THE UNIVERSITY OF TEXAS AT AUSTIN

Lyndon B. Johnson School of Public Affairs

# The Past and Future of the Water Quality in the Rio Grande/Rio Bravo

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# Outline

- The Rio Grande/Rio Bravo Basin
- Water quality in the basin
- Investments, outcomes and lessons learned from cross-border water quality
- Options for managing pollutant loadings
- Challenges in trans-boundary water quality management

# The Rio Grande/Rio Bravo Region

- Size
- Population
- Wealth of communities
- Water quality
- Responsibilities for water quality


USA
Pecos River
Rio Grande/Bravo
Rio Conchos
Mexico

# Size

- Rio Grande/Rio Bravo border: 1,254 miles long, 2019 km
- Involves 4 Mexican states and Texas
- Border zone is 300 kilometers on Mexico side and 100 km on Texas side
- Rio Grande/Rio Bravo watershed 1/4 the size of Mexico (complete drainage area)

# Population

- Different ‘border’ definitions
- In 2000, 12 million along Mexico/US border
- An estimated 15 million in Texas and 4 border Mexican states

  (not all is counted as border)
- 2+ million in 16 Texas border counties
- Border region to have 19 million by 2020 and 23+ million by 2030

# Wealth of Communities

- Texas border communities among the poorest in the US
- Mexican border communities have high per-capita incomes vs Mexico
- Mexican communities much poorer than Texas: minimum hourly US wage is ten times the average hourly wage in Mexico

# Water Quality

- In every survey of river water quality in the US, Rio Grande is among the worst
- Bacteriological violations - in some locations over 1000 times the standard
- Problems with dissolved oxygen, fecal coliform, metals, chloride, sulfates, total dissolved solids

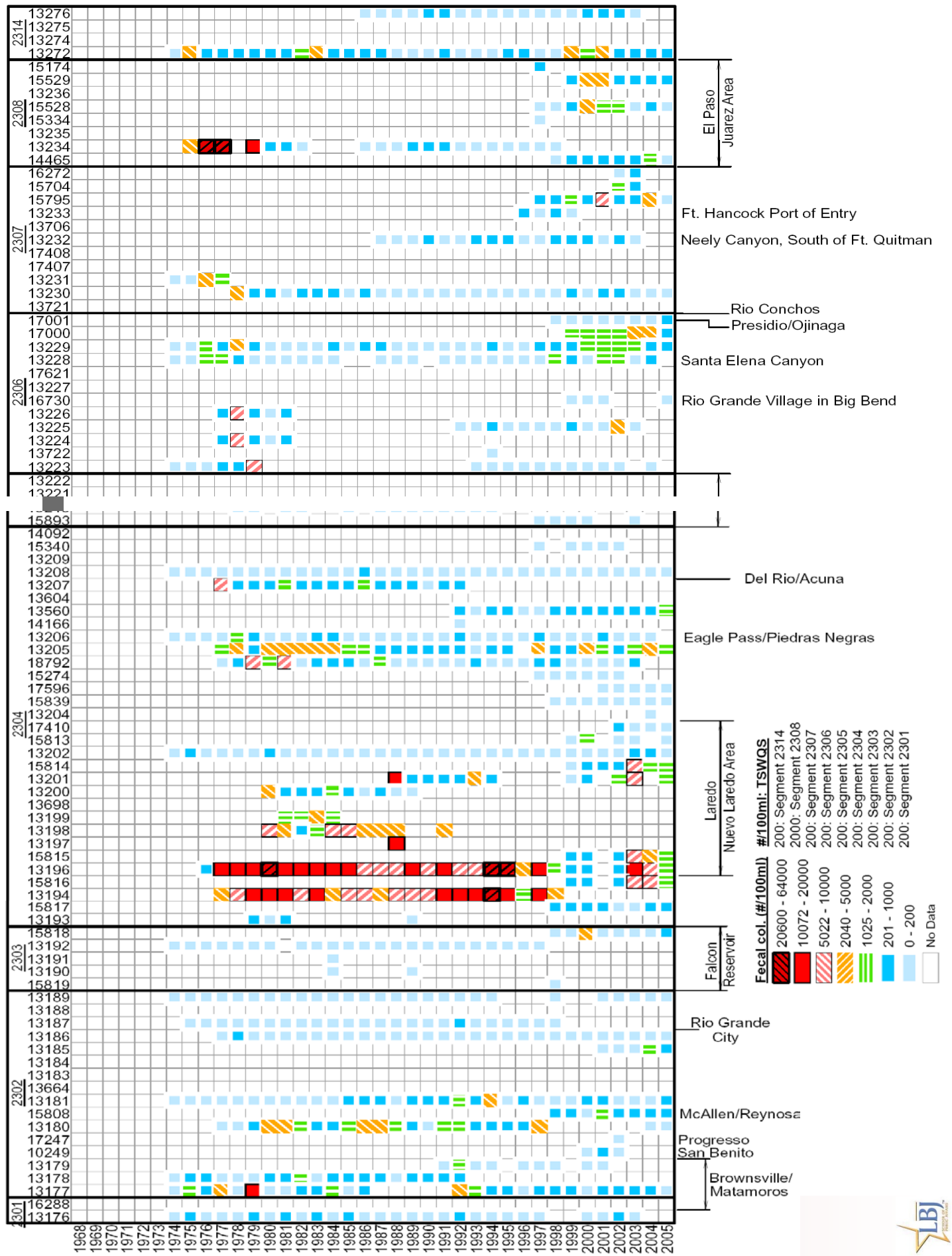
# Texas Water Quality Standards

- Conventional parameters:
  - dissolved oxygen
  - bacteria
  - water temperature
  - pH
  - chloride
  - sulfate
  - total dissolved solids

# Texas Bacteriological Criteria

(colonies per 100 ml)

| | E. Coli | Fecal Coliform |
|---|---|---|
| **Existing Surface Water Quality Standards** | | |
| Contact Recreation | 126 | 200 |
| Noncontact Recreation | 605 | 2000 |
| **Proposed Standards** | | |
| Primary Contact | 206 | 200 |
| Secondary contact 1 | 630 | 1000 |
| Secondary contact 2 | 1030 | 1000 |
| Noncontact recreation | 2060 | 2000 |
| **Mexican Standards** | | |
| Ecological criteria | | 200 |
| Domestic use | | 1000 |


2314
13276
13275
13274
13272
2308
15174
15529
13236
15528
15334
13235
13234
14465
El Paso
Juarez Area
2307
16272
15704
15795
13233
13706
13232
17408
17407
13231
13230
13721
Ft. Hancock Port of Entry
Neely Canyon, South of Ft. Quitman
2306
17001
17000
13229
13228
17621
13227
16730
13226
13225
13224
13722
13223
13222
13221
Rio Conchos
Presidio/Ojinaga
Santa Elena Canyon
Rio Grande Village in Big Bend
15893
2304
14092
15340
13209
13208
13207
13604
13560
14166
13206
13205
18792
15274
17596
15839
13204
17410
15813
13202
15814
13201
13200
13698
13199
13198
13197
15815
13196
15816
13194
15817
13193
Del Rio/Acuna
Eagle Pass/Piedras Negras
Laredo
Nuevo Laredo Area
2303
15818
13192
13191
13190
15819
Falcon
Reservoir
2302
13189
13188
13187
13186
13185
13184
13183
13664
13181
15808
13180
17247
10249
13179
13178
13177
Rio Grande
City
McAllen/Reynosa
Progresso
San Benito
Brownsville/
Matamoros
2301
16288
13176
Fecal col. (#/100ml)
20600 - 64000
10072 - 20000
5022 - 10000
2040 - 5000
1025 - 2000
201 - 1000
0 - 200
No Data
#/100ml: TSWQS
200: Segment 2314
2000: Segment 2308
200: Segment 2307
200: Segment 2306
200: Segment 2305
200: Segment 2304
200: Segment 2303
200: Segment 2302
200: Segment 2301
1968
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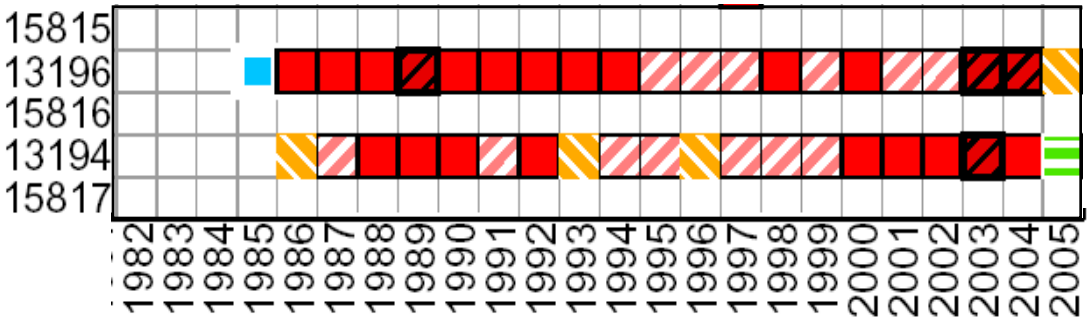
2005

# Station Bacteriological WQ




**Fecal col. (#/100ml)**

- 20600 - 64000
- 10072 - 20000
- 5022 - 10000
- 2040 - 5000
- 1025 - 2000
- 201 - 1000
- 0 - 200
- No Data

**#/100ml: TSWQS**

200: Segment 2314
2000: Segment 2308
200: Segment 2307
200: Segment 2306
200: Segment 2305
200: Segment 2304
200: Segment 2303
200: Segment 2302
200: Segment 2301

# Responsibility for water quality

- Is Texas responsible for Rio Grande bacteriological quality?
- Does Texas have an interest in Rio Grande bacteriological quality?
- Is their a precedent for Texas' involvement?

# Is Texas responsible for water quality?

- No - treaty of 1944
  - NAFTA Side Agreement

# Does Texas have an interest?

- Texas border population is 2 million+
- Rio Grande is a state river under the Clean Water Act
- Citizens want to
  - Consume water and fish
  - Swim and have recreation
  - Use it for multiple purposes

# What is the precedent for Texas' role in water quality?

- TWDB's State water planning processes
- Texas bacterial WQ standards by segment
- Texas WW investments along border
- Texas colonia investments in WQ projects
- Texas has influenced investment in Mexico
- Texas has invested in Mexico

# How Has Infrastructure Investment Affected Bacteriological Water Quality?

- Investment
- Impacts
- What does it mean?
- Needs
- Lessons learned

# Major Issues

- Water
  - No rural access (trucking)
  - urban coverage
- Wastewater
  - Discharges
  - Septic tank overflows
- Agriculture
  - Water supply
  - Conveyance

# Investment

- Texas Funds
  - HUD:  Community Development Block Grants (ORCA)
  - State of Texas: Economically Distressed Areas Programs (TWDB)
  - USDA: Rural Utility Services (TX-USDA RD)
- Mexico Funds: CONAGUA
  - Various urban programs
  - PROSSAPYS
  - BANOBRAS and others
- Binational: certification process (BECC/NADB)
  - Loan
  - Border Environment Infrastructure Fund

# US Programs

- U.S. Dept. Agriculture: Rural development
- Texas Water Development Board: Water infrastructure
- Texas Office of Rural Community Affairs: Rural development

# Mexico Programs

- CONAGUA: improve local municipality and rural water infrastructure

  - National Water Program (PNH)

  - Drinking Water, Sewerage and Sanitation in Urban Areas (APAZU)

  - Rural Community Sustainable Water and Wastewater Program (PROSSAPYS)

  - Clean Water Program (PAL)

  Water Utility Modernization (PROMAGUA)

  - Sanitation Action Program (PAS)

  - Program for Reimbursing Duties (PRODDER)

  - Northern Program

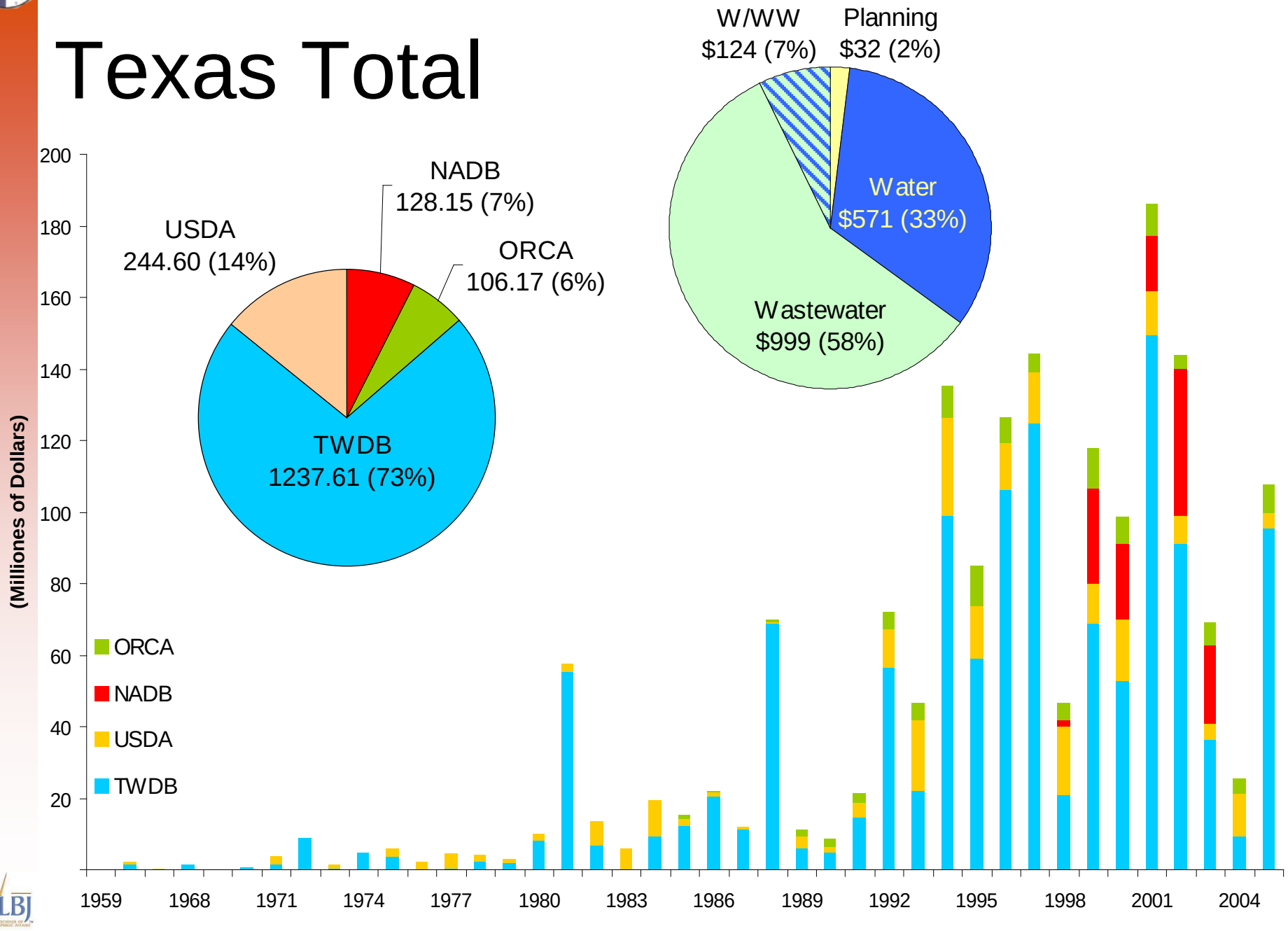
# Bi-national Programs

- International Boundary and Water Commission (IBWC/CILA)
- Border Environmental Cooperation Commission (BECC)
- North American Development Bank (NADB)

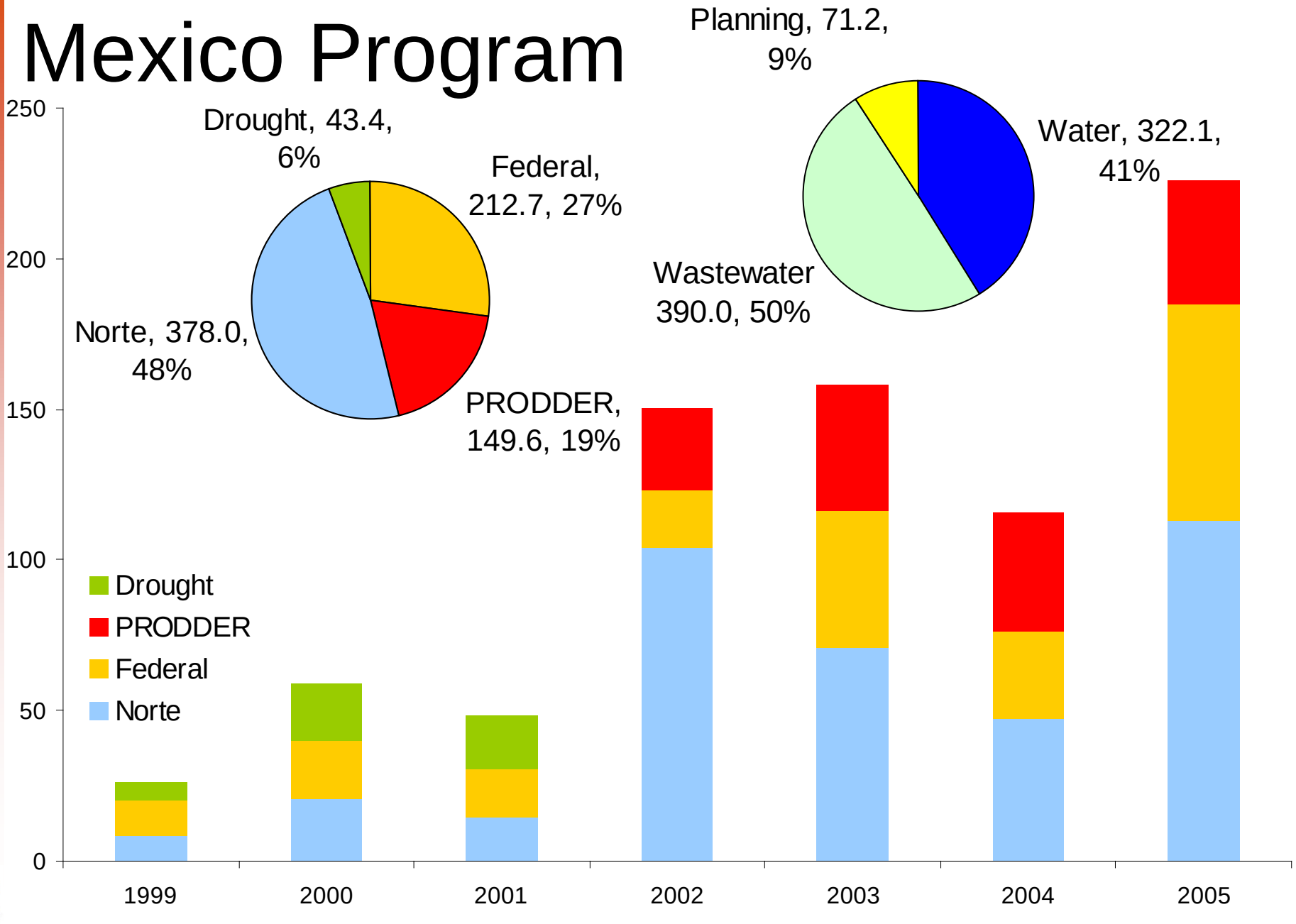
# Investment Summary

- Since 1999, over $1.5 billion invested in border water related infrastructure in 14 Texas border counties and 3 Mexican states
- Prior to 1999, $1 billion invested in Texas border water related infrastructure (data not available for Mexico)

# Texas Total


W/WW
$124 (7%)
Planning
$32 (2%)
Water
$571 (33%)
Wastewater
$999 (58%)
NADB
128.15 (7%)
USDA
244.60 (14%)
ORCA
106.17 (6%)
TWDB
1237.61 (73%)
(Milliones of Dollars)
200
180
160
140
120
100
80
60
40
20
ORCA
NADB
USDA
TWDB
1959
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004

# Mexico Program



# 1999-2005 Investment ($millions)

**Texas Border Counties**

| Programs | | | | Purpose | | | | Total |
|---|---|---|---|---|---|---|---|---|
| USDA | TWDB | ORCA | NADB | W | WW | W&WW | P&O | |
| 70 | 503 | 50 | 126 | 271 | 372 | 98 | 8 | 749 |

**Mexican Border States**

| Programs | | | | Purpose | | | | Total |
|---|---|---|---|---|---|---|---|---|
| Federal | PRODDER | Norte | Drought | W | WW | W&WW | P&O | |
| 213 | 150 | 378 | 43 | 322 | 390 | | 71 | 783 |

| | | | | | |
|---|---|---|---|---|---|
| Mexico-Texas Border Total | 593 | 762 | 98 | 79 | 1,532 |

*Texas has invested $1 billion between 1959 to 1998*

# Benefits

- Primary
  - Health
  - Water quality
  - Access to water
- Secondary
  - Subsequent infrastructure
  - Economic growth (box retail, housing, etc)
  - Quality of life
  - Fairness

# What does it mean

- WW investment has improved WQ
- With no investment- WQ has gotten worse
- Without future investment- WQ degradation

# Needs

- Texas 2003 (TWDB): $553 million
- Mexico 2006 (CONAGUA): $138 million
- BECC applications 2006
  - Texas: $195 million
  - Mexico:$455 million

# Lessons: Design Finance, Enforcement

- Institutional design: No ideal government structure; Multiple institutions an asset; Outcomes count
- Financing: No ideal source of funds; multiple sources help

Enforcement: Legal powers a weak stick;

Community consent useful; Continuity of institutions, not people

# Lessons: Infrastructure/Capacity

- Water infrastructure and development

  Ideal can impede the real

  Water infrastructure can lead development

  Water institutions can lead community
- Capacity building

  Poor communities with limited staff cannot act alone

  Capacity building a continuous process

# Lessons: Grants and Loans

- Grants important  for poor communities

  Users willing to pay, do pay and should pay

  Cross border subsidies can work

  Attractiveness of loans depends upon market alternatives

# Lessons: Public Participation

- More participated in Mexico than Texas
- Participation unusual in Mexico - provided first direct access; affecting other politics
- Citizens became stakeholders
- Participation provided rate rationale
- Public drove administrative continuity
- Participation facilitation regional solutions

# Lessons: Post-Project

- Infrastructure induces growth
- Citizens pay fees when there are services

# Future needs

- Infrastructure to improve bacterial WQ
  - Encourage U.S. and Mexican investment in sewers, WWTP, and other WQ investment
  - Make strategic investments
- Basin-wide WQ planning (none currently)
  - Texas should encourage it
  - Should address point and nonpoint sources
- Cooperation among national, state, regional, and local institutions

# Prospects for the Future

- Shortage of local funds indicates that the wastewater treatment investment is likely to fall behind the pattern of growing effluent
- Building wastewater collection/treatment systems remains a key priority
- The efforts to restrain point sources through building of sewers and wastewater treatment plants indicates that treatment alone is not sufficient

# Key Challenge: Binational Planning to Limit Pollutant Loads

- Bi-national water quality planning experience
- Point source opportunities in Mexico
- Non-point source reductions possible in both US and Mexico
- Political resistance to non-point controls
- Potential for cooperative planning

# Joint Water Quality Planning

- IBWC experience: the Minutes
- BECC-NADBANK experience: the infrastructure
- El Paso-Juarez Regional Water Planning
- Senate Bill 1 Process
- Groundwater Management Process
- Water Summit (2008)
- Lower Rio Grande Water Quality Initiative

# IBWC Actions

| Treatment Plants | Standards Adopted |
|---|---|
| Nuevo Laredo/Laredo | US and Texas standards |
| Tijuana/San Diego | State of California |
| Tijuana/San Diego | Mexico |
| Mexicali/Calexico | Mexico and US |

# BECC-NADBANK

- 1994-2005: $0.9 billion investment in wastewater infrastructure

# El Paso-Juarez Joint Planning

- Informal planning among water institutions in the El Paso del Norte region
- Forum for discussion of issues

# Senate Bill 1 Process

- Senate Bill 1 Process (water planning}
- Regions E, J and M
- Informal observation by Mexican officials

# Rio Grande/Rio Bravo Water Summit

- IBWC/CILA-sponsored joint discussions on water quality management issues by over 200 Mexican and Texas participants (McAllen)

# Lower Rio Grande Water Quality Initiative

- Lower Rio Grande Pilot Project (2008)
- Three meetings (2008-9) of Mexican and Texas water quality management staff: Reynosa, El Paso and Harlingen
- Re-structured process with 5 joint meetings in 11 months, 2011-12 (international, national, and state agencies)
- Agreement on a framework document to limit point and nonpoint waste-load sources
- Agreement to work towards an IBWC/CILA Minute

# Steps Towards a Trans-boundary Water Quality Management Plan

1. Recognize need for a trans-boundary WQ management plan and joint action
2. Agree to common data sets, monitoring
3. Plan investments and management actions to reduce point source and steady-state non-pint source discharges
4. Implement measures to improve and sustain WQ

# Rio Bravo/Rio Grande Current Water Quality

- Bacterial pollution exceeds Texas' water contact recreation standards in many locations
- Bacterial pollution does not exceed Mexican general use standards in many locations
- Where investment has occurred, water quality has improved
- Where investment has not occurred or population/industrial investment has increased, water quality is worse

# How should trans-boundary river water quality be managed?

- Voluntary principles do not provide guidance
- Treaty agreements an practices do not provide guidance
- Rational principles do not provide guidance
- Successful joint action will require respect for sovereignty

# Voluntary Principles for Trans-boundary Water Management

- Participation by basin states
- Cooperation among states
- Equitable utilization
- Determination of equitable and reasonable use
- Preference among users (principles)
- Avoidance of trans-boundary harm

# Rules do not help

- Rules have yet to be accepted by sovereign nations
- Principles have no performance measures accepted by sovereign nations
- Rules provide no mechanism (in theory or practice) for planning or managing together
- Rules do not help states manage water quality or allocate wastes within a basin

# Water Quality Rationality

- In principle it is possible to create rational rules to help states manage trans-boundary river water quality
- Behavior of states violates most of the rational rules

# Trans-boundary Water Quality Rules-1

- (1) *Basin-wide management*: water quality should be managed within a river basin
- (2) *Measurement:* Comprehensive, validated measurement of water quality, use and effluents
- (3) *Data*: Transparency of data: all parties should make available water use and waste discharge data in a transparent manner

# Trans-boundary Water Quality Rules-2

- (4) *Models*: Excellence of models: the most detailed and analytical models should be used to estimate how effluents affect water quality
- (5) *Water Use*: Parties should agree upon a common river use
- (6) *Quality Standard*: Parties should agree to a single quality standard for the use
- (7) *Responsibilities*: Parties should concur on the water flow and each other's waste discharge

# Trans-boundary Water Quality Rules-3

- (8) *Cost Minimization*: Waste collection, treatment and management should minimize total costs to achieve the common ambient standard
- (9) *Costs and Benefits*: Contribution of costs from parties should reflect relative benefits that accrue
- (10) *Implementation*: Actions (management is building infrastructure) should achieve anticipate water quality goals.
- (11) *Validation*: Investments or management actions should be validated to ensure performance

# Rio Grande Reality Contradicts Principles-1

- (1) *Basin management*: Mexico and US cannot agree over definition of the basin; they do not accept the actual basin as the appropriate scale for problem solving
- (2) *Measurement*: Mexico and the US differ over how to measure ambient surface water quality
- (3) *Data*: Mexico and US do not agree yet on what data ought to be shared (even though they actually share it unofficially)
- (4) *Models*: Mexico and the US have yet to select a joint model (even though they both prefer an early generation water quality model [40 years old] because of its simplicity to run, transparency to use, and outcomes that imply actions that can be implemented (collection and treatment)

# Rio Grande Reality Contradicts Principles-2

- (5*) Water use*: Mexico and US differ over uses of the shared river
- (6a) *Quality Standard*: Mexico and US differ over quality standards for uses regarding both content and measurement
- (6b) Mexico and US do not have and are not likely to develop common ambient standards
- (7) *Responsibilities*: Mexico and US have yet to accept each others' assumptions regarding waste-load estimation

# Rio Grande Reality Contradicts Principles-3

- (8a) *Cost Minimization*: Costs to build/operate/maintain infrastructure and manage wastes differ between Mexico and the US
- (8b) *Cost Minimization*: Both Mexico and the US, separately and together (through joint institutions) respond via the dictum ‘the squeaky wheel gets the grease’
- (9) *Costs/Benefits*: Cost contributions: US and Texas subsidize Mexican water quality investments and management

# Rio Grande Reality Contradicts Principles-4

- (10a) Implementation: Projects are implemented because they can be (project feasibility, efficiency, or cost-effectiveness are not pre-requisites)
- (10b) Implementation: Mexico and the US invest to improve water quality (without common project expectations)
- (11) Validation: Water quality improvements are relative, not a solution to the problem (no solution due to continuing growth, regional development, and potential climate change)

# Implications of Urbanization and Potential Global Warming for Rio Grande Trans-boundary Water Quality Management

- Bottom line: we can't tell what the future holds
- Both climate change and urban growth appear to lead to increased flows and pollutant loadings
- For trans-boundary water quality management, a strategy of continuing improvements in water quality acceptable to both sovereigns is low-risk and cost-effective
- Political sensitivity to sovereignty works in practice and responds well to uncontrolled and unknown trends in climate change and economic growth

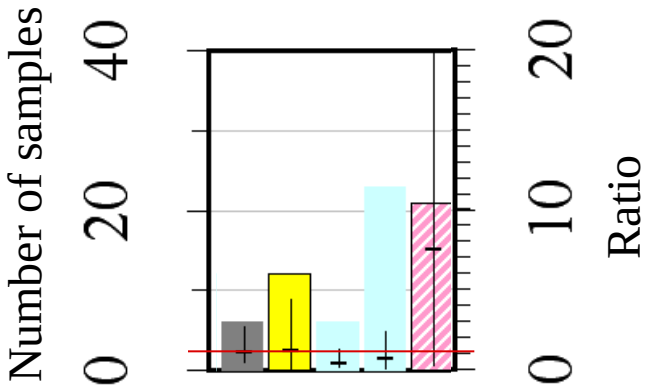
# Language of water quality violations

- Fully supporting a use: less than 10% exceedence of standard
- Partially supporting: 10-25% exceedence
- Not supporting: over 25% exceedence
- Concerns: for small sample numbers

  - Tier 1 Primary: 4-9 samples, exccedences

  - Tier 2 Secondary: 10+ samples, more violations

# Bacteriological Water Quality




$$Ratio = \frac{Average}{Criterion} \quad \begin{matrix} <1\ (a < C) \\ >1\ (a > C) \end{matrix}$$

*Ratio maximum*

*Ratio average*

*Ratio minimum*

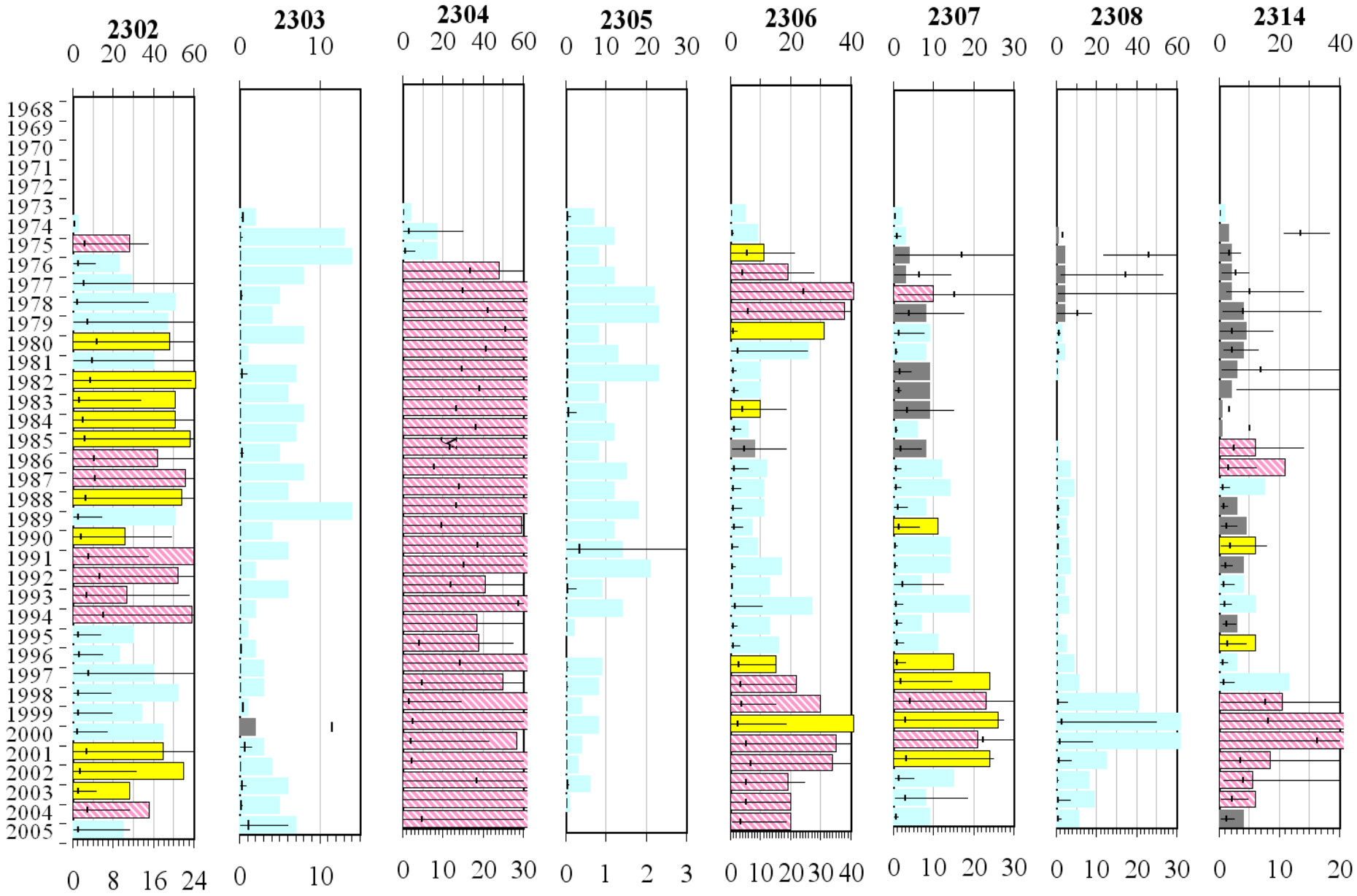
*Fully supporting*
*(Avg. < C) and (Avg. > C, <25%), n>10*
*20 % probability*
*or all samples < C*

*Not supporting*
*(Avg. > C) and/or (Avg. > C, >25%), n>10*
*20 % probability*

*Tier 2 Primary Concern*
*(Avg. > C, >25%) n>10*
*50 % probability*

*Tier 1 Primary Concern*
*(Avg. > C, >25%) 4<n<9*
*50 % probability*

# Fecal Coliform Water Quality Ratio



# Questions?