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# **WATER, WASTEWATER and URBAN GROWTH in Tucson Metropolitan Region**

With the participation of  
Stuart Marsh and Kyle Hartfield



## FOCUS

Interdisciplinary approach: hydrology / urban  
planning / regulation / utility management /  
remote sensing

to analyze and explain

Water & wastewater and urban interactions

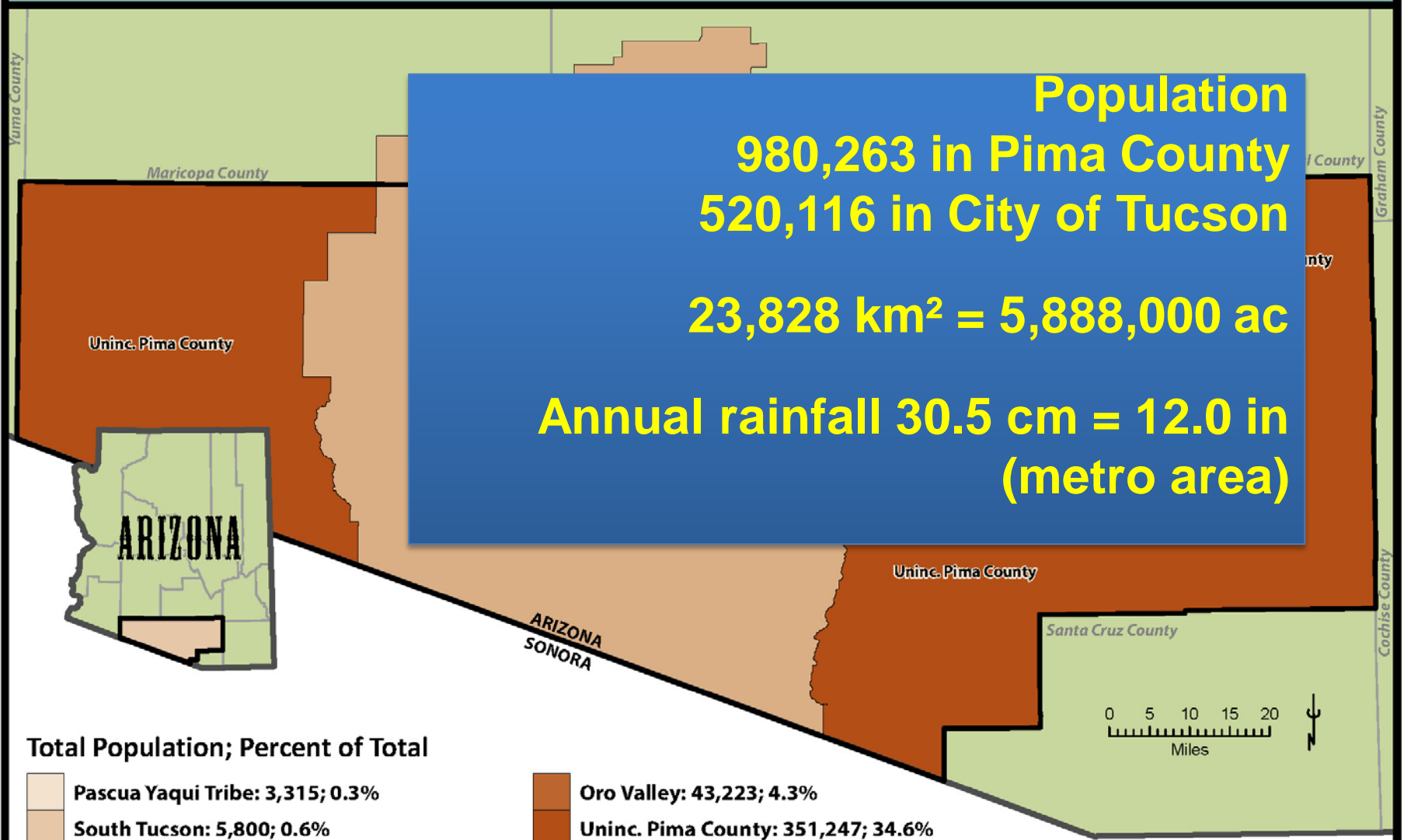
Implications for policy and management.












**1. TUCSON METROPOLITAN REGION**

**Pima Association of Governments  
Member Jurisdictions Population and Percent of Total**

**Population**  
**980,263 in Pima County**  
**520,116 in City of Tucson**  
**23,828 km<sup>2</sup> = 5,888,000 ac**  
**Annual rainfall 30.5 cm = 12.0 in**  
**(metro area)**



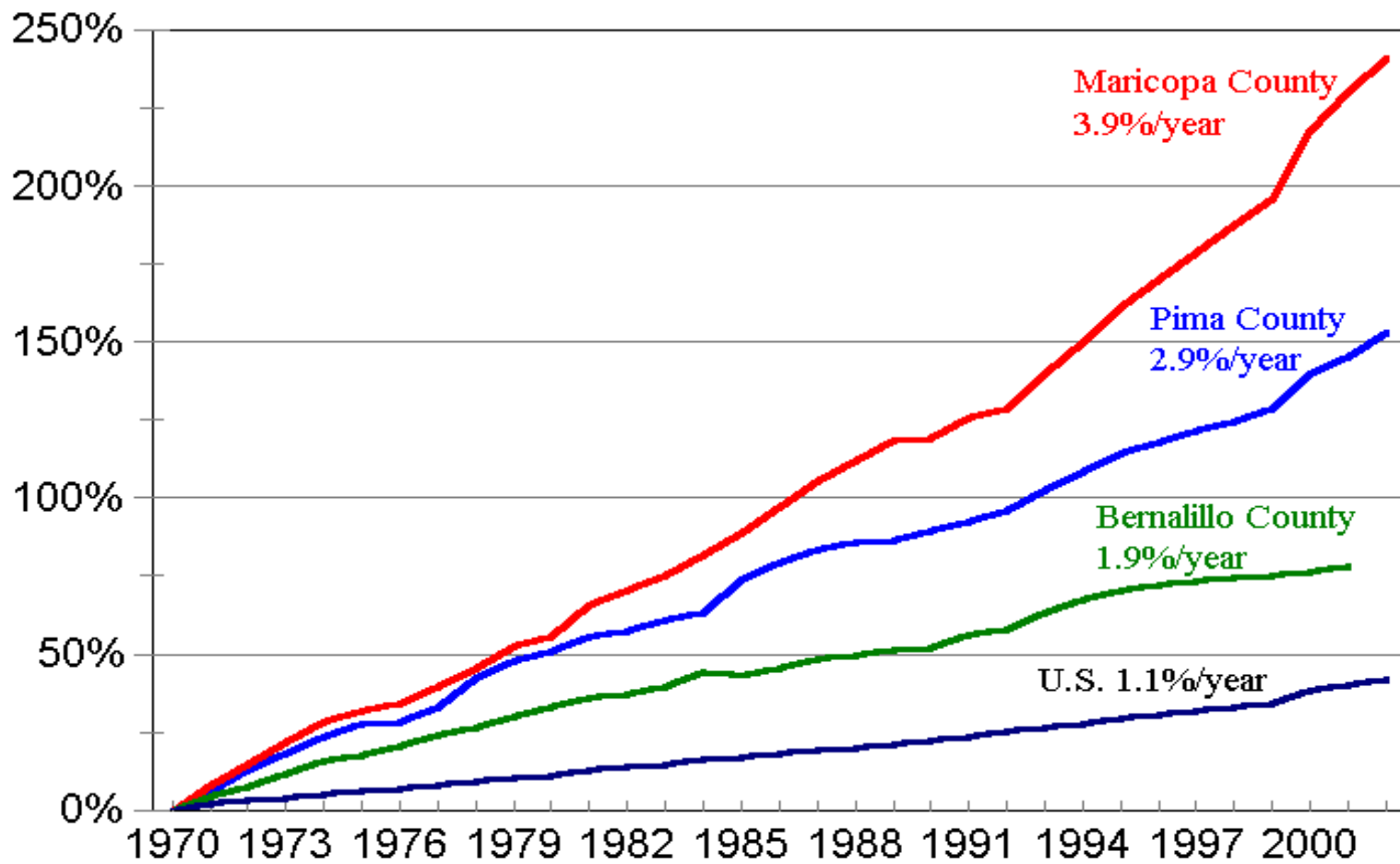
**Total Population; Percent of Total**

	<b>Pascua Yaqui Tribe: 3,315; 0.3%</b>		<b>Oro Valley: 43,223; 4.3%</b>
	<b>South Tucson: 5,800; 0.6%</b>		<b>Uninc. Pima County: 351,247; 34.6%</b>
	<b>Tohono O'odham Nation Total: 9,545; 0.9%</b>		<b>Tucson: 543,959; 53.6%</b>
	<b>Sahuarita: 23,190; 2.3%</b>		<b>Pima County Total: 1,014,023</b>
	<b>Marana: 33,744; 3.3%</b>		

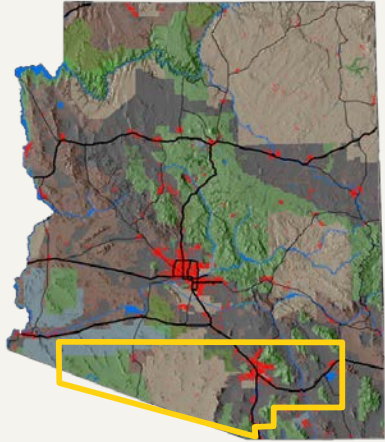
The information included on this map has been compiled from a variety of sources and is subject to change without notice. Pima Association of Governments makes no representation or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information.



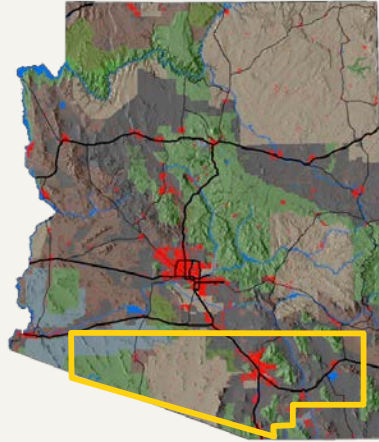
## Percent Population Growth from 1970



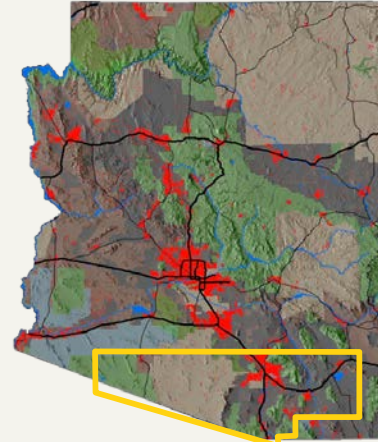
# Evolution of Urban Corridor



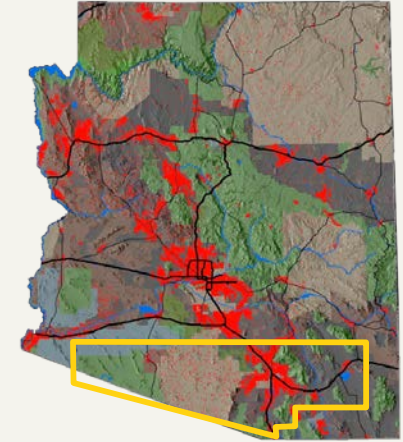
**2000**  
5 M habitantes



**2010**  
7 million habitants



**2030**  
12M habitantes

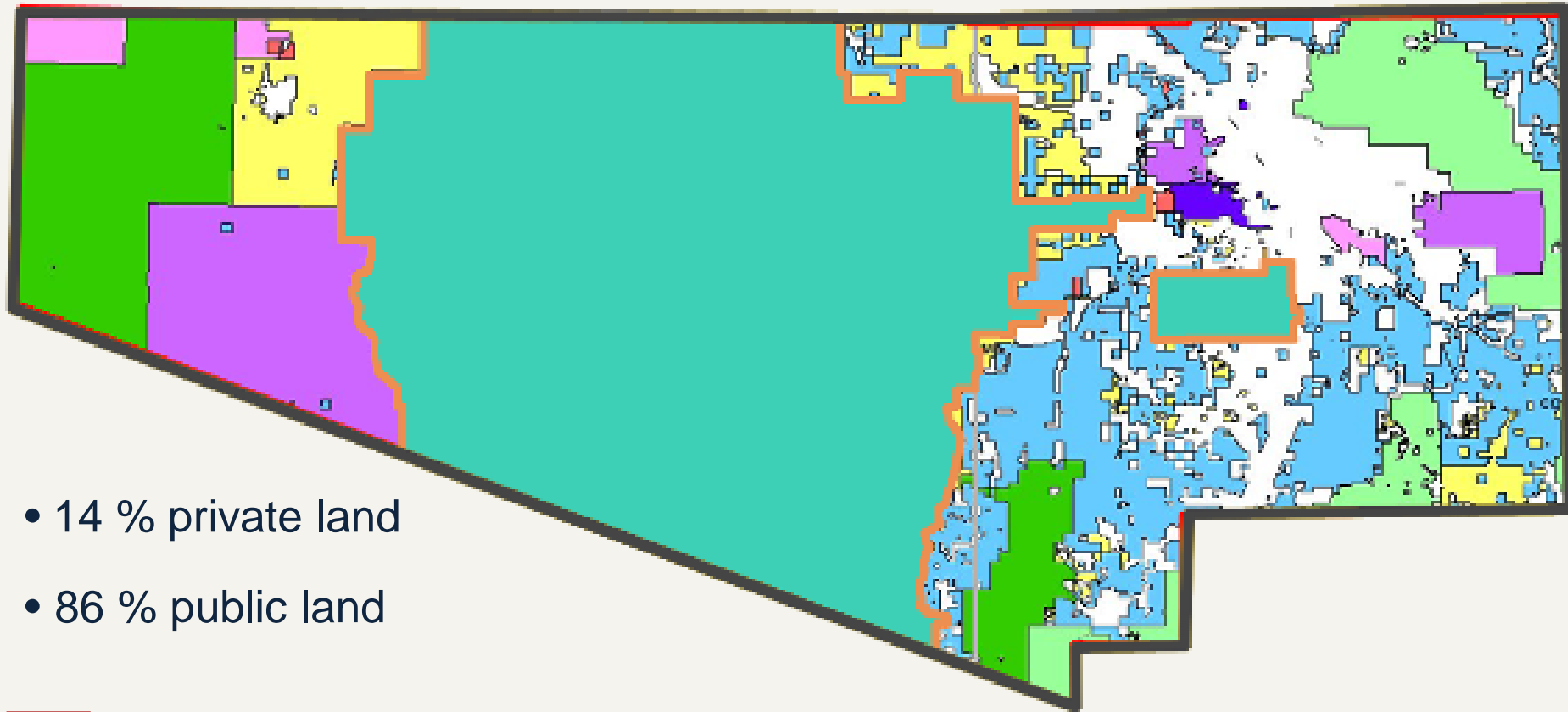


**2050**  
16M habitantes

The growth scheme follows the megalopolis transportation routes.



# Land Status in Pima County



- 14 % private land
- 86 % public land





An aerial photograph of a city, likely Los Angeles, showing a dense urban grid. A semi-transparent dark blue banner is overlaid across the center of the image, containing the text '2. URBAN MODELS, WATER & WASTEWATER'. The city is surrounded by rugged, hilly terrain with some green vegetation. A river or canal system is visible winding through the city. The image has a slightly grainy, high-resolution appearance.

## 2. URBAN MODELS, WATER & WASTEWATER



## 2.1. water resources

More than 100 years ago, the Santa Cruz River flowed nearly year-round through Tucson.

Human activities and natural events (drought) in the late 19th led to its decline

Now it flows only as the result of floods or sewage effluent

Groundwater pumping has led to a major decline of the riparian habitat.



1940



1975

**Surface water:** from the Colorado River to the Central Arizona Project recharge & banking

**Groundwater**

domestic wells: the non regulated slot

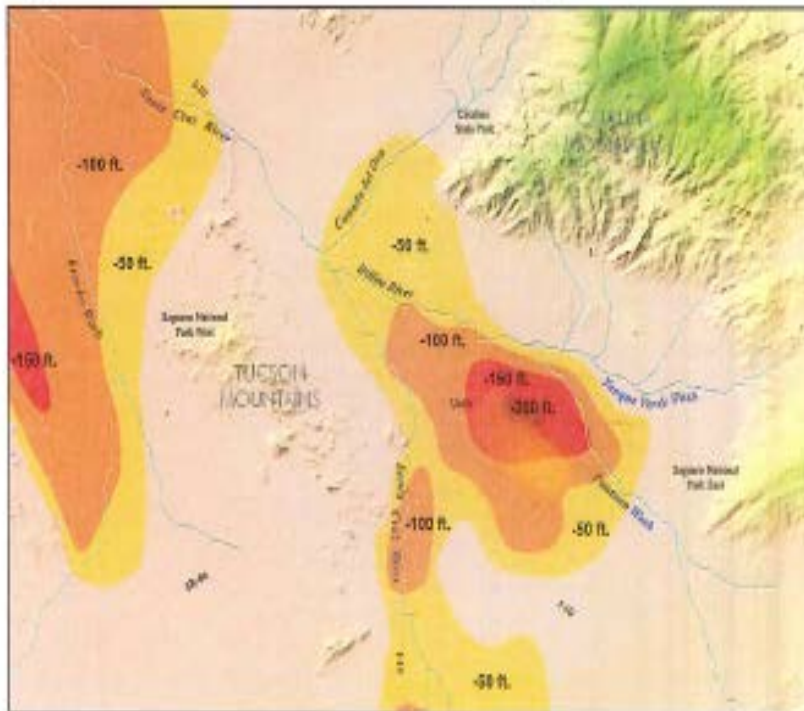
**Wastewater**

**AND**



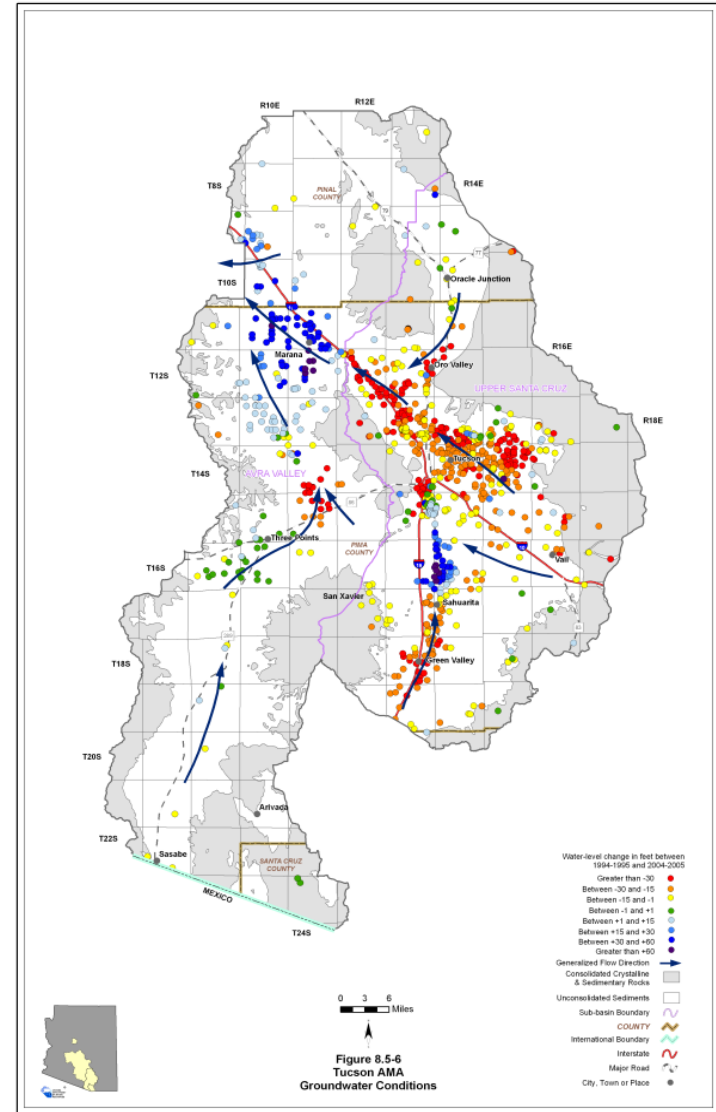
Reclaimed Water  
Water Harvesting  
Stormwater Recharge

Approximate Decline in Groundwater Levels, 1940-1995



Data sources: Arizona Department of Water Resources, Pima County Technical Services, Water Resources Research Center

Groundwater Elevation Decline 1940-1995



Groundwater Flow and Water Level Changes in Eastern Pima County

Source: Arizona Water Atlas



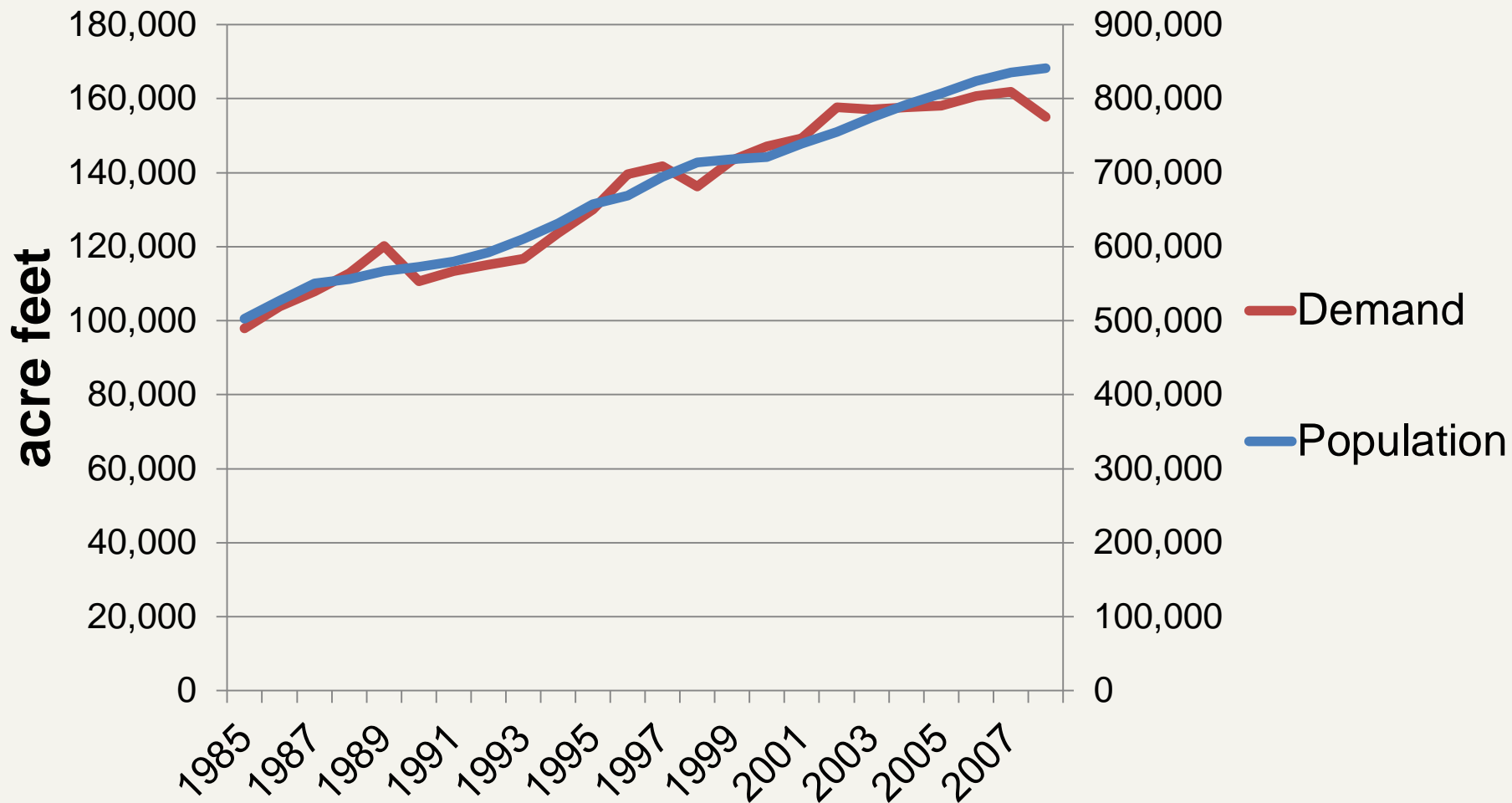
Central Arizona Project CAP: \$3.6 Billion; 1.5 MAF/Yr (1850 Hm<sup>3</sup>/yr) Colorado River



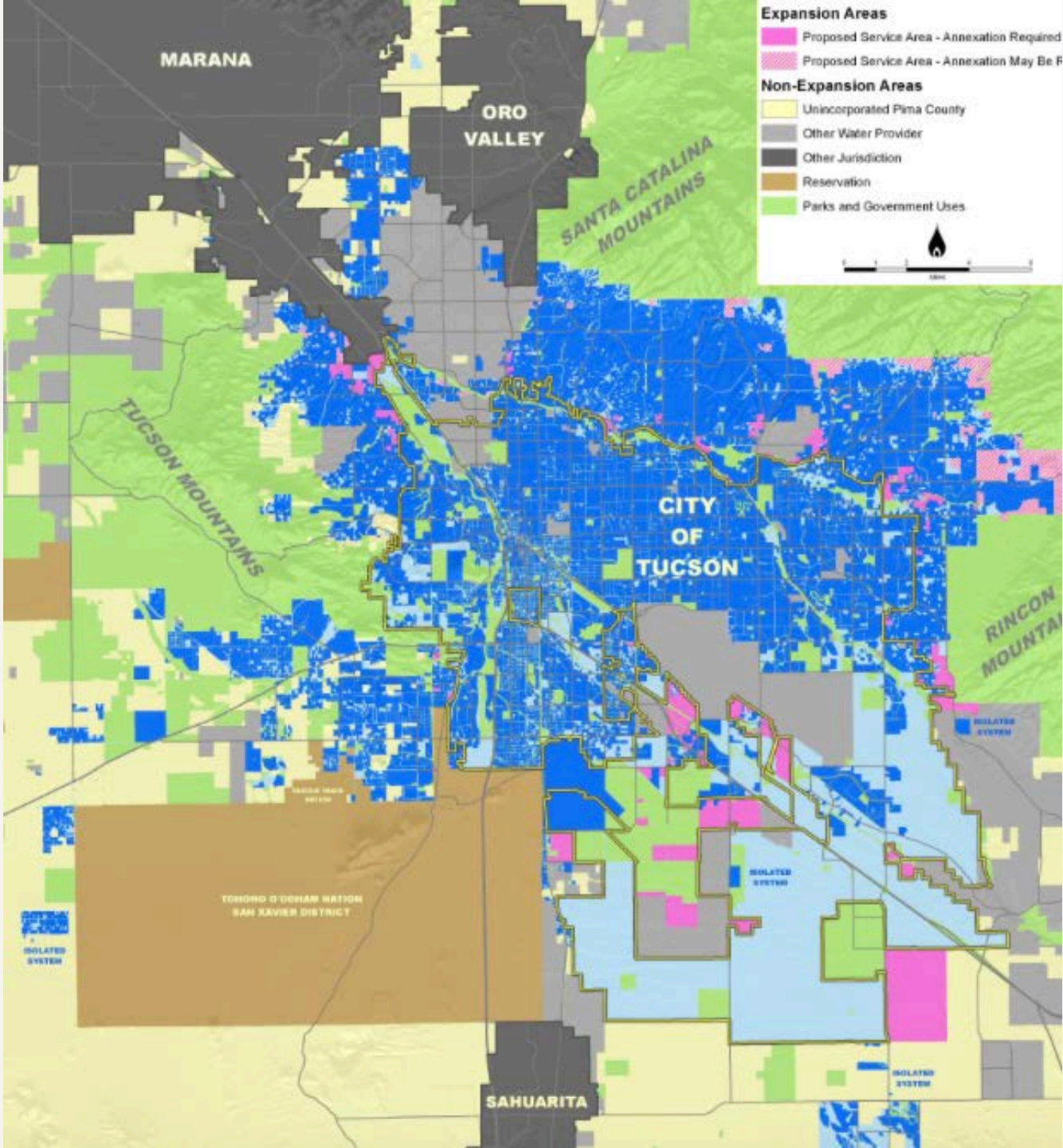
# Avra Valley Recharge Project



## Total Water Providers







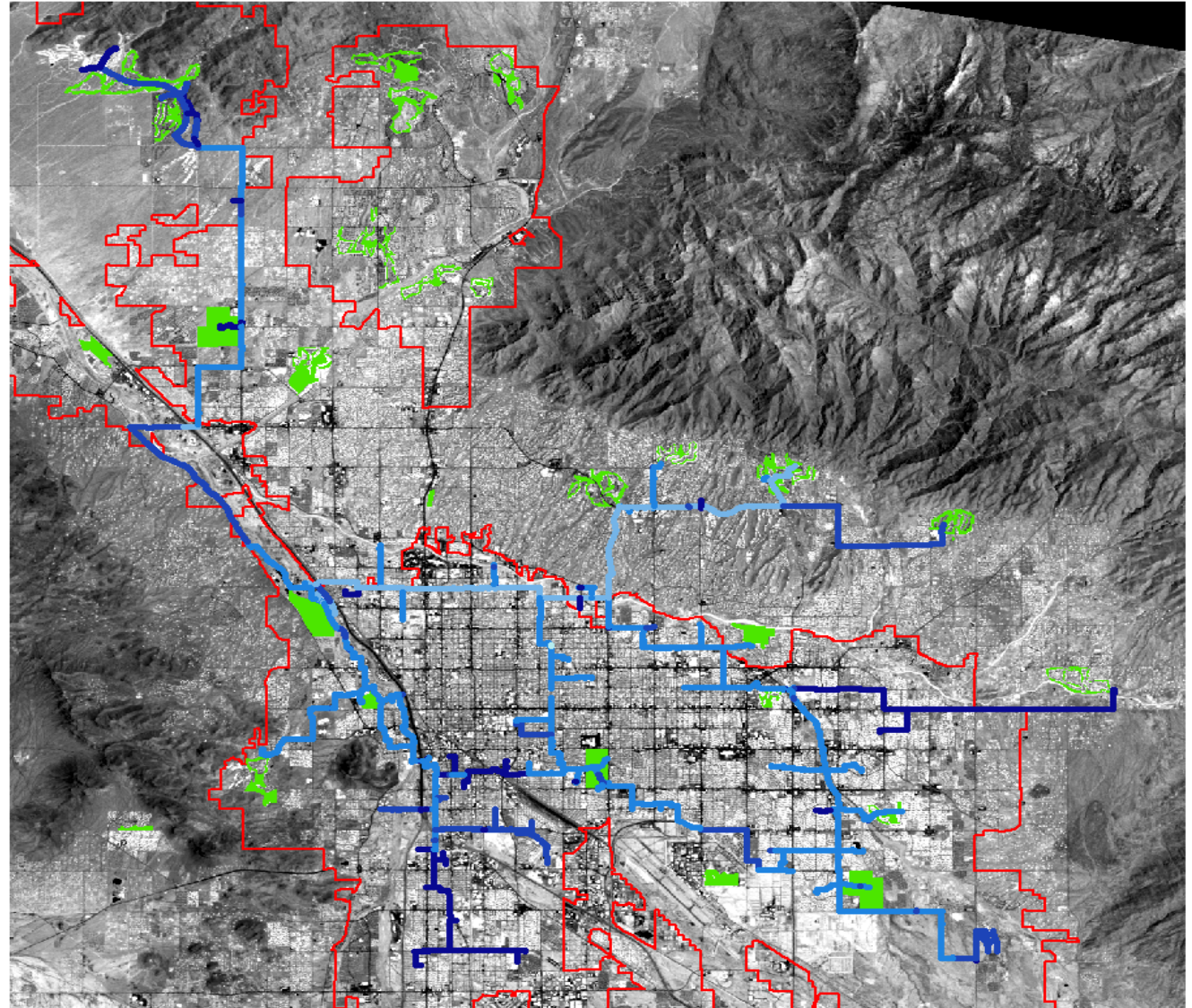
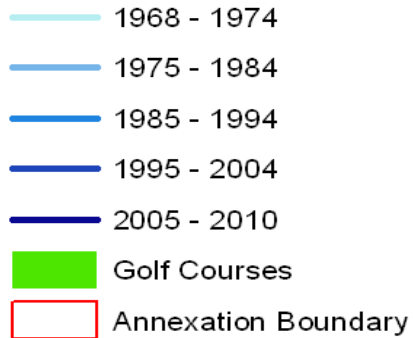
# Water Supply: Tucson Area Water Providers



# Reclaimed Water Mains 1968-2010

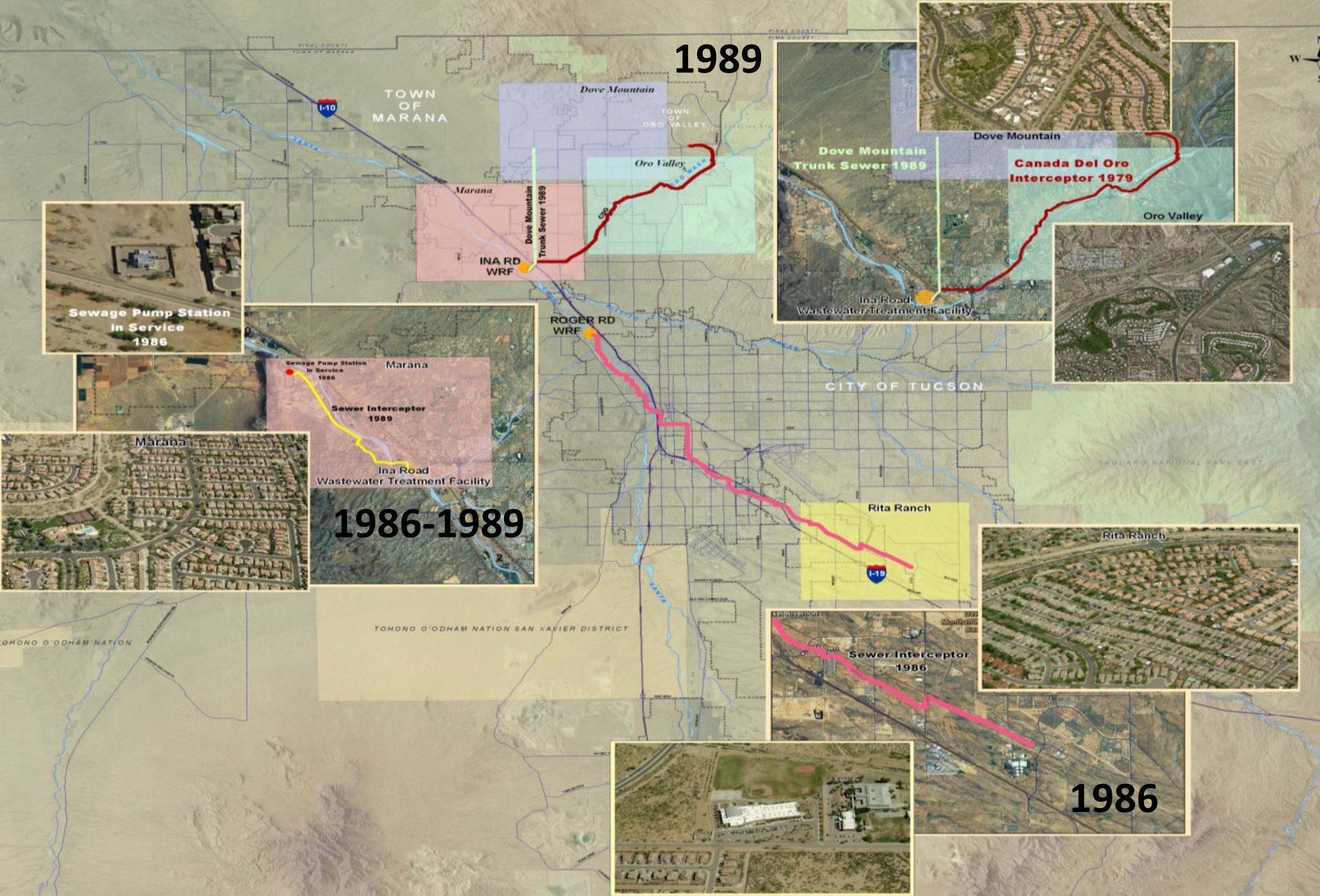


## Reclaimed Water Mains Installation Year

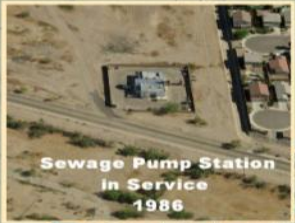




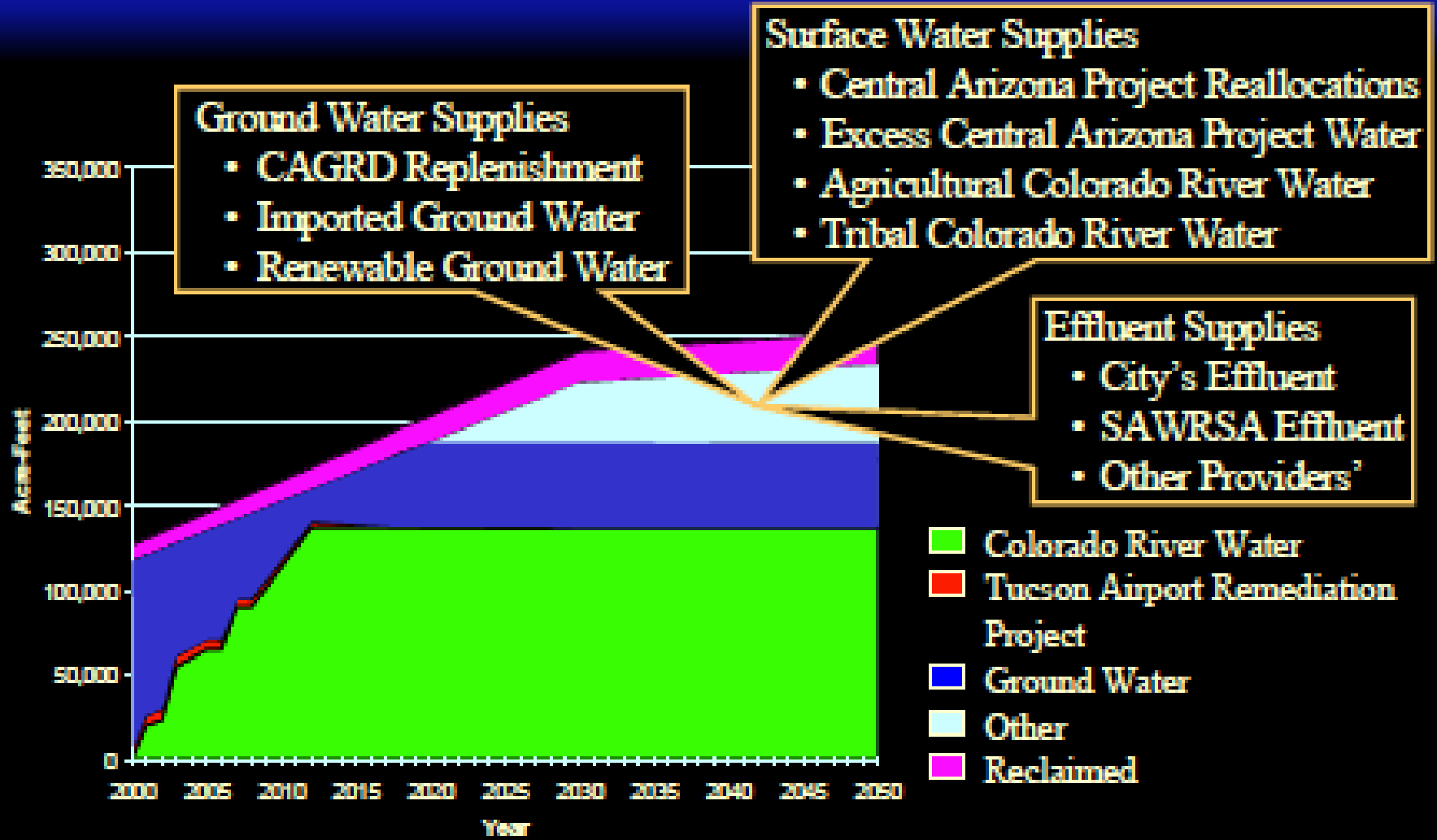
# Wastewater networks



**1989**



# Projected Total Demand and Resources 2000-2050

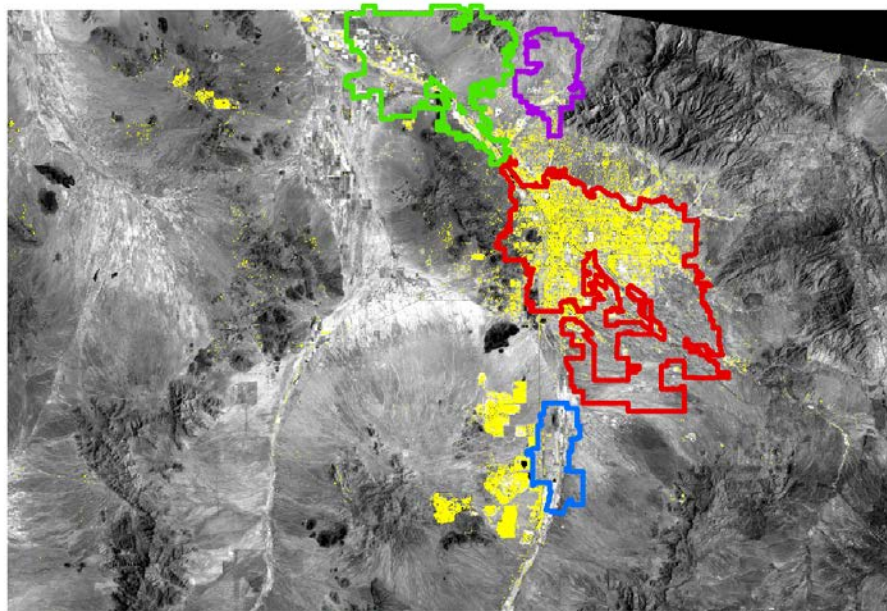


# **THE EXPANSION PROCESS OF THE URBAN AREA: Oro Valley, Marana and Sahuarita.**



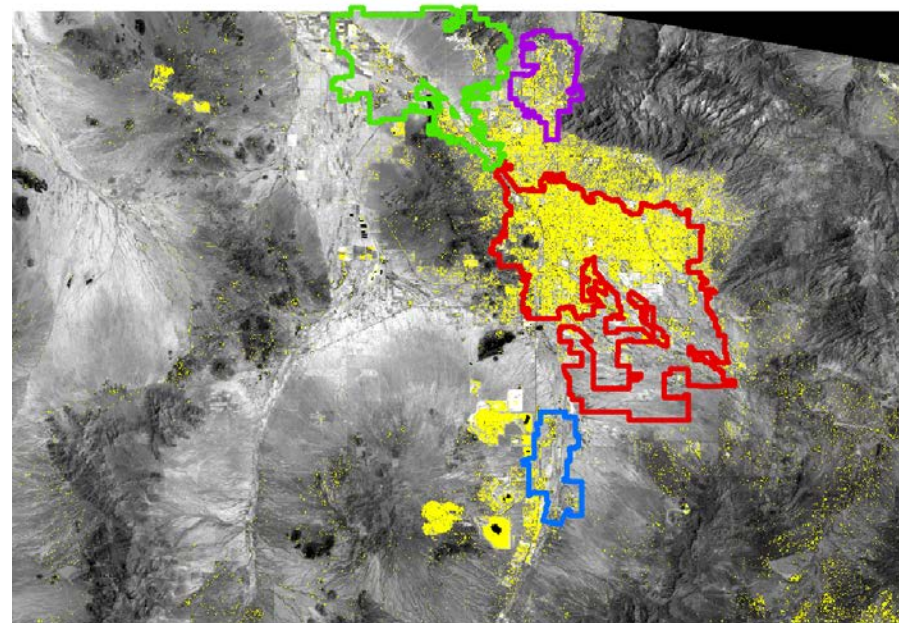
# The Tucson metropolitan region expansion(1984-2010)

1984 Land Cover/ Land Use



■ Built/Urban  
— Tucson — Oro Valley  
— Marana — Sahuarita

2010 Land Cover/ Land Use



■ Built/Urban  
— Tucson — Oro Valley  
— Marana — Sahuarita

## 2.3 REGULATIONS & NORMS



## 2.3. regulations & norms : surface & groundwater

Allocation of surface water is determined by the doctrine of Prior Appropriation: “First in Time – First in Right” “Senior vs. Junior” rights.

Until the Gold Rush water law in the West developed within the context of Spanish water law (priority of the community vs. the individual) and English water law (riparian water rights – water running through an individual’s property was theirs to use).

Farmers settling in the West used mining principles for irrigation rights.

Groundwater – the “American Rule” of reasonable use.



*Dove Mtn.*

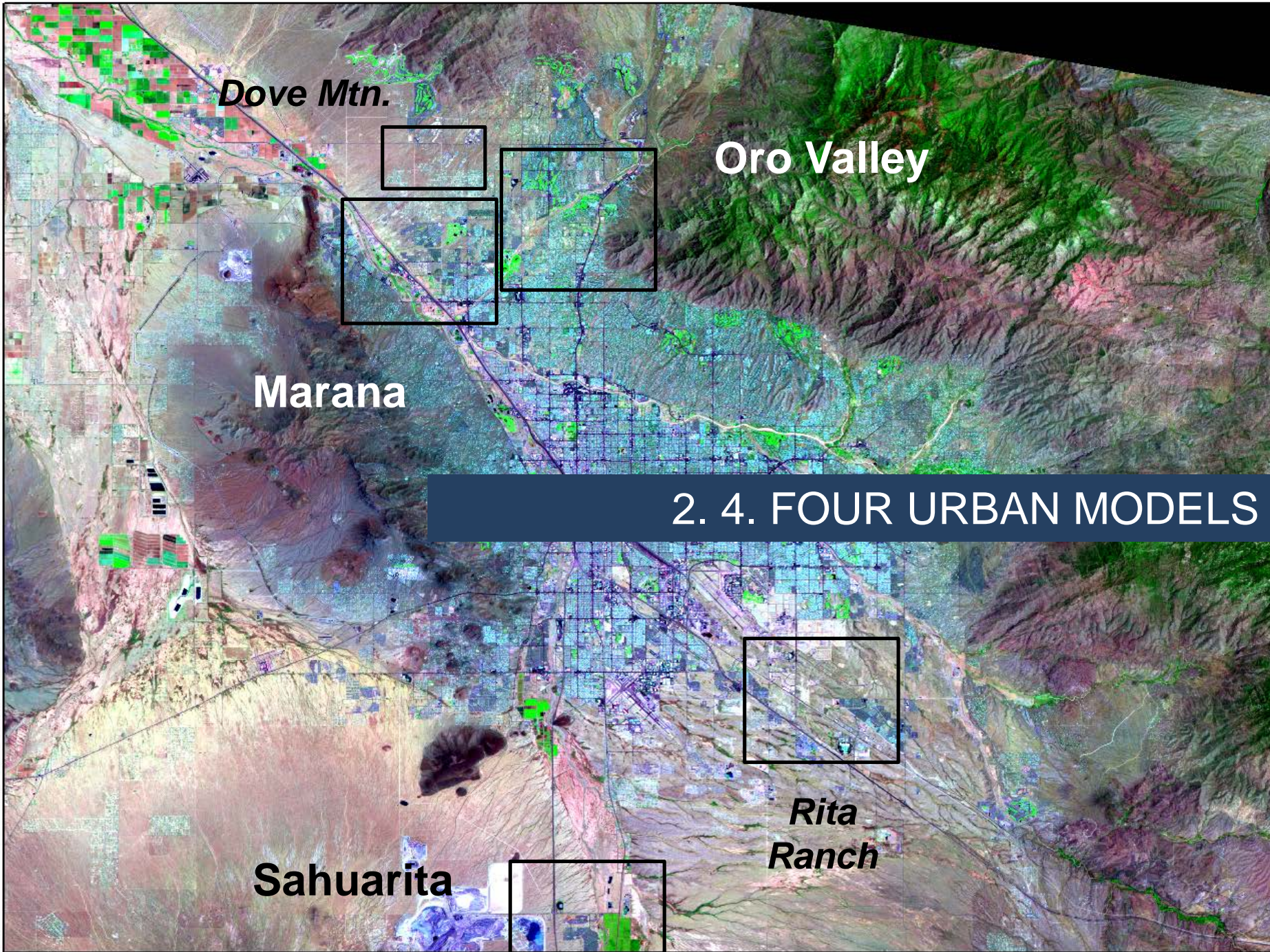
**Oro Valley**

**Marana**

**2. 4. FOUR URBAN MODELS**

**Sahuarita**

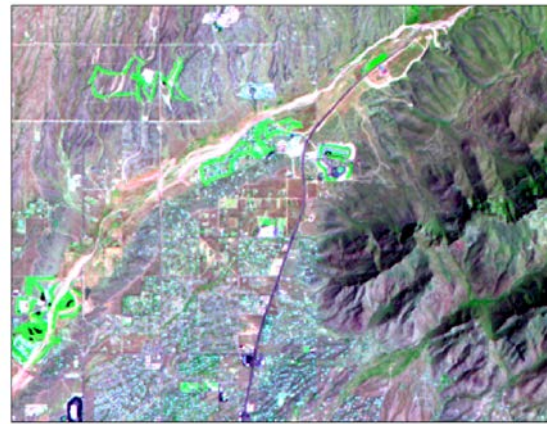
*Rita  
Ranch*



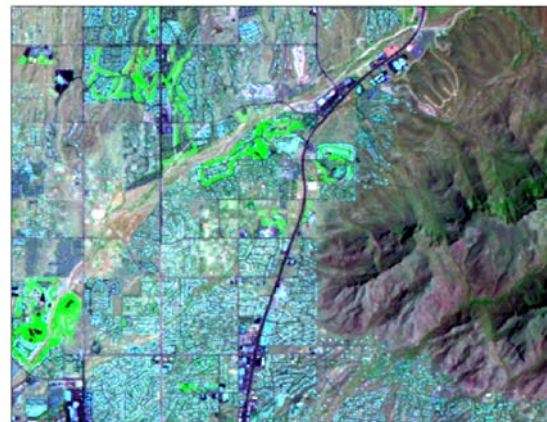


# Lower Oro Valley

1984

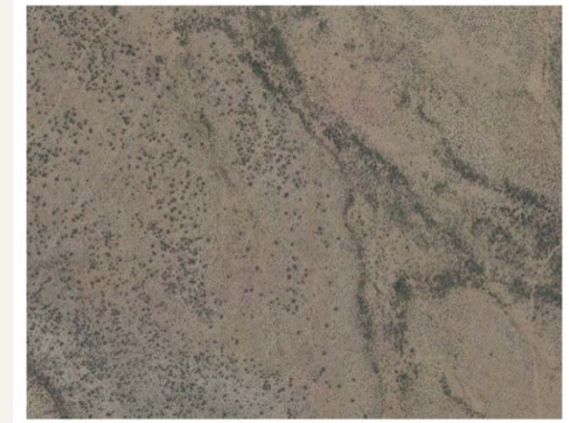
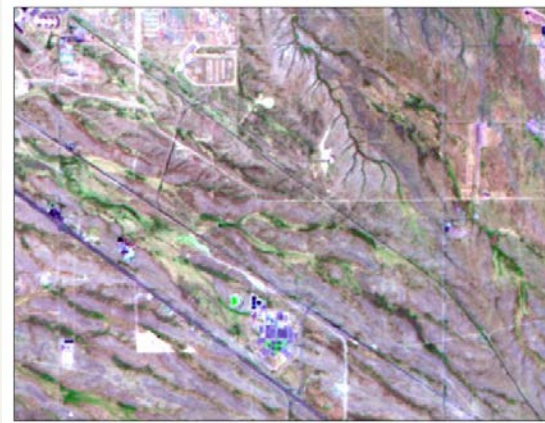


2010



# *Rita Ranch (Tucson, Pantano Wash)*

**1984**



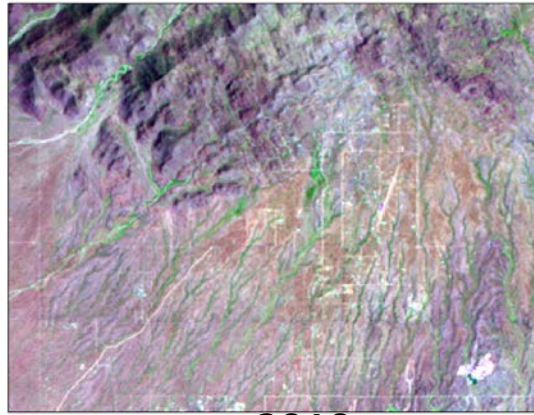
**2010**



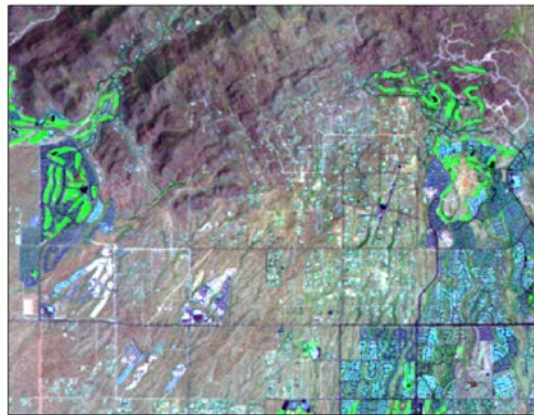


# *Dove Mountain (Marana) & Rancho Vistoso (Marana)*

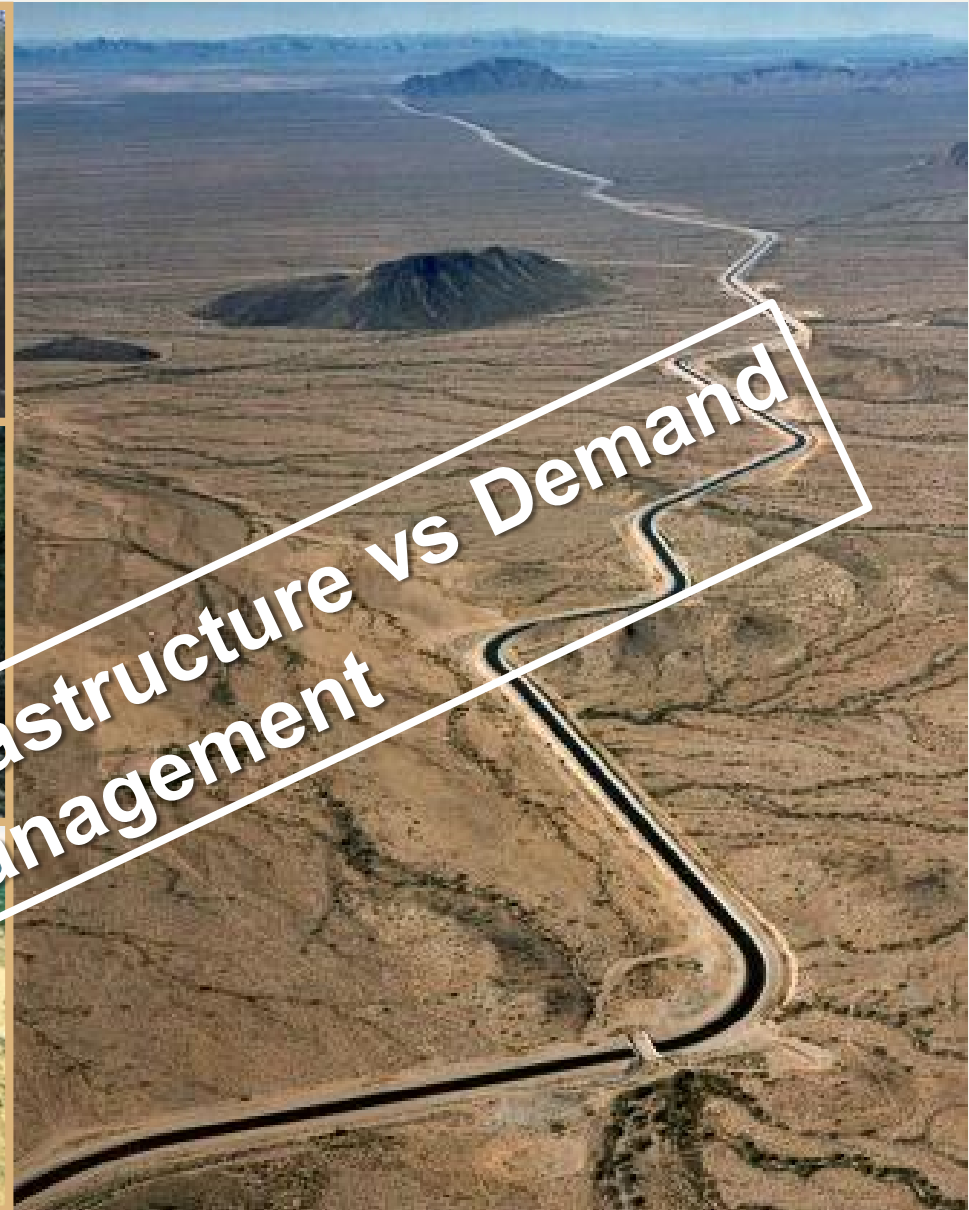
**1984**



**2010**



## 3. SCENARIi FOR PUBLIC POLICY



new Infrastructure vs Demand  
management





## 4. CONCLUSIONS

PHOTOS BY KELLY PEGSKELL / ARIZONA DAILY STAR

Jack and Jean Snider hook the 200-gallon tank in the back of their pickup up to a water outlet along Gates Pass Road. They'll take the water about a mile to their home. Hauling water is becoming more common around the fringes of Tucson as wells dry up.

# As wells dry up on outskirts, hauling water becomes norm

## **Significant scientific, technical and governance challenges.**

- *Disconnection Between Water and Urban Growth*
- *Need to Integrate Private Actions into Public Policy*
- *Increasing Governance Challenges*
- *Need for More Sophisticated Choices*
- *Significant Data Collection Needs*
- *Multi-disciplinary Skills*