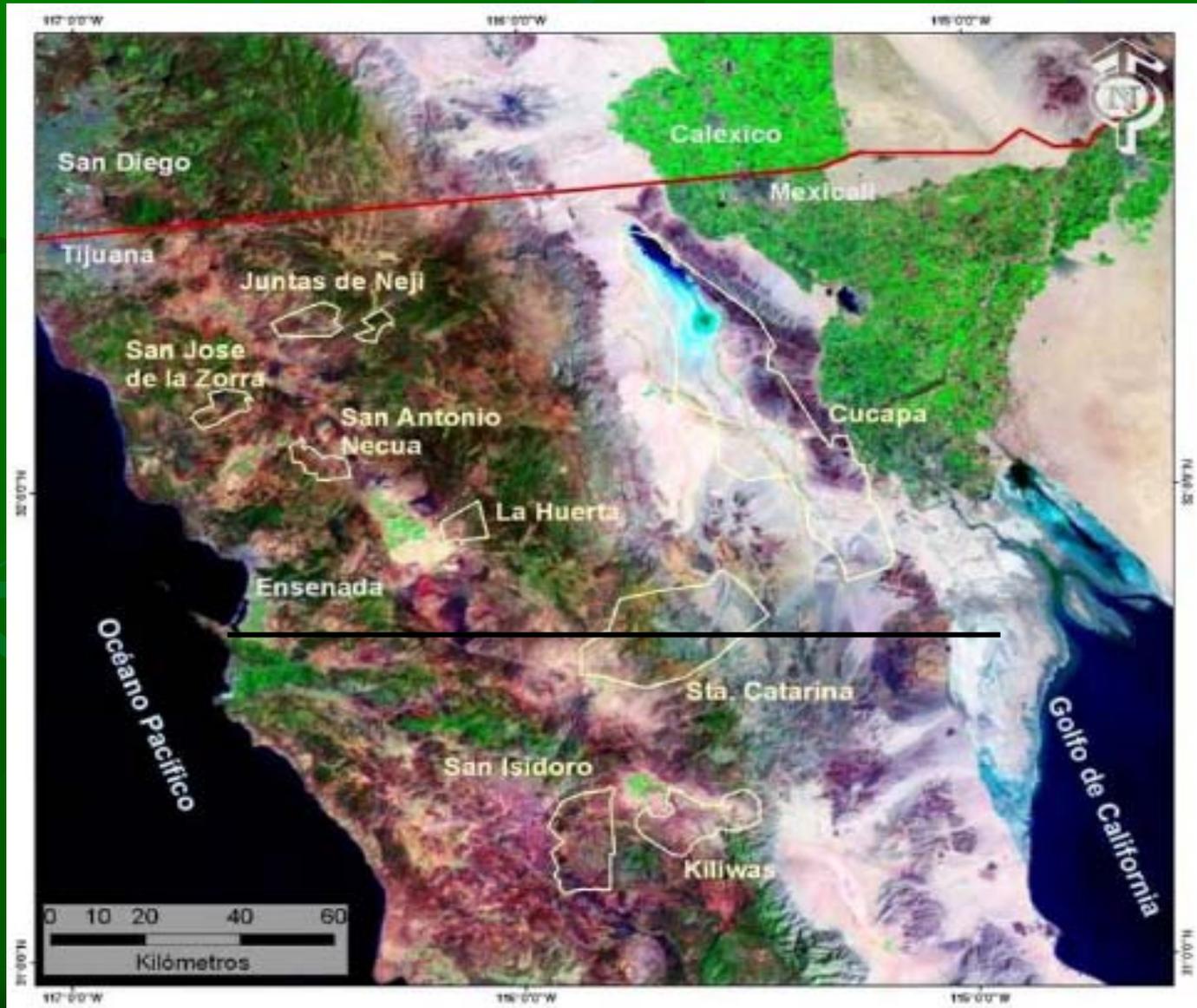
# **Improved Water Quality and Community Health in the Border Indigenous Communities of Baja California**

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# Presentation Outline

- Background
- Phase I – Initial Assessment
- Phase II – Water Quality and Health Surveys
- Phase III – Infrastructure Assessment
- Phase IV – Infrastructure Improvements
- Phase V – Infrastructure O & M
- Phase VI – Epidemiological Study
- Community-Based Approach
- Lessons Learned and Next Steps

# Background: Indigenous Communities of Northern Baja Mexico



# Background: Indigenous Groups of Baja California Border Region

- 2 Baja CA native indigenous groups with a permanent land base entirely within 100 km of the border:
  - Kumiai (Kumeyaay)
  - Cucapá (Cocopah)
- Paipai could be considered a third because part of their land is within the 100 km
- All are directly related to tribes in the US, some continuing to inhabit ancestral territory that was divided by the U.S.-Mexican border



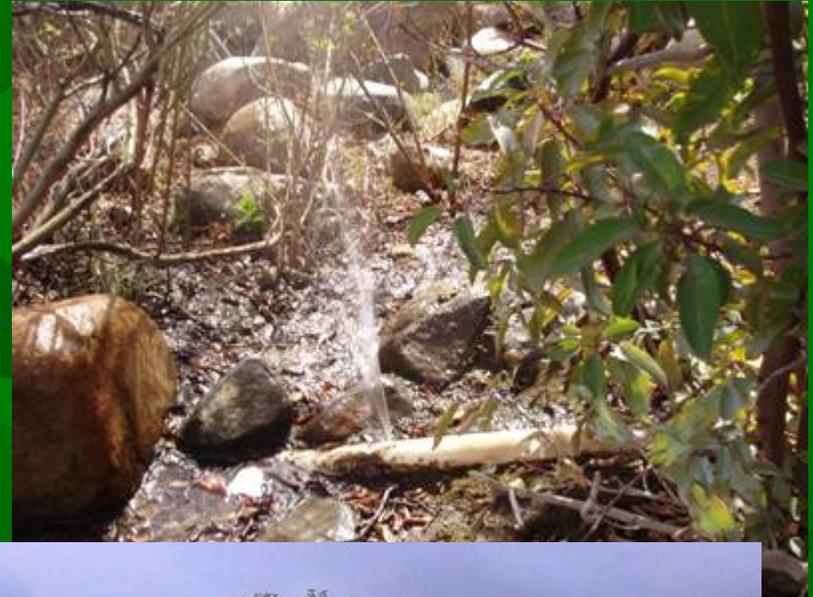
# Background: Indigenous Governance In Mexico

- All tribal communities have their own governments that may include both traditional and elected authorities
- Most tribes hold regular community *asambleas*, or meetings, to discuss issues and make decisions
- There are regional councils such as the Baja California Intertribal Council, which includes elected and traditional authorities from Kumiai, Paipai, Kiliwa and Cucapá tribes at the state level



# Background: Water Issues

- Lack of infrastructure
  - Most communities utilize hand dug wells or spring boxes
- Operation and maintenance concerns
- Quantity and quality
- Non-point source contamination and source water protection



# Background: Water Issues



Infrastructure Issues

# Background: Water Issues



Storage and transportation issues

# Background: Non-point source contamination



# Background: Environmental Health

- Higher rates of gastrointestinal illnesses
- Wastewater management issues
- Lack of infrastructure
- Operation and maintenance of current systems



# Phase I: Initial Assessment

- 1996-1998 Mike Wilken and Campo Tribe conduct a wetlands restoration project in San Jose de la Zorra
- Found drinking water in some Indigenous Communities to be contaminated with fecal coliform

# Phase II: Water Sampling and Environmental Health Survey

## Study

- Drinking water samples taken in 4 communities
  - JA JAN Coalition – Laboratory Network
  - *US EPA / Mexican Standard*
  - Indicator Bacteria (*E. coli* / Total Coliform)
  - IDEXX System (Standard Method)
  - Data Reports generated



# EVALUATION OF BACTERIA LEVELS IN DRINKING WATER OF INDIGENOUS COMMUNITIES OF BAJA CALIFORNIA

Monitoring conducted on April 16th and 17th, 2005

Place	Risk Level	Total Coliforms (MPN/100-ml)	<i>E. coli</i> (MPN/100-ml)
Kiliwas Faustinos storage drum 04/16/05 (54 hour hold time)	Moderate-High Risk	1413.6 (866.4)	63.1 (95.9)
Kiliwas Reservoir 04/16/05 (53 hour hold time)	High Risk	980.4 (648.8)	79.8 (115.3)
Santa Catarina Intake hose in river 04/16/05	Moderate Risk	1986.28 (1413.60)	44.3 (52.9)
Cucapa Museum tap 04/17/05	Low Risk	27.2 (6.3)	2.0 (<1.0)
Cucapa School tap 04/17/05	No Risk	<1.0	<1.0
Cucapa River, pump intake 04/17/05	Low Risk	248.1 (<1.0)	1.0 (<1.0)

The health risk levels established by the World Health Organization (WHO) for drinking water contaminated with *E.coli* :

1-10            low risk  
 11-100       moderate risk  
 101-1,000   high risk  
 >1,000       very high risk

Source: WHO Guidelines for Drinking Water Quality

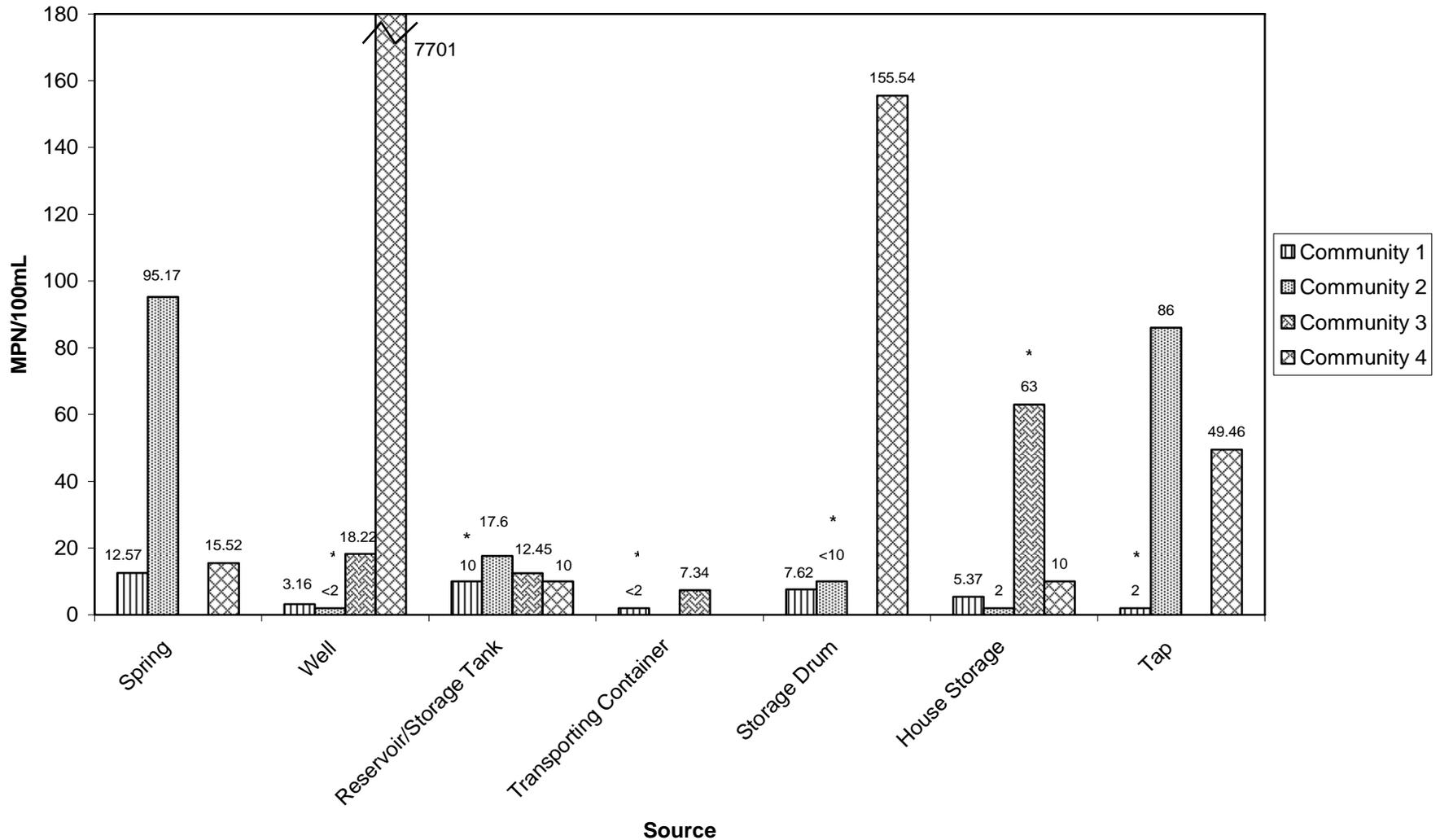
# Results

- Community 1 – San Antonio Necua (SAN)
- Community 2 – Santa Catarina (SC)
- Community 3 – San Jose de la Zorra (SJZ)
- Community 4 – La Huerta (LH)

# Median and Range of Water Samples from the Four Communities by Source

Water Source	Community 1			Community 2			Community 3			Community 4		
	N	Median	Range	N	Median	Range	N	Median	Range	N	Median	Range
<b>Spring/Stream/Creek</b> Total Coliform	4	924	75 – 1454	3	3973	1777 – 4884				2	1973.5	1120 – 2827
<i>E. Coli</i>		16	2 – 52		145	41 – 145					121	<2 – 241
<b>Well</b> Total Coliform	4	9	1 – <10	1	88		7	2420	299 – >2419	1	299	
<i>E. coli</i>		7	1 – <10		<2			13	<1 – 727		7701	
<b>Reservoir/Storage Tank</b> Total Coliform	1	2599		2	562	450 – 674	2	12517.5	5172 – 19863	1	4106	
<i>E. Coli</i>		10			21	10 – 31		18	<10 – 31		<10	
<b>Transporting Container</b> Total Coliform	1	>4838					8	1211.5	179 – 24196			
<i>E. Coli</i>		<2						<10	<1 – 317			
<b>Storage Drum</b> Total Coliform	2	297	267 – 326	1	1935					2	13305.5	>4838 – >24192
<i>E. Coli</i>		16	2 – 29		<10						12096.5	<2 – >24192
<b>House Container</b> Total Coliform	3	50	<10 – 882		1733			517		1	4106	
<i>E. Coli</i>		<10	<2 – 31	1	2		1	63			<10	
<b>Tap</b> Total Coliform		206			>2419					3	3654	2827 – >24192
<i>E. Coli</i>	1	2		1	86						<10	<2 – >24192

Geometric Mean of *E. coli* (MPN/100mL) by Source



Geometric mean of *E. coli* (MPN/100mL) by source. Asterisk indicates that n = 1

# Phase II: Environmental Health Survey and Water Sampling

- Environmental health and sanitary surveys taken in same 4 communities
  - a 1x survey taken for initial visit
  - Followed by a survey every 2 weeks over 4 months
  - Survey instruments implemented by community *promotoras*
  - Instrument designed in collaboration with community doctor, health agencies and SDSU GSPH faculty



# Phase II: Survey Results

What was the main source of water for your family?								
	Community 1		Community 2		Community 3		Community 4	
	n	%	n	%	n	%	n	%
Community Fountain	6	8.7	<b>113</b>	<b>52.1</b>	21	10.6	<b>154</b>	<b>95.1</b>
Purchased Water	6	8.7	71	32.7	3	1.5	3	1.9
Small Pond	3	4.3	0	0	19	9.5	4	2.5
Spring	<b>50</b>	<b>72.5</b>	15	6.9	1	0.5	1	0.6
Water Wheel	0	0	0	0	12	6.0	0	0
Reservoir/Storage Tank	0	0	0	0	1	0.5	0	0
Well	2	2.9	16	7.4	<b>142</b>	<b>71.4</b>	0	0
Purified Water	1	1.4	0	0	0	0	0	0
No Answer	1	1.4	2	0.9	0	0	0	0
Total	69		217		199		162	
What type of container was used to transport the water?								
Large Drum	15	21.7	53	24.4	9	4.5	6	3.7
Bucket	5	7.2	41	18.9	<b>152</b>	<b>76.4</b>	<b>141</b>	<b>87.0</b>
Gravity Piping	<b>23</b>	<b>33.3</b>	57	26.3	3	1.5	0	0
5-Gallon Jug	10	14.5	<b>63</b>	<b>29.0</b>	7	3.5	9	5.6
Filter	0	0	0	0	1	0.5	0	0
Hose	15	21.7	2	0.9	26	13.1	0	0
Pila	0	0	2	0.9	1	0.5	0	0
Spigot	0	0	1	0.5	0	0	2	1.2
Zinc	0	0	0	0		0	3	1.9
No Answer	1	1.4	4	1.8	1	0.5	1	0.6
Total	69		217		199		162	

### What type of container did you use to store water in your home?

Large Drum	<b>25</b>	<b>36.8</b>	60	27.6	55	27.6	4	2.5
Bucket	12	17.6	<b>106</b>	<b>48.8</b>	<b>113</b>	<b>56.8</b>	<b>138</b>	<b>85.2</b>
5-Gallon Jug	21	30.9	59	27.2	17	8.5	8	4.9
Key/Spigot	1	1.5	0	0	2	1.0	0	0
Hose	2	2.9	0	0	0	0	0	0
Water Filter	0	0	0	0	7	3.5	0	0
Thermos	0	0	1	0.5	4	2.0	0	0
Well	0	0	1	0.5	2	1.0	2	1.2
Zinc	0	0	0	0	0	0	5	3.1
Do Not Know	0	0	0	0	0	3	1.9	
No Answer	4	5.6	11	5.1	2	1.0	1	0.6
Total	68		217		199		162	

### Is the water storage container covered?

Yes	<b>59</b>	<b>85.5</b>	<b>201</b>	<b>92.6</b>	<b>153</b>	<b>76.9</b>	<b>96</b>	<b>59.3</b>
No	5	7.2	6	2.8	43	21.6	61	37.7
Do Not Know	1	1.4	0	0	3	1.5	0	0
No Answer	4	5.8	10	4.6	0	0	5	3.1
Total	69		217		199		162	

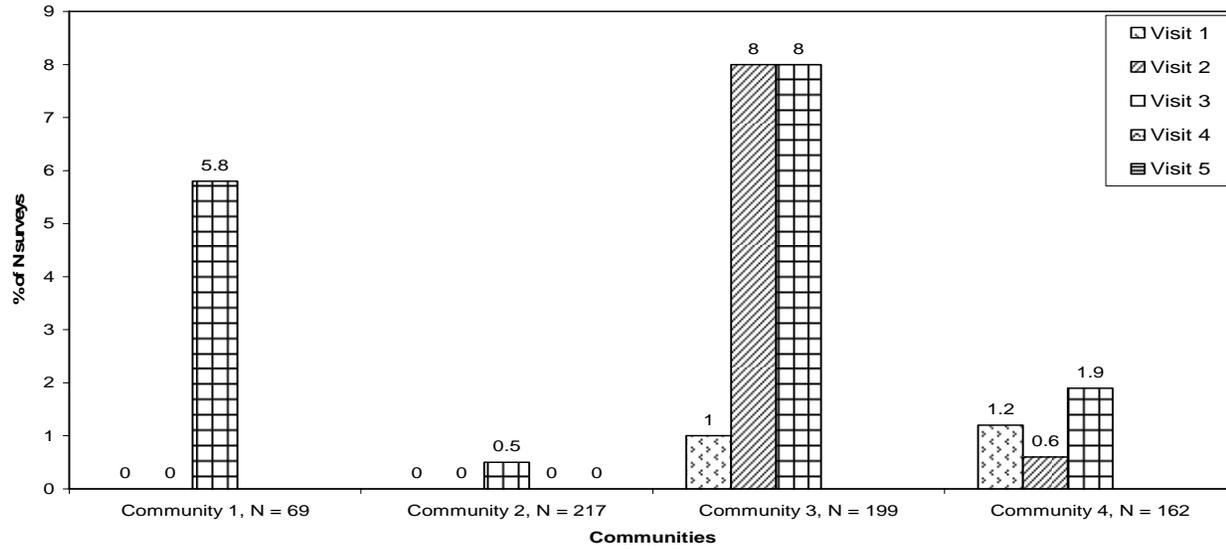
### Where is the water storage container kept?

Floor	8	11.8	26	12.0	16	8.0	14	8.6
On a rock on the floor	3	4.4	36	16.6	18	9.0	36	22.2
On top of furniture	<b>46</b>	<b>67.6</b>	<b>136</b>	<b>62.7</b>	<b>138</b>	<b>69.3</b>	<b>108</b>	<b>66.7</b>
Inside the House	6	8.8	16	7.4	21	10.6	<b>140</b>	<b>86.4</b>
Outside of the house	3	4.4	8	3.7	14	7.0	2	1.2
On the dirt	4	5.9	11	5.1	4	2.0	0	0
On a bucket	0	0	0	0	1	0.5	0	0
Water is purchased	1	1.5	0	0	0	0	0	0
Spigot	0	0	0	0	0	0	1	0.6
Zinc	0	0	0	0	0	0	2	1.2
Do Not Know	1	1.5	0	0	0	0	0	0
No Answer	2	2.9	6	2.8	1	0.5	0	0
Total	68		217		199		162	

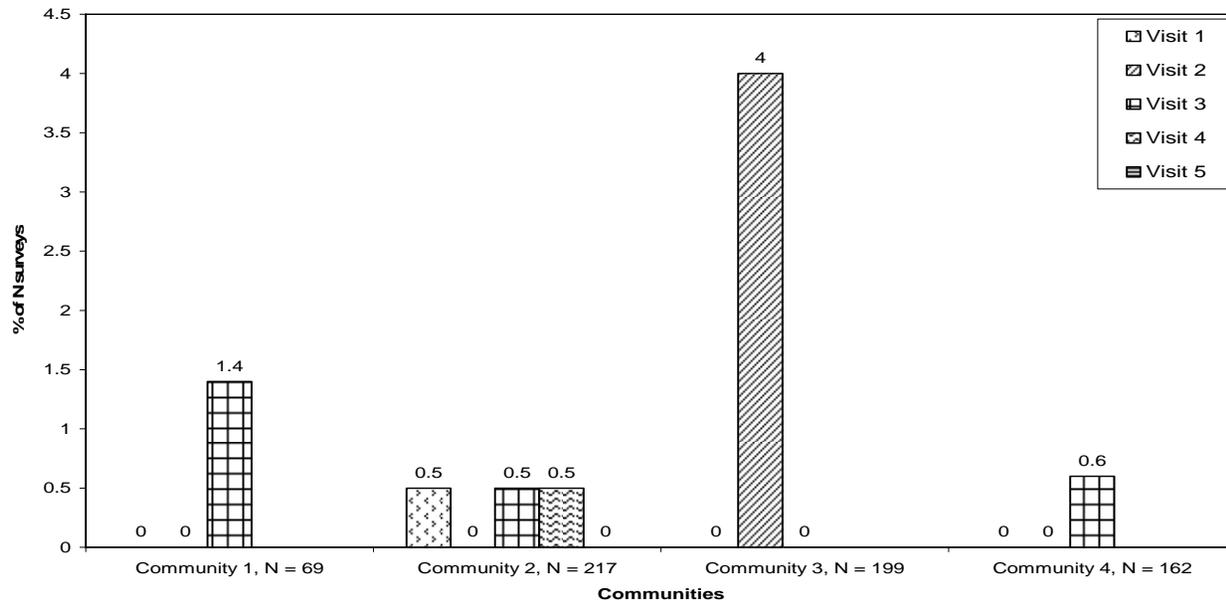
### Have you disinfected the water in the past two weeks?

Yes	23	33.8	17	7.8	24	12.1	10	6.2
Daily	1	1.5	3	1.4	4	2.0	6	3.7
2 or more times	10	14.7	6	2.8	10	5.0	2	1.2
Bleach	5	7.4	12	5.5	19	9.5	0	0
Boiling	0	0	0	0	0	0	2	1.2
No	<b>31</b>	<b>45.6</b>	<b>194</b>	<b>89.4</b>	<b>161</b>	<b>80.9</b>	<b>151</b>	<b>93.2</b>
Purchased water	9	13.2	0	0	3	1.5	0	0
Do Not Know	0	0	1	0.5	10	5.0	0	0
No Answer	0	0	5	2.3	1	0.5	1	0.6
Total	68		217		199		162	

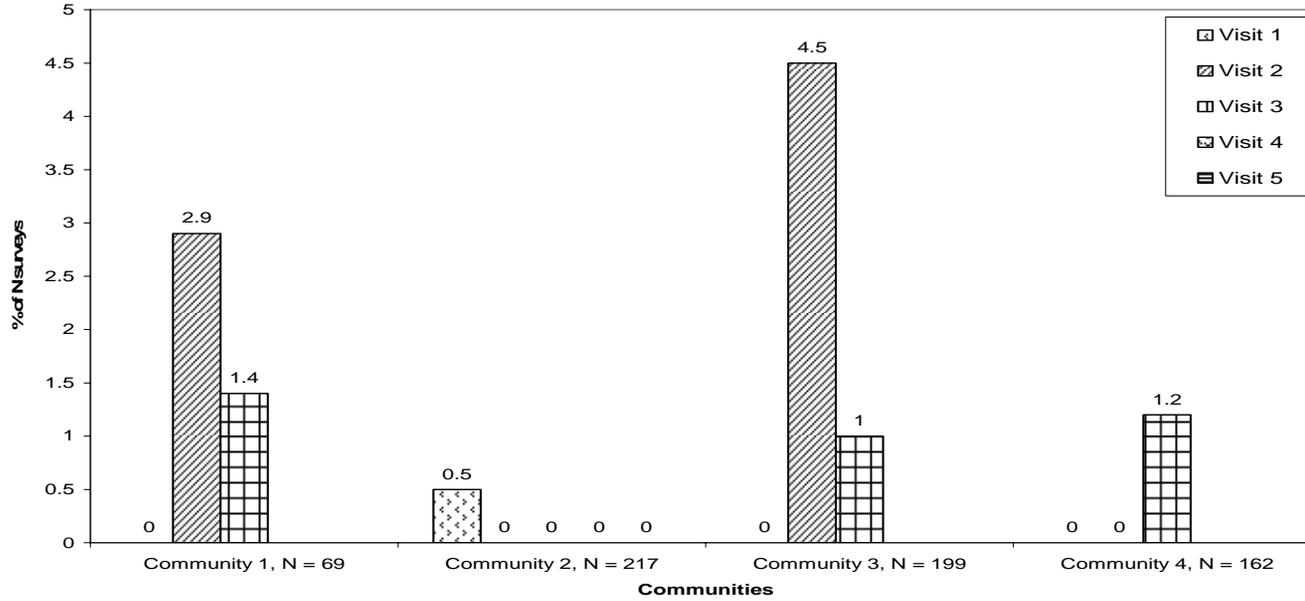
### Cases of Diarrhea in the Four Communities



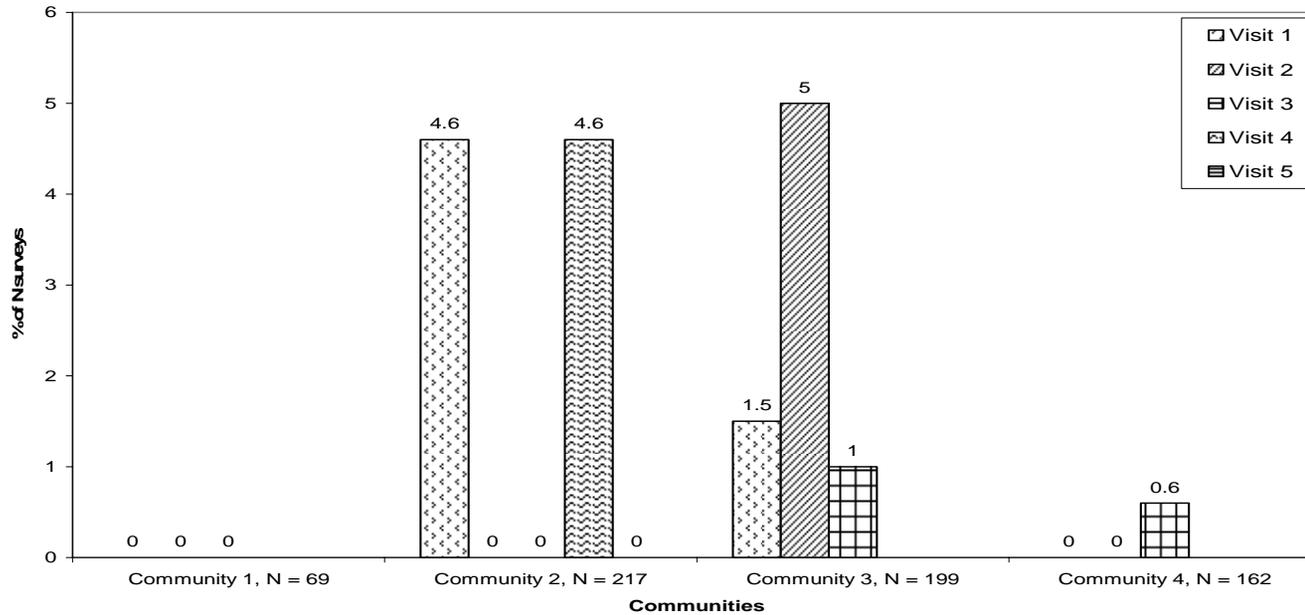
### Cases of Vomiting in the Four Communities



### Cases of Fever in the Four Communities

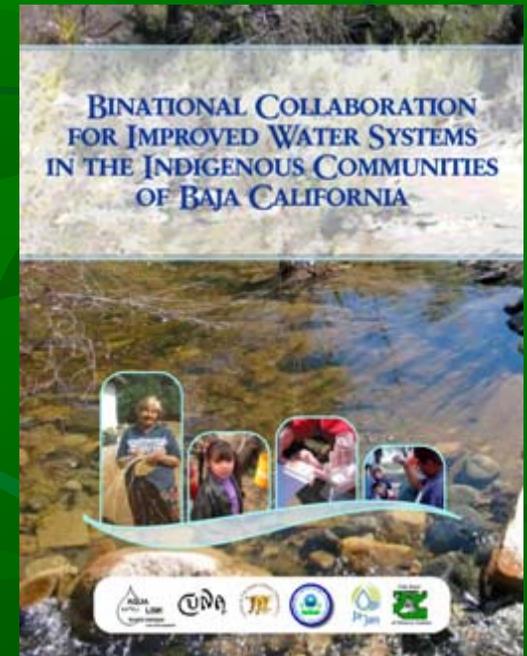


### Cases of Stomach Ache in the Four Communities



# Phase III: Site Inspection and Assessment of Water Systems

- Sanitary site inspection and water quality testing conducted in 7 indigenous communities
- \$36k provided by U.S. EPA to conduct assessment
- Pala Band of Mission Indians sponsored the project
- U.S. and Mexican non-profit groups conducted assessment (Aqualink, CUNA, JA JAN Coalition)
- Recommendations made for improvements to the water systems



# Ranking of Needed Improvements to Water Systems

Rank	Water System	Water Quality E. Coli MPN/100ml Range	Risk Level	Electricity	Population	Estimated Cost for Improvements per Capita	Project Cost	
1	San José de La Zorra	1.0-727.0	High	Yes	185	\$1117	\$206,615	
2	San Antonio Necua	12.2-29.2	Moderate	Yes	195	\$1210	\$235,892	
3	Santa Catarina	45.0-52.9	Moderate	No, 2006	350	\$161	\$56,392	
4	Kiliwas	95.9-115.3	High	No	70	\$85	\$6,000	
5	Neji	11.4-86.5	High	No	60	\$96	\$5,750	
6	La Huerta	2.0-10.0	Low	Yes	193	\$565	\$108,950	
NA	Cucapá	<1.0	No Risk	Yes	180	0	0	
					Total	1,233	\$503	\$619,599

# Phase IV: New Water Systems in Mexican Indigenous Communities

New water systems being installed with funding provided by Mexican government with supplemental money from EPA through the Pala Band of Mission Indians



# ■ San Jose de la Zorra

- Mexico committed \$236,238 USD to construct a new well, water storage tank and distribution system
- EPA provided \$33,000 of supplemental funding to complete the project



# ■ San Antonio Necua

- Mexico committed \$235,509 USD to construct a new well, water storage tank and distribution system
- EPA provided \$33,000 of supplemental funding to complete the project



# Phase VI: Operation and Maintenance

- Border 2012 funding, \$56k
- Community capacity building for system operation and maintenance
  - Groundwater Source Protection Training
  - O&M training for new systems
- Community access to outside technical resources and US tribal resources
- Sustainability

# Phase VI: Prospective Epidemiological Study

- Funding from Pan American Health Organization – still pending
- Goal: to show a causal association between improved access to potable water and improved health among community members in the 2 communities of Necua and San Jose de la Zorra
- Design:
  - health surveys taken 1x per month
  - drinking water quality samples 1x per month
  - 2 virus samples taken
  - Compare results to previous study's findings
- Outreach and education on upkeep of new systems and environmental health issues will also be a part of this project

# Community-Based Approach

- Community Buy-in & Continual Communication
  - Council and general assembly meetings
- Tribal community needs oriented projects
- CUNA (Central Role)
- Tribal representation in projects
  - Decision making and participation of promotoras
- Projects build capacity of tribal community to continue efforts (sustainability)

# Lessons Learned & Next Steps

- Tribal communities environmental health concerns must be addressed, on BOTH sides of the border
- Community-based & multidisciplinary approach
- There is a general lack of understanding of cross-border tribal relationships
- Not just bi-national, but **tri-national** issues
- It is important to respect and honor the sovereignty of the tribes, the responsibilities and rights to self-governance, and the differences between tribal nations and individuals

# Acknowledgements

- Partners:
  - Tribal Communities
  - CUNA
  - PALA
  - UCSD SBRP
  - JA JAN Coalition
  - AQUALINK
  - SDSU GSPH
  - SCERP
  
- Funding:
  - US EPA Border XXI
  - US EPA Border 2012
  - US EPA GAP Funding
  - Mexican Government
    - State of Baja California / Federal Government (CDI)
  - Pan American Health Organization
  - Pala Band of Mission Indians
  - UCSD SBRP Community Outreach Core (NIEHS)

# Citations

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