BUREAU OF RECLAMATION

Southwestern Navajo Rural Water Appraisal Study

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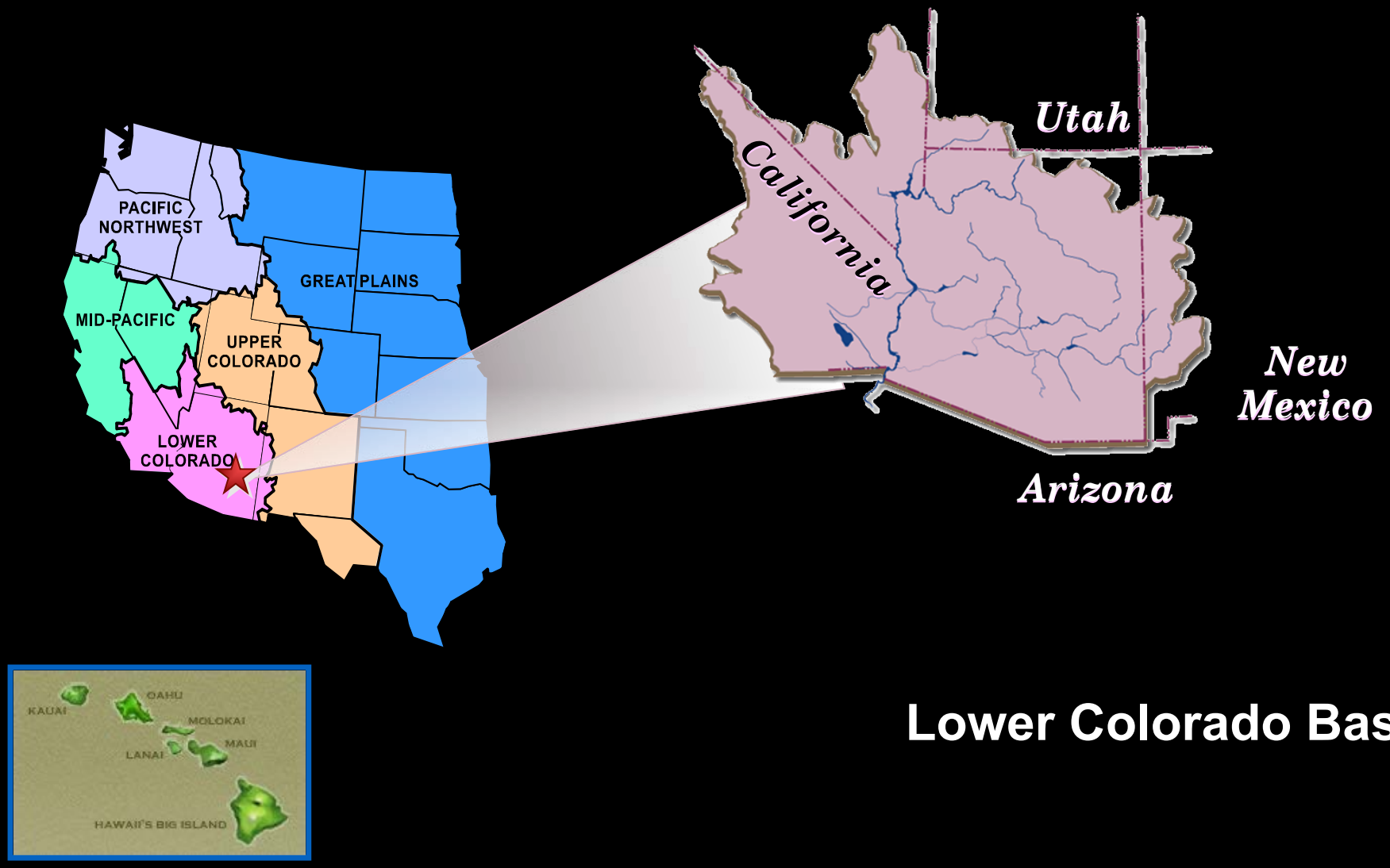
Planning Program Manager
Program Development Division
Phoenix Area Office

Reclamation Mission Statement

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

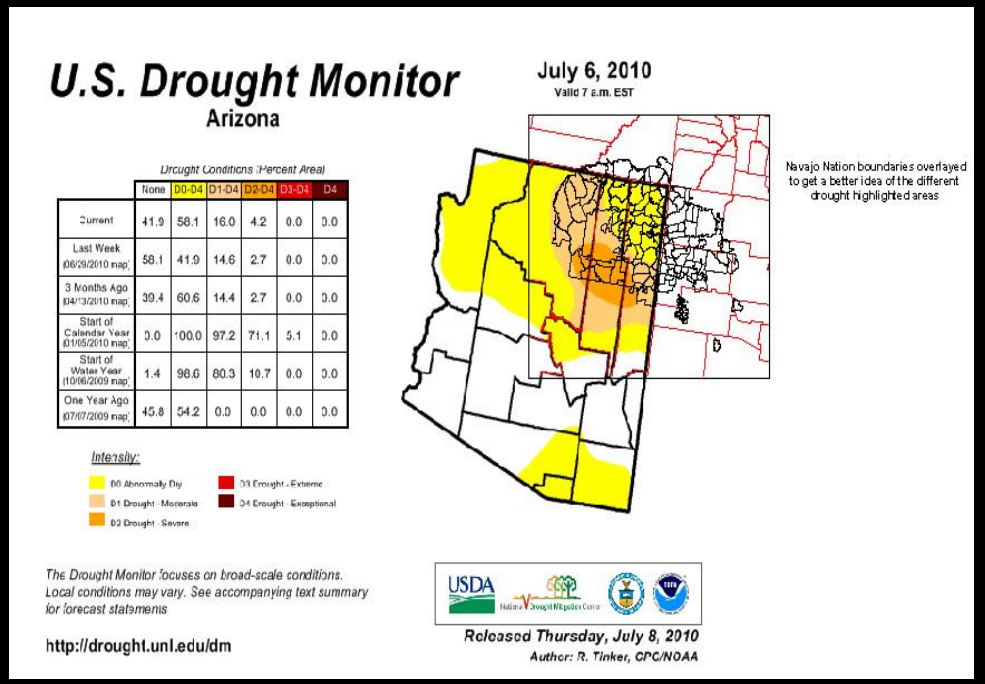


Lower Colorado Basin


UT
AZ
NM
NV
Kingman
Flagstaff
CA
Central Arizona Project
PHOENIX AREA OFFICE
BOUNDARY
Phoenix
Central Arizona Project
Yuma
Tucson
MEXICO

Rural Water Supply Act of 2006

- Federal Assistance for Planning Rural Water Projects



PURPOSE AND SCOPE

Appraisal Investigation

Study Area

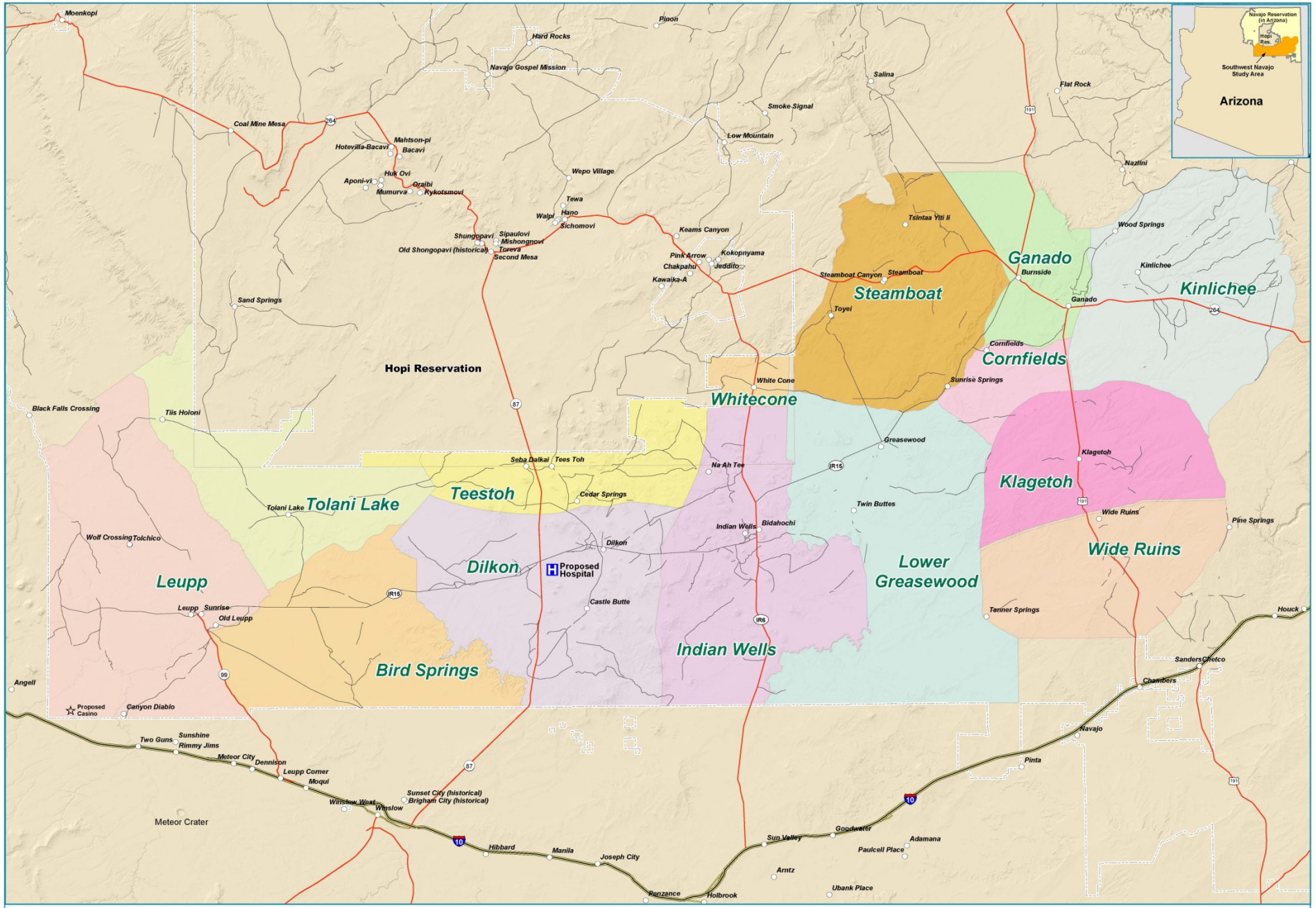
Needs Assessment

Stakeholders

BUREAU OF RECLAMATION

Appraisal Investigation

- An analysis of domestic, municipal, and industrial water supply problems, needs, and opportunities in the planning area primarily using existing data.
- Includes a preliminary assessment of alternatives to address the identified water supply problems, needs, and opportunities.
- Determine if there is at least one viable alternative that warrants a more detailed investigation through a feasibility study.



Southwest Navajo
Rural Water Appraisal Study Area

RECLAMATION
Managing Water in the West

SWNAV_StudyArea.mxd, 11/8/2011

Needs Assessment

- To replace, extend and interconnect existing water systems with new water supplies and additional infrastructure to meet current and future demands, and;

- to integrate various tribal and federal water development programs to plan, design, and construct water systems in an efficient and sustainable manner, and;

- to determine an appropriate water budget for system design that would include average/peak demand, emergency supply and “fire-flow.”

Technical Advisory Group Stakeholders

- Reclamation – Chair
- Navajo Nation
- Navajo Tribal Utility Authority
- Local Navajo Chapters (Government and Water Users)
- Indian Health Service
- Bureau of Indian Affairs
- USDA NRCS
- USDA Rural Development
- Private Engineering Firms

TAG Objectives

- Short-term
  - Assess and mitigate District 7 Public Water System problems
  - Develop livestock water supplies to mitigate drought impacts
  - Develop partnership among members and secure funding contributions
  - Complete proposal for rural water funding through USDA
- Mid-term
  - Establish assured water supply for proposed Dilkon Health Care Facility
  - Complete Reclamation Rural Water Appraisal Study and seek feasibility authority/funding
- Long-term
  - Develop planning products that were compatible with proposed LCR Settlement to expedite implementation

RESEARCH METHOD

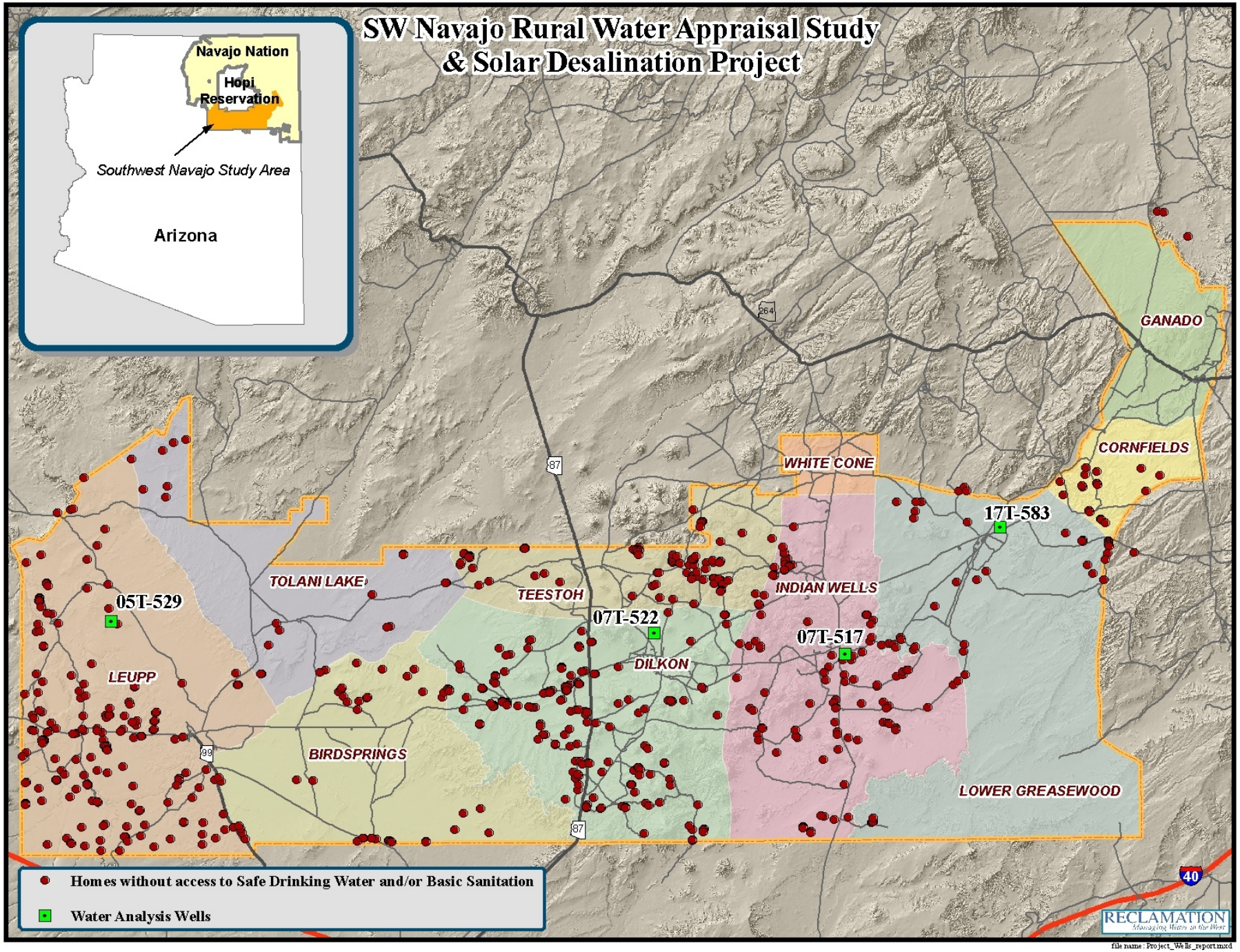
Case Study
Quantitative Data
Qualitative Data
Stakeholder Input

Rural Water

- Groundwater dependent
- Economics
- Supply/Demand imbalances
- Priority for resources
- Changes

NE Arizona – Rural Water Planning

- Regional Water Resource Investigations
- Drought Planning and Mitigation
- Impaired and brackish Groundwater
- Wastewater
- Dispersed Population
- Limited Resources
- Federal, State and Tribal – Water Programs


SW Navajo Rural Water Appraisal Study
& Solar Desalination Project
Navajo Nation
Hopi Reservation
Southwest Navajo Study Area
Arizona
GANADO
CORNFIELDS
WHITE CONE
17T-583
TOLANI LAKE
TEESTOH
INDIAN WELLS
05T-529
07T-522
07T-517
DILKON
LEUPP
BIRDSPRINGS
LOWER GREASEWOOD
264
87
99
40
Homes without access to Safe Drinking Water and/or Basic Sanitation
Water Analysis Wells
RECLAMATION
Managing Water in the West
file name : Project_Wells_report.mxd

Resources

- Inventory of present and future resource conditions that have a bearing on plan formulation to meet identified problems.

- Land Resources
- Approximately 2,625 square miles
- Trust land with small parcels of allotted land.

Land Resources (cont.)

- Grazing land with minor amount of agricultural subsistence farming
- Some “in-holding” private parcels used for aggregate mining, private hospital
- Minimal industrial development
- Each Chapter has at least one commercial operation
- Public facilities – schools, government offices, college extensions, judicial campus

Opportunities

- New water supplies could be developed in existing groundwater aquifers and from impaired/brackish groundwater to meet current and future water demands.

- Renewable energy and advanced water treatment could be economically applied for portions of the population.

- Integration with Indian Health Service Sanitary Deficiency Listing, USDA Rural Development and proposed NE Arizona Water Rights Settlement could produce a preferred alternative that is acceptable, efficient, effective and complete.

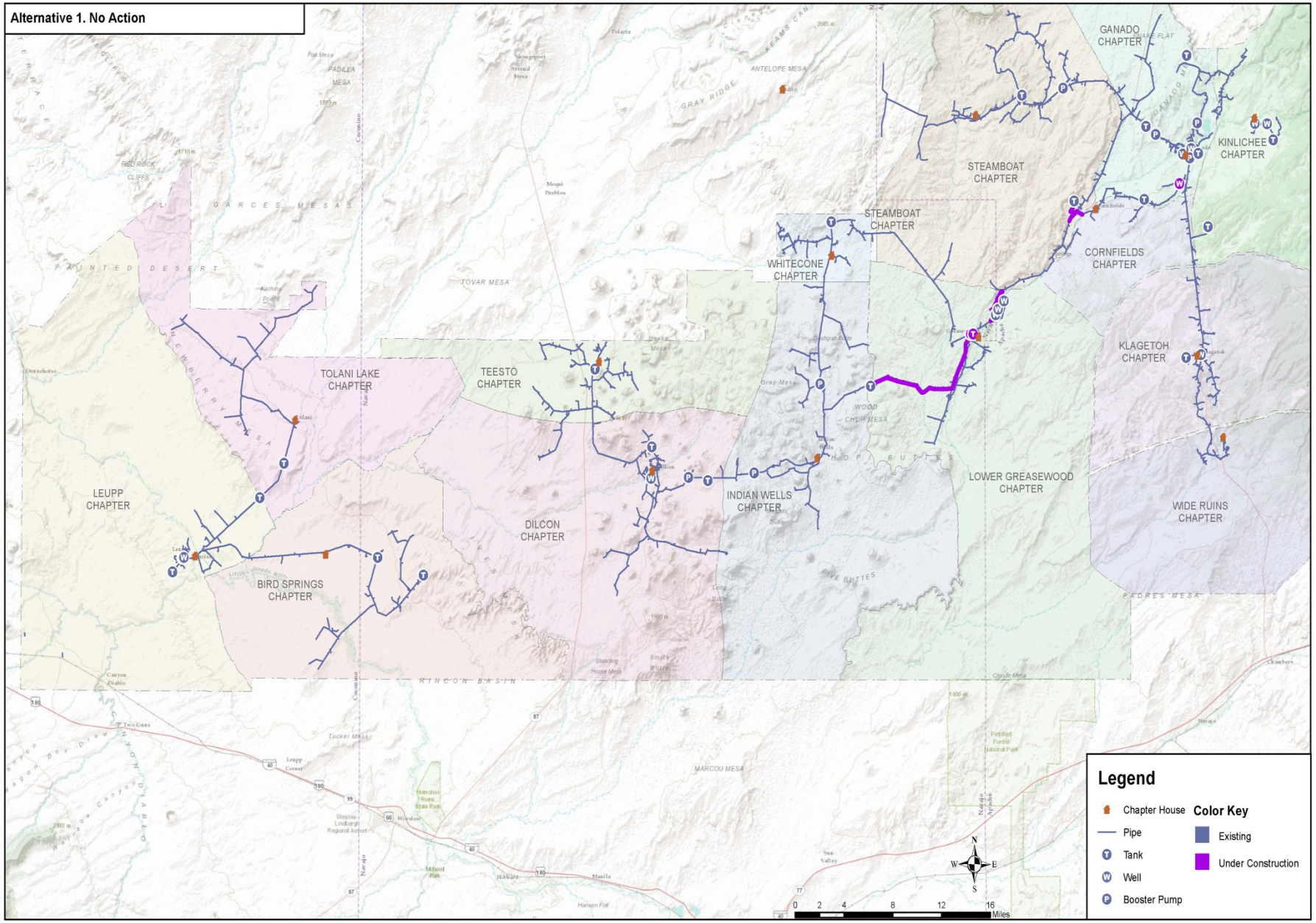
Cultural Resources

- At the appraisal level, it is not possible to provide specific information on the number and kinds of cultural resources that will be affected by the project.

- The preliminary assessment of pertinent literature indicates the study area is rich in prehistoric and historic cultural resources going back perhaps as far as 10,000 years in age. Likewise, TCP are also present and, like prehistoric sites, a certain number will be affected by construction of the proposed Navajo Nation Rural Water Project's well field, pipelines, and related facilities.

Economics

- Unemployment > 45%
- Median household income range $20K - $30K per year
- Per-capita $7K - $10K among Ranchers and Rural population
- 1/3 the level of per-capita incomes in Arizona
- Good paying and permanent jobs are very scarce.
- Large portion of population below poverty level



Brown AND Caldwell

SW Navajo Rural Water Appraisal

Alternative 1

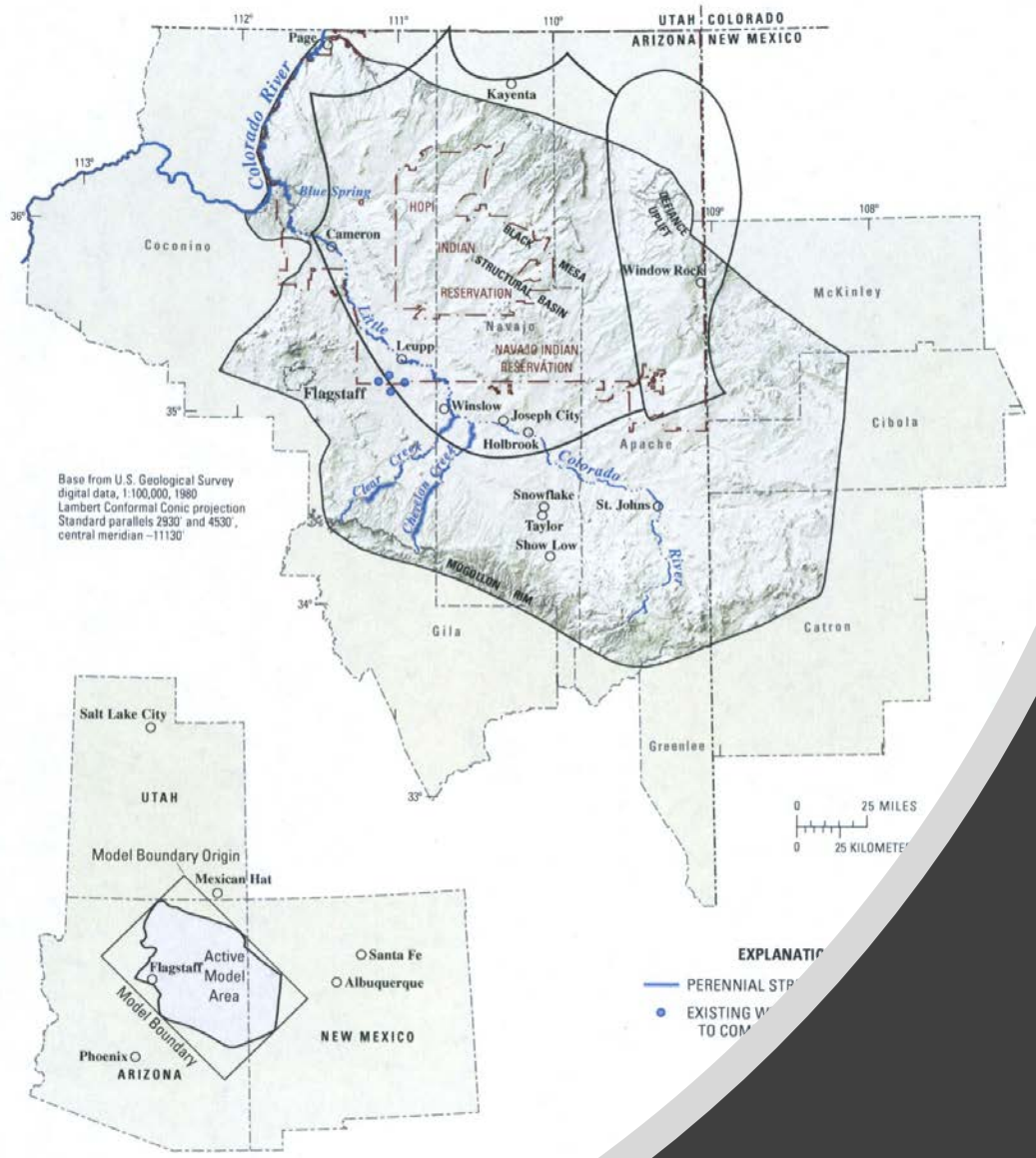
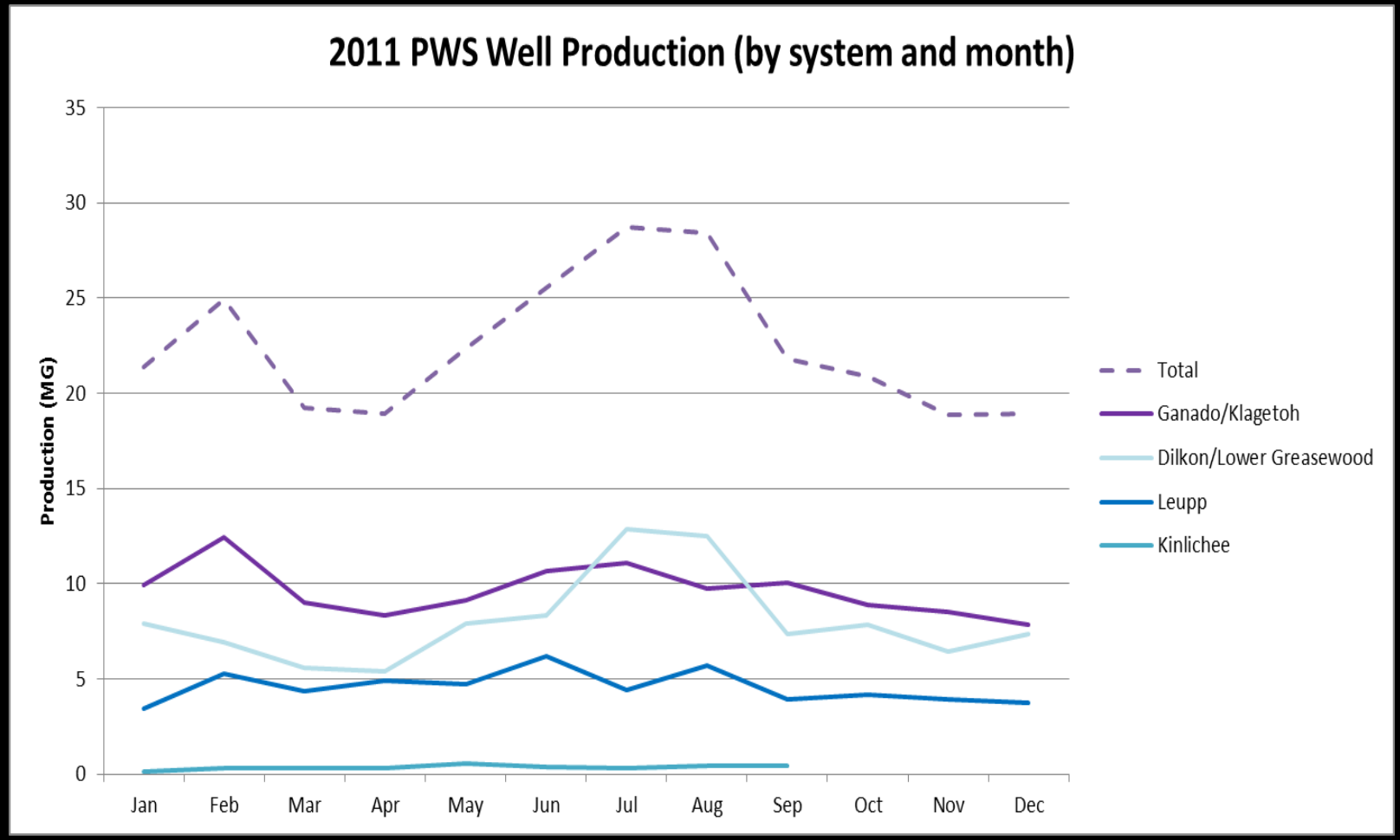
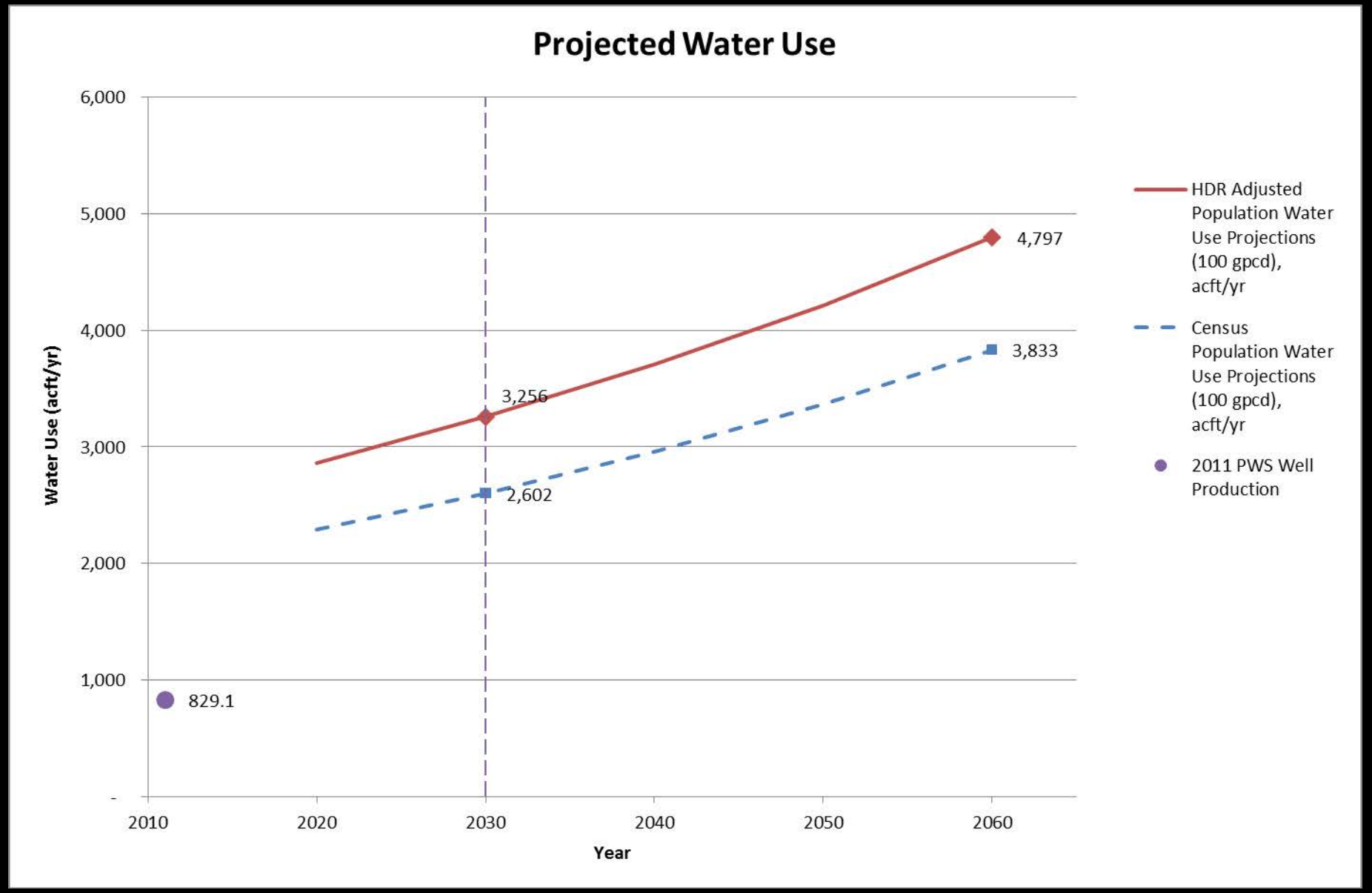
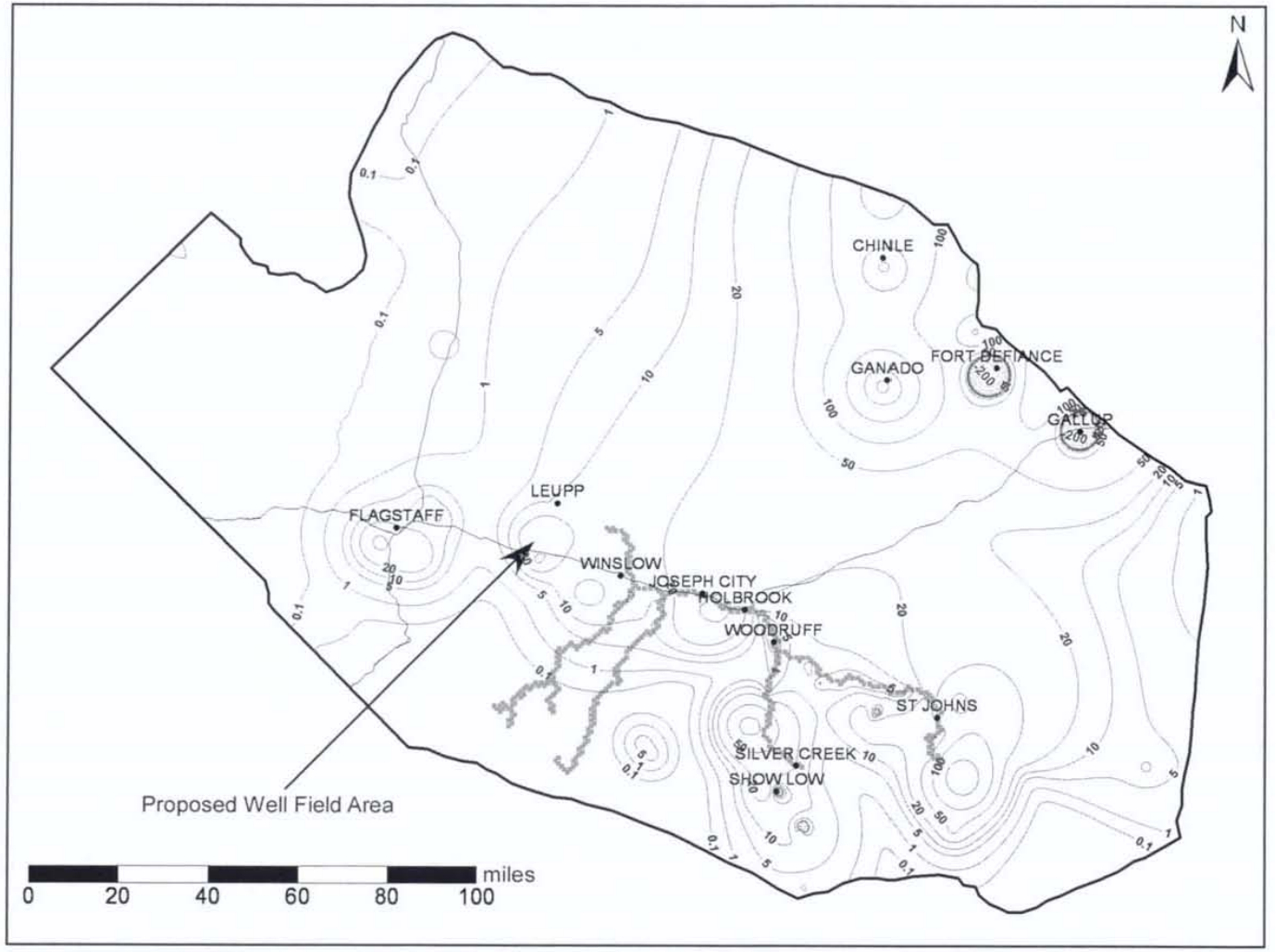


Figure 1. Location of modeled area of the C aquifer, northeastern Arizona.

Coconino Aquifer


2011 PWS Well Production (by system and month)
Production (MG)
35
30
25
20
15
10
5
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Total
Ganado/Klagetoh
Dilkon/Lower Greasewood
Leupp
Kinlichee


Projected Water Use
6,000
5,000
4,000
3,000
2,000
1,000
-
Water Use (acft/yr)
2010
2020
2030
2040
2050
2060
Year
4,797
3,256
3,833
2,602
829.1
HDR Adjusted Population Water Use Projections (100 gpcd), acft/yr
Census Population Water Use Projections (100 gpcd), acft/yr
2011 PWS Well Production



B-3 Drawdown Map, Water Level Decline, 2000 to 2060 (in feet): NEPA + 6,500 AFY (Scenario 1c)

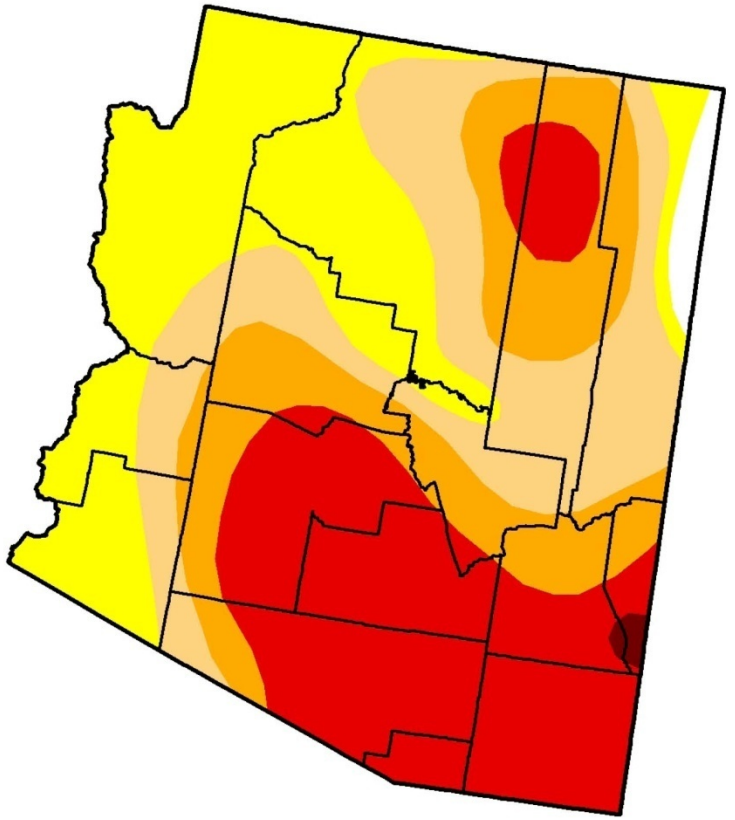
U.S. Drought Monitor

Arizona

December 6, 2011
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	1.53	98.47	71.18	48.80	29.99	0.38
Last Week (11/29/2011 map)	1.53	98.47	72.24	48.80	29.99	0.38
3 Months Ago (09/06/2011 map)	0.01	99.99	70.40	39.34	19.15	1.67
Start of Calendar Year (12/28/2010 map)	31.40	68.60	32.45	0.00	0.00	0.00
Start of Water Year (09/27/2011 map)	0.02	99.98	69.76	42.81	15.34	1.67
One Year Ago (11/30/2010 map)	50.48	49.52	6.76	0.00	0.00	0.00



Intensity:

- *D0 Abnormally Dry*
- *D1 Drought - Moderate*
- *D2 Drought - Severe*
- *D3 Drought - Extreme*
- *D4 Drought - Exceptional*

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu

Released Thursday, December 8, 2011

David Miskus, NOAA/NWS/NCEP/Climate Prediction Center

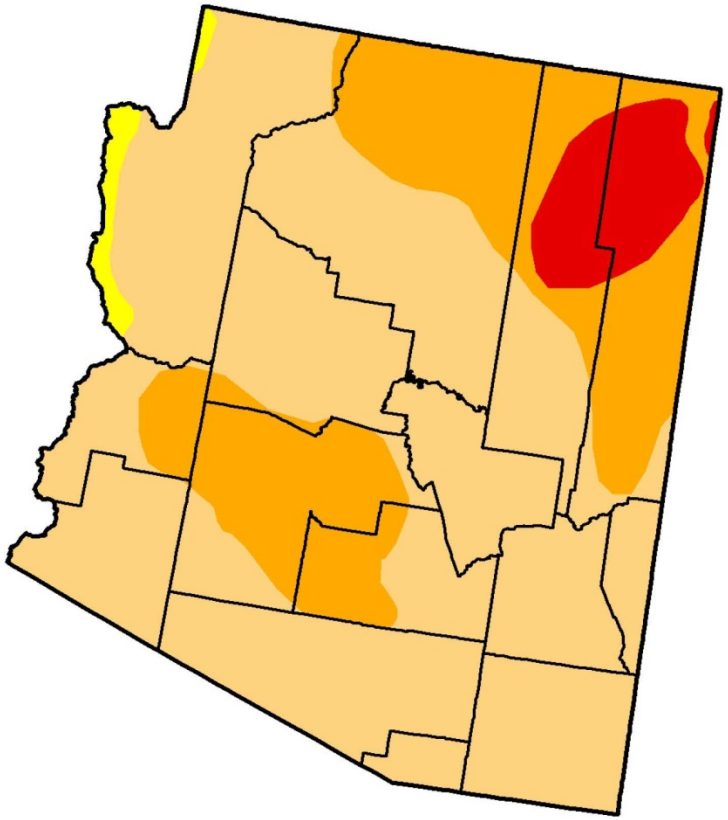
U.S. Drought Monitor

Arizona

October 23, 2012
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	98.66	31.28	5.67	0.00
Last Week (10/16/2012 map)	0.00	100.00	98.66	31.28	5.67	0.00
3 Months Ago (07/24/2012 map)	0.00	100.00	100.00	94.07	25.07	0.00
Start of Calendar Year (12/27/2011 map)	16.70	83.30	60.34	36.56	2.78	0.00
Start of Water Year (09/25/2012 map)	0.00	100.00	100.00	31.93	5.67	0.00
One Year Ago (10/18/2011 map)	1.43	98.57	68.57	42.81	15.12	1.24



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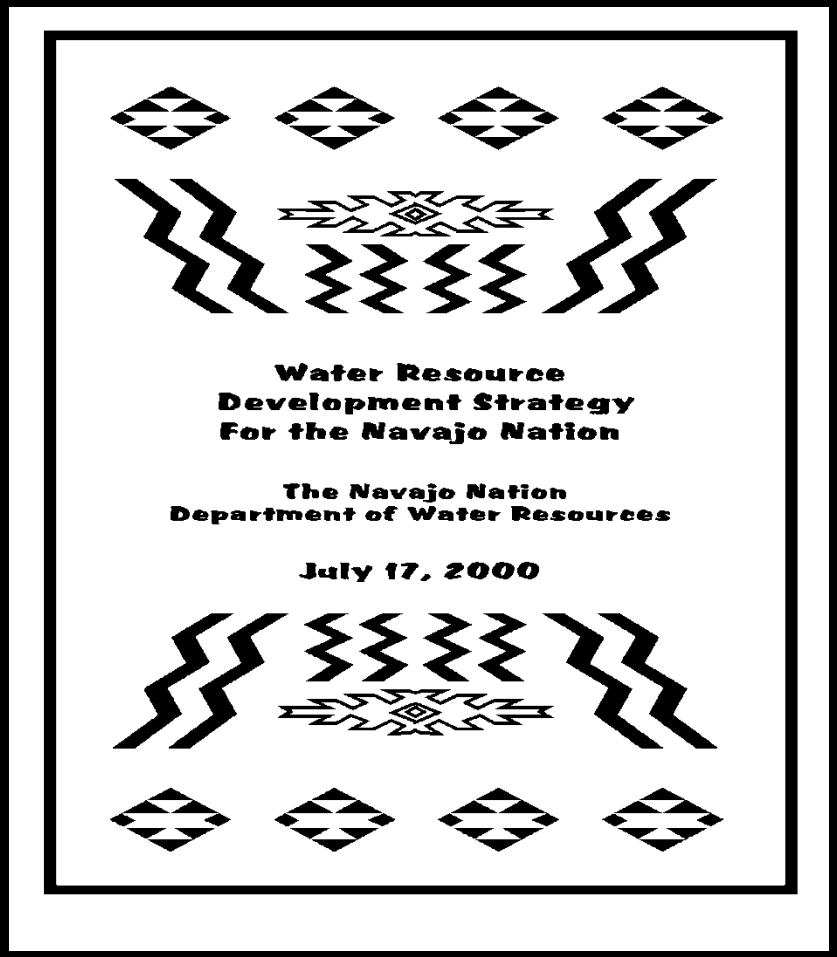
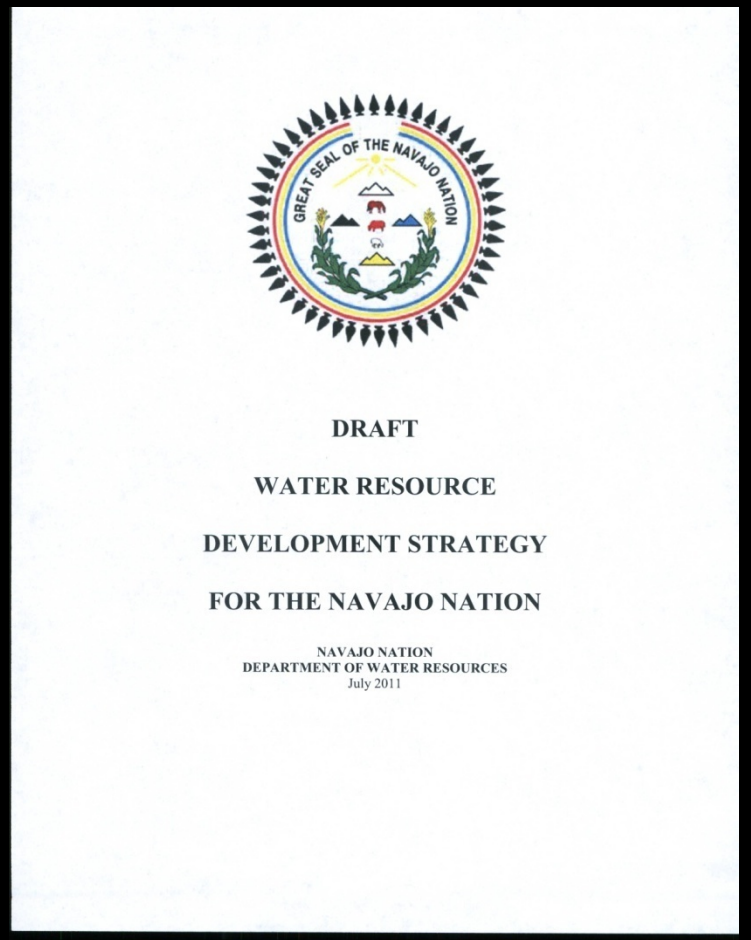
http://droughtmonitor.unl.edu

Released Thursday, October 25, 2012

Brad Rippey, U.S. Department of Agriculture

Water Development Strategy



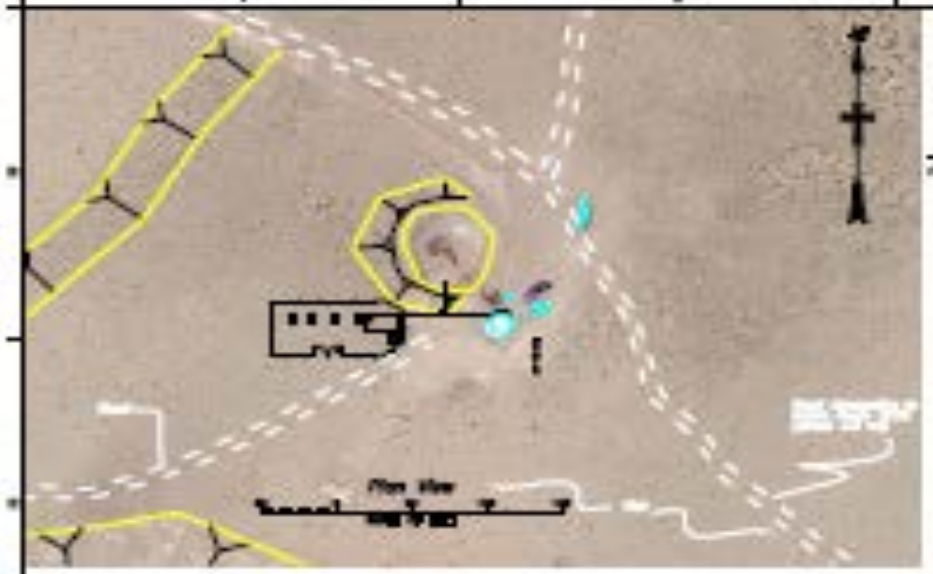


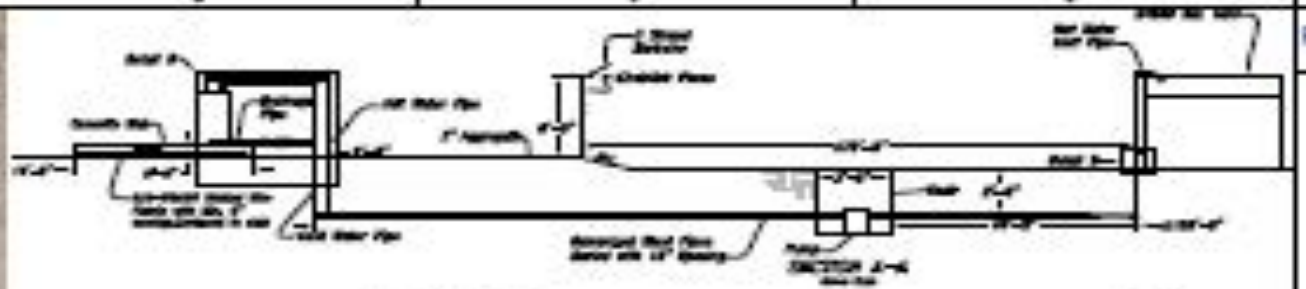
Alternatives

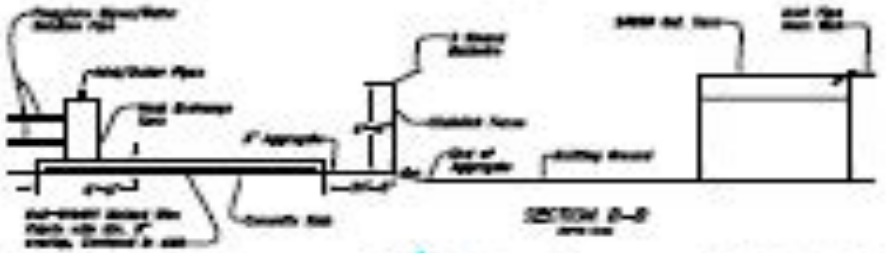
- Assumptions
  - 100 gallons per capita
  - 1.3% annual population growth
  - Make full use of existing infrastructure and supply components
  - Improved access to rural and remote water users will be substantially improved with “regulated watering points”
  - Proposed alternatives will enable integration with Federal rural water development programs
  - Emphasis on Indian Health Service Sanitary Deficiency Listing Priority Criteria

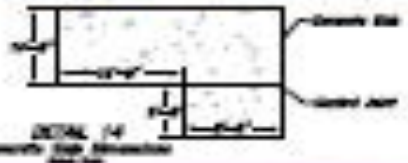
(No Action) Alternative #1

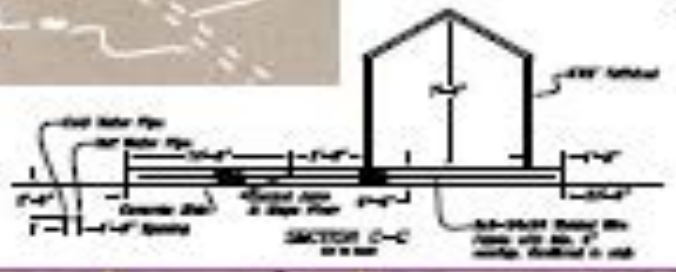
- Out-migration may continue
- Economic Development limitations
- Hospital water supply limited to IHS Dilkon Health Care Facility Budget
- Limited supply for rural water users
- Continued impacts on alluvial water supply in Lower Greasewood – Pueblo Colorado Wash
- Limited to programmatic budget allocations among federal water development programs
- High and variable operation, maintenance and replacement costs

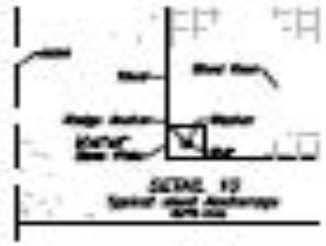


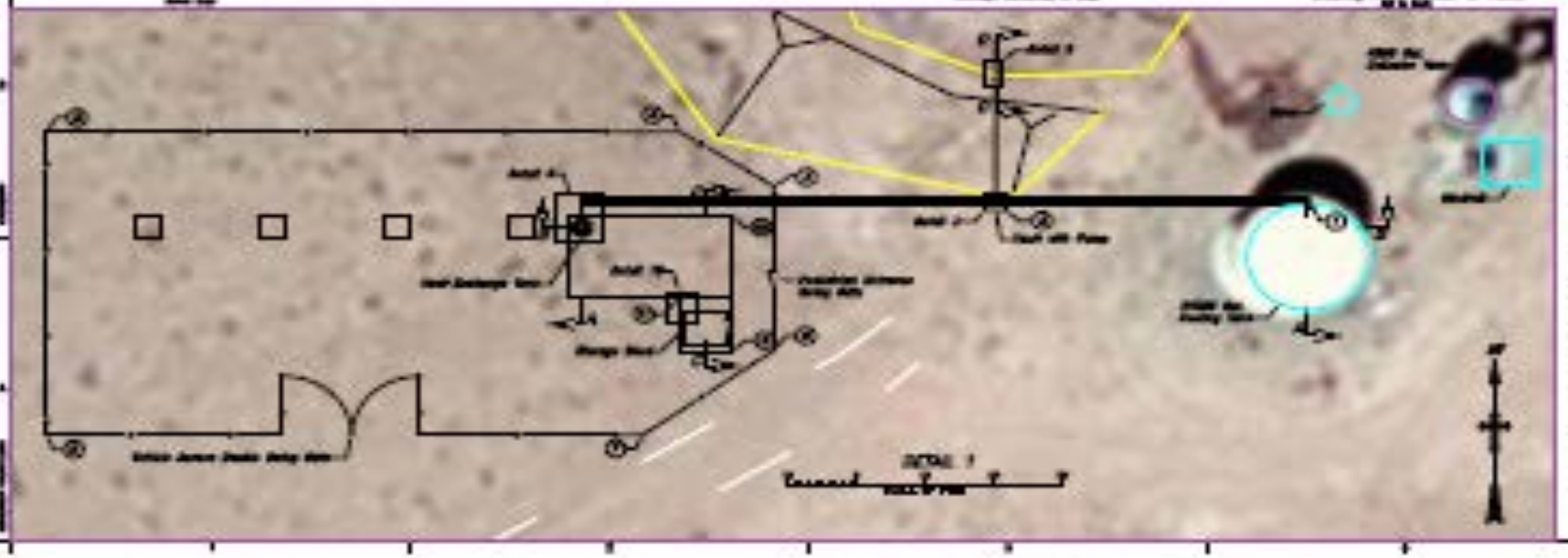


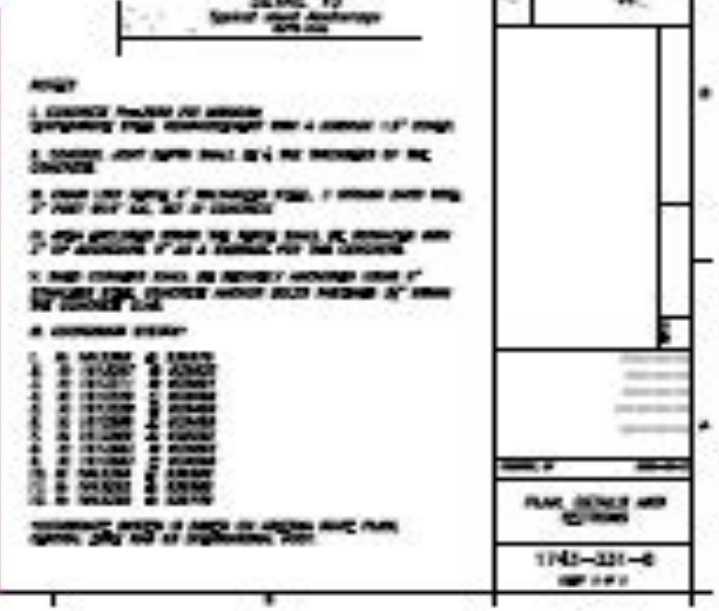


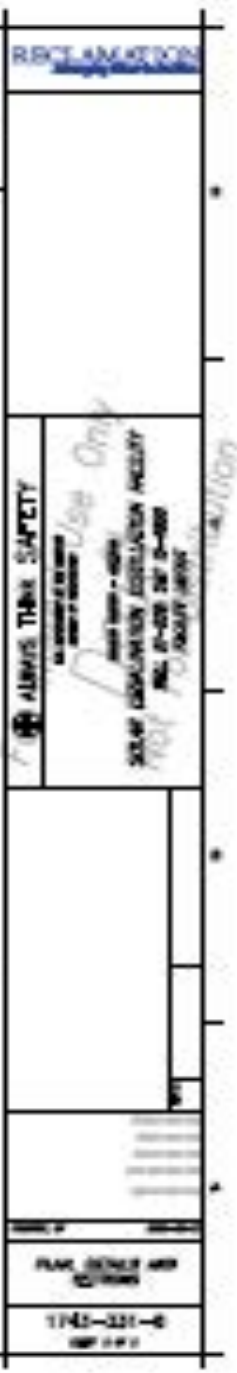


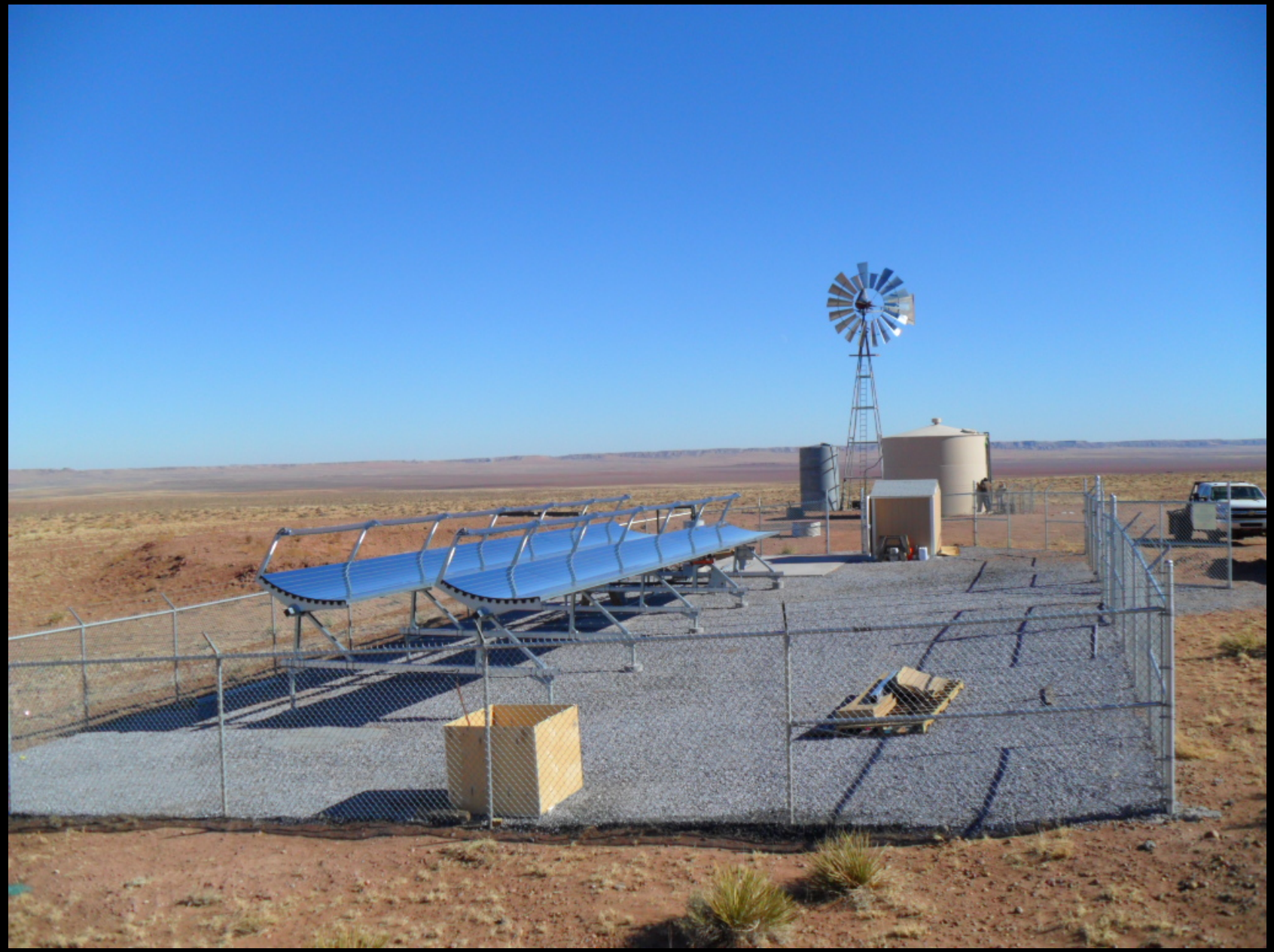












RECLAMATION *Managing Water in the West*

SOLAR DESALINATION USING DISTILLATION on the NAVAJO NATION

INTRODUCTION

[illegible]

OBJECTIVE

[illegible]

BACKGROUND INFORMATION

Figure 1. [illegible]

Figure 2. [illegible]

Figure 3. [illegible]

Table 1. Groundwater Quality Survey. [illegible]

[illegible]

PROGRESS

[illegible]

Figure 5. Membrane Distillation [illegible]

Figure 6. [illegible]

Figure 4. Solar Desalination [illegible]

Figure 7. [illegible]

PROJECT PARTNERS

ARIZONA

GRAND CANYON TRUST

Alternatives															
Chapter		Leupp	Tolani Lake	Birdsprings	Teesto	Dilkon	Indian Wells	White Cone	Lower Greasewood	Cornfields	Ganado	Steamboat	Klagetoh	Wide Ruins	Kinlichee
Supply Source	Alt 1A (3)	C aquifer-Leupp							C aquifer-Ganado and Lower Greasewood alluvium						
	Alt 1B (2)	C aquifer-Leupp					C aquifer-Ganado and Lower Greasewood alluvium								
	Alt 2A (4)	C aquifer-Leupp blended with brackish water							C aquifer-Ganado and Lower Greasewood alluvium						
	Alt 2B	C aquifer-Leupp blended with brackish water					C aquifer-Ganado and Lower Greasewood alluvium								

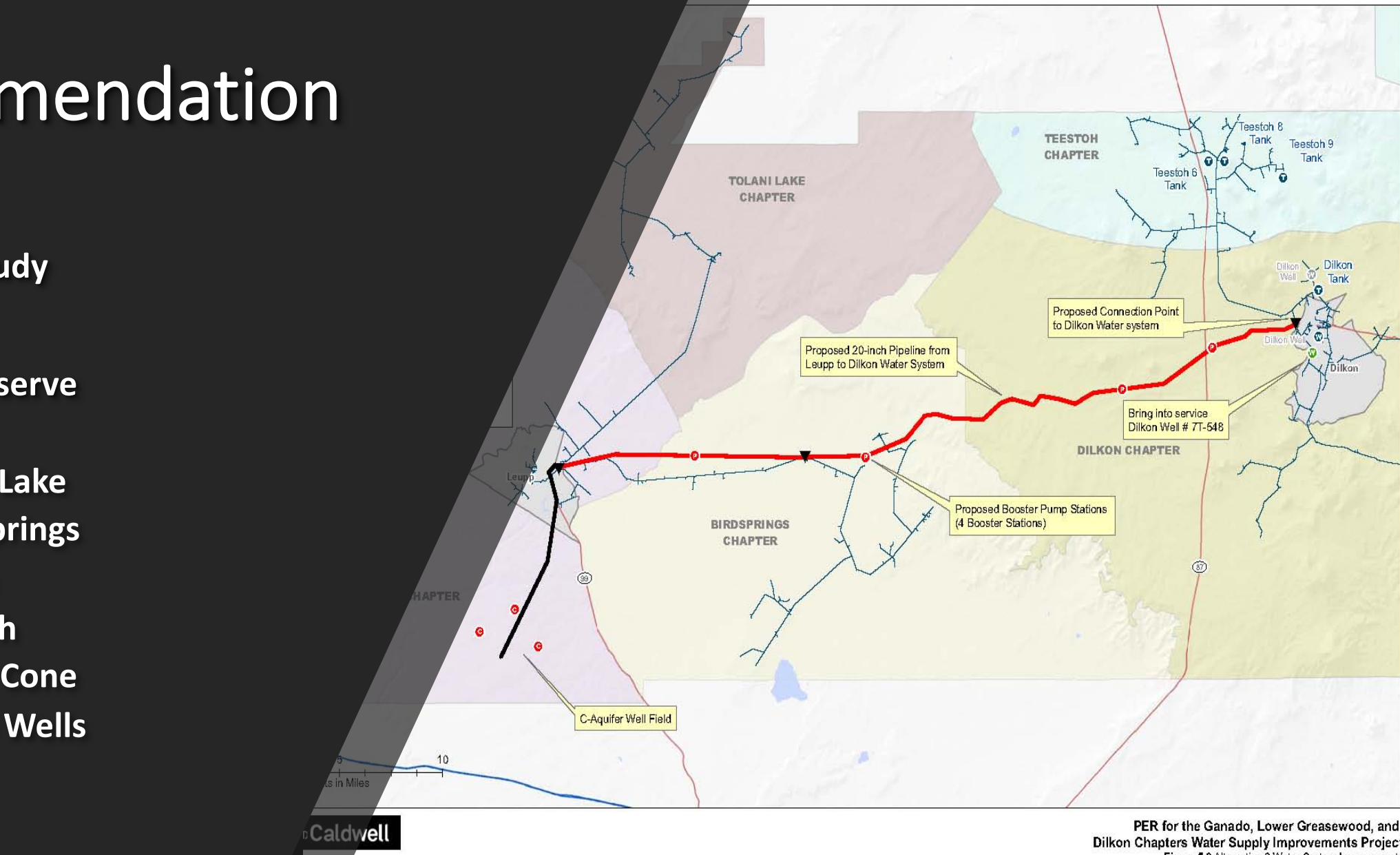
	EVALUATION CRITERIA												
ALTERNATIVES	**Identifies viable water supplies and water rights**	**Positive effect on public and health and safety**	**Will meet water demand including future demand**	**Provides environmental benefits including source water protection**	**Applies regional or watershed perspective**	**Implements an integrated water resources management approach**	**Enhances water management flexibility, including providing local control of water supplies**	**Promotes long-term protection of water supplies**	**Complete** Meets stated planning objectives and goals, takes advantage of opportunities within identified constraints	**Efficient** Capital Cost Lowest Capital Cost = highest score	**Efficient** Operation, Maintenance and Replacement Cost More rate payers higher score Capacity to pay higher score	**Effective** Meets identified criteria, enhances economic and environmental benefits and is implementable	**Acceptable** Meets terms and conditions established by TAG
Metrics	***10pts***	***10pts***	***10pts***	***10pts***	***4pts***	***10pts***	***No score***	***10pts***	***10pts***	***4pts***	***6pts***	***10pts***	***10pts***
1. No Action	Continues to rely disproportionately on alluvial supply for majority of service area. Water rights exist	Water quality drafted from alluvial source high in manganese and iron. Over 30% of current population haul water and do not have sanitary facilities	Current infrastructure only meets 70% of the current population water demands. No capacity available or sufficient infrastructure to meet future demand	Continues to rely disproportionately on alluvial supply in effect mining the groundwater stored in the system. Source water is not protected from non-Navajo development south of Leupp Chapter	Water management limited to the Indian Health Service and Navajo Tribal Utility limits of funding and authority. Ad hoc participation of other federal programs (i.e. USDA, EPA, BIA)	Continues the non-integrated practice of Indian Health Service Sanitary Deficiency Program with limited contributions from other federal agencies.	Water management continues to be manual with limited flexibility and continued shortages during peak demand. Local control continues with impacts to water haulers	Does not protect alluvial source nor are there protections of the Coconino Aquifer south of Leupp Chapter	YES 10pts NO 0pts	$	$	YES 10pts NO 0pts	YES 10pts NO 0pts
Score Alternative #1	*5*	*3*	*3*	*3*	*2*	*3*	***No score***	*3*	*NO 0pts*	*4*	*2*	*NO 0pts*	*NO 0pts*
2. Coconino Aquifer + Alluvial Aquifer Ganado Well Field Ganado Kinlichee Wide Ruins Klagetoh Steamboat Cornfields Lower Greasewood White Cone Indian Wells Dilkon Teestoh Leupp Well Field Leupp Tolani Lake Bird Springs	Alternative identifies viable water supplies and water rights exist	Conjunctive use of the C Aquifer in Ganado with the alluvial supply (interconnection of Ganado PWS and Lower Greasewood PWS) with the development of the C Aquifer in Leupp will provide additional reliability and supply for proposed water supply extensions reported in the Indian Health Service Sanitary Deficiency Listing that would allow more access to public water supplies	Alternative will increase supply for current and future demand to 2060 Questions regarding long-term viability of alluvial supply water quality may present limitations	Alternative will provide source water protection by reducing demand on alluvial aquifer and provide protection of source waters. Impacts to groundwater at Ganado Well Field and Leupp Well Field not fully quantified.	Alternative is the product of 10+ years of investigations associated with water rights negotiations and public water development. Local Chapters, water managers, federal water development entities have collaborated with the Navajo Nation Government to develop the proposed alternative	Alternative implements an integration of Indian Health Service, Navajo Tribal Utility Authority, EPA, USDA Rural Development and USDA NRCS EQIIP water development programs.	Alternative substantially enhances water management flexibility by interconnecting the three existing public water systems and incorporates watering points for local water users access	Alternative promotes long-term protection of water supplies in the alluvial aquifer and the C Aquifer south of Leupp.		$216M	$		
Score Alternative #2	*8*	*8*	*6*	*6*	*4*	*8*	***No score***	*8*	*YES 10*	*1 – 4*	*1 - 6*	*YES 10*	*YES 10*

3. Coconino Aquifer + Alluvial Aquifer Ganado Well Field Ganado Kinlichee Wide Ruins Klagetoh Steamboat Cornfields Lower Greasewood Leupp Well Field Leupp Tolani Lake Bird Springs Dilkon Teestoh White Cone Indian Wells	Alternative identifies viable water supplies and water rights exist	Conjunctive use of the C Aquifer in Ganado with the alluvial supply (interconnection of Ganado PWS and Lower Greasewood PWS) with the development of the C Aquifer in Leupp will provide additional reliability and supply for proposed water supply extensions reported in the Indian Health Service Sanitary Deficiency Listing that would allow more access to public water supplies	Alternative will increase supply for current and future demand to 2060 Water quality will be improved in the alluvial aquifer by substantially reducing the supply to Chapters east of Lower Greasewood Chapter	Alternative will provide source water protection by reducing demand on alluvial aquifer and provide protection of source waters. Impacts to groundwater at Ganado Well Field and Leupp Well Field not fully quantified.	Alternative is the product of 10+ years of investigations associated with water rights negotiations and public water development. Local Chapters, water managers, federal water development entities have collaborated with the Navajo Nation Government to develop the proposed alternative	Alternative implements an integration of Indian Health Service, Navajo Tribal Utility Authority, EPA, USDA Rural Development and USDA NRCS EQIIP water development programs	Alternative substantially enhances water management flexibility by interconnecting the three existing public water systems and incorporates watering points for local water users access	Alternative promotes long-term protection of water supplies in the alluvial aquifer and the C Aquifer south of Leupp.		$188M	$		
Score Alternative #3	*8*	*8*	*9*	*6*	*4*	*8*	***No score***	*8*	*YES 10*	*1 – 4*	*1 – 6*	*YES 10*	*YES 10*	
4. Coconino Aquifer + Alluvial Aquifer + Brackish Groundwater Ganado Well Field Ganado Kinlichee Wide Ruins Klagetoh Steamboat Cornfields Lower Greasewood Leupp Well Field Leupp Tolani Lake Birds Springs Dilkon Teestoh Indian Wells White Cone	Alternative incorporates brackish groundwater in conjunction with C Aquifer proximate to Leupp as a blend to meet identified service area demand Questions regarding the impacts to the aquifer, viability of the brackish aquifer to produce sufficient water, and whether blend would be within secondary standard.	Conjunctive use of the C Aquifer in Ganado with the alluvial supply (interconnection of Ganado PWS and Lower Greasewood PWS) with the development of the C Aquifer in Leupp will provide additional reliability and supply for proposed water supply extensions reported in the Indian Health Service Sanitary Deficiency Listing that would allow more access to public water supplies	Alternative will increase supply for current and future demand to 2060	Alternative will provide source water protection by reducing demand on alluvial aquifer and provide protection of source waters of the C Aquifer southwest of Leupp by helping limit brackish groundwater movement in the C Aquifer. Impacts to groundwater at Ganado Well Field and Leupp Well Field not fully quantified.	Alternative is the product of recent investigations associated with research and has not been proven to be viable for public water supply. Investigations of brackish water in the study area are limited to research activities.	Questions remain with regard to the Navajo Tribal Utility Authority's acceptance of the brackish water supply and the compatibility with the Indian Health Service Sanitary Deficiency	Alternative substantially enhances water management flexibility by interconnecting the three existing public water systems and incorporates watering points for local water users access	Alternative promotes long-term protection of water supplies in the alluvial aquifer and the C Aquifer south of Leupp.	YES NO	$193M	$	YES NO	YES NO
Score Alternative #4	*5*	*8*	*8*	*6*	*1*	*3*	***No score***	*8*	*NO 0pts*	*1 – 4*	*1 – 6*	*NO 0pts*	*YES 10*	

Summary of Scores	Rank														**Total**
1. No Action	4	5	3	3	3	2	3	0	3	0	4	2	0	0	**28**
2. Coconino Aquifer + Alluvial Aquifer – Service Area East	2	8	8	6	6	4	8	0	8	10	2		10	10	80
3. Coconino Aquifer + Alluvial Aquifer – Service Area West	**1**	8	8	9	6	4	8	0	8	10	3		10	10	84
4. Coconino Aquifer + Alluvial Aquifer + Brackish Water	3	5	8	8	6	1	3	0	8	0	1		0	10	50

Recommendation

- Feasibility Study
  - Alt #3
  - Limited to serve
    - Leupp
    - Tolani Lake
    - Bird Springs
    - Dilkon
    - Teestoh
    - White Cone
    - Indian Wells



Summary and Recommendations

- Rural water users are among the population who use the least amount of water, pay the largest amount for water and allocate the largest portion of their discretionary income for water.
- Federal – Tribal partnerships are necessary and possible to combine resources both technically and financially to meet the unmet water demand
- An action plan is required to complete a road map of improved water development and management
- WATER IS LIFE

“Water is a necessary but not sufficient condition for economic development”


Dilkon Health Care Facility

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