Roosevelt Irrigation District (RID)

Voluntary Groundwater Remediation in the West Van Buren Area (WVBA)

October 2, 2015

Presented to: Water Resources Research Center

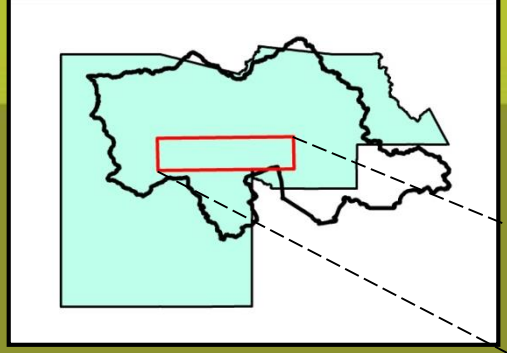
Donovan Neese, PE (RID Superintendant)

Joel D. Peterson, PE (Synergy Environmental)

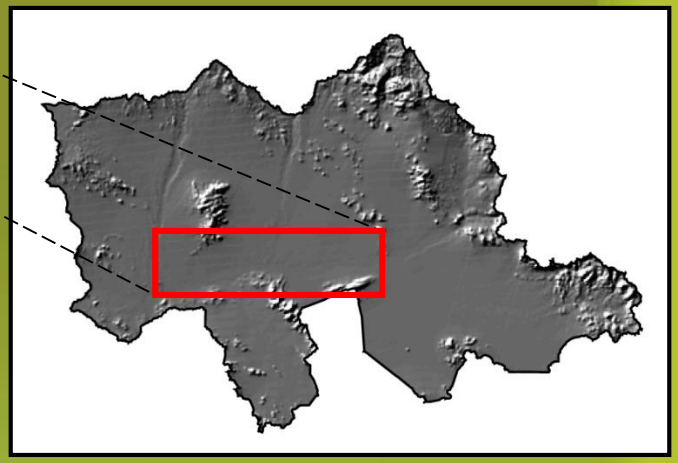
AGENDA

- **RID – Past, Present and Future**
- **WVBA – Site History**
- **RID Voluntary Remediation Actions**
- **Regulatory Path Forward**
- **Discussion/Q&A**

ROOSEVELT IRRIGATION DISTRICT

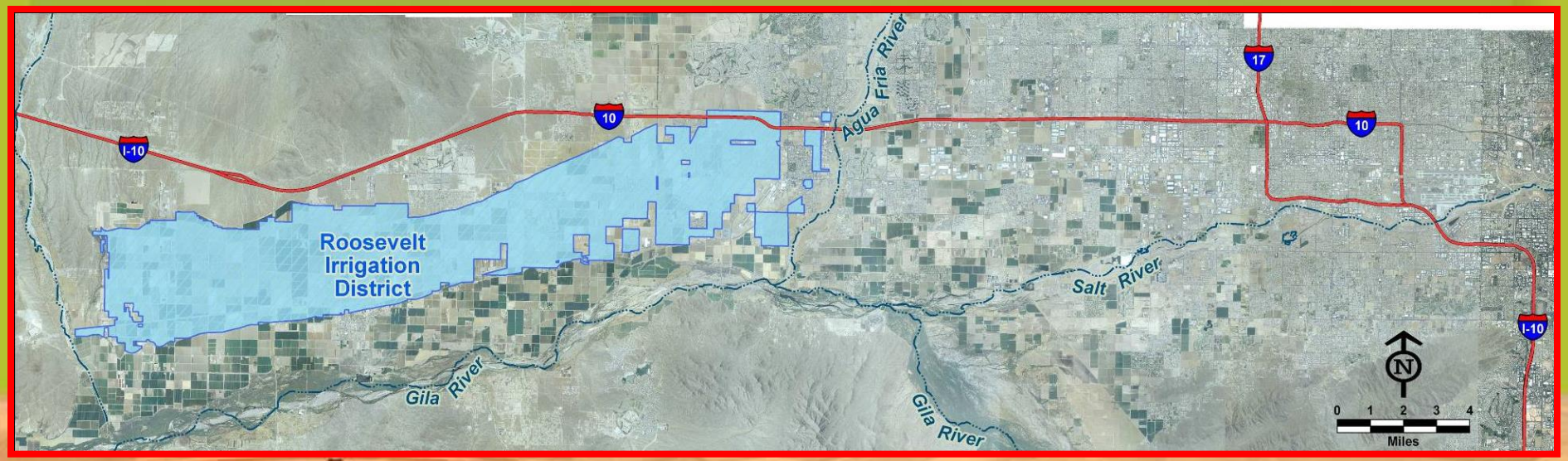


Maricopa County

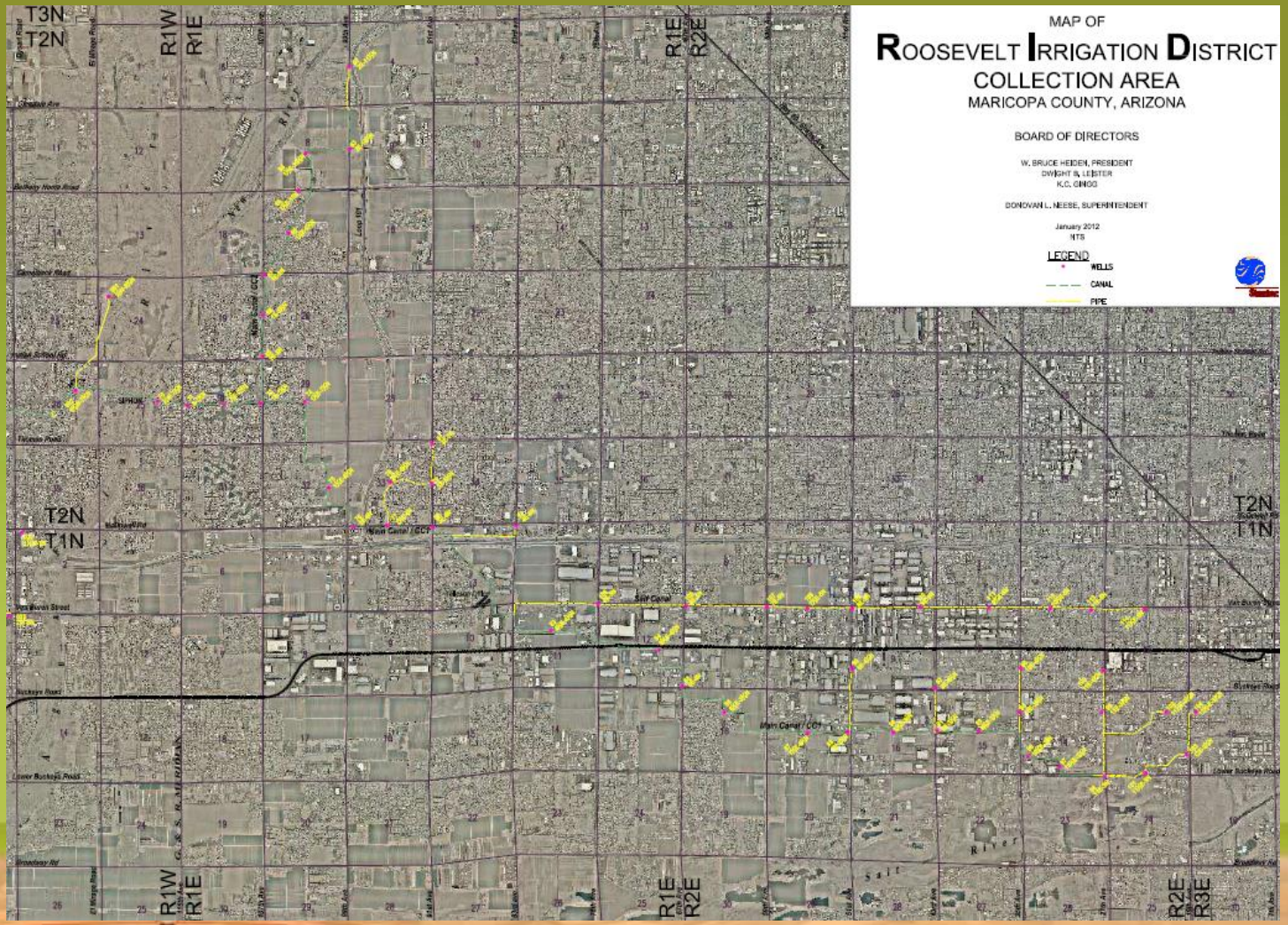


Phoenix Active Management Area

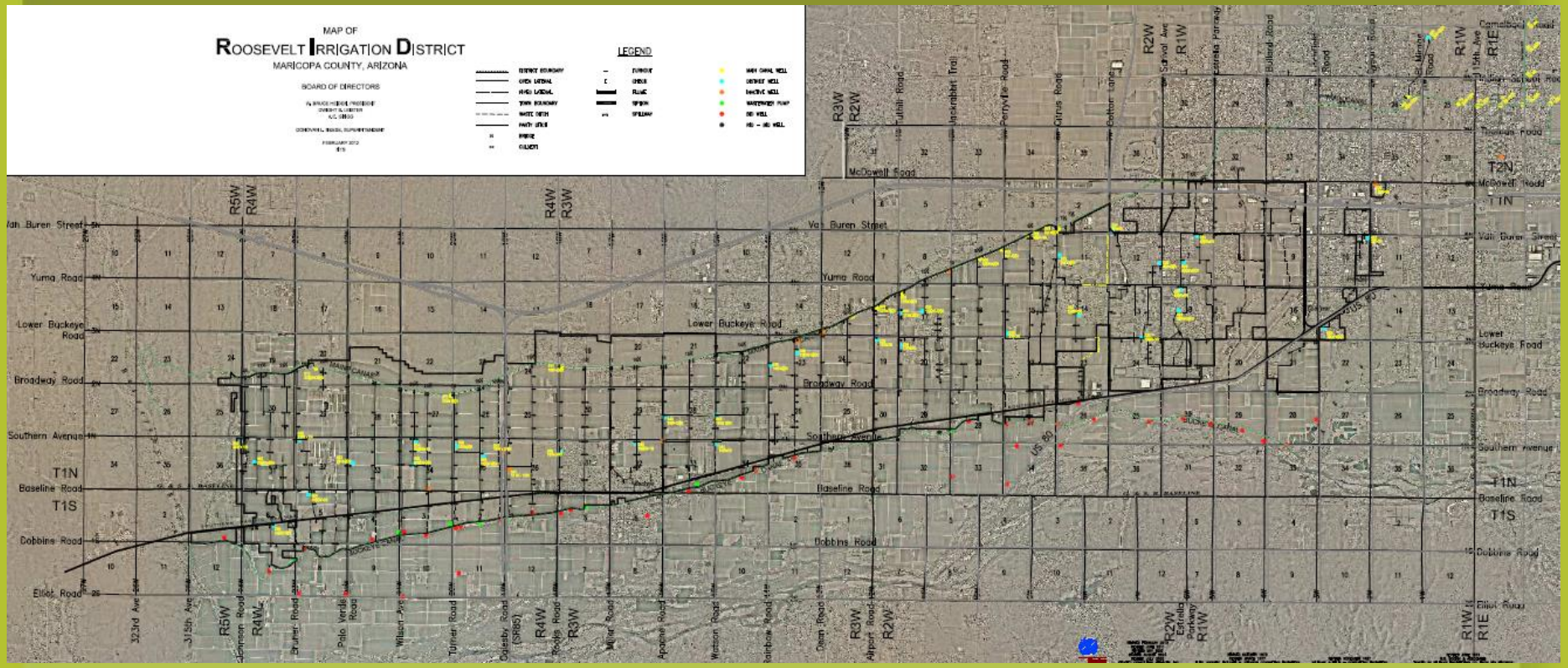
Created in 1920s to dewater portions of southwest Phoenix and deliver irrigation water to western Maricopa County



RID Wellfields



Roosevelt Irrigation District

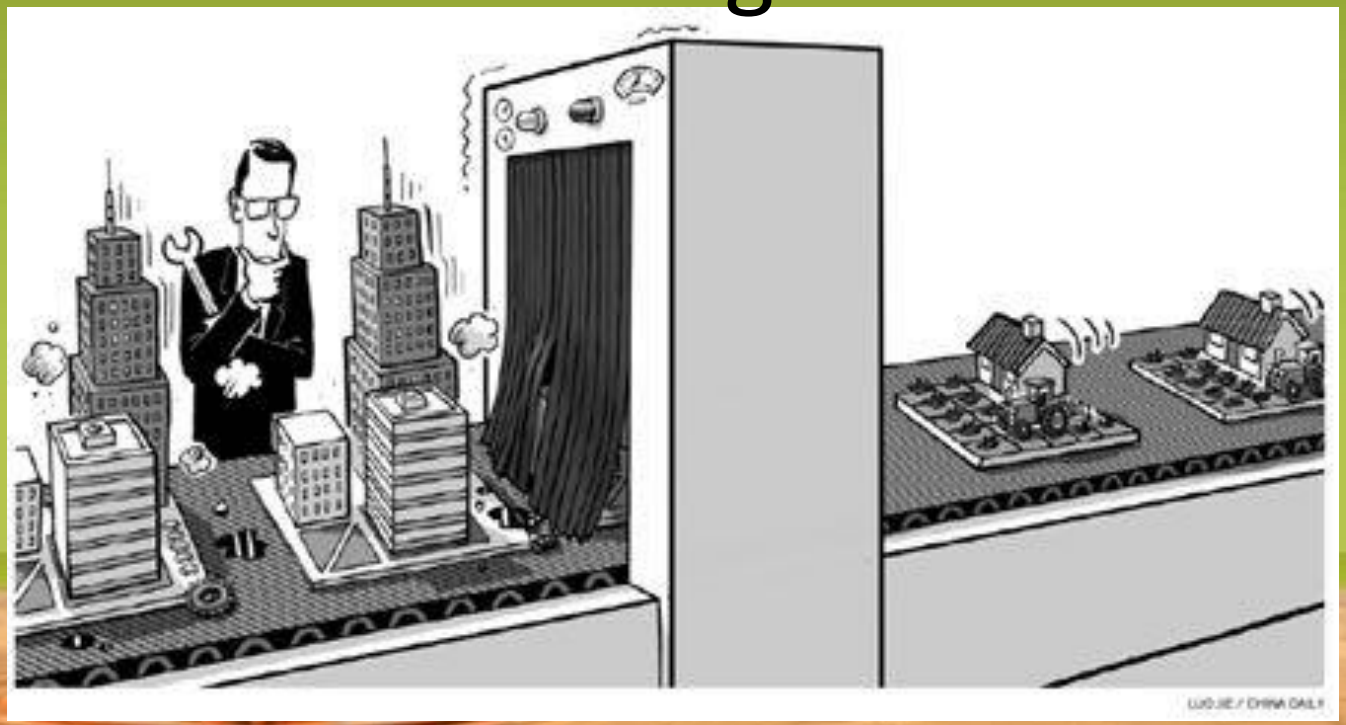


RID Present

- RID Water Resources:
  - Reclaimed Water
  - East Side Wells
  - West Side Wells
- Other Operations

RID Future

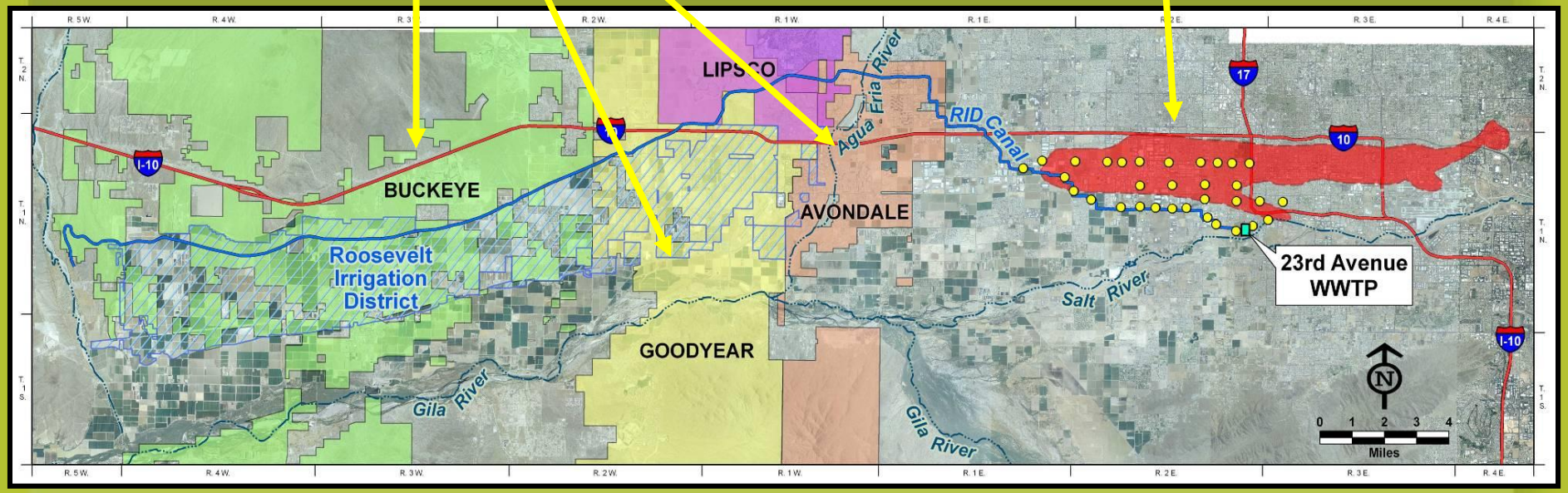
- Urbanization
- Water Reuse
- Resource Planning



Our Challenge .... And Opportunity

West Valley Municipalities High-Growth and In Need of Water

Up to 21 Existing RID Wells Impacted by VOC Plume



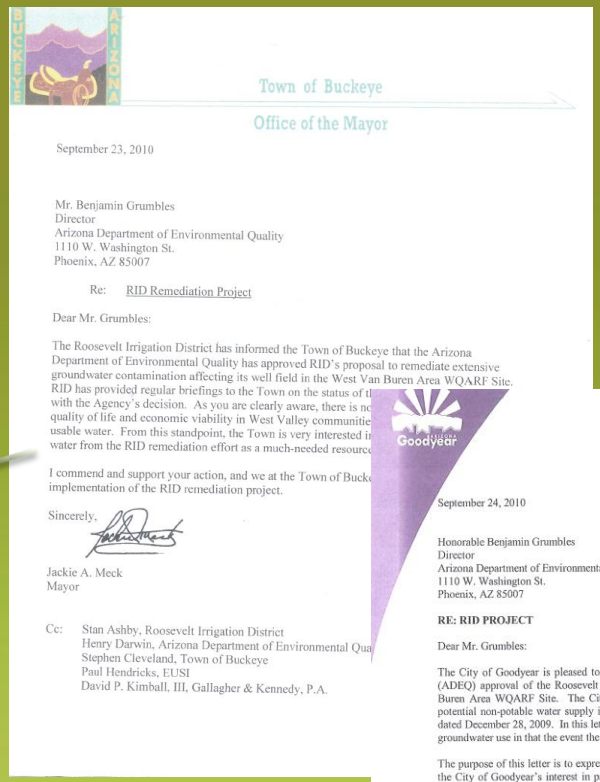
Water Supply Interests

" … there is no issue more important to the quality of life and economic viability … than dependable source of usable water … the Town is very interested in the utilization of treated water from the RID remediation effort as a much-needed resource of our future development."

-- Jackie A. Meck, Mayor

" … express our support … and inform you of the City of Goodyear's interest in participation in future utilization of the remediated water supply."

-- Charles McDowell, Public Works Director



Town of Buckeye

Office of the Mayor

September 23, 2010

Mr. Benjamin Grumbles
Director
Arizona Department of Environmental Quality
1110 W. Washington St.
Phoenix, AZ 85007

Re: RID Remediation Project

Dear Mr. Grumbles:

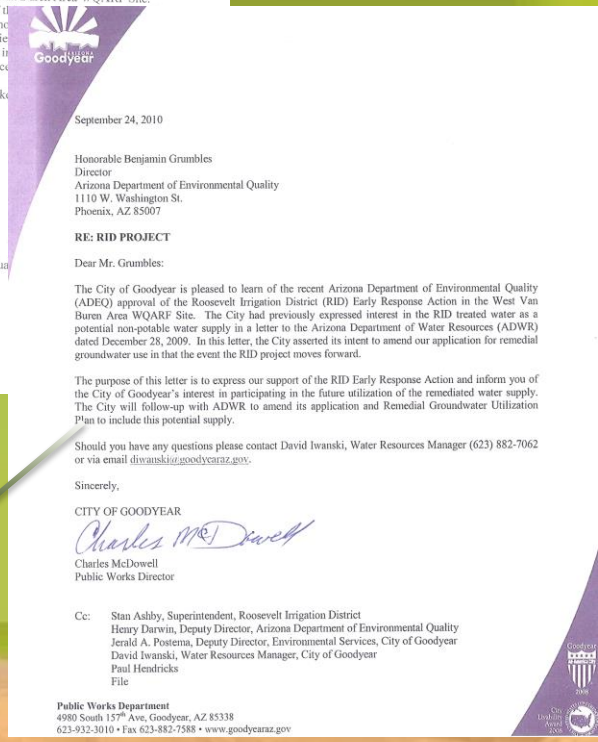
The Roosevelt Irrigation District has informed the Town of Buckeye that the Arizona Department of Environmental Quality has approved RID's proposal to remediate extensive groundwater contamination affecting its well field in the West Van Buren Area WQARF Site. RID has provided regular briefings to the Town on the status of t with the Agency's decision. As you are clearly aware, there is nc quality of life and economic viability in West Valley communitie usable water. From this standpoint, the Town is very interested i water from the RID remediation effort as a much-needed resourc

I commend and support your action, and we at the Town of Buck implementation of the RID remediation project.

Sincerely,

Jackie A. Meck
Mayor

Cc: Stan Ashby, Roosevelt Irrigation District
Henry Darwin, Arizona Department of Environmental Qua
Stephen Cleveland, Town of Buckeye
Paul Hendricks, EUSI
David P. Kimball, III, Gallagher & Kennedy, P.A.



September 24, 2010

Honorable Benjamin Grumbles
Director
Arizona Department of Environmental Quality
1110 W. Washington St.
Phoenix, AZ 85007

RE: RID PROJECT

Dear Mr. Grumbles:

The City of Goodyear is pleased to learn of the recent Arizona Department of Environmental Quality (ADEQ) approval of the Roosevelt Irrigation District (RID) Early Response Action in the West Van Buren Area WQARF Site. The City had previously expressed interest in the RID treated water as a potential non-potable water supply in a letter to the Arizona Department of Water Resources (ADWR) dated December 28, 2009. In this letter, the City asserted its intent to amend our application for remedial groundwater use in that the event the RID project moves forward.

The purpose of this letter is to express our support of the RID Early Response Action and inform you of the City of Goodyear's interest in participating in the future utilization of the remediated water supply. The City will follow-up with ADWR to amend its application and Remedial Groundwater Utilization Plan to include this potential supply.

Should you have any questions please contact David Iwanski, Water Resources Manager (623) 882-7062 or via email diwanski@goodyearaz.gov.

Sincerely,

CITY OF GOODYEAR

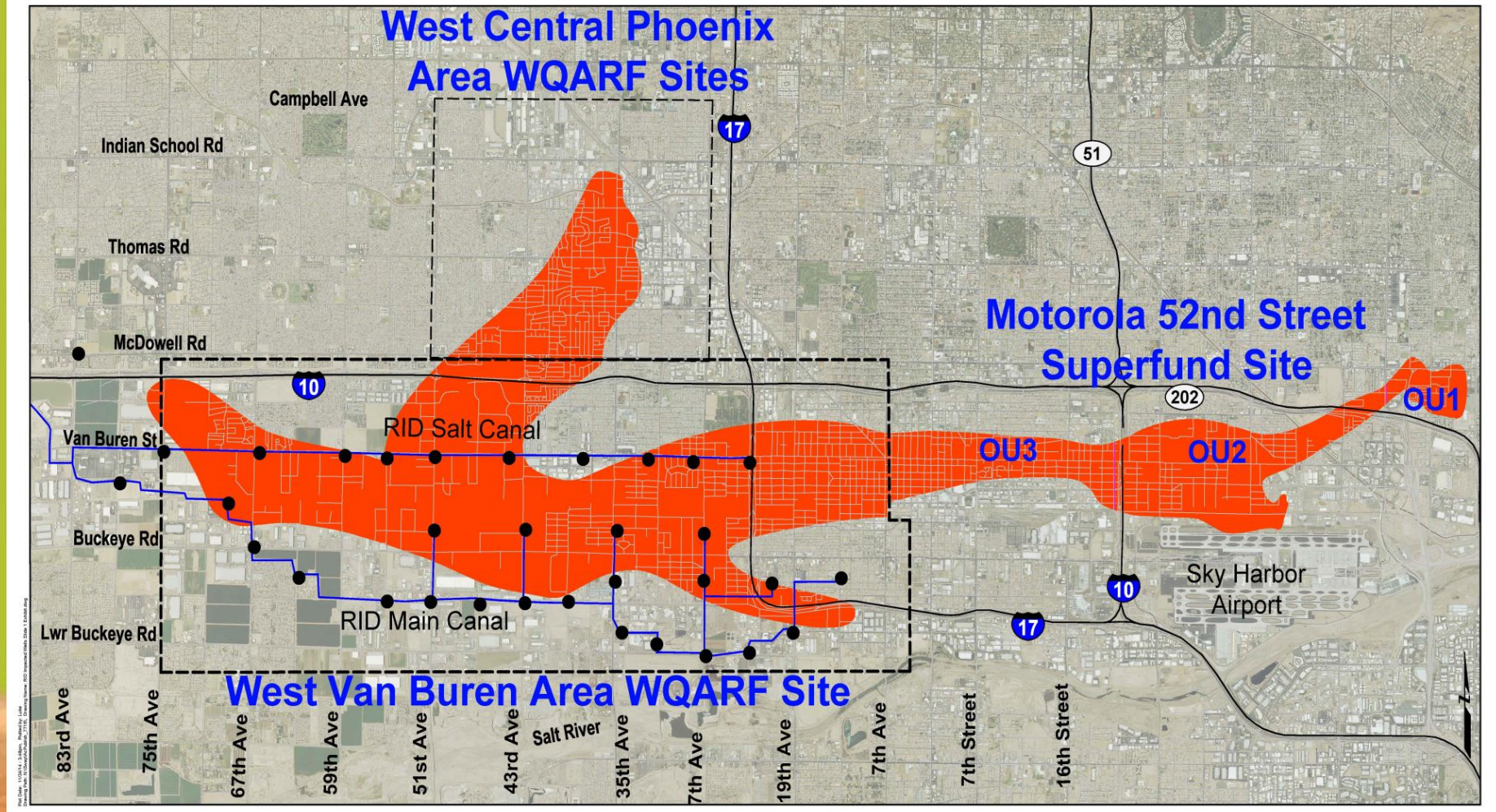
Charles McDowell
Public Works Director

Cc: Stan Ashby, Superintendent, Roosevelt Irrigation District
Henry Darwin, Deputy Director, Arizona Department of Environmental Quality
Jerald A. Postema, Deputy Director, Environmental Services, City of Goodyear
David Iwanski, Water Resources Manager, City of Goodyear
Paul Hendricks
File

Public Works Department
4980 South 157th Ave, Goodyear, AZ 85338
623-932-3010 • Fax 623-882-7588 • www.goodyearaz.gov

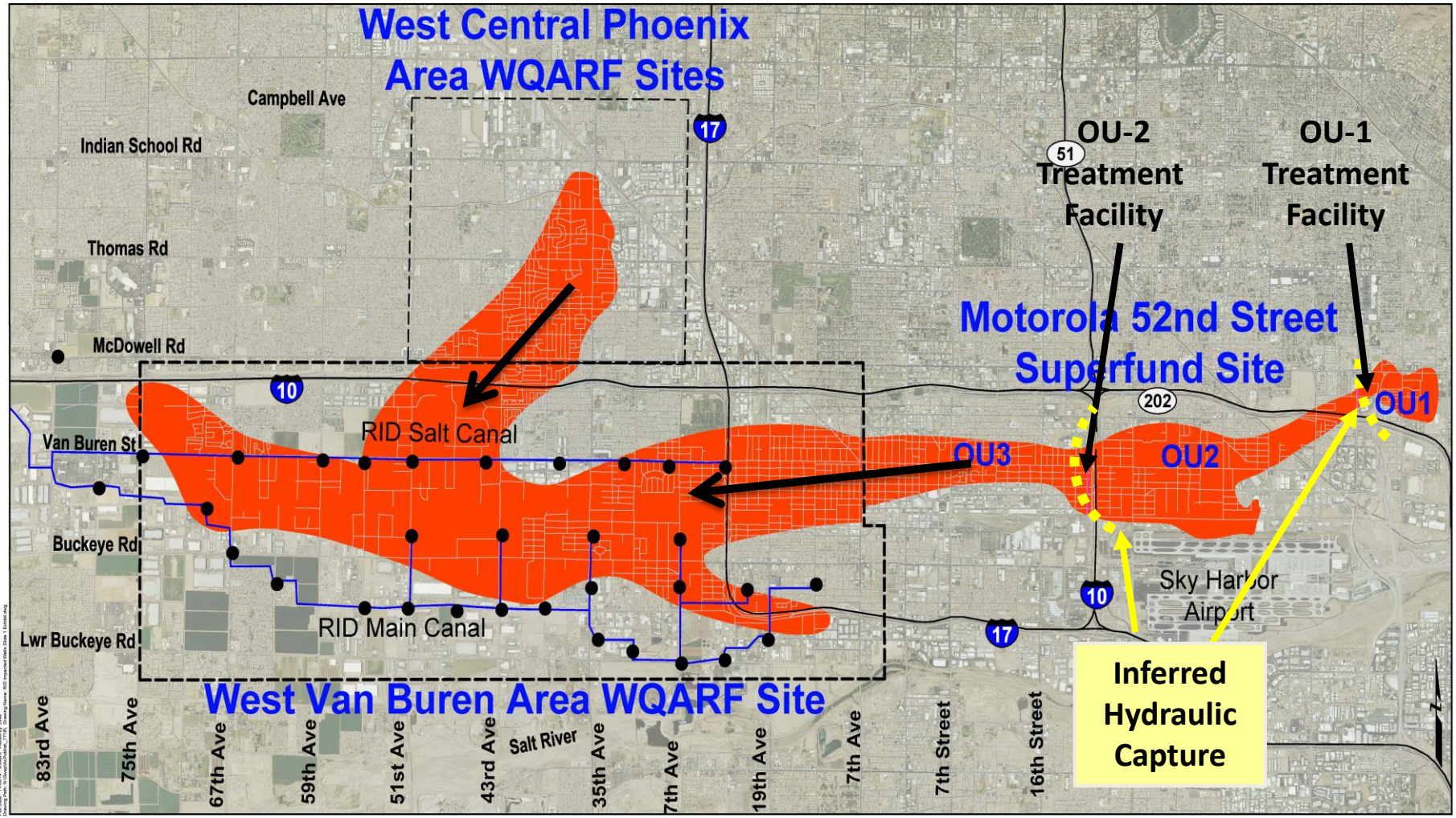
West Van Buren Area WQARF Site

- One of the Largest Contaminated Groundwater Sites in U.S.
- Multiple Sources of VOC Contamination from Numerous PRPs



Central Phoenix Plume

- Groundwater/Contaminant Movement Influenced by Pumping of RID Wells
- RID Operates 32 Wells in the WVBA that Pump ~ 75,000 AFY (24 Billion Gals/YR)



Major Arizona Superfund Sites

- **At Least Three Major Sites in Arizona**
  - Tucson International Airport Area (TIAA)
  - North Indian Bend Wash (NIBW)
  - Central Phoenix (M52+WVBA+West Central Phx (WCP))
- **Characteristics of Complex Contaminated Sites**
  - Large Size with Multiple Sources
  - Multiple, Recalcitrant Contaminants **(TCE, PCE, 1,1-DCE)**
  - Heterogeneous Stratigraphy, Structure, Hydrology

Status of Phoenix Area Remedial Actions

	Site Listing - Discovery	Remedial Investigation (RI)	Feasibility Study (FS)	Proposed Remedial Action Plan (PRAP)	Record of Decision (ROD)	Remedial Action
Operable Unit 1 Motorola 52nd St. CERCLA Site	1982					
Operable Unit 2 Motorola 52nd St. CERCLA Site	1983					
Operable Unit 3 Mmotorola 52nd St. CERCLA Site	1987					
Motorola North Indian Bend Wash CERCLA Site	1983					
West Osborn Complex WQARF Site	1982					
West Van Buren Area WQARF Site	1987	2012				

ADEQ Unable to Implement a Regional Groundwater Remedy Under the WQARF Program

WQARF (State) vs. CERCLA (federal) Superfund Programs

- WQARF Has No Joint and Several Liability
  - ADEQ Must Apportion Liability/Costs and Technically Justify and Legally Defend the Allocations
  - EPA Can Impose All Liability on a Single PRP (Joint and Several)
- WQARF Lacks Resources
  - The Legislature Continues to Sweep WQARF Program Funds, Limiting Both Staff and Dollars to Implement Remediation
  - ADEQ Obligated to Pay Orphan Share Costs of Remediation

WVBA Site: Early Timeline

1980s

- WVBA Site Listed on WQARF Registry in 1987
- Site Characterization Begins in 1988

1990s

- Facility Investigations and Source Control Actions
- West Van Buren Group Formed 1992; Suspended 1996
- ADEQ Site Characterization, PRP Search, Facility Regulatory Actions, and Groundwater Modeling
- ADEQ Groundwater Remediation Strategy

ADEQ Groundwater Remediation Strategy

- "Innovative" Alternative to Aquifer Restoration
- Plume Management … Source Control, Hot Spot Containment, Wellhead Treatment for Consumptive Uses
- ADEQ Estimated Cost of $30-60 MM Compared to $800 MM for Traditional Project Approach
  - ADEQ Briefed Industry Groups, Cities, and Public
  - Concept Languished Once WQARF Reforms Enacted (and Joint and Several Liability Went Away)

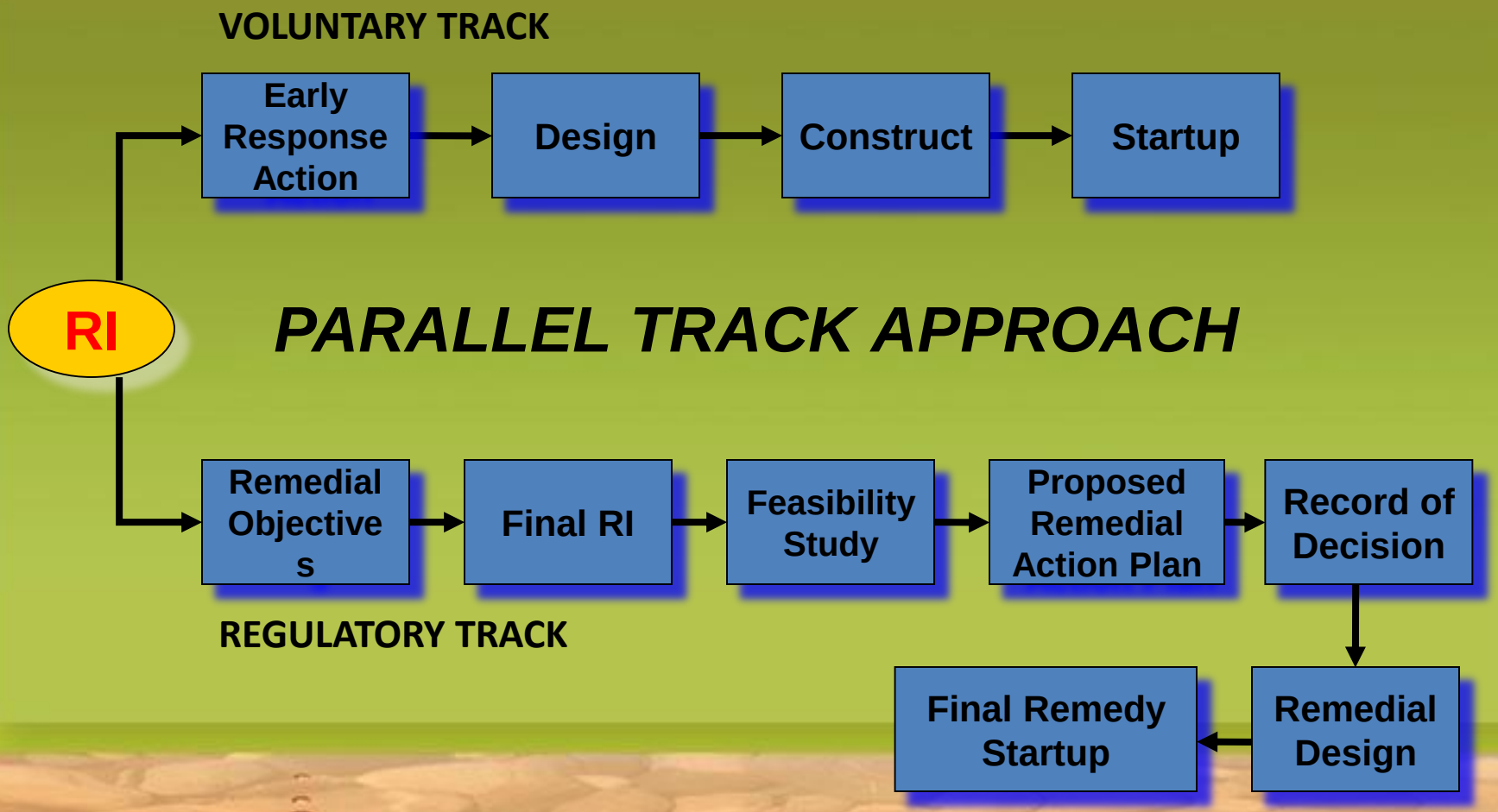
WVBA Site: Recent Timeline

2000s (twenty years later)

- Facility Investigations and Source Control Actions
- ADEQ PRP Search, Facility Regulatory Actions, Land and Water Use Study, and Remedial Investigation
- Early Response Action (ERA) at PRP Facility
- ADEQ Issued Draft Remedial Investigation (RI) Report Identifying the PRPs (Late 2008)

Identification of PRPs Enabled RID to Initiate Voluntary Remedial Action

RID's Voluntary Approach



PRELIMINARY

RID's Involvement

- Draft RI Report Identified RID as the Sole Water Provider Impacted by the WVBA Groundwater Contamination
- Since Then … RID Has Taken an Active and Voluntary Role to Advance a Groundwater Remedy
- RID Entered into a Working Agreement with ADEQ in Late 2009 to Conduct an ERA, a Feasibility Study, and Implement the Final Regional Groundwater Remedy

- **RID Approached the PRPs with a Proposal to Partner in Implementing the Groundwater Remedy (9/2009)**
  - The PRPs Dismissed RID's Proposal with the Confidence that ADEQ Could Not Likely Complete a Cost Allocation
- **RID Initiated a Voluntary Early Response Action Under WQARF Rules (AAC R18-16-405)**
  - The PRPs Asserted Considerable Influence in Strong Opposition to RID's Proposed ERA
- **RID's Only Recourse to Engage the PRPs was to Sue in Federal Court as a CERCLA (Joint and Several) Action**

RID Early Response Action

- RID's Draft ERA Work Plan Submitted in October 2009 and Revised February 2010:
  - Proposed Pump and Treat of 10 Most Highly-Contaminated RID Wells at Centralized GAC Facility
- ERA Approved by ADEQ in June 2010, With Conditions:
  - Public Health Exposure Assessment
  - Well Investigations
  - Groundwater Modeling
  - Engineering Design Study

Public Health Exposure Assessment

Required .... To determine ...

- "... the quantity of ... releases to the air through volatilization..."
- "The potential exposure ... to nearby residents ... Industrial workers..."
- "... procedures/remedial activities ... to mitigate the risk."

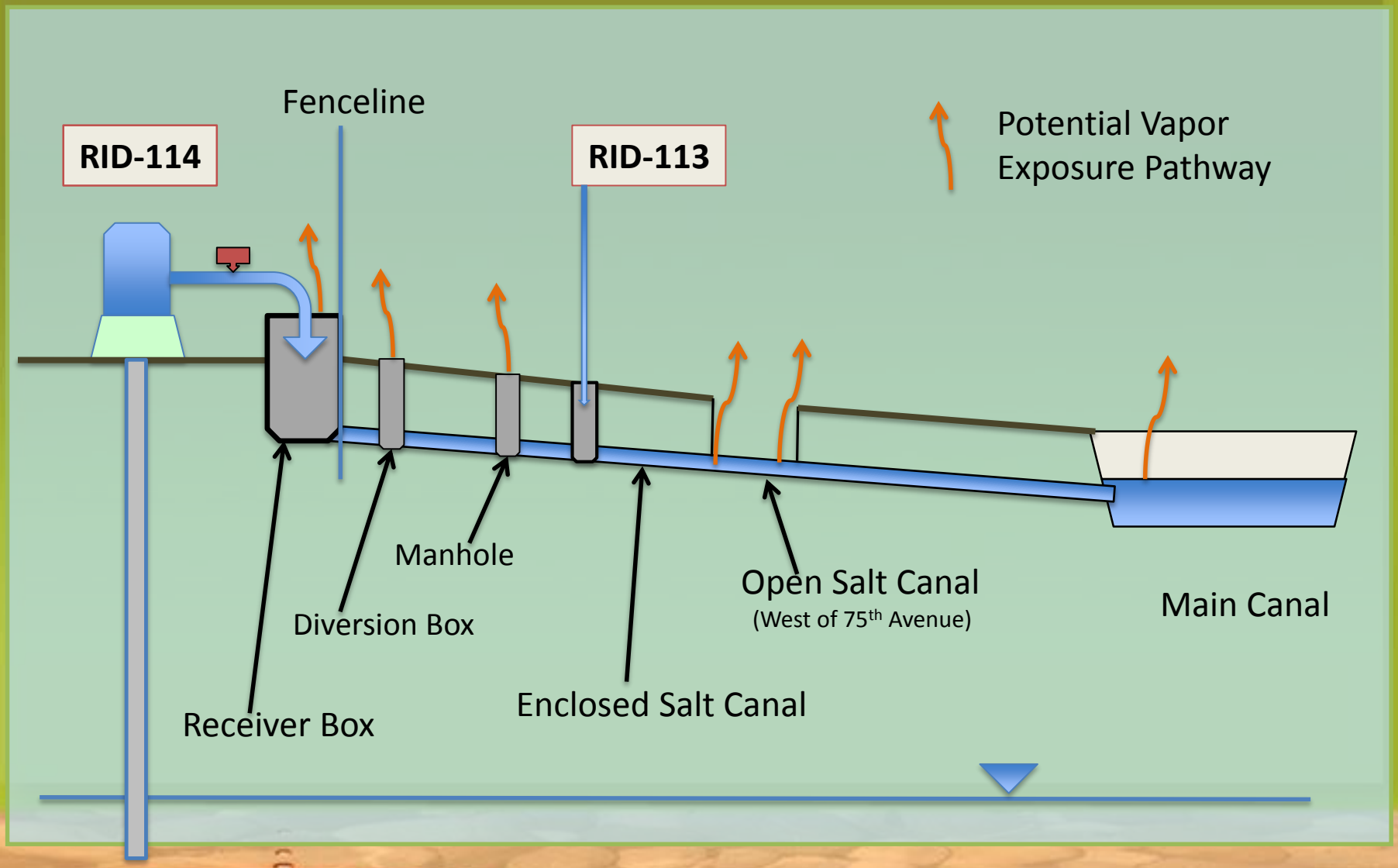
Method:

- Air sampling at two highly-contaminated wells and at points downstream.
- 1-hour composite samples in SS Summa canisters
- Analysis using EPA Method TO-15 and TO-15 SIM
- Headspace, breathing zone, fenceline and canal surface samples collected

Results:

- Compared to Health Based Guidance Levels – "Screening-Level Determination" of potential exposure and risk to public health

Schematic of RID-114 to Salt Canal to Main Canal



Public Health Exposure Assessment

Results:

- Mass Balance – Approx. 3,000 Pounds of Volatile Contaminants Released to the Environment Annually (2008 - 2010 data)
- VOCs Present in <u>All</u> Air Samples in/near the RID Wells and Conveyances (Background Samples Non-detect)
- Some Samples Exceeded **<u>Acute</u>** Guidance-levels But Risk to the Public Low Due to Limited Exposure Potential at These Locations
- Many Breathing-zone Samples Exceeded **<u>Chronic</u>** Guidance-levels for Exposure to TCE & PCE (Annual AAAQGs, Industrial/Residential RSLs)

Public Health Exposure Assessment – Air Sampling Results

Sample Location/ID	Sample Description	Sample Method	Analytical Results (ug/m^3)		
			1,1-DCE	TCE	PCE
A1	RID-114 @ head space of collection box	TO-15	1,390	4,080	115
A3	RID-114 @ breathing zone above collection box	TO-15 SIM	0.87	7.52	0.95
A5	RID-114 @ breathing zone of virtual fence (N)	TO-15 SIM	0.67	6.44	0.88
A6	RID-114 @ breathing zone of virtual fence (E)	TO-15 SIM	0.67	6.44	0.95
A7	RID-114 @ breathing zone of virtual fence (W)	TO-15 SIM	1.19	10.2	1.08
A8	RID-114 @ breathing zone of virtual fence (S)	TO-15 SIM	1.07	10.7	1.22
A13	Background location north of RID-114	TO-15 SIM	<0.16	<0.21	<0.27
A15	RID-114 @ head space of diversion box	TO-15	1,620	3,110	35.3
A16	RID-114 @ breathing zone above diversion box	TO-15 SIM	3.92	29.0	4.07
A17	Head space in Salt Canal manhole	TO-15	2,570	17,700	1,020
A18	Head space in Salt Canal pipe @ opening (79th Ave)	TO-15	5.15	25.2	4.88
Duplicate D	Duplicate of A18	TO-15	5.94	26.9	7.46
A19	Surface of Salt Canal @ open section	TO-15 SIM	2.18	17.7	5.09
A23	Surface of Main Canal @ Salt Canal Discharge	TO-15 SIM	0.79	6.44	1.70

SCREENING LEVEL STANDARDS AND GUIDELINES (ug/m^3)**:**

Constituent	AAAQG, 1-hr	AAAQG, 24-hr	AAAQG, Annual	RSL - Residential	RSL - Industrial	MRL - Acute	MRL - Intermediate	MRL - Chronic
1,1-DCE	130	63	--	210	880	N/A	80	N/A
TCE	810	210	0.58	1.2	6.1	11,000	540	N/A
PCE	1,300	640	1.7	0.41	2.1	1,350	N/A	270

Public Health Exposure Assessment

- Not a Quantitative Risk Assessment, Screening-Level
- Results Used to Determine Whether an Acute Exposure Risk Existed
- Combination of Wellhead Treatment and Engineering Controls Recommended to Reduce Public Exposure

- Health Based Guidelines for TCE Being Reconsidered For Both Inhalation and Drinking Water (MCLs)
- TCE is Now Thought to be Far More Toxic Than Current Numeric Guidelines Reflect

Well Investigations

- Required *"… to insure that changes in pumping will not adversely affect groundwater quality and levels …" and "… Affect both the aquifer and wells in the area …"*

- 3 RID Wells Taken Out-of-Service to Run Spinner Logs and Video
  - Upward Flow Measured from Lower Alluvial Unit Under Non-Pumping Conditions
  - No Adverse Impacts Predicted as a Result of ERA

Groundwater Modeling

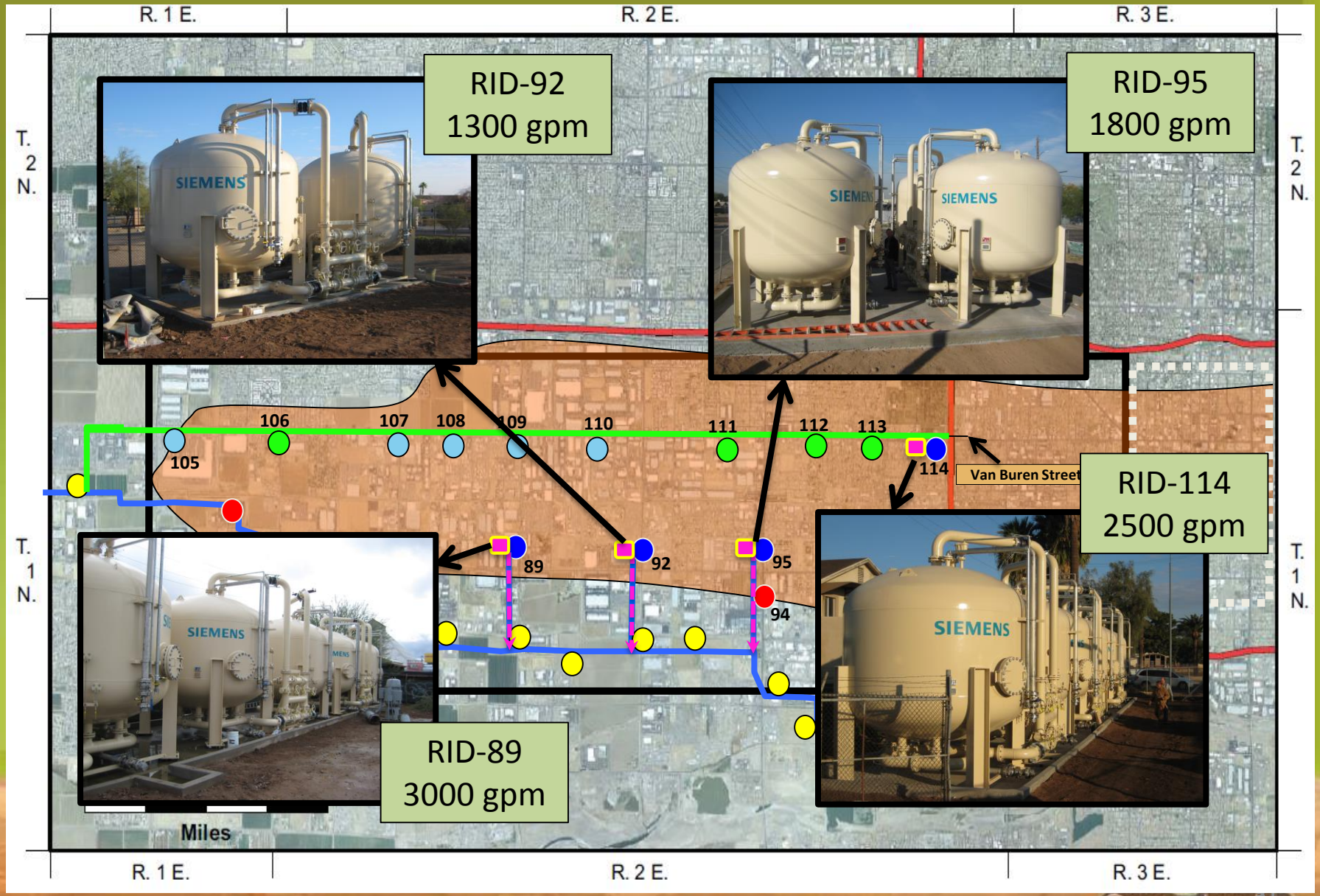
- Required *"... To estimate the effects of the changed RID well pumping rates ... on drawdown and capture zones."*
- ADEQ's Central Phoenix Plume Model was Updated by Montgomery & Associates
  - No Significant Affect Noted in Modeling the Modified Pumping Approach of the ERA
  - *"Negligable Impact on Futuer Water Table Elevation"*
  - *"Negligable Impact on Future Movement of Other Contaminant Plumes (West Central Phenix and OU3)"*
  - *"ERA Pumping Projected to Enhance WVBA Plume Containment"*

Engineering Design Study

- Required … To define all of the technical design requirements of the pump and treat remediation system.
- Wellhead Pilot Treatment System Proposal/Work Plan Developed and Submitted to ADEQ on August 18, 2011
- ADEQ Concurred With the Implementation of the Work Plan on September 2, 2011. Work Plan Included:
  - Wellhead GAC Treatment Systems Installed on the Four (4) Highest Contaminated RID Wells

RID Pilot Treatment System Initiative

- Utliized a Lead/Lag Configuration of Liquid-phase GAC to Provide Redundant and Protective Treatment Technology
- Combined 9000 gpm Nominal Treatment Capacity
- Used Commercially Available Modular Treatment Systems (Siemens HP1220)
- System Performance was Monitored and Used to Refine Remedial Action Cost Estimates


R. 1 E.
R. 2 E.
R. 3 E.
T. 2 N.
T. 1 N.
RID-92
1300 gpm
RID-95
1800 gpm
RID-114
2500 gpm
RID-89
3000 gpm
SIEMENS
105
106
107
108
109
110
111
112
113
114
Van Buren Street
89
92
95
94
Miles

RID WellheadTreatment Systems

- Designed and Constructed in Less-than 6 Months
- Started Up in Early 2012
- Performance Metrics to Date (through 8/2015):
  - Treated over **5.4 Billion Gallons** of Contaminated Groundwater
  - Removed Over **2,200 Pounds** of Hazardous VOCs From the Local Environment
  - O&M Cost Data Used to refine the ERA Cost Projections

RID Modified ERA

- Based on the Successful Pilot Initiative, ERA Work Plan was Modified and Submitted to ADEQ in October 2012
  - **Wellhead** Treatment in lieu of **Central** Facility
  - Treat the **8** most highly-contaminated RID wells (including the 4 existing systems) in lieu of **10**
  - Blending of lower level contaminated wells to achieve water quality standards

Modified ERA Work Plan Approved in February 2013

RID Feasibility Study

- In the Meantime, the Regulatory Track Progressed ……
- RID Completed the Feasibility Study and Further Refined the Proposed Groundwater Remedy
  - Four Remedial Alternatives were evaluated
    - Reference Remedy
    - Less Aggressive Remedy
    - More Aggressive Remedy
    - Most Aggressive Remedy

FS Estimated Costs

- The Proposed Remedy in the RID FS is the **Less Aggressive** Remedy and is Estimated to Cost:
  - **~ $9.4 million in capital**
  - **~ $1.7 million in annual O&M**

~ $71 Million Over the Next 30-years (Net Present Value)

- The Proposed RID Remedial Action Alternative, as Detailed in the RID FS Report and Recaped in the RID PRAP .....
  - Is the Most Effective and Efficient Groundwater Remedial Action Alternative
  - Removes > 1400 lbs. TCE and 690 lbs of PCE annually

The PRPs Also Submitted an FS, However, Their FS ....

- Only Includes a 500 gpm Pump and Treat Remedy (with one new well drilled in the plume with treated water to RID Canal)
- Would Remove ~70 lbs. of TCE and 4 lbs. of PCE annually

AND, Costs an Additional ..... $ 88.6 Million in 30-year NPV

Compared to $71MM for Over 13,000 gpm P&T with > 2,000 lbs of Contaminants Removed Annually

The PRP - FS Fails to Provide Substantial Increases to Contaminant Mass Removal .....

... Or Protect the Public Health, Welfare and the Environment

... Or Comply with the Remedial Objectives

... Or Control Migration of the Plume

... Or Provide for Expeditious Cleanup of the Aquifer

AND, Costs an Additional $ 88.6 Million in 30-year NPV

RID Action is Cost Effective

Groundwater Remedial Action	Capital Cost (year completed)	Capital Cost (in 2014 dollars)	Maximum Water Supply Addressed
WVBA WQARF Site RID Modified ERA	$10,000,000 (in progress)	$9,400,000	25,000 gpm
M52 CERCLA Site Operable Unit 2	$13,200,000 (2001)	$16,200,000	5,300 gpm
NIBW CERCLA Site CGTF Facility	$10,442,000 (1993-2000)	$16,200,000	9,400 gpm
NIBW CERCLA Site MRTF Facility	$10,292,000 (1995-1997)	$15,300,000	6,300 gpm
TIAA CERCLA Site TARP Facility	$8,700,000 (1994)	$13,900,000	6,200 gpm

Comparison of Performance - Local Superfund Sites

Site	Treatment Technology	Remedy Capital Cost (in yrs completed)	Remedy Capital Cost (2014 dollars)	Design Treatment Capacity	Average Annual Groundwater Pump & Treat Rate	VOC Mass Removal Rate	Remedy O&M Costs Summary	Routine O&M Cost ($/lb$_{VOC}$)	Routine O&M Cost ($/Kgal)
M52 Site Operable Unit 1	Air Stripping with VGAC	$3.1 MM (1992)	$5.3 MM	810 gpm	230 gpm (2010-2013) 215 gpm	813 pounds/year (2010-2013) 899 pounds	$1.3 MM/year (2006-2010)	$1,210 $1,446	$6.37 (2006-2010) $11.50
M52 Site Operable Unit 2	LGAC (lead/lag)	$12.0 MM (2001)	$16.2 MM	5,300 gpm	2,108 gpm (2010-2013) 1,919 gpm	612 pounds/year (2010-2013); 401 pounds	$1.1 MM/year (2006-2010)	$794 $2,743	$0.84 (2006-2010) $1.09
Central Groundwater Treatment Facility (@ NIBW Site)	Air Stripping with VGAC	$10.4 MM (1993-2000)	$16.2 MM	9,400 gpm	4,343 gpm (2010-2013) 3,624 gpm	TCE only 1,065 pounds/year (2010-2013) 1,004 pounds	$0.86 MM/year (2005-2009)	$807 (2010-2013) $856	$0.37 (2010-2013) $0.45
Miller Road Treatment Facility (@ NIBW Site)	Air Stripping with VGAC	$10.3 MM (1995-97)	$15.3 MM	6,300 gpm	4,891 gpm (2010-2013) 4,003 gpm	TCE only 574 pounds/year (2010-2013) 401 pounds	$0.54 MM/year (2005-2007) ~ $2.3 MM/year (2008)	$932 - 4,064 (2010-2013) $1,334 - 5,818	$0.21 - 0.91 (2010-2013) $0.25 - 1.11
Tucson Airport Remediation Project (@ TIAA Site)	Air Stripping with VGAC	$8.7 MM (1994)	$13.9 MM	6,200 gpm	3,274 gpm (2010-2013) 2,511 gpm	TCE only 161 pounds/year (2010-2013) 107 pounds	$0.85 MM/year[8] (before 1,4-dioxane treatment began)	$5,280 (2010-2013) $7,944	$0.49 (2010-2013) $0.64
WVBA Site Proposed Less Aggressive Remedy	LGAC (lead/lag)	~ $9.4 MM	~ $9.4 MM	~13,300 gpm	~ 11,758 gpm	~ 2,503 pounds/year	~ $1.7 MM/year	~ $670	~ $0.27

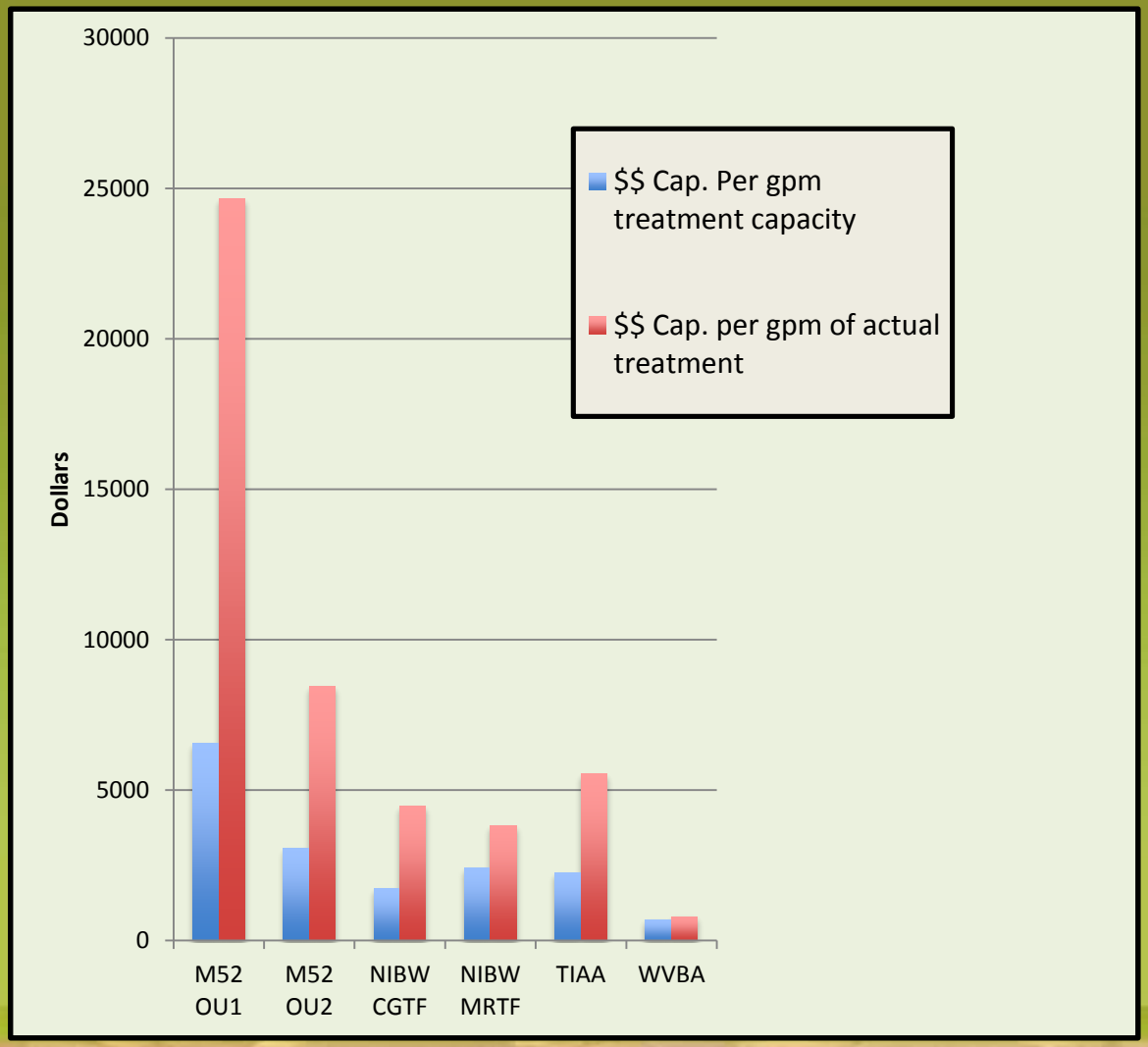
Notes: Values in red denote 2013 reported values/metrics

RID Action is Cost Effective

Compare On Equal Terms:

- $$ of Capital / gpm of Treatment System Capacity
- $$ of Capital / gpm of Actual Treatment
- $$ of Capital / lb. of Contaminant Removed

- $$ of O&M / gpm of Treatment
- $$ of O&M / lb. of Contaminant Removed



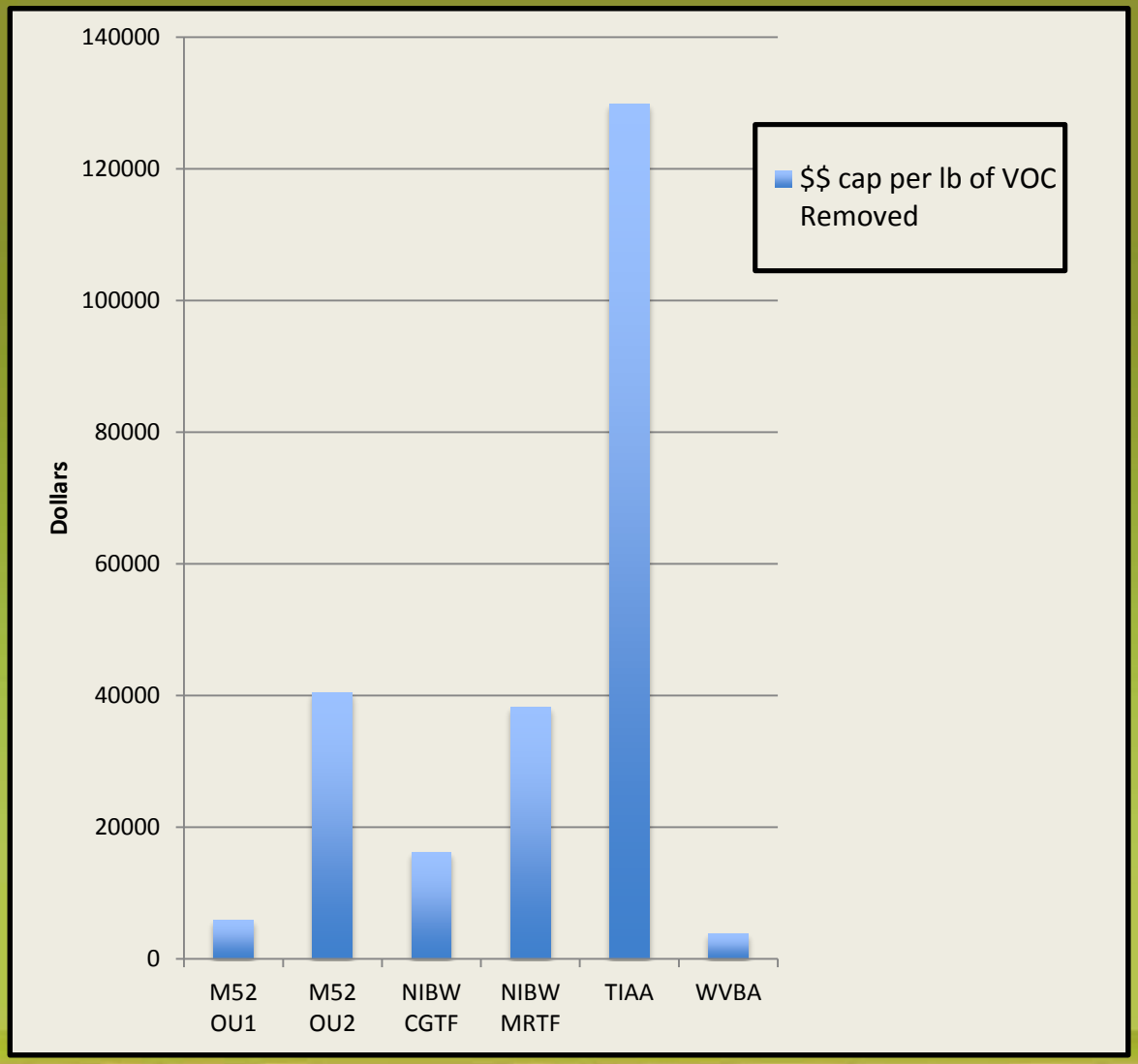
Comparison of Capital Costs

Versus

Total Treatment System Capacity

And

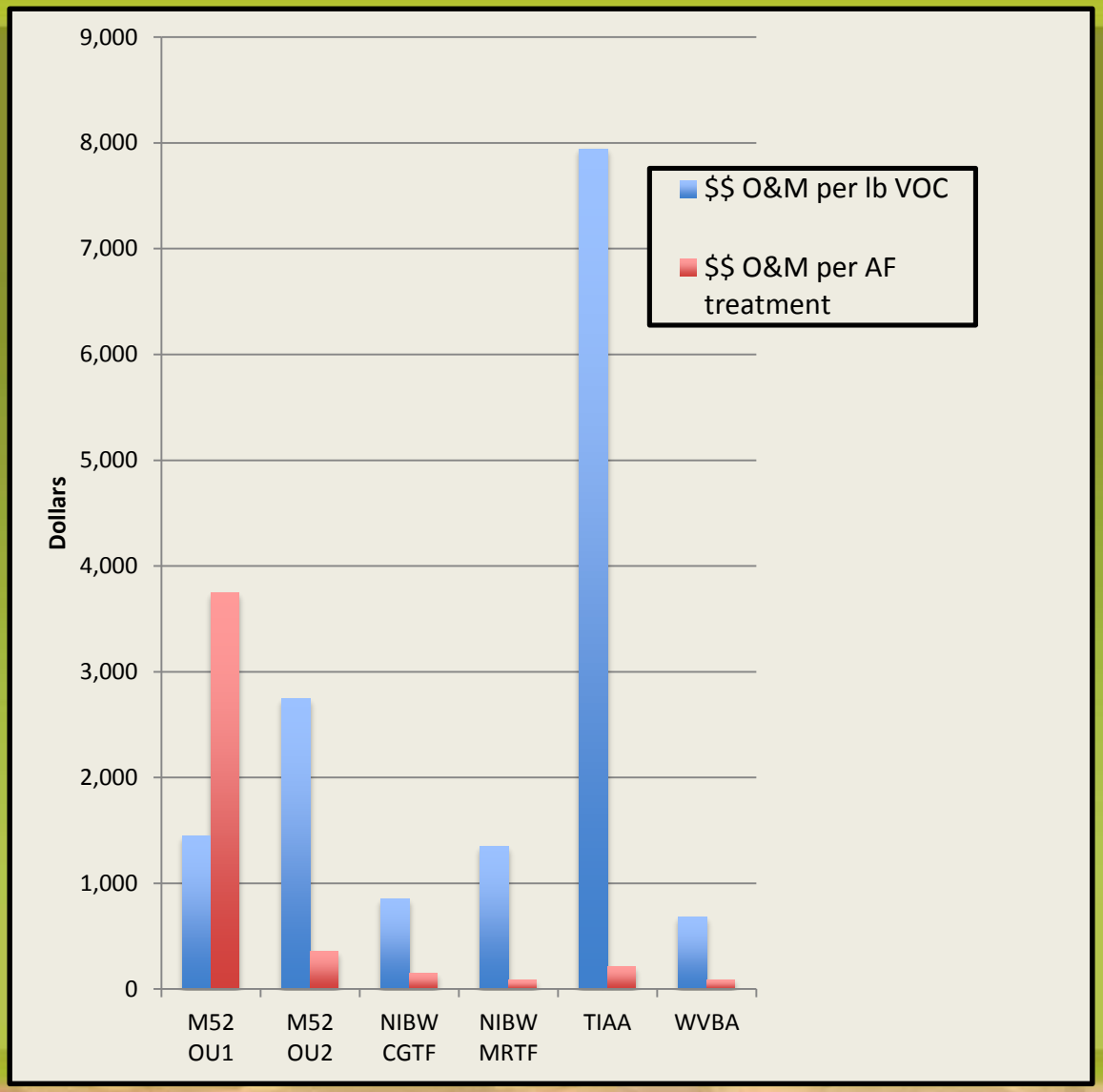
Actual Treatment System Flows



Comparison of Capital Costs

Versus

Pounds of Contaminants Removed



Comparison of Annual O&M Costs

Versus

Pounds of Contaminants Removed

And

Acre-Feet of Water Treated

The Path Forward

Merge the Voluntary with the Regulatory

- ADEQ Approval of RID PRAP
- Completion of the PRAP Actions
- Litigation Settlement for Cost Recovery