RECLAMATION

Managing Water in the West

From Brine to Devine
A Story of Waste to Wetlands

2016 MSSC Annual Salinity Summit

January 28, 2015

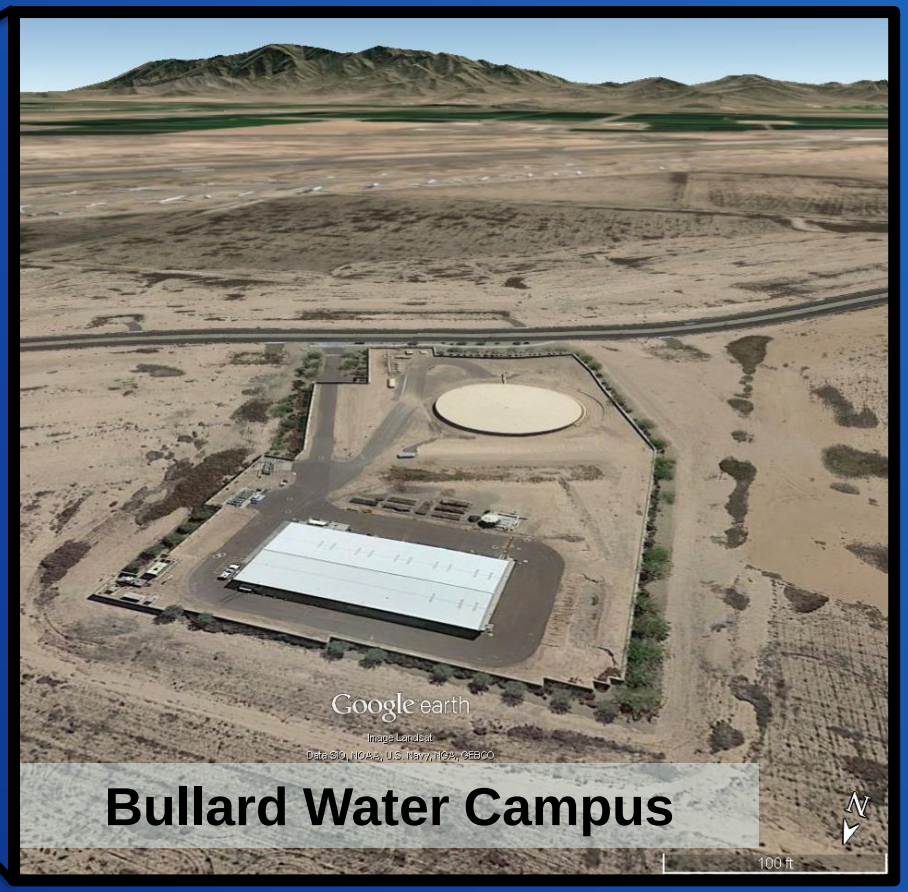
U.S. Department of the Interior

Bureau of Reclamation

CITY OF Goodyear

City of Goodyear
Bullard Water Campus, Arizona

USGS 2001



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Bullard Water Campus Reverse Osmosis Facility

Process produces 0.5 mgd brine at 8,070 mg/L TDS

RO produces 3.5 mgd permeate blended with groundwater for potable supply

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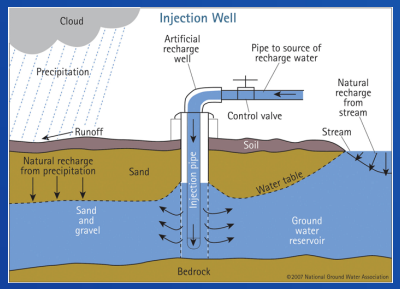
Inland Management Alternatives
RO Concentrate

1. Evaporation Ponds
   a. Large land requirements
   b. No incidental benefits
2. Mechanical Concentrator
   a. Large cost requirements
   b. Industrial facility
3. Deep Well Injection
   a. Not permitted in Arizona
4. Wetland Treatment and Blending
   a. Innovative technology
   b. Multiple benefits



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Concentrate Management Alternative Comparison Central Arizona Salinity Study

Alternative Comparison 30 mgd (millions of dollars)

30 MGD	Pipeline to Yuma	Evaporation Pond	Brine Concentrator	Soften/ 2nd RO/ VSEP	Wetlands Surface Discharge	Injection Well
Capital	$580.25	$1,837.74	$724.78	$718.94	$399.75	$204.98
O&M	$ 1.41	$ 10.22	$ 88.69	$ 20.01	$ 5.14	$ 33.60
Annualized	$ 32.58	$ 114.22	$125.63	$ 58.66	$ 26.62	$ 44.62

Source: CASS, January 2010, Strategic Alternatives for Brine Management in the Valley of the Sun

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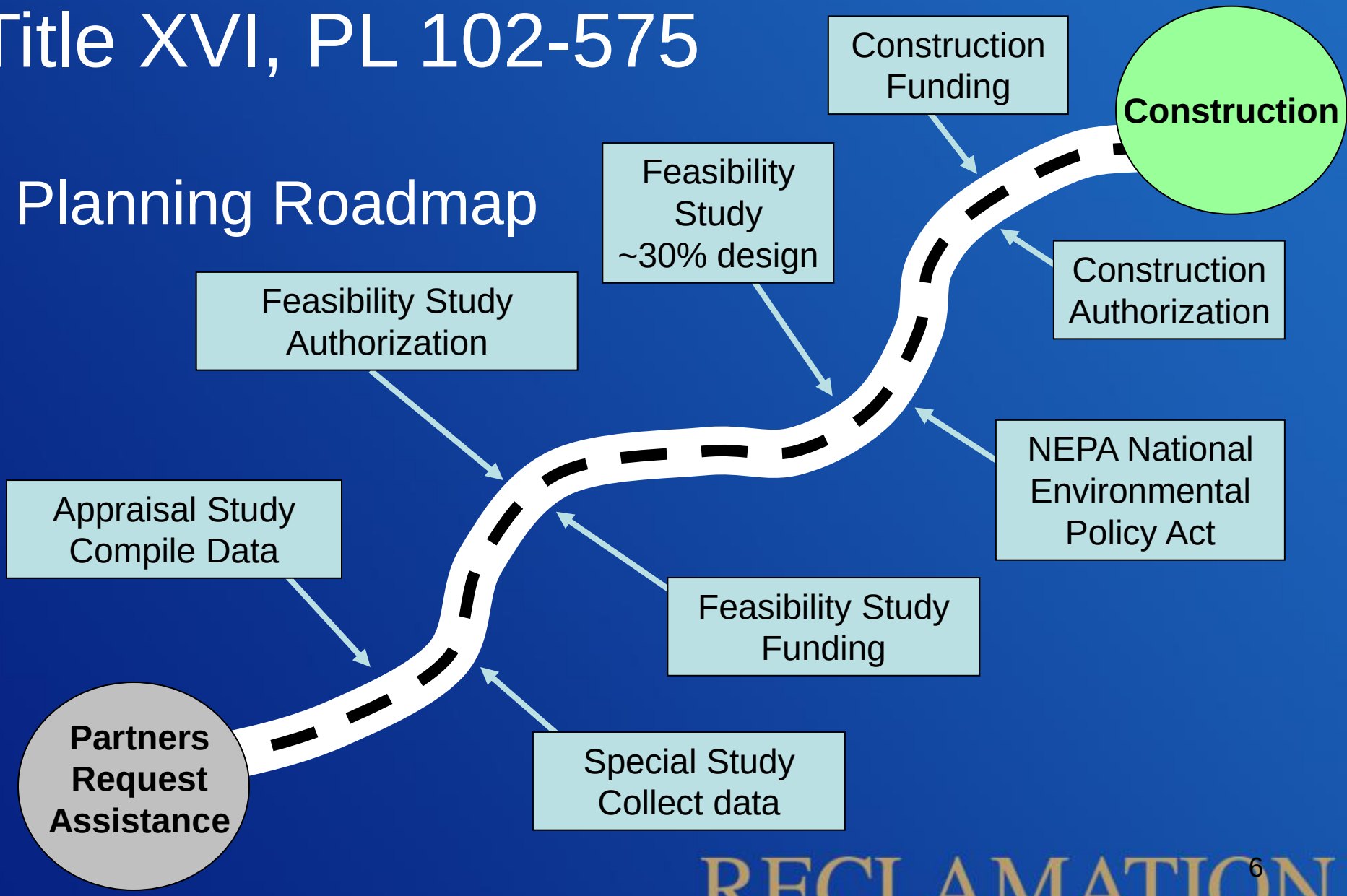
Bureau of Reclamation Act of 1902 and Title XVI, PL 102-575

Planning Roadmap



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Goodyear Bullard RO Facility and Pilot Wetlands

Google Earth, accessed September 2015

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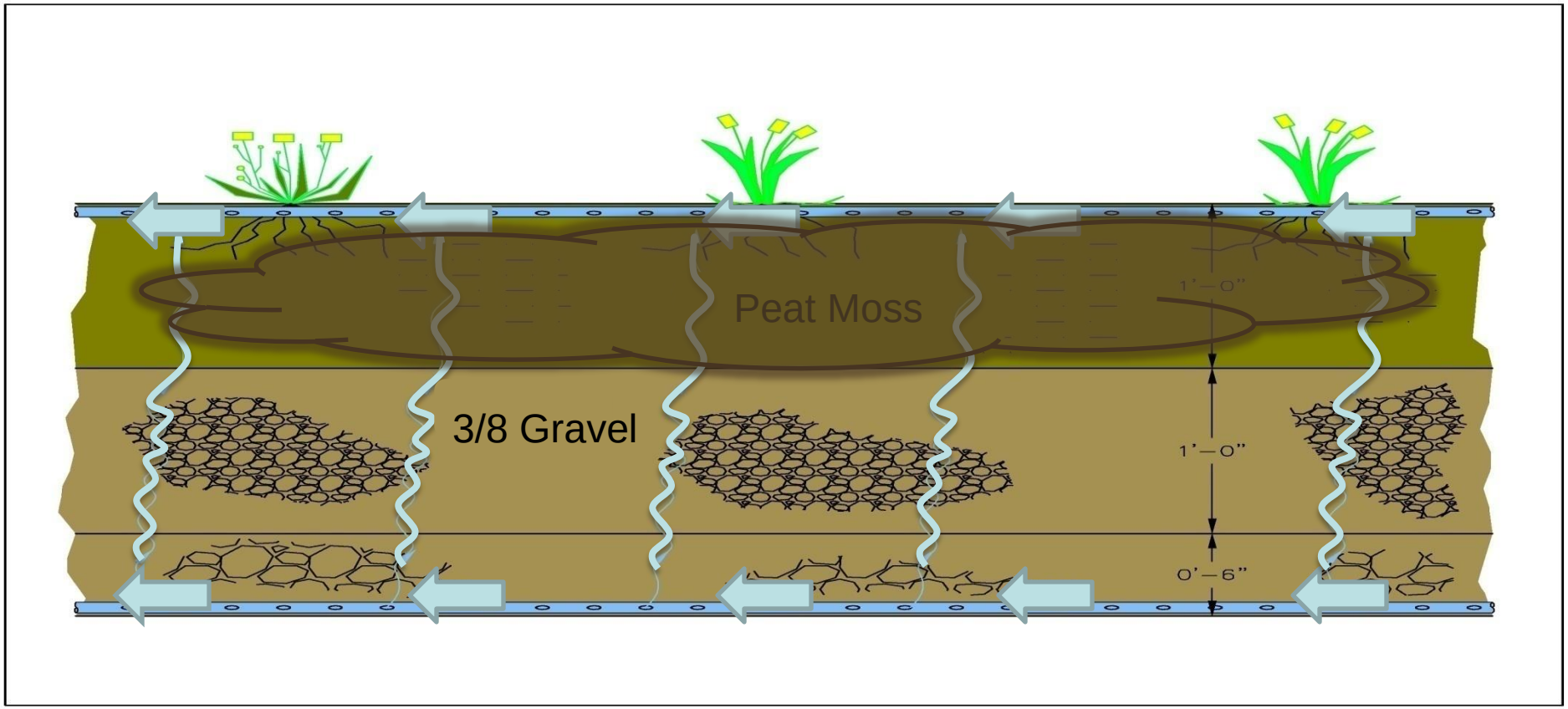
Pilot Wetlands Concentrate Management

Concentrate Management Wetlands
Vertical Flow Wetlands



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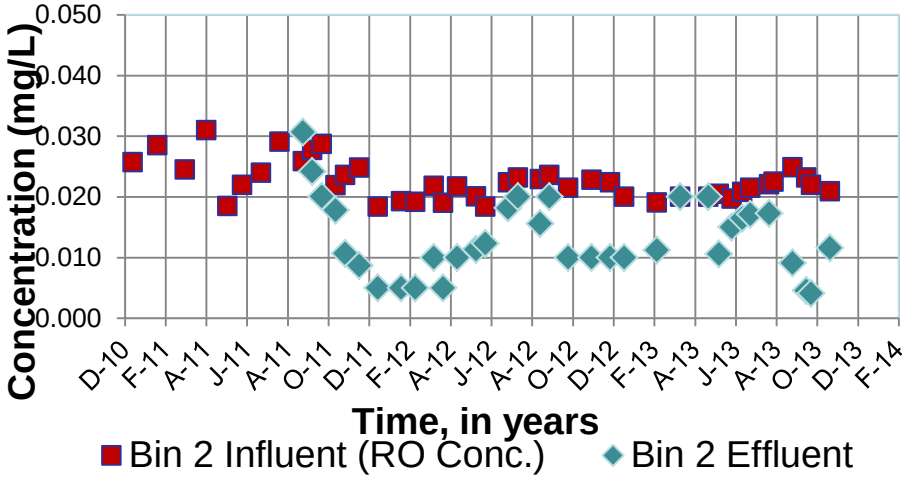
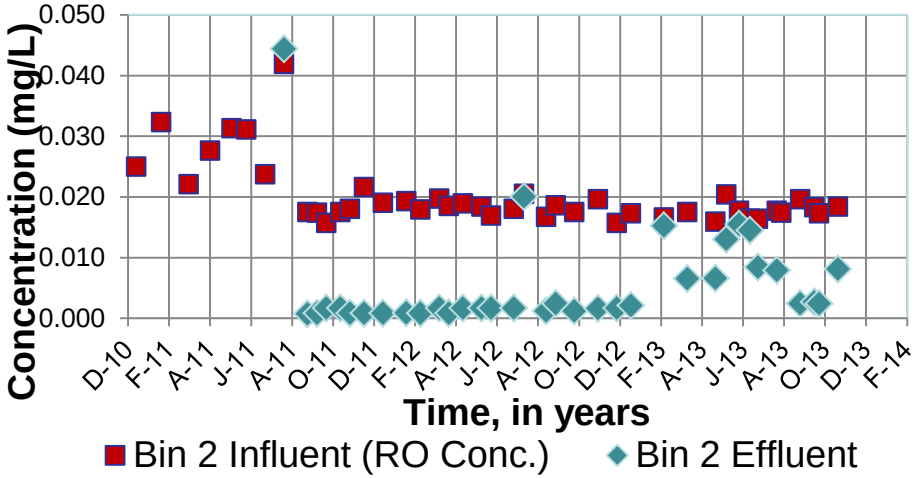
Pilot Wetlands Water Quality Data

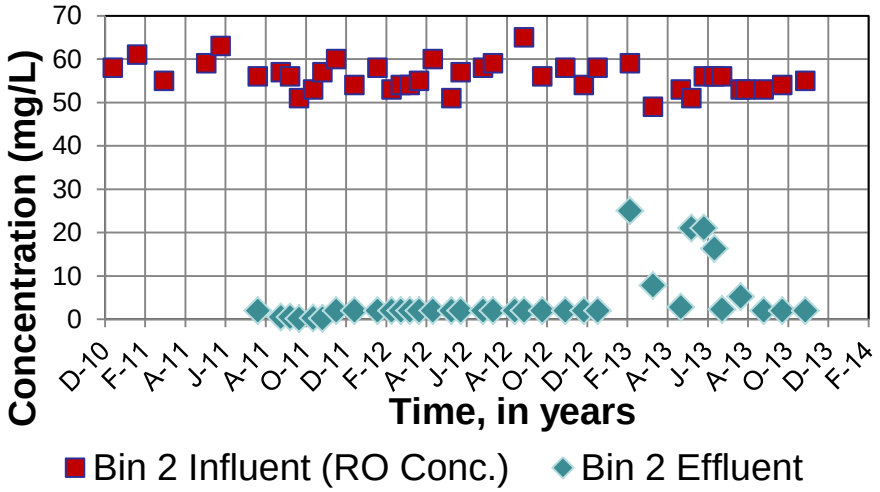
Total Arsenic Reduction Bin 2



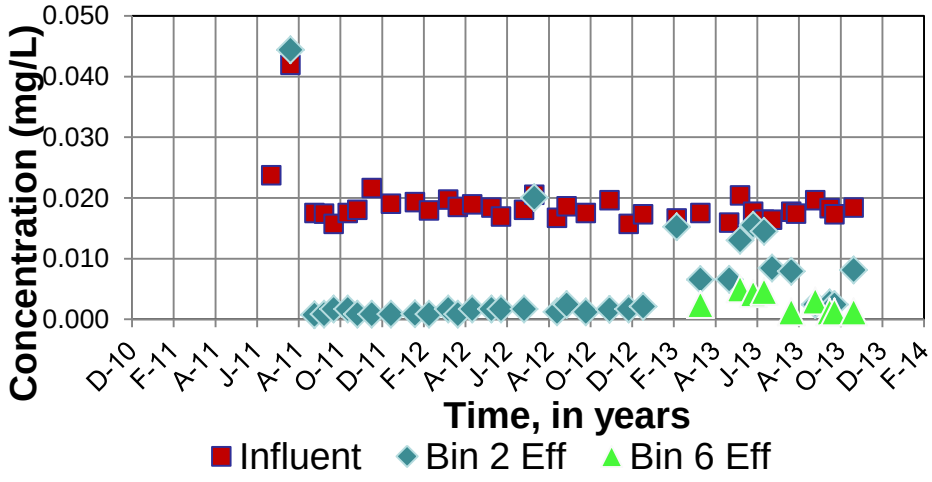
Total Selenium Reduction Bin 2



Nitrate-N Reduction Bin 2



Total Se Reduction Bins 2 and 6



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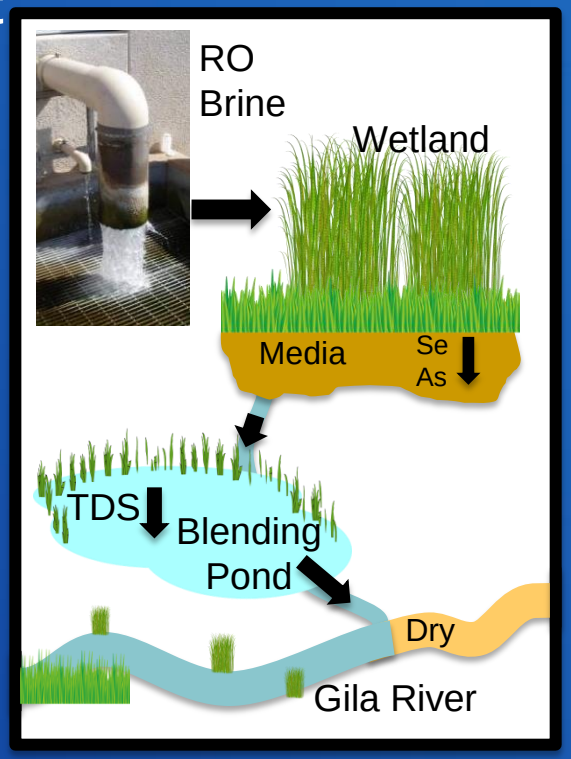
Concentrate Management Wetlands Pilot to Demonstration Feasibility

- **Pilot Wetlands - inland treatment of RO brine cost effective and multi-beneficial**
  - remove regulated constituents
  - TDS concentrations blended down using effluent, treated superfund and/or groundwater
  - meet Clean Water Act Surface Water Discharge Standards
  - discharge in Gila River
  - environmental restoration and public amenities
- **Demonstration Wetlands - Feasibility Study using Geographic Information System (GIS)**
  - Develop criteria and ranking
  - Develop model
  - identify potential demonstration scale wetland locations



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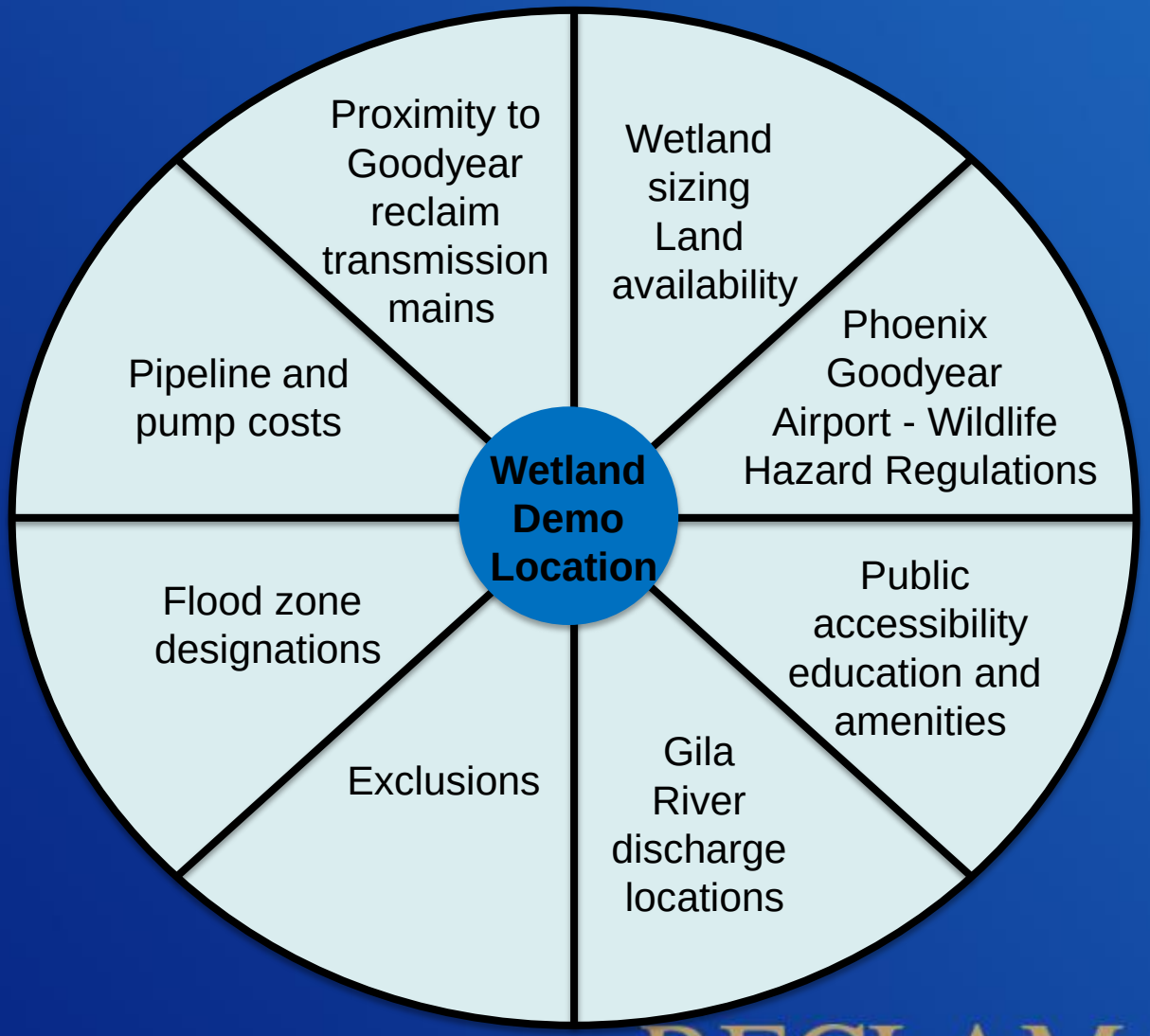
GIS Criteria for Demo Wetland Locations



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Demo Wetlands
GIS Criteria Matrix and Ranking

GCM Wetland (Effluent, Brine, Superfund Blend)-Criteria and Ranking							
	Excluded	Least Suitable	Low Suitability	Medium Suitability	Optimal Suitability	Weighting	Max Score
GIS Layers/Factors	0	1	2	3	4	*n	*NA*
Land Acquisition/Ownership	Residential, COG Platted Land	Commercial	Industrial	Agricultural	COG Property	1	4
Public Accessibility	*NA*	> 1 mile	1 mile - 1,000 ft	1,000 ft - 500 ft	< 500 ft	4	16
Site accessibility	*NA*	> 1 mile	1 mile - 1,000 ft	1,000 ft - 500 ft	< 500 ft	4	16
Required pipeline length for Brine (6-inch)	*NA*	> 20,000 ft	20,000 - 5,000 ft	5,000 - 500 ft	< 500 ft	1	4
Required pipeline length from treated Superfund (8-inch)	*NA*	> 20,000 ft	20,000 - 5,000 ft	5,000 - 500 ft	< 500 ft	1	4
Required pipeline length from treated Effluent (8-inch)	*NA*	> 20,000 ft	20,000 - 5,000 ft	5,000 - 500 ft	< 500 ft	1	4
Required pipeline length for Blend (12-inch)	*NA*	> 20,000 ft	20,000 - 5,000 ft	5,000 - 500 ft	< 500 ft	1	4
Distance from COG reclaimed transmission main	*NA*	>1,000 ft	1,000 - 500 ft	500 - 100 ft	< 100 ft	1	4
Fiber Optic-Line Distance Needed	> 2 miles	2 - 1.5 miles	1.5 - 3/4 miles	3/4 - 1/4 mile	< 1/4 mile	1	4
Energy requirements for Pumped Brine	> $25,000 annually	$25,000 - $15,000 annually	$15,000 - $7,500 annually	$7,500 - $1000 annually	< $1000 annually	1	4
Energy requirements for Pumped Superfund	> $25,000 annually	$25,000 - $15,000 annually	$15,000 - $7,500 annually	$7,500 - $1000 annually	< $1000 annually	1	4
Energy requirements for Pumped Effluent	> $25,000 annually	$25,000 - $15,000 annually	$15,000 - $7,500 annually	$7,500 - $1000 annually	< $1000 annually	1	4
Flood Zone Designations	*NA*	Floodway (FW)	100 year (No elevations)(A,AE)	100 year (1-3 ft depths) (AH)	500 year Flood (X1)	2	8
Goodyear Airport Bird Strike Mitigation FAA requirements	*NA*	Under 2,000 ft and/or in flight-path zone	2,000 - 5,000 ft and off to side of airport	10,000 - 5,000 ft and off to side of airport	outside of 10,000 ft buffer	2	8
Future Road Buffers - COG transportation planning	Removal from Developable area (road buffers based upon COG Master Plan)					*NA*	
Power line transmission Rights-of-Way	Removal from developable area (500 ft buffer)					*NA*	
MAXIMUM POSSIBLE SUITABILITY SCORE							***88***

Interactive process with technical team consisting of Goodyear & stakeholders

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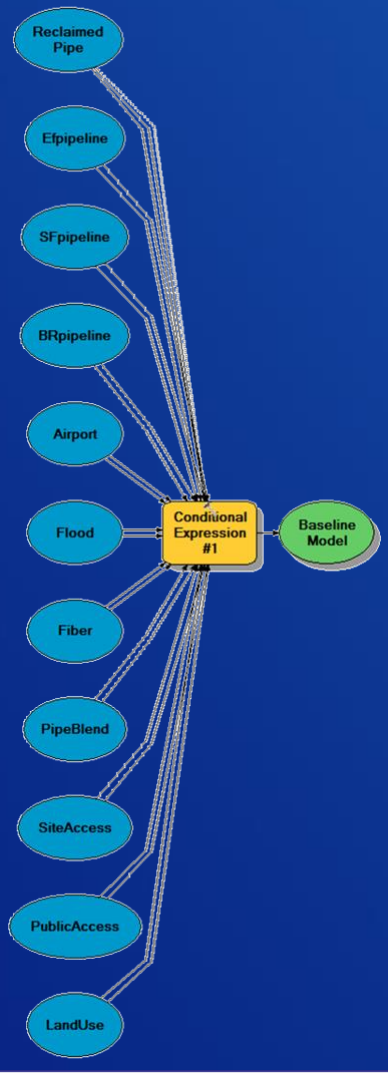
GIS Rasters used in Baseline Model

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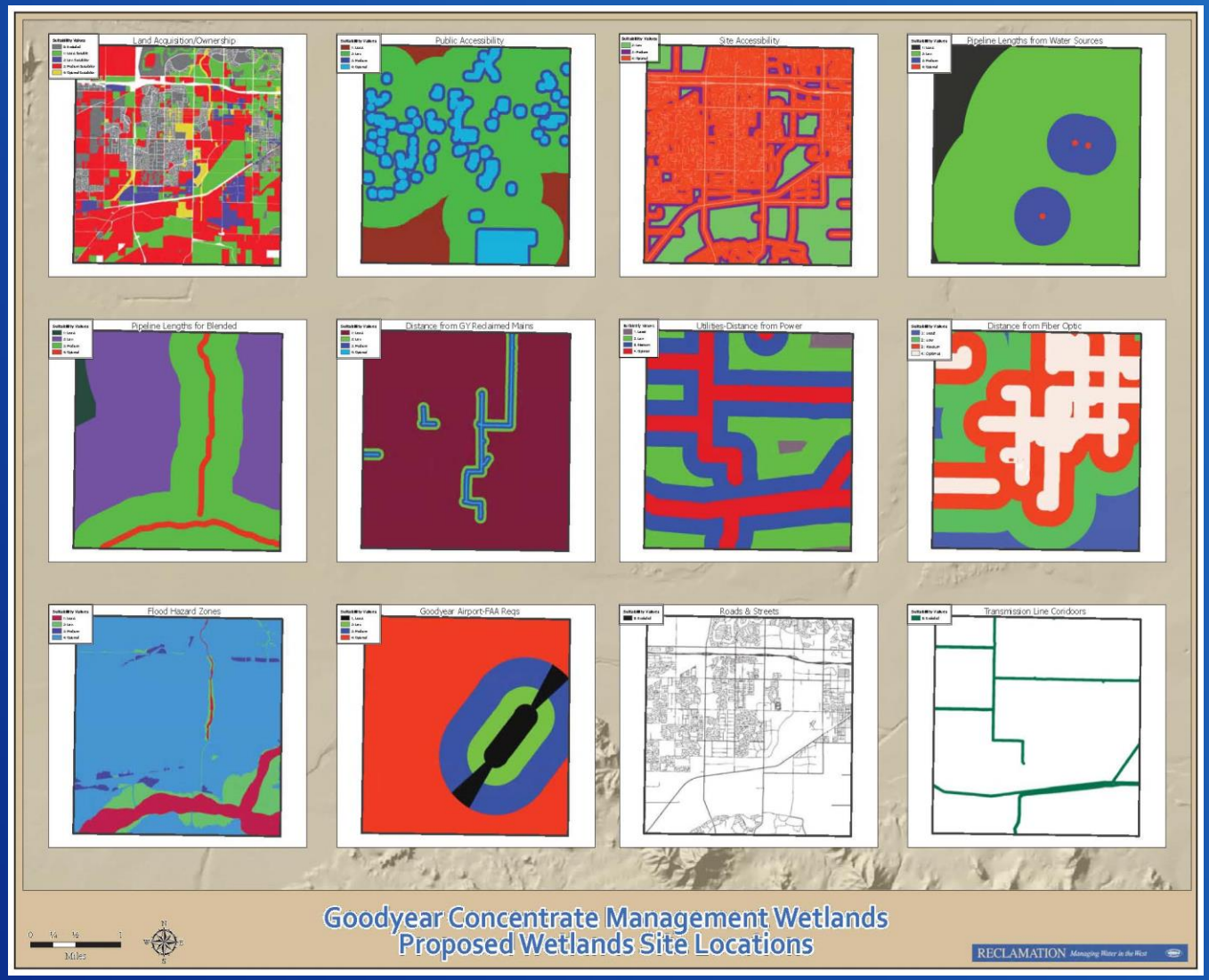

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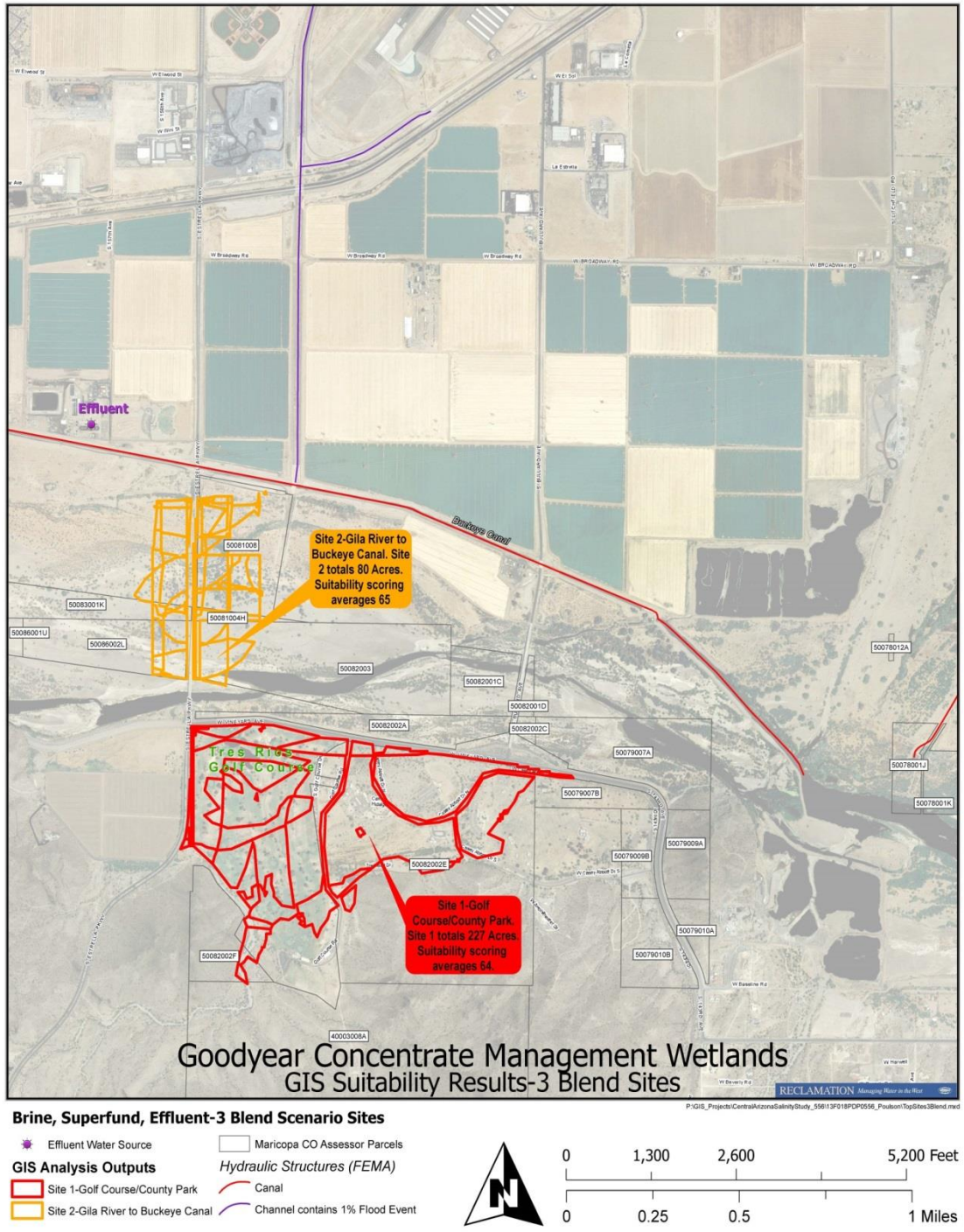
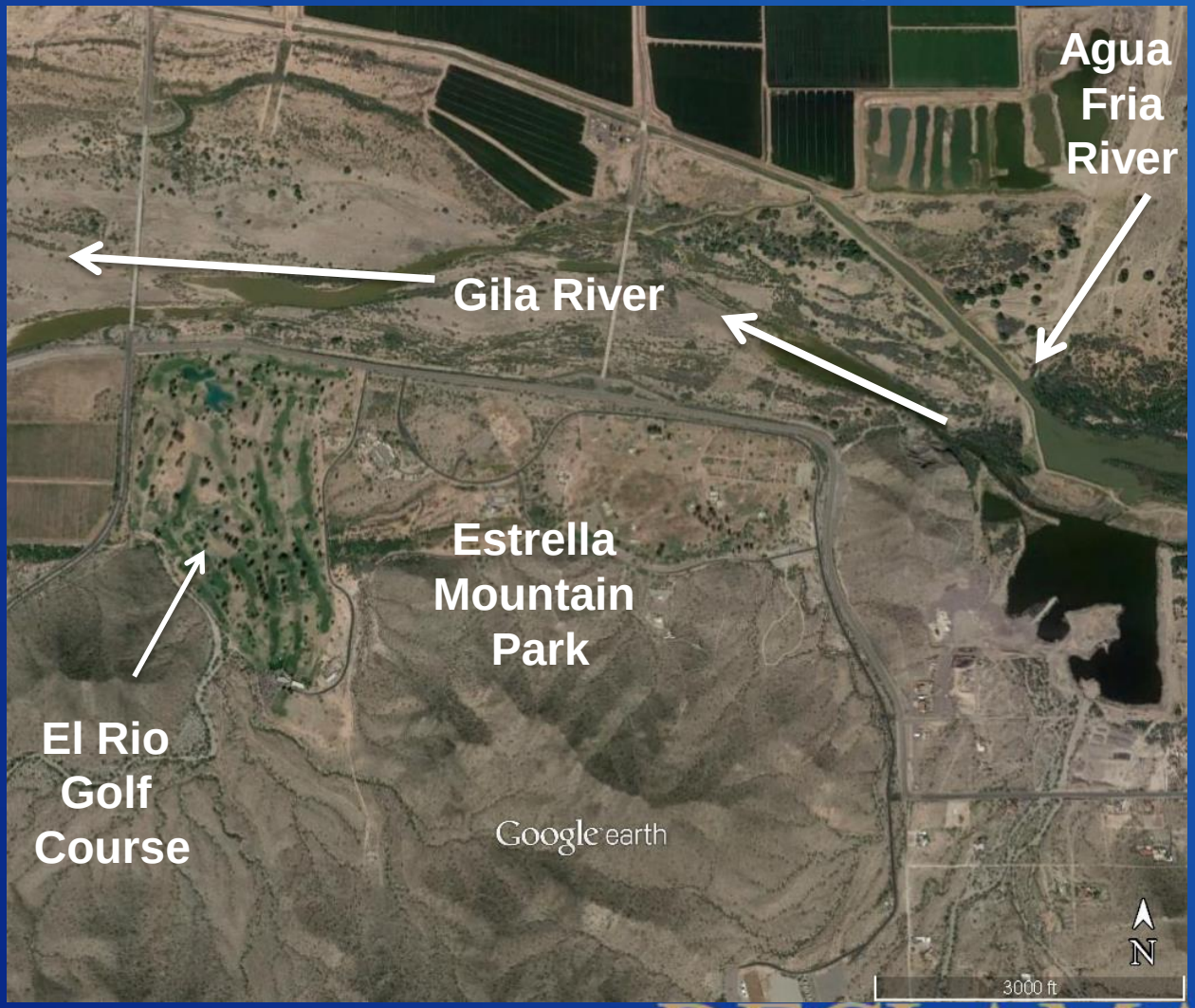
Concentrate Management Wetlands

GIS Modeling Results



Concentrate Management Wetlands
Estrella Mountain Regional Park



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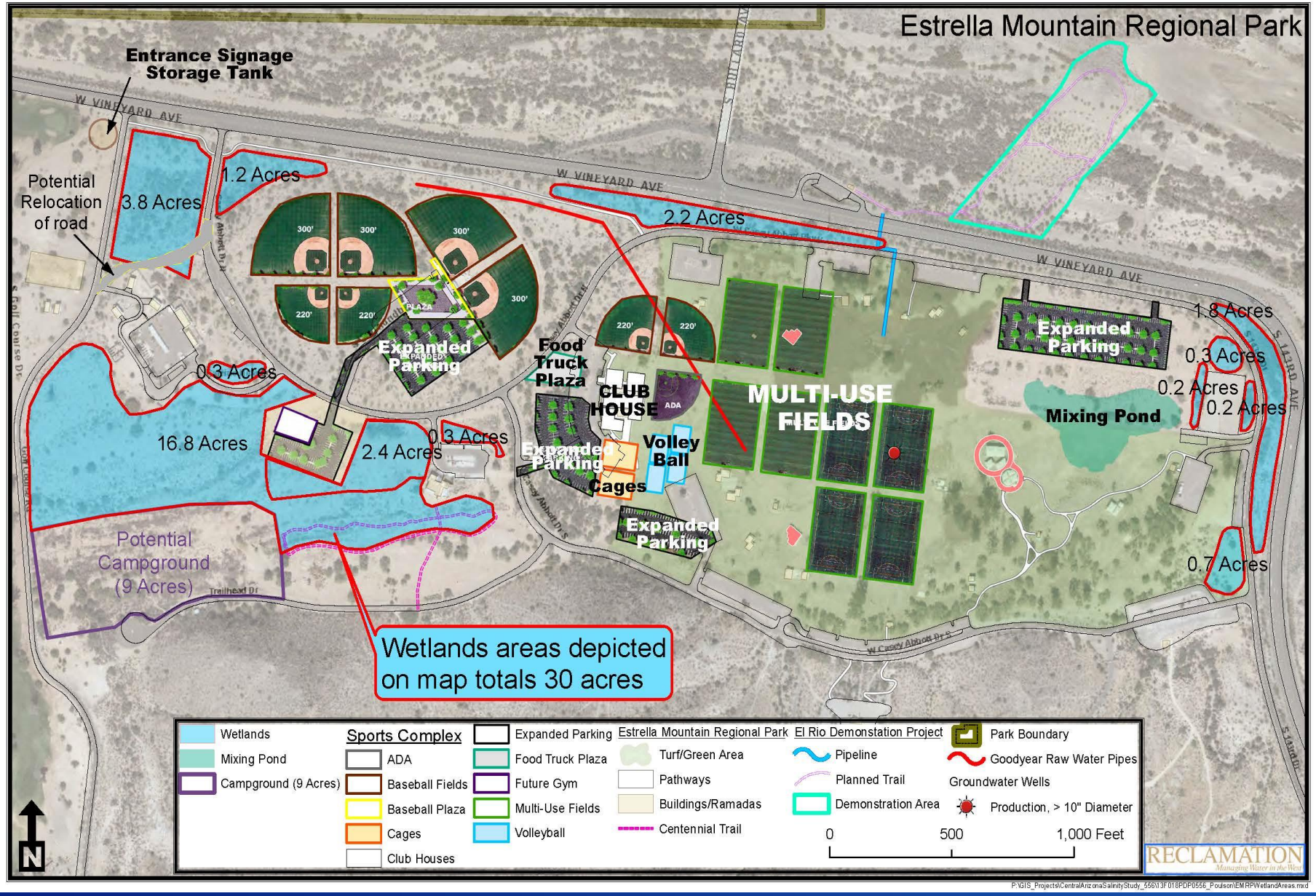

Estrella Regional Park Draft Master Plan and Possible Wetland Locations

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Concentrate Management Wetlands
Estrella Mountain Regional Park

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Concentrate Management Wetlands Goodyear RFP Engineering

Project Report November 1, 2015 – November 15, 2015

Brine Management Wetland (BMW) Demonstration Project – WW1301:

Project Description: To develop a Design Concept Report and 30% plans and specifications for a BMW Demo Project.

The City currently relies on groundwater for all of its water needs. The City constructed and operates the Bullard Water Treatment Plant (RO facility), a 3.5 million gallons per day (mgd) reverse osmosis (RO) facility to treat brackish groundwater for potable use. The RO facility produces potable water for municipal purposes with a brine concentrate waste of 0.5 mgd that has TDS of around 8,500 milligrams per liter (mg/L). The brine concentrate also exceeds maximum contaminate levels (MCL) for nitrates, arsenic, selenium, and chromium. The City's current practice is to discharge the brine concentrate into the sanitary sewer system and have it treated at the 157th Ave Water Reclamation Facility (WRF) where the TDS levels of the treated effluent are about 2,000 mg/L.

The City and BOR have been collaborating since 2009 on an innovative approach to managing the RO brine concentrate discharged from the RO facility. The City of Goodyear's RO facility Pilot Project uses vertical flow wetlands to test the concentration reduction of regulated constituents in the RO brine concentrate.

As part of a BOR grant executed in January 2013, the City and the BOR would like to expand the Pilot Project to a BMW demo scale project that could treat up to 125,000gpd of brine. The City is also working on lease agreement with the Maricopa County Parks and Recreation Department to locate the BMW Demo project within Estrella Regional Park and Tres Rios Golf Course. The ultimate build out of the BMW could grow to 1 mgd of brine spread over 45 acres. The treated water is anticipated to be used to develop riparian habitat at the Park and in the Gila River.

Project Manager: Walt Kinsler (623-882-7959)
Project Start Date: 1/26/14 **Project End Date: 11/23/16**
Procurement Delivery: RFQ

Construction Schedule:

Milestone	Date	Status
Advertise RFQ	7/29/15-9/18/15	COMPLETED

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Pilot Wetland Concentrate Management Preliminary Conclusions

Gila River, Google Maps 2015

- Constructed vertical flow wetlands can remove metals and nitrate in RO concentrate.
- Plant establishment can be achieved in a wetland system that is supplied by RO concentrate over a season of maturation.
- Wetland Treatment is a viable concentrate management alternative that increases water supply reuse options and could be used to restore wetland habitat in Central Arizona.

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Concentrate Management Wetlands

QUESTIONS/COMMENTS

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