Sierra Vista Subwatershed Domestic Well Study

Prepared for Western Resource Advocates by
Plateau Resources, LLC

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Western Resource Advocates

- Non-profit environmental law and policy organization dedicated to protecting the west's land, air, and water
- Founded in 1989, 30+ employees and offices in seven western states (2 Arizona staff)
- Approach
  - Work to progress good policies from the beginning
  - http://www.westernresourceadvocates.org/

Significance of domestic well use

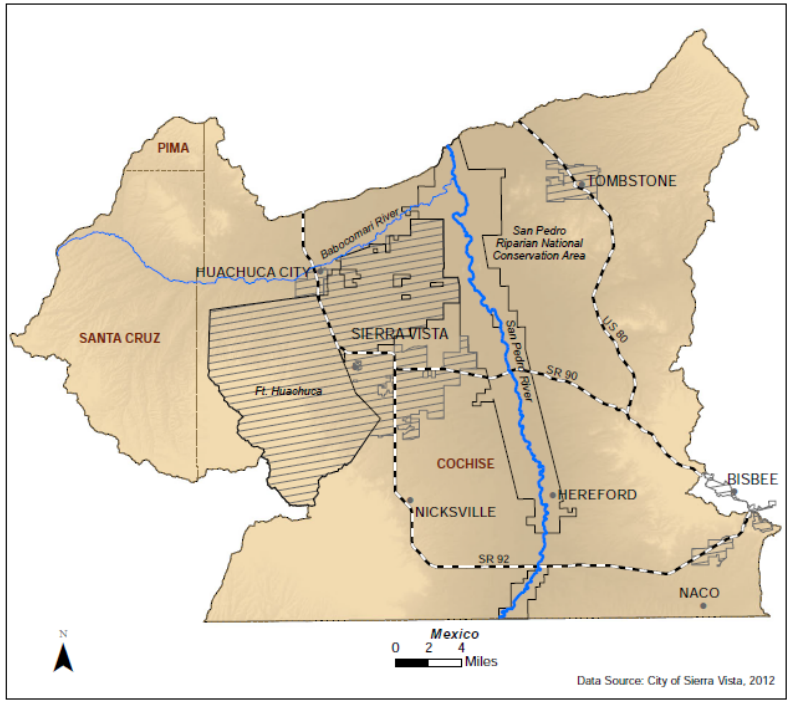
- Uncertainty in demand and impact
- Potential to conserve
- Domestic wells serve almost 20% of population
- Proximity to San Pedro River and SPRNCA
- Contribute to overdraft and have a stake in aquifer sustainability

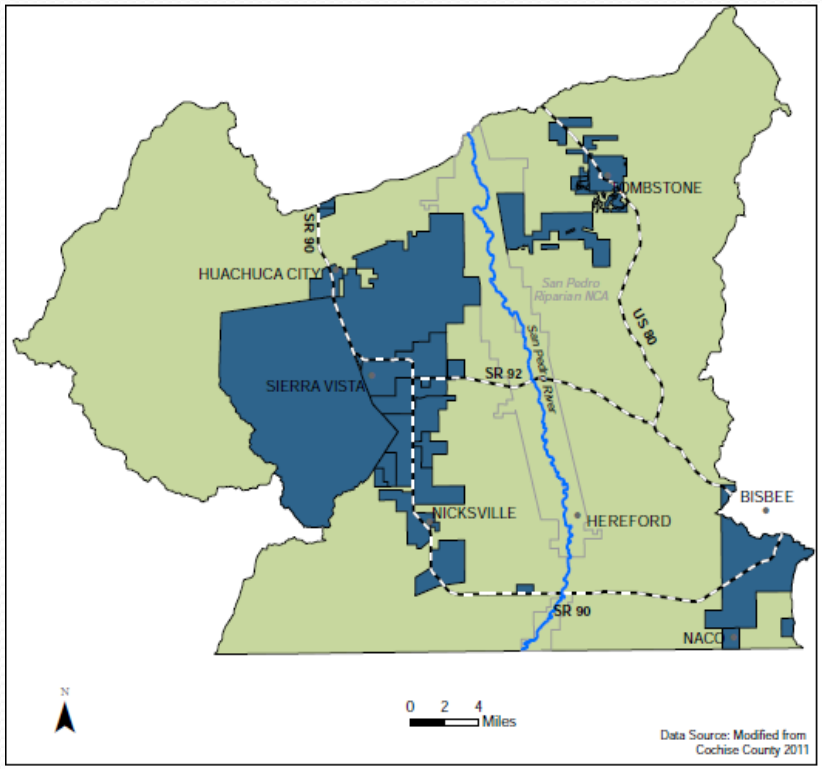
Purpose of study

- Provide information for planning and conservation program purposes
- Study does not propose a demand estimate
- Is it possible to identify water conservation potential using proxies for metered demand?
  - Housing age indicator of plumbing fixture use
  - Remote sensing to identify irrigated areas
  - Identify and target conservation programs and savings
  - Develop a methodology transferable to other areas

Study area

- Unincorporated area outside water provider service area
- 12,000 residents, 5,000 parcels





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Water Provider Service Areas

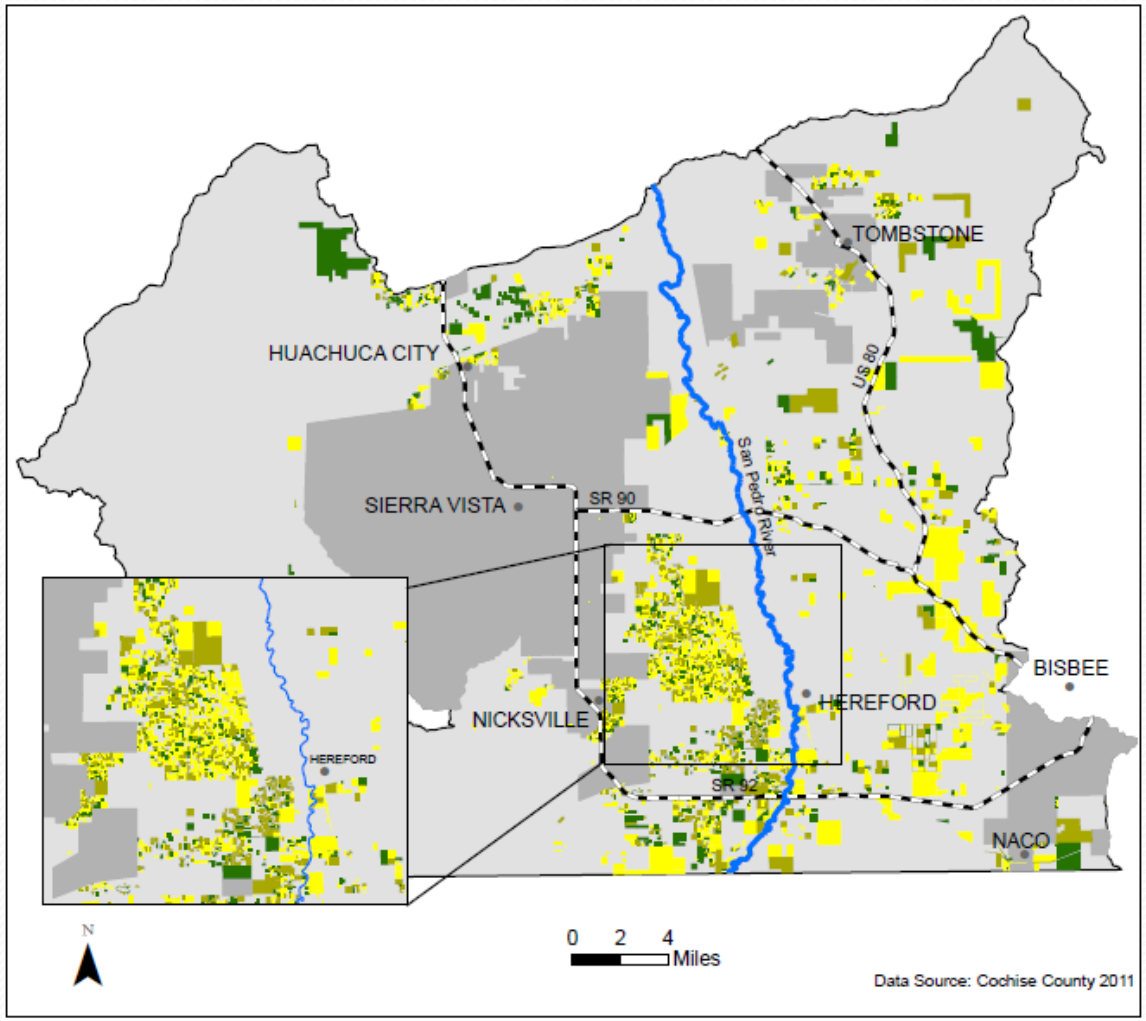
Area Outside of Water Provider Serivce Area

POPULATION AND PARCEL DATA

Area	2010 Population
Sierra Vista Subwatershed (SVS)	77,300
Portion of SVS Served by Water Providers	62,100
Portion of SVS Not Served by Water Providers	15,200 (12,050)
Type of Parcel Improvement	Approximate Number of Private Parcels in Study Area Not Served by Water Providers
Single Family Residence	2,150 (2,490)
Mobile Home (includes affixed and park models)	2,180 (2,530)
Multi-Family Residence	2
Commercial	20
Public	10
Yard	3
Other	170
None	3,970 (3,290)
Total	8,515

Indoor Demand

- Cochise County Assessor Records to identify construction dates
  - Prior to 1997 (2,190 houses)
  - 1997-2004
  - 2005 to present → (2,140 houses)
  - No dates for 690+ houses
- Estimated demand based on large-scale studies
  - Prior to 1997 – 69 gpcd (AWWA 1999)
  - 1997 to present – 48 gpcd (Aquacraft, 2011)
  - HE fixture retrofit – 41 gpcd achievable



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- City or Town
- Water Provider Service Areas

Year Built

- Before 1997 (~2,190 parcels)
- 1997 to 2004 (~1,330 parcels)
- 2005 to Present (~810 parcels)

Indoor Limitations/Observations

- Assessor data inaccuracies - incomplete evaluation of demand and savings potential
- Some homes have already installed efficient fixtures (e.g. Cochise County toilet rebate program @ 600+) – where?
- Conservation studies conducted in metropolitan areas
- All indoor use discharged to septic systems does not recharge the aquifer due to loss and evapotranspiration
  - Depends on depth of leach field- about 1/3 of indoor use
  - EEC (2002) and ADEQ

Outdoor Demand

- Remote sensing-National Agricultural Imagery Program (NAIP)
  - Initial visual analysis of June 2010, 1-meter, 4-band imagery followed by spectral analysis and then ground-truthed
  - Grouped 'irrigated' areas into categories- pasture, orchard, landscape plants, turf, pools
  - Quantified use by multiplying acres mapped in each category by its annual watering requirement and application efficiency

ESTIMATED OUTDOOR WATER USE IN THE STUDY AREA DURING 2010

Type	Number of Areas Mapped	Total Area (acres)	Annual Watering Requirement (feet)	Assumed Application Efficiency	Estimated Annual Outdoor Water Use (acre-feet)
Pasture	**10**	**31.6**	**2.3 to 3.3**	**70 to 85%**	**86 to 149**
Orchards	**18**	**20.1**	**1.3 to 2.8**	**70 to 90%**	**29 to 80**
Turf	**165**	**12.4**	**0.0 to 2.6**	**40 to 75%**	**0 to 81**
Landscape Plants	**115**	**8.5**	**0.3 to 2.7**	**40 to 95%**	**3 to 57**
Pools	**64**	**0.5**	**4.2**	**Near 100%**	**2**
Total	***372***	***73.1***	**---**	**---**	***120 to 369***

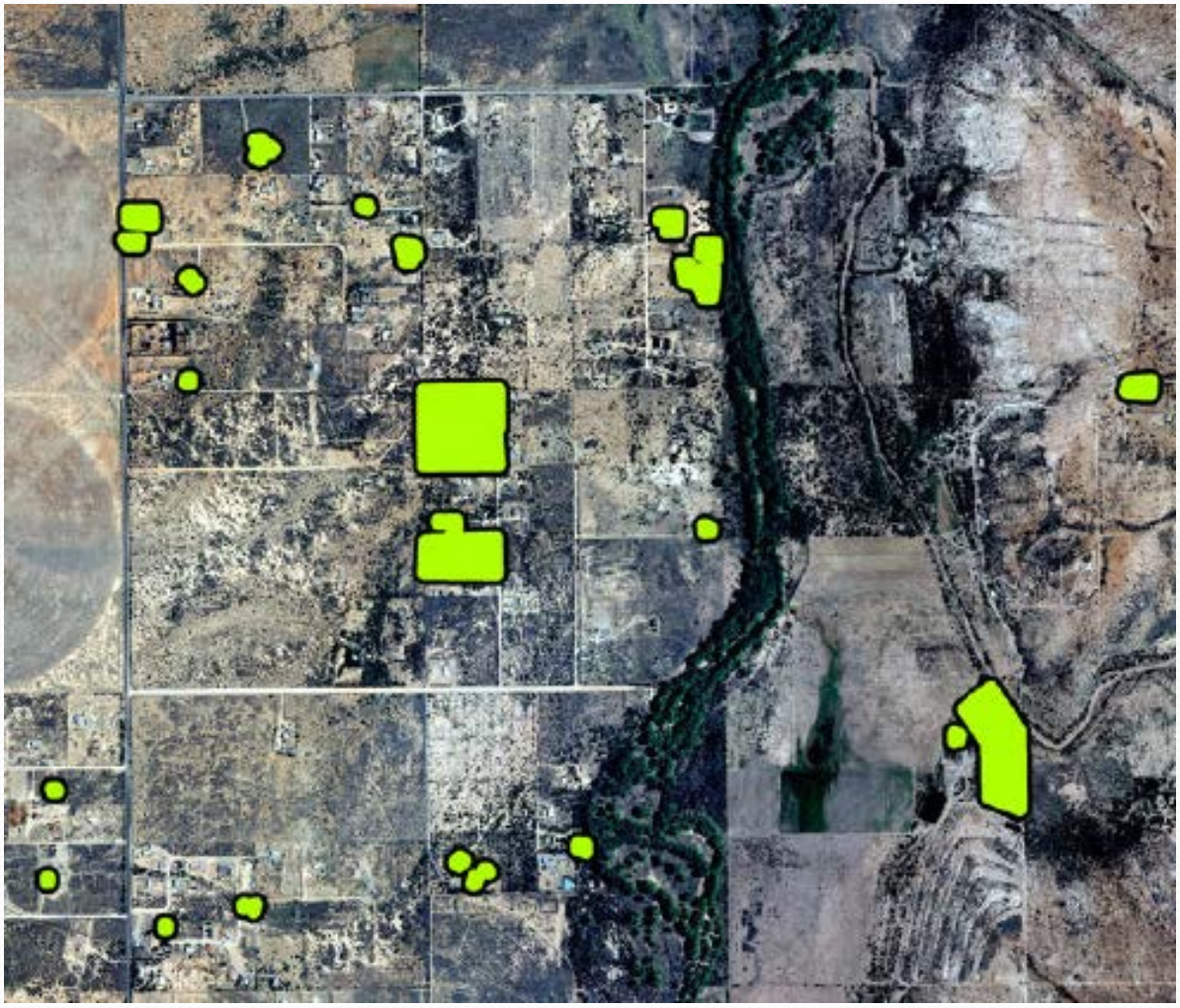
Notes:

(1) Local data used, as available, for water requirements and application efficiencies;

(2) Some turf is non-irrigated natural grass; and

(3) Pasture includes turf greater than 0.5 acres.

Outdoor water use in the Hereford area – June 2010

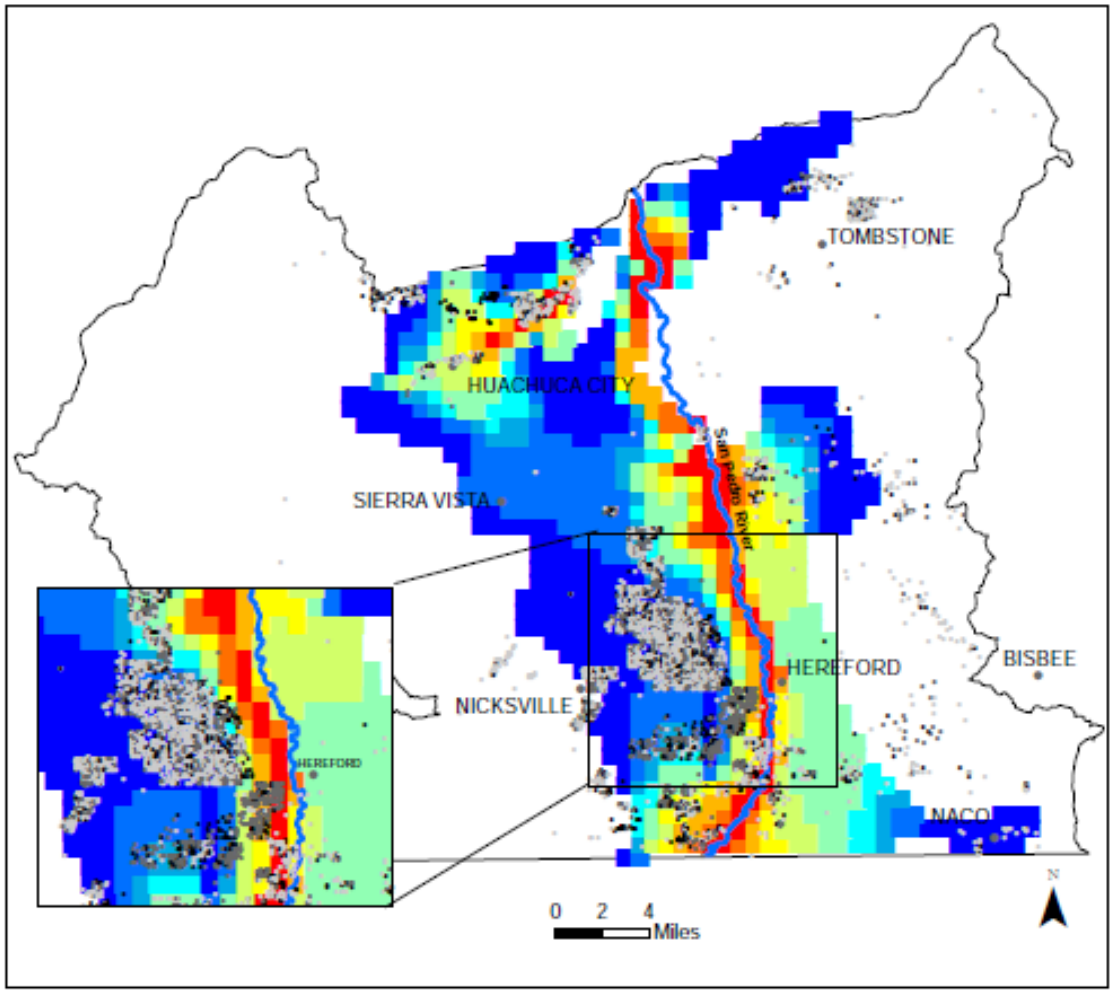


Outdoor Limitations/Observations

- Higher resolution imagery may identify additional irrigation
  - small deficit irrigated or rainfall-dependent areas
- Other outdoor uses (e.g. evaporative coolers, livestock, dust control, etc.) not measureable

Potential pumping impact

- Groundwater capture by well pumpage can impact SPRNCA ecosystem by reducing stream flow, spring discharge and riparian ET
- Domestic wells assumed to be shallow and in uppermost water-bearing zone
- Simulated groundwater capture zones assuming constant pumping rate for 25 years



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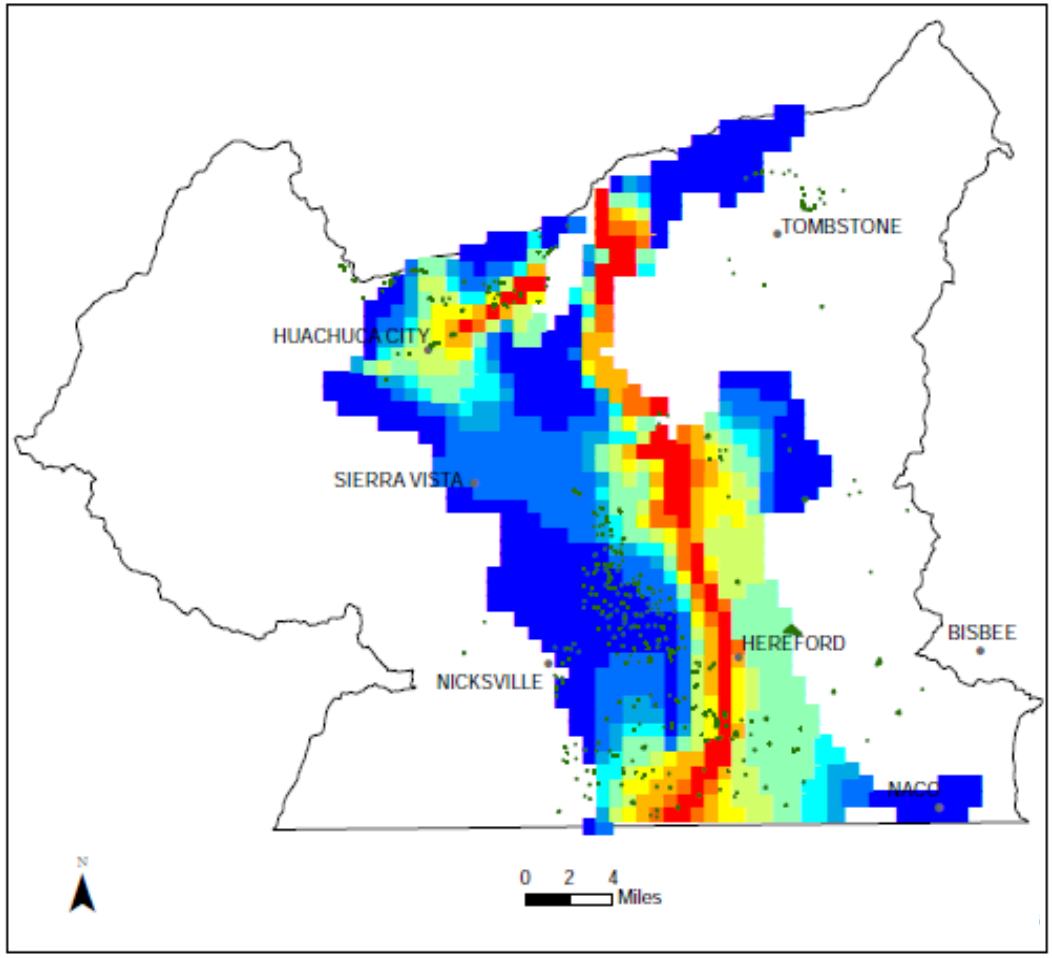
0.4
0.5
0.6
0.7
0.8
0.9
1.0

Computed capture of streamflow, riparian evapotranspiration, and springflow along the San Pedro River as a fraction of pumping after 25 years of constant rate withdrawals from shallow wells.

Age of Single-Family Homes Served by Domestic Wells

- Before 1997 (~2,190 parcels)
- 1997 to 2004 (~1,330 parcels)
- 2005 to Present (~810 parcels)



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Outdoor Use
(area exaggerated for mapping purposes)

Indoor Water Conservation

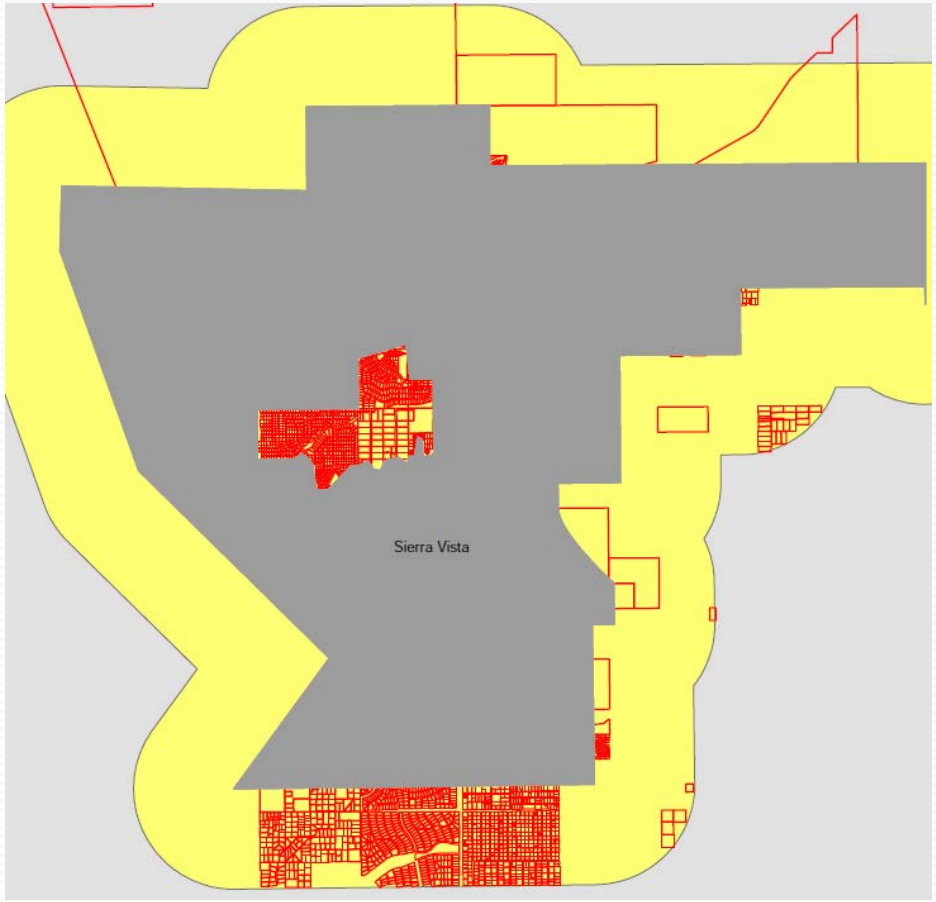
- Local Programs
  - Rebates, building codes, education (Water Wise), USPP grants, etc.
- Indoor conservation potential
  - HE retrofit potential savings = 7 (newer) 28 gpcd (older)
    - 40 afy (newer) 164 afy (older) @ 100%
  - Focus toilet (and other fixture) replacement, leak reduction, audits on older homes closest to the river
  - On-demand hot water recirculation systems
    - 30 afy @ 100%

Outdoor Water Conservation

- Savings more difficult to quantify
  - Improve orchard and pasture irrigation efficiency
    - 46 afy @ 20% improvement
  - Rainwater harvesting/gray water for landscaping
    - 57 afy @ 100%
  - Turf to xeriscape conversion
  - Pre-1997 houses slightly more outdoor use
- Target larger water users capturing greatest fraction of groundwater that would otherwise flow to the river

Water/Sewer service area extension

- Pros
  - Effluent for regional management
  - Water reliability to users
  - Maintenance cost avoidance
  - Conservation messaging
- Cons
  - Expensive to utility and user
  - Low housing density
  - Prior homeowner investment
  - Acceptability



Sewer service area (dark gray)

Reported Domestic Well Use

Location	Year	Number of Homes	Average Annual Use (acre-feet)		Data Source
			Per capita	Per household	
Metered					
Sierra Vista Subwatershed[1]	Between 2005 and 2007	8	0.12 (107 gallons per day)	0.24	Daily (2011a)
Sierra Vista, AZ[2]	2010	799	0.09 (76 gallons per day)	0.21	Liberty Water Company (2011)
Near Santa Fe, NM[3]	2009	250	---	0.30	Chavez (2010)
Estimated or Assumed Values					
Sierra Vista Subwatershed	Current	---	0.13 (118 gallons per day)[4]	0.31[5]	USFWS (2007)
			0.35 (312 gallons per day)[6]	0.84[5]	USGS (2010)
Statewide *('standard' domestic use when filing an application to appropriate water)*			0.20 (180 gallons per day)	0.48[5]	ADWR (2011b,c)
Adjudication Areas *(suggested domestic use when filing adjudication claims)*			0.17 (150 gallons per day)[7]	0.41[5]	

Conclusions

- Water use by domestic wells can be reduced through targeted conservation programs
- Potential indoor savings <230 afy
  - Septic tank recharge does not equal indoor demand – indoor conservation important
- Potential outdoor savings <100 afy
- Studies support current well demand of ≤ 0.30 afy
- Focus on greatest conservation potential in proximity to river
- Homeowner surveys, well metering, site visits, higher resolution imagery would improve estimates

Conclusions

- Transferable methodology – first estimation
  - Water provider service area maps
  - Population data
  - Parcel maps and files with construction dates
  - Aerial imagery (recent, 1-meter resolution or better, multi-spectral bands, during irrigation season but before monsoon)
  - Climate records (local watering requirements and evaporation rates)

Study available at:

http://www.westernresourceadvocates.org/water/SVS_domestic_well_conservation_June.pdf

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