REGION D
EVALUATIONS OF WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

HUNT COUNTY

WUGs:

B H P WSC
Caddo Basin SUD
Caddo Mills
Cash SUD
The City of Celeste
Hunt County-Other
The City of Greenville
Hickory Creek SUD
Hunt County Irrigation
Hunt County Livestock
Hunt County Mining
North Hunt SUD
Poetry WSC
The City of Wolfe City

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF B H P WATER SUPPLY CORPORATION IN HUNT COUNTY

Description of Water User Group:

B H P WSC provides water service in western Hunt County, southeastern Colin County and northeastern Rockwall County. The WUG population is projected to be 5,233 people in 2020 and 18,110 by the year 2070. The water supply for this WSC is treated surface water purchased from Royse City, the source of whose supplies derive from the NTMWD system (i.e., indirect reuse via Lake Lavon and the NTMWD reservoir system) and the Sabine River Authority's system (i.e., Lake Fork and Lake Tawakoni). The WSC is projected to have a deficit of 3 ac-ft/yr in 2020 increasing to a deficit of 505 ac-ft/yr by 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	5,233	6,647	8,426	10,583	13,664	18,110
Projected Water Demand	391	467	571	711	918	1,216
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	389	395	446	502	585	711
Projected Supply Surplus (+) / Deficit (-)	**-2**	**-72**	**-125**	**-209**	**-333**	**-505**

Evaluation of Potentially Feasible Water Management Strategies:

Multiple alternative strategies considered to meet B H P WSC's water supply shortages are listed in the table below. Advanced conservation was not selected because the per capita use per day was less than the 140 gpcd threshold set by the water planning group; however, coordination with the Region C Planning Group indicates that conservation is a potential strategy for that portion of the WSC within the Region C planning area, thus conservation amounts identified by the Region C Planning Group have been incorporated herein for this WUG. Reuse is not a feasible option because water supply is mainly used for public consumption. Potentially feasible strategies include increase of the existing contract with Royse City, or alternatively establishing a new water supply contract with North Texas Municipal Water District. Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County. Groundwater use from the portion of the Nacatoch Aquifer located in the Sabine River Basin in Hunt County was also evaluated as a potentially feasible strategy.

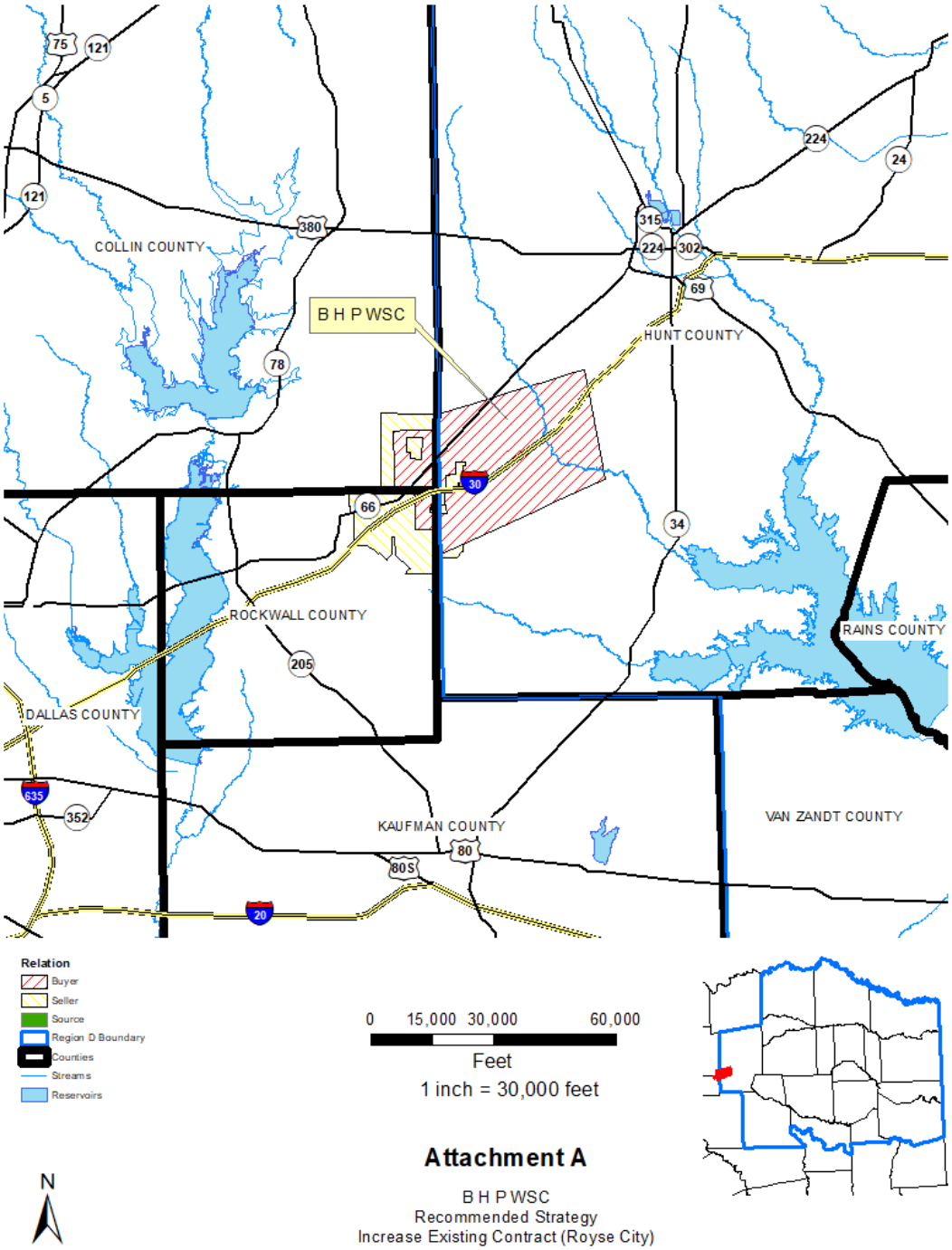
Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annual Cost	Unit Cost	Environmental Impact
Advanced Water Conservation	**3**	**$0**	**$0**	**$0**	**1**
Water Reuse					
Drill New Wells (Hunt, Nacatoch Aquifer, Sabine Basin)	**505**	**$1,689,000**	**$416,000**	**$824**	**1**
Increase Contract (Royse City)	**502**	**$0**	**$251,000**	**$500**	**1**
Wood County Pipeline Tie-in	**502**	**$5,704,000**	**$1,184,000**	**$2,345**	**2**

Recommendations:

	2020	2030	2040	2050	2060	2070
Advanced Water Conservation (ac-ft/yr)	0	1	1	1	2	3
Increase Contract (NTMWD) (ac-ft/yr)	2	71	124	208	331	502

The recommended strategy for BHP WSC is to implement Advanced Water Conservation up to the amounts identified herein over the 2020-2070 planning period (consistent with preliminarily identified recommendations for conservation for this WUG from the 2021 Region C Plan), and to increase the

existing contract with the City of Royse City. As Royse City obtains its supply from the NTMWD system, this strategy is contingent upon Region C recommended strategies for the NTMWD.



Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

B H P WSC - Increase Existing Contract (Royse City)

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	***Estimated Costs for Facilities***
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treamtent Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr)	$0
Purchase of Water (502 acft/yr @ 500 $/acft)	$251,000
TOTAL ANNUAL COST	**$251,000**
Available Project Yield (acft/yr)	502
Annual Cost of Water ($ per acft), based on PF=1	$500
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$500
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$1.53
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.53

JMP *10/5/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF CADDO BASIN SUD IN HUNT COUNTY

Description of Water User Group:

Caddo Basin SUD provides water service in western Hunt County and eastern Collin County. The WUG population is projected to be 10,115 in 2020 and 43,698 by the year 2070. The SUD purchases treated water from North Texas MWD and Farmersville. The SUD is projected to have a shortage beginning in 2020 based on the availability of current firm supplies from North Texas MWD. The SUD is projected to have a deficit of 8 ac-ft in 2020 increasing to a deficit of 1,866 ac-ft by 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	10,115	13,263	17,792	23,883	32,195	43,698
Projected Water Demand	1,128	1,417	1,855	2,465	3,314	4,493
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	1,121	1,197	1,449	1,743	2,112	2,627
Projected Supply Surplus (+) / Deficit (-)	**-7**	**-220**	**-406**	**-722**	**-1,202**	**-1,866**

Evaluation of Potentially Feasible Water Management Strategies:

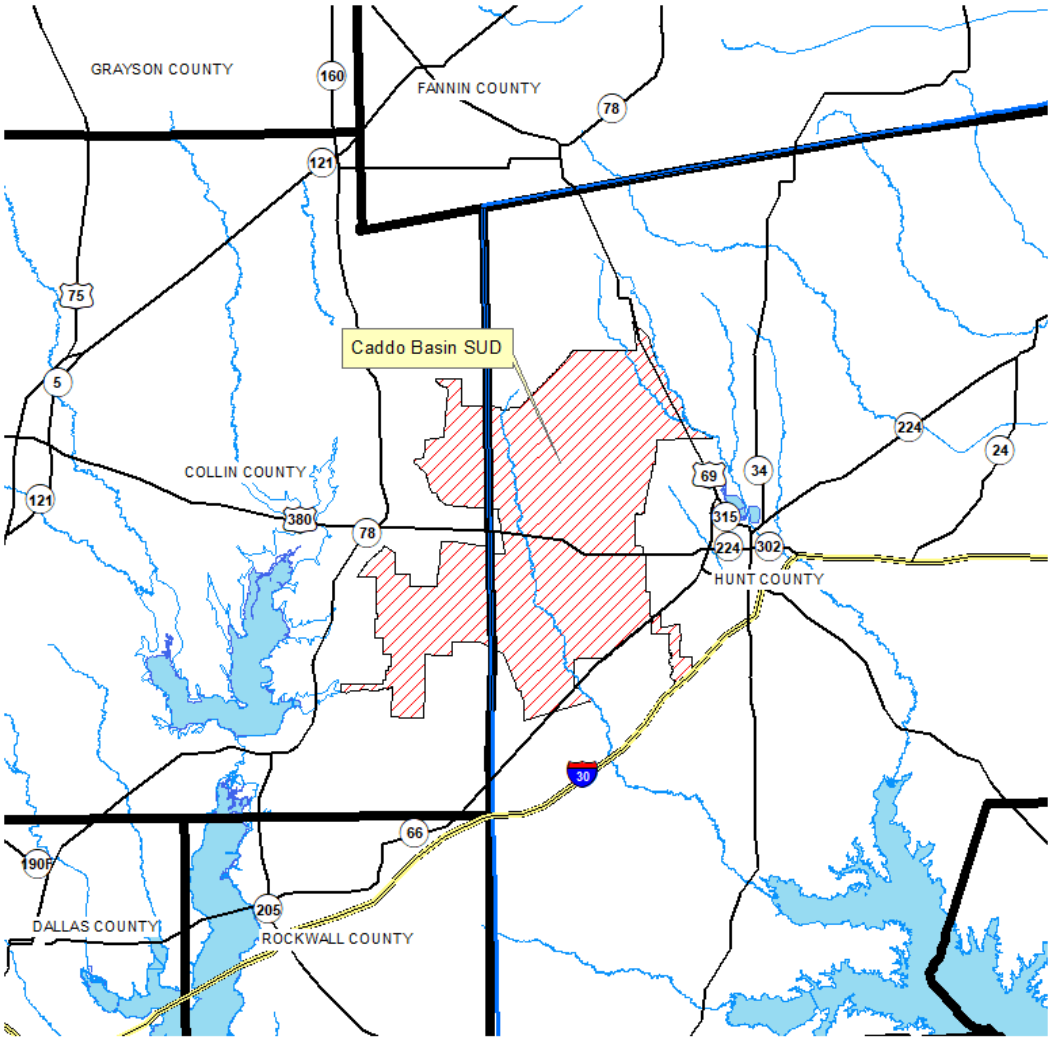
Seven alternative strategies were considered to meet the SUD's water supply shortages as summarized in the following table. Advanced conservation was not selected because the per capita use per day was less than the 140 gpcd threshold set by the water planning group; however, preliminary coordination with the Region C Planning Group indicates that conservation is a potential strategy for that portion of the WUG within the Region C planning area, thus conservation amounts identified by the Region C Planning Group have been incorporated herein for this WUG. Water reuse was not considered because the SUD does not have a demand for non-potable water. Groundwater was considered, but the SUD has previously indicated that it currently purchases treated water from NTMWD and is planning to meet its future needs from water purchases. Thus, the SUD could potentially increase existing contracts with NTMWD. Another potentially feasible contract increase could be from the City of Farmersville. The SUD also has an existing emergency interconnect with the City of Greenville, thus, a contract with the City of Greenville was considered. Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation (Region C Portion)	**18**	**$0**	**$0**	**$0**	**1**
Water Reuse	**0**	**-**	**-**	**-**	**-**
Ground Water (Hunt, Woodbine Aquifer, Trinity)	**0**	**-**	**-**	**-**	**-**
Increase Existing Contract (NTMWD)	**1,848**	**$0**	**$421,000**	**$228**	**1**
Increase Existing Contract (Farmersville)	**1,848**	**$0**	**$421,000**	**$228**	**1**
New Contract (Greenville)	**1,866**	**$2,473,000**	**$1,889,000**	**$1,012**	**1**
Wood County Pipeline	**1,866**	**$5,953,000**	**$3,192,000**	**$1,711**	**2**

Recommendations:

	2020	2030	2040	2050	2060	2070
Advanced Water Conservation (Region C Portion; ac-ft/yr)	**2**	**4**	**4**	**7**	**12**	**18**
Increase Contract (NTMWD; ac-ft/yr)	**5**	**216**	**402**	**715**	**1,190**	**1,848**

The recommended strategy for Caddo Basin SUD is to implement Advanced Water Conservation up to the amounts identified herein over the 2020-2070 planning period (consistent with preliminarily identified recommendations for conservation for this WUG for the 2021 Region C Plan), and to increase the existing contract with the NTMWD. This strategy is contingent upon Region C recommended strategies for the NTMWD.



Attachment A

Caddo Basin SUD
Recommended Strategy
Increase Existing Contract (NTMWD)

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Caddo Basin - Increase Existing Contract with NTMWD

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr)	$0
Purchase of Water (1848 acft/yr @ 228 $/acft)	$421,000
TOTAL ANNUAL COST	**$421,000**
Available Project Yield (acft/yr)	1,848
Annual Cost of Water ($ per acft), based on PF=1	$228
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$228
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.70
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.70

JMP *10/5/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF CADDO MILLS IN HUNT COUNTY

Description of Water User Group:

The City of Caddo Mills provides water service in Hunt County. This City's population was 1,338 in 2010 and is projected to increase to 1,710 by 2020 and 7,147 by 2070. The City purchases treated water from the City of Greenville and is projected to have a shortage beginning in 2030 based on the availability of current supplies to Greenville. Caddo Mills is projected to have a deficit of 1 ac-ft in 2030 increasing to a deficit of 254 ac-ft by 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	1,710	2,214	2,898	3,843	5,190	7,147
Projected Water Demand	152	187	237	310	417	573
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	178	186	201	242	309	319
Projected Supply Surplus (+) / Deficit (-)	**26**	**-1**	**-36**	**-68**	**-108**	**-254**

Evaluation of Potentially Feasible Water Management Strategies:

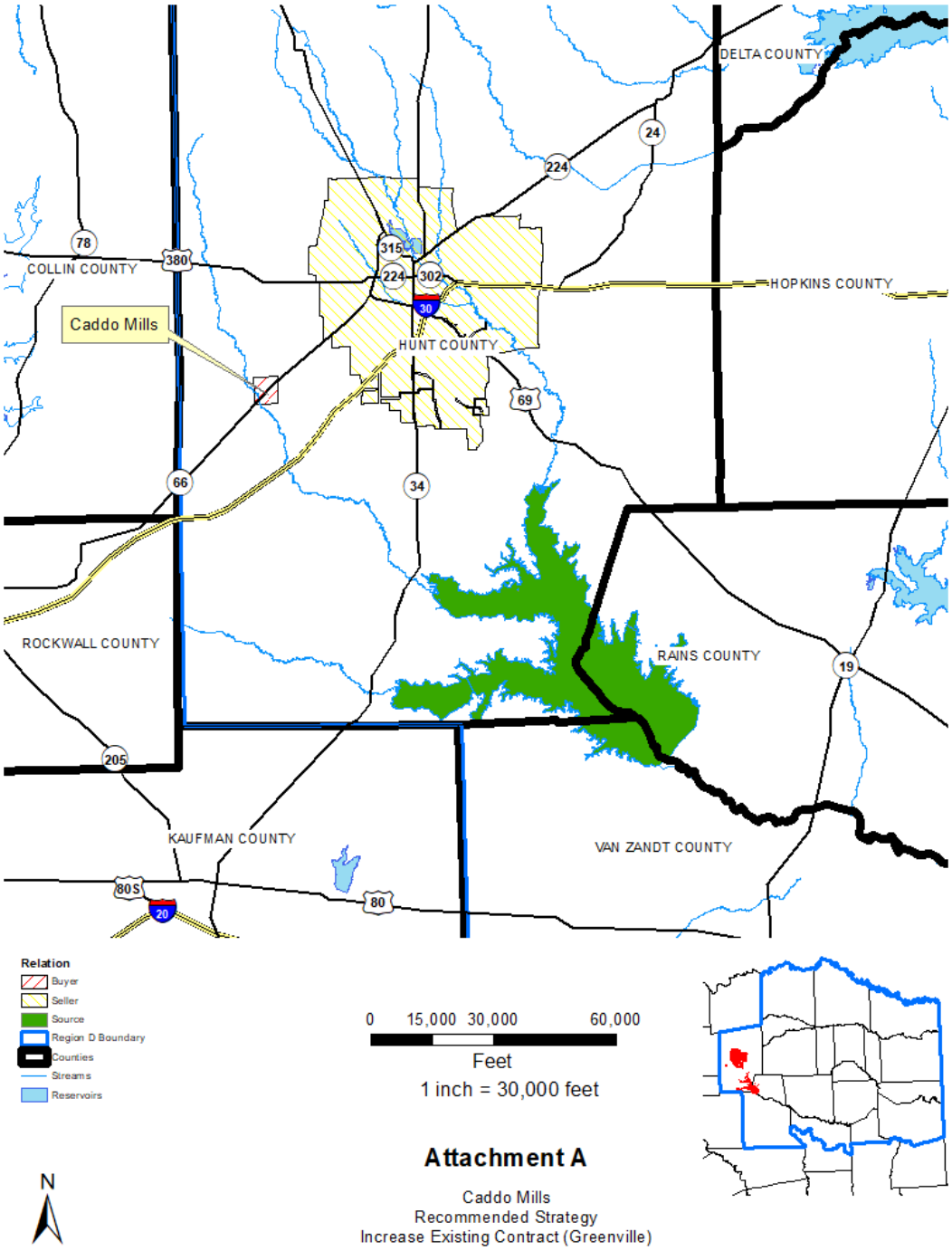
Four alternative strategies were considered to meet the City of Caddo Mills water supply shortages as summarized in the following table. Advanced conservation was not considered because the per capita use per day was below the 140 gpcpd threshold set by the planning group. Water reuse was not considered because the City does not have a demand for non-potable water. Groundwater was considered, although the City has previously indicated that it plans to meet its future needs from water purchase from the City of Greenville. Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County via existing infrastructure from Greenville.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Drill New Wells (Hunt, Nacatoch Aquifer, Sabine Basin)	**254**	**$1,014,000**	**$221,000**	**$870**	**1**
Increase Existing Contract (Greenville)	**254**	**$0**	**$224,000**	**$882**	**1**
Wood County Pipeline, Increase Contract	**254**	**$0**	**$366,000**	**$1,442**	**2**

Recommendations:

	2020	2030	2040	2050	2060	2070
Increase Existing Contract (ac-ft/yr)	0	1	36	68	108	254

The recommended strategy for the City of Caddo Mills to meet their projected deficit of 1 ac-ft/yr in 2030 and 254 ac-ft/yr in 2070 is to increase the volume of treated surface water purchased from the City of Greenville, contingent upon Greenville strategies.



Attachment A

Caddo Mills
Recommended Strategy
Increase Existing Contract (Greenville)

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Caddo Mills - Increase Existing Contract with Greenville

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	***Estimated Costs for Facilities***
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treamtent Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr)	$0
Purchase of Water (254 acft/yr @ 883 $/acft)	$224,000
TOTAL ANNUAL COST	**$224,000**
Available Project Yield (acft/yr)	254
Annual Cost of Water ($ per acft), based on PF=1	$882
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$882
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$2.71
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$2.71

JMP *10/3/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF CASH SUD IN HUNT COUNTY

Description of Water User Group:

Cash SUD provides water in the south-central portion of Hunt County and small areas of northwestern Rains County, western Hopkins County, and eastern Rockwall County from purchased surface water supplies from the North Texas Municipal Water District (NTMWD) and the Sabine River Authority for supplies out of Lake Fork and Lake Tawakoni. Over 90% of the SUD's demand is located in Region D (Hunt County), with less than 10% in Region C (Rockwall County). In both regions, the system is projected to serve a total of 20,491 people in 2020 and 50,195 people by the year 2070. Cash SUD is projected to have a supply deficit of 111 ac-ft/yr by 2020 increasing to 1,860 ac-ft/yr by 2070.

Water Supply and Demand Analysis:

In coordination with Cash SUD and Region C, the below summarization of Cash SUD supplies and demands has been developed.

Cash Special Utility District (Region C & D)

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Region Population (C&D)	**20,491**	**24,592**	**29,451**	**35,192**	**42,044**	**50,195**
Projected Region Population (D)	19,271	23,012	27,462	32,789	39,180	46,841
Projected Region Population (C)	1,220	1,580	1,989	2,403	2,864	3,354
Projected Water Demand						
Municipal Demand (Region D)	2,213	2,560	2,998	3,548	4,228	5,049
Municipal Demand (Region C)	140	176	217	260	309	362
Total Projected Total Demand	***2,353***	***2,736***	***3,215***	***3,808***	***4,537***	***5,411***
Currently Available Water Supplies						
North Texas Municipal Water District	1,450	1,514	1,663	1,744	1,571	1,442
Sabine River Authority (current and future)	896	943	1,086	1,342	2,017	2,945
Total Current Supplies	***2,346***	***2,457***	***2,749***	***3,086***	***3,642***	***4,387***
Need (Demand - Current Supply)	***7***	***279***	***466***	***722***	***895***	***1,024***
Water Management Strategies						
Water Conservation	5	7	9	11	14	18
Increase Contract with NTMWD	2	272	457	711	881	1,006
Additional Delivery Infrastructure from NTMWD	*2*	*272*	*457*	*711*	*881*	*1,006*
Wood County Pipeline (Alt Region D Needs)	0	0	466	722	895	373
Total Water Management Strategies	***7***	***279***	***466***	***722***	***895***	***1,024***

Evaluation of Potentially Feasible Water Management Strategies:

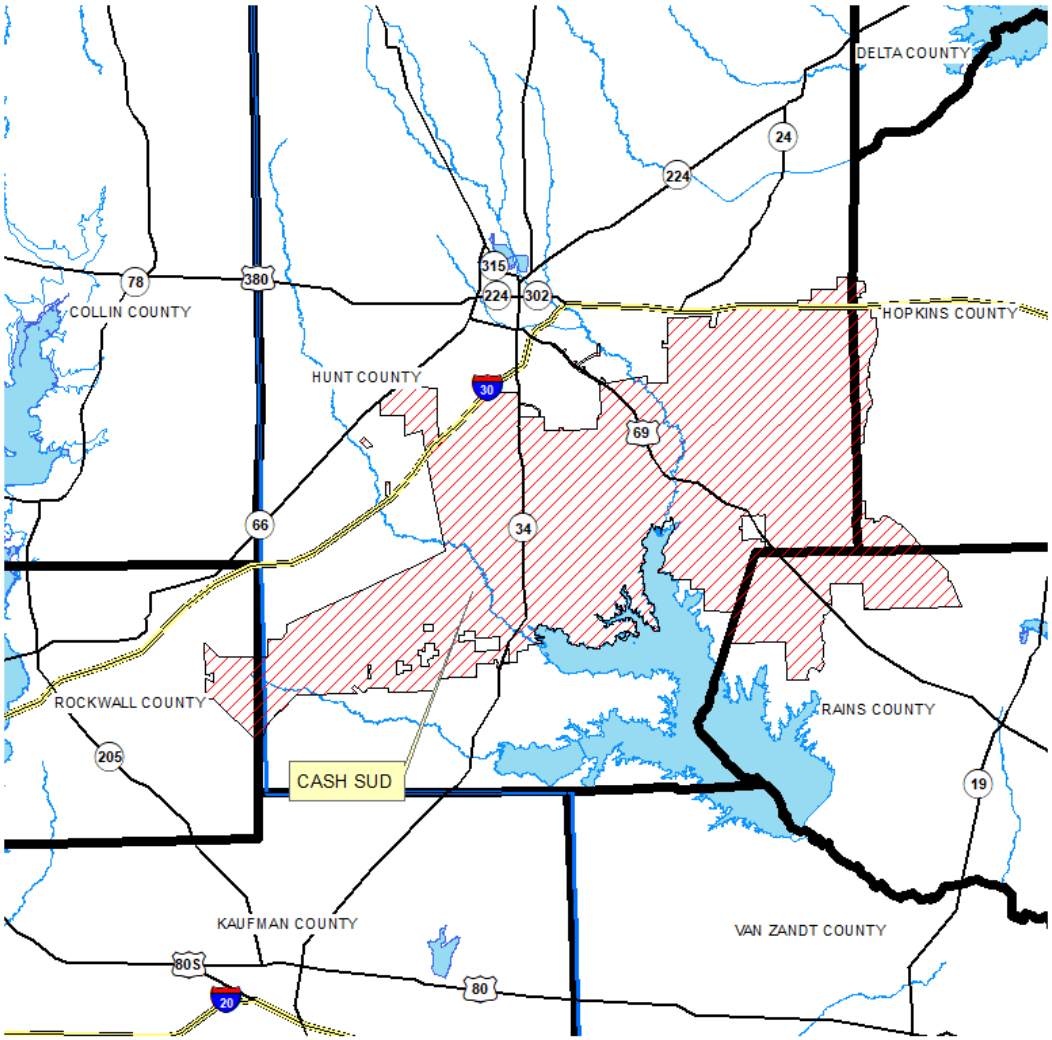
Cash SUD has a contract with NTMWD for 2.2 MGD (2,466 ac-ft/yr). Additional supply comes from the SRA. Cash SUD operates its own water treatment plant within Region D to treat the supply from SRA. The water management strategies for Cash SUD include conservation, acquisition of additional supplies from NTMWD, including additional delivery infrastructure. Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annual Cost	Unit Cost	Environmental Impact
Advanced Water Conservation (Region C Portion)	**18**		**$0**	**$0**	**1**
Water Reuse					
Increase contract w/ NTMWD (contingent upon Region C NTMWD WMS)	**1,006**	**$8,272,000**	**$2,155,000**	**$2,446**	**1**
Wood County Pipeline Tie-in	**881**	**$1,863,000**	**$1,433,000**	**$1,627**	**2**

Recommendations:

	2020	2030	2040	2050	2060	2070
Advanced Water Conservation (ac-ft/yr)	**5**	**7**	**9**	**11**	**14**	**18**
Increase Contract (NTMWD; ac-ft/yr)	**7**	**279**	**466**	**722**	**895**	**1,024**

The NETRWPG recommends Cash SUD increase its' existing contract with the NTMWD, contingent upon Region C NTMWD strategies. The NETRWPG supports the recommendation (as previously indicated by Region C for the purposes of the 2016 Plan) for construction of a new 16" transmission line from Fate to Union Valley, for an approximate cost of $6 million. The NETRWPG also supports the preliminary strategy recommendation from Region C for advanced water conservation for Cash SUD.



Attachment A

Cash SUD
Recommended Strategy
Increase Contract w/ NTMWD (contingent upon Region C NTMWD WMS)

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Cash SUD - Increase Contract with NTMWD

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Transmission Pipeline (0 in dia., miles)	$6,000,000
TOTAL COST OF FACILITIES	**$6,000,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,800,000
Environmental & Archaeology Studies and Mitigation	$250,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$222,000
TOTAL COST OF PROJECT	**$8,272,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$582,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$60,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treamtent Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr)	$0
Purchase of Water (881 acft/yr @ 1717 $/acft)	$1,513,000
TOTAL ANNUAL COST	**$2,155,000**
Available Project Yield (acft/yr)	881
Annual Cost of Water ($ per acft), based on PF=1	$2,446
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$1,785
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$7.51
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$5.48
Note: One or more cost element has been calculated externally	

JMP *10/3/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF CITY OF CELESTE

Description of Water User Group:

The City of Celeste is a small public water supply located in northwest Hunt County. The system is projected to serve 1,012 people in 2020 and 3,658 people by the year 2070. The current sources of supply are two wells into the Woodbine Aquifer with production capacities of 150 gpm and 200 gpm. The City provides water to its own customers in the Sabine River Basin and is projected to have a water supply deficit of 29 ac-ft/yr in 2020 increasing to 316 ac-ft/yr by 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	1,012	1,257	1,590	2,051	2,706	3,658
Projected Water Demand	124	147	181	231	304	411
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	95	95	95	95	95	95
Projected Supply Surplus (+) / Deficit (-)	**-29**	**-52**	**-86**	**-136**	**-209**	**-316**

Evaluation of Potentially Feasible Water Management Strategies:

Multiple alternative strategies considered to meet Celeste's water supply shortages are listed in the table below. Advanced conservation was not selected since per capita use is less than 140 gpcd. The purchase of surface water from the City of Greenville and construction of a treated water pipeline was identified as a potentially feasible strategy and evaluated. Additional supplies from the City of Greenville would be contingent upon City of Greenville water strategies. Pumping of additional groundwater from the Woodbine Aquifer was also considered as an alternative for this entity. There is sufficient source availability in the Woodbine Aquifer through 2060, but if this alternative were to be implemented availability would be insufficient by 2070, which would necessitate a smaller contract and infrastructure for treated supply from the City of Greenville by 2070. Such an approach would be contingent upon recommended seller strategies for the City of Greenville. Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annual Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Drill New Wells (Woodbine, Sabine Basin)					
Drill New Wells (Woodbine, Sulphur Basin)					
Drill New Wells (Woodbine, Trinity Basin)	**229**	**$1,686,000**	**$292,000**	**$1,275**	**1**
New Contract and Treated Water Pipeline (Greenville, contingent on Seller WMS)	**87**	**$3,342,000**	**$341,000**	**$3,920**	**1**
New Contract and Treated Water Pipeline (Greenville contingent on Seller WMS)	**316**	**$5,076,000**	**$690,000**	**$2,184**	**1**
Wood County Pipeline Tie-in	**316**	**$5,076,000**	**$867,000**	**$2,744**	**2**

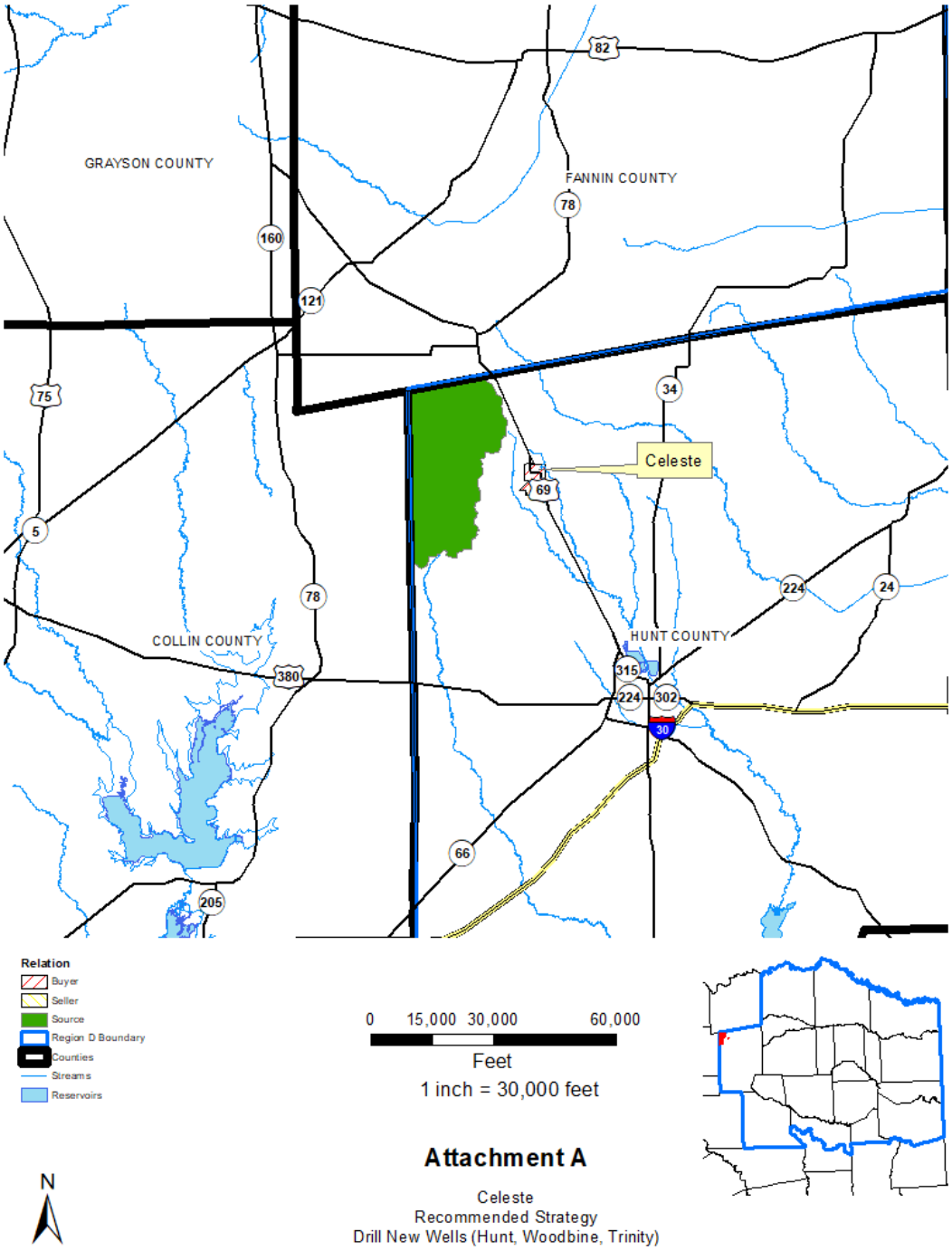
Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Woodbine, Trinity Basin; ac-ft/yr)	**29**	**52**	**86**	**136**	**209**	**229**
New Contract and Treated Water Pipeline (Greenville, contingent on Seller WMS)	**0**	**0**	**0**	**0**	**0**	**87**

The recommended strategy for the City of Celeste to meet their projected deficit of 29 ac-ft/yr in 2020 and 316 ac-ft/yr in 2070 would be to construct three additional water wells similar to their existing wells just prior to each decade as the deficits occur. The recommended supply source will be the Woodbine Aquifer in Hunt County. Three wells with rated capacity of 150 gpm each would provide approximately 81 acre-feet each. The portion of the Woodbine Aquifer in Hunt County within the Trinity River Basin is projected by Region D to have a more than ample supply availability to meet the needs of the City of Celeste through 2060.

To meet the remaining 2070 needs, it is recommended that the City of Celeste contract with the City of Greenville for treated water supply of up to 87 ac-ft/yr by 2070, and construct a treated water pipeline with necessary infrastructure to convey this amount from the City of Greenville's system to the City of Celeste. This strategy is contingent upon the recommended seller strategies for the City of Greenville.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.



Attachment A

Celeste
Recommended Strategy
Drill New Wells (Hunt, Woodbine, Trinity)

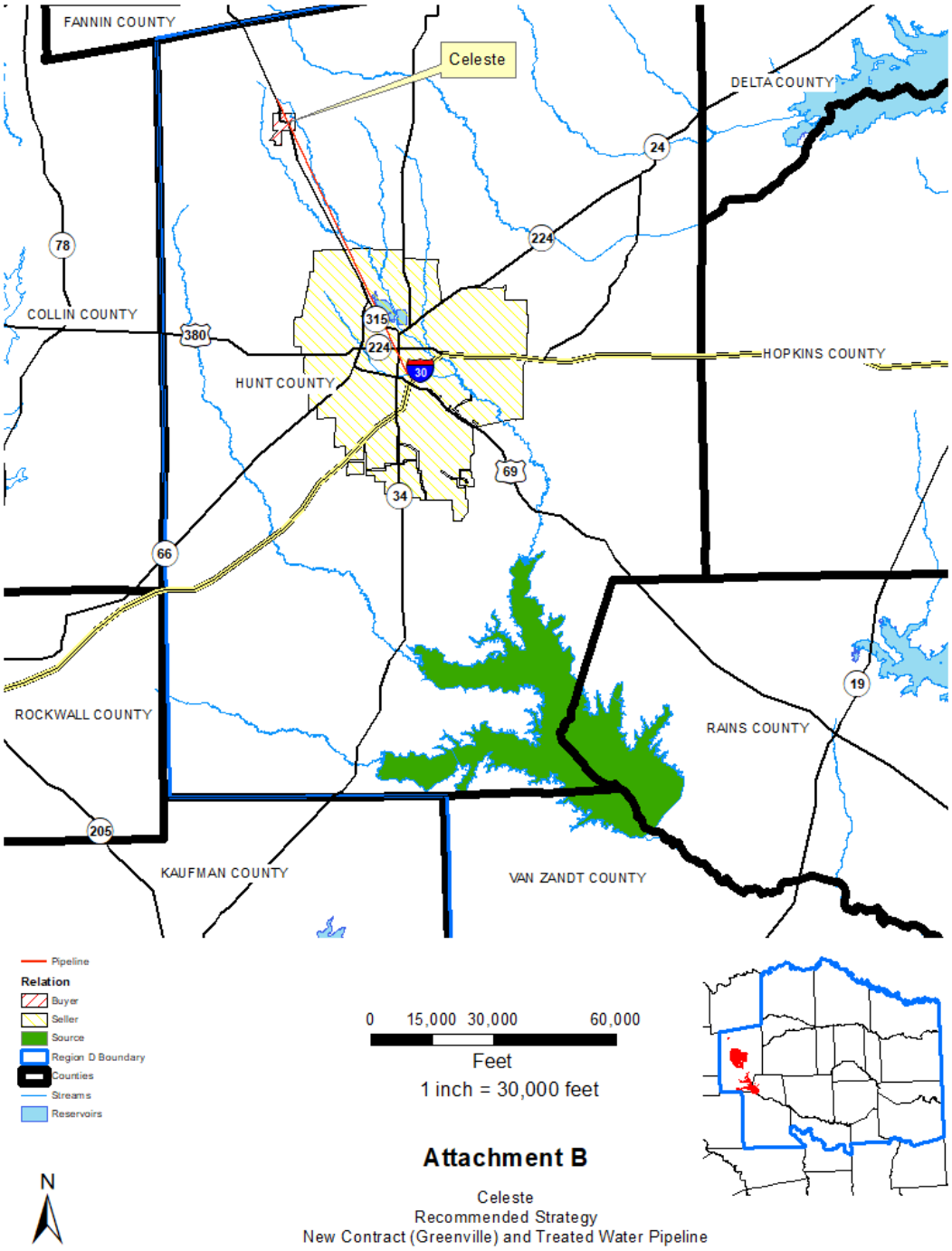
Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Celeste - Drill New Wells (Hunt, Woodbine Aquifer, Trinity Basin)

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$1,105,000
Water Treatment Plant (0.6 MGD)	$61,000
TOTAL COST OF FACILITIES	**$1,166,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$408,000
Environmental & Archaeology Studies and Mitigation	$44,000
Land Acquisition and Surveying (4 acres)	$22,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$46,000
TOTAL COST OF PROJECT	**$1,686,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$119,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$11,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$36,000
Advanced Water Treamtent Facility	$0
Pumping Energy Costs (141126 kW-hr @ 0.08 $/kW-hr)	$11,000
Purchase of Water (229 acft/yr @ 500 $/acft)	$115,000
TOTAL ANNUAL COST	**$292,000**
Available Project Yield (acft/yr)	229
Annual Cost of Water ($ per acft), based on PF=1	$1,275
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$755
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$3.91
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$2.32

JMP *10/5/2019*



Attachment B

Celeste
Recommended Strategy
New Contract (Greenville) and Treated Water Pipeline

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Celeste - New Contract with Greenville

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Primary Pump Station (0 MGD)	$865,000
Transmission Pipeline (0 in dia., miles)	$2,509,000
TOTAL COST OF FACILITIES	**$3,374,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,055,000
Environmental & Archaeology Studies and Mitigation	$325,000
Land Acquisition and Surveying (34 acres)	$186,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$136,000
TOTAL COST OF PROJECT	**$5,076,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$357,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$25,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$22,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treamtent Facility	$0
Pumping Energy Costs (85412 kW-hr @ 0.08 $/kW-hr)	$7,000
Purchase of Water (316 acft/yr @ 883 $/acft)	$279,000
TOTAL ANNUAL COST	**$690,000**
Available Project Yield (acft/yr)	316
Annual Cost of Water ($ per acft), based on PF=1	$2,184
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$1,054
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$6.70
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$3.23

JMP *10/3/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF COUNTY-OTHER IN HUNT COUNTY

Description of Water User Group:

The County-Other WUG in Hunt County comprises all or portions of Campbell WSC, Jacobia WSC, City of Lone Oak, Maloy WSC, and Aqua Texas within Hunt County. The WUG population is projected to be 6,342 in 2020 and 58,270 by the year 2070. The WUG is supplied by groundwater from the Nacatoch, Trinity, and Woodbine Aquifers and purchases surface water from Cash SUD, City of Cooper, and City of Greenville. In Hunt County, the County-Other WUG is projected to have a deficit of 20 ac-ft in 2020 increasing to 283 ac-ft by 2070 within the Sulphur River Basin. Within the Sabine River Basin a deficit of 65 ac-ft is projected by 2040 increasing to 3,426 ac-ft by 2070. In the Trinity River Basin a deficit of 2 ac-ft is projected by 2030 increasing to 125 ac-ft by 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	6,342	11,000	17,951	23,690	36,034	58,270
Projected Water Demand	790	1,326	2,130	2,792	4,238	6,846
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	1,652	1,775	1,964	2,089	2,421	3,012
Projected Supply Surplus (+) / Deficit (-)	**862**	**449**	**-166**	**-703**	**-1,817**	**-3,834**

Evaluation of Potentially Feasible Water Management Strategies:

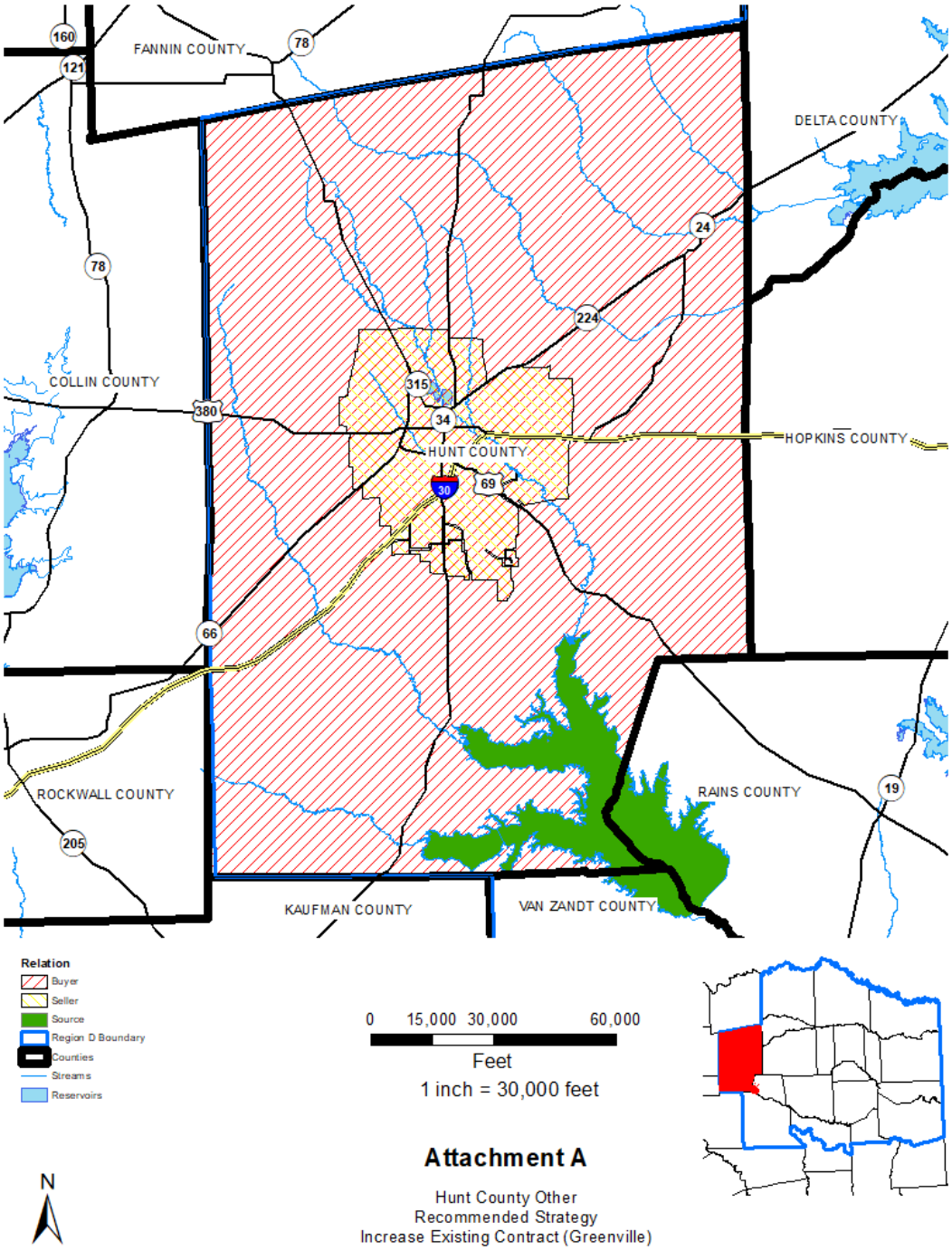
Multiple alternative strategies were considered to meet the WUG's water supply shortages as summarized in the following table. Advanced conservation was not considered because the per capita use per day was below the 140 gpcpd threshold set by the planning group. Water reuse is not a feasible option because water supply is mainly used for public consumption. Groundwater was identified as a potential source of water for Hunt County-Other, but the Nacatoch aquifer does not have sufficient availability to cover all shortages. Various sources of treated surface water are available to the entities in the County-Other WUG based on proximity and availability. Potential sources for contracted surface water include the City of Greenville, City of Commerce, Combined Consumers SUD, and City of West Tawakoni. Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County via existing infrastructure with the City of Greenville.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Drill New Wells (Nacatoch Aquifer, Sabine Basin)	**703**	**$8,609,000**	**$1,150,000**	**$1,636**	**1**
Increase Existing Contract with City of Greenville (contingent upon Greenville WMSs)	**3,834**	**$0**	**$3,385,000**	**$883**	**1**
Wood County Pipeline, Increase Contract	**3,834**	**$0**	**$5,529,000**	**$1,442**	**2**

Recommendations:

	2020	2030	2040	2050	2060	2070
Increase Existing Contract (w/Greenville, contingent upon Greenville WMSs)	0	0	166	703	1,817	3,834

Increasing the existing water supply contracts with the City of Greenville to purchase treated surface water is recommended to provide sufficient supply to meet the demands of the County-Other WUG through 2070. Increasing contracted supply with the City of Greenville is recommended, contingent upon the City of Greenville's recommended WMSs.



Attachment A

Hunt County Other
Recommended Strategy
Increase Existing Contract (Greenville)

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Hunt County Other - Increase Existing Contract with Greenville

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr)	$0
Purchase of Water (3834 acft/yr @ 883 $/acft)	$3,385,000
TOTAL ANNUAL COST	**$3,385,000**
Available Project Yield (acft/yr)	3,834
Annual Cost of Water ($ per acft), based on PF=1	$883
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$883
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$2.71
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$2.71

JMP *10/4/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF CITY OF GREENVILLE

Description of Water User Group:

The City of Greenville provides water service in Hunt County. The WUG population is projected to be 29,871 in 2020 increasing to 77,705 by the year 2070. The City of Greenville uses surface water from Greenville's city lake and purchases surface water out of Lake Tawakoni from the Sabine River Authority. The City of Greenville sells water to the City of Caddo Mills, Shady Grove WSC and entities within Hunt County-Other, Manufacturing, Mining and Steam Electric WUGs in Hunt County. The City of Greenville is projected to have a deficit of -314 ac-ft in 2020 increasing to -11,816 ac-ft by 2070. When incorporating projected treated water demands of existing and potential customers, the projected deficit increases from -3,279 ac-ft in 2020 to 25,041 ac-ft in 2070.

Water Supply and Demand Analysis:

	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population	29,871	34,309	40,330	48,645	60,491	77,705
Projected Water Demand	9,271	10,481	12,187	14,624	18,163	23,319
Existing Water Demand from other entities	2,431	2,608	2,807	3,022	3,213	3,410
Current Total (Raw & Treated) Water Supply	13,718	23,783	23,615	23,448	23,300	23,111
Projected Supply Surplus (+) / Deficit (-)	**2,016**	**10,694**	**8,621**	**5,802**	**1,924**	**-3,618**

	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Greenville WUG Water Demand	9,271	10,481	12,187	14,624	18,163	23,319
Existing Water Demand from other entities	2,431	2,608	2,807	3,022	3,213	3,410
Existing Customer Projected Needs	0	1	202	771	1,925	4,088
Potential Customer Projected Needs	96	273	519	920	1,523	2,490
Current Treated Water Supply	8,090	8,090	8,090	8,090	8,090	8,090
Projected Treated Supply Surplus (+) / Deficit (-)	**-3,335**	**-4,900**	**-7,252**	**-10,874**	**-16,361**	**-24,844**

Evaluation of Potentially Feasible Water Management Strategies:

Multiple alternative strategies have been identified and evaluated to meet the City of Greenville's water supply shortages as summarized in the below table. Advanced conservation is recommended as the gpcd associated with the projected population and demand is approximately 277 gpcd. The City of Greenville's 2019 water conservation plan utilizes a base per capita water use of 156 gpcd. Thus, the recommended advanced water conservation strategy is to achieve the identified per capita water use of 156 gpcd. Water reuse was not considered because the City has not presently indicated an identified a demand for non-potable water. Groundwater was not determined to be feasible due to limited availability and the City's current utilization of surface water supplies.

Potentially feasible surface water strategies include the purchase of water out of Chapman Lake from either the City of Sulphur Springs and/or NTMWD, and purchase of raw water from the Sabine River Authority's proposed Toledo Bend Transfer. To utilize the City of Sulphur Springs supply from Chapman Lake, one strategy would necessitate that the City construct an intake structure, pump station, pipeline, and new Water Treatment Plant (WTP) to bring water from Chapman Lake to the City. The City is also presently

evaluating the feasibility of a water swap whereby the City would obtain NTMWD supply from Chapman Lake (via construction of a tie-in pipeline to NTWMD's existing raw water line) in a 1-to-1 exchange for Greenville's supply from Lake Tawakoni. Since this strategy would not produce additional supply for the City, it has not been included herein as a feasible strategy to produce additional supply. However, given the identified need, a strategy to purchase supply from NTMWD and construct a tie-in pipeline has been identified and evaluated. Additionally, according to preliminary discussions with Region C, Phase 1 of the Toledo Bend Transfer is currently not being considered until 2070, and was thus not considered a feasible alternative for Greenville until 2070.

Because the City of Greenville currently provides wholesale water to a number of entities in the surrounding area, shortages for Caddo Mills, Hunt County-Other, Hickory Creek SUD (a potential new customer), the City of Wolfe City (a potential new customer) and the City of Celeste (a potential new customer) were included in the analysis of needed supply for Greenville under the assumption that Greenville could sell treated and untreated water, as needed, to these other entities.

The City of Greenville's existing water treatment plant was expanded in 1993-1994 to a capacity of 13 MGD. Based on TWDB projections, the City will need to expand the WTP by 2030 to accommodate projected demand for the City and its customers. With an assumed peaking factor of 1.8, expanding the WTP to include an additional 15 MGD of capacity will ensure adequate capacity through 2060. By 2070, the City will need to construct an additional new WTP with a total production capacity of 15 MGD to meet projected demands of the City and its customers.

To meet projected demands for the City along with the other existing and potential customers, the City of Greenville would need to implement a voluntary reallocation of surplus supplies to Hunt County Manufacturing.

Projected demands for Steam Electric power generation are associated with a proposed 1,750 MW combined cycle generation facility at Greenville. This facility was announced in 2002, but has not yet been constructed. The facility has been estimated to require approximately 4,000 acre-feet per year of supply, while the projections for Steam Electric water demand in Hunt County range from 12,400 ac-ft in 2020 to 28,500 ac-ft in 2070. Because of the uncertainty in demand and when this facility will be constructed, for the purposes of the 2021 Plan, Steam Electric demands have not been included in the strategy for the City of Greenville. Depending on the actual demand, the City may need to construct a pipeline to other water resources earlier than the 2070 planning horizon.

Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County.

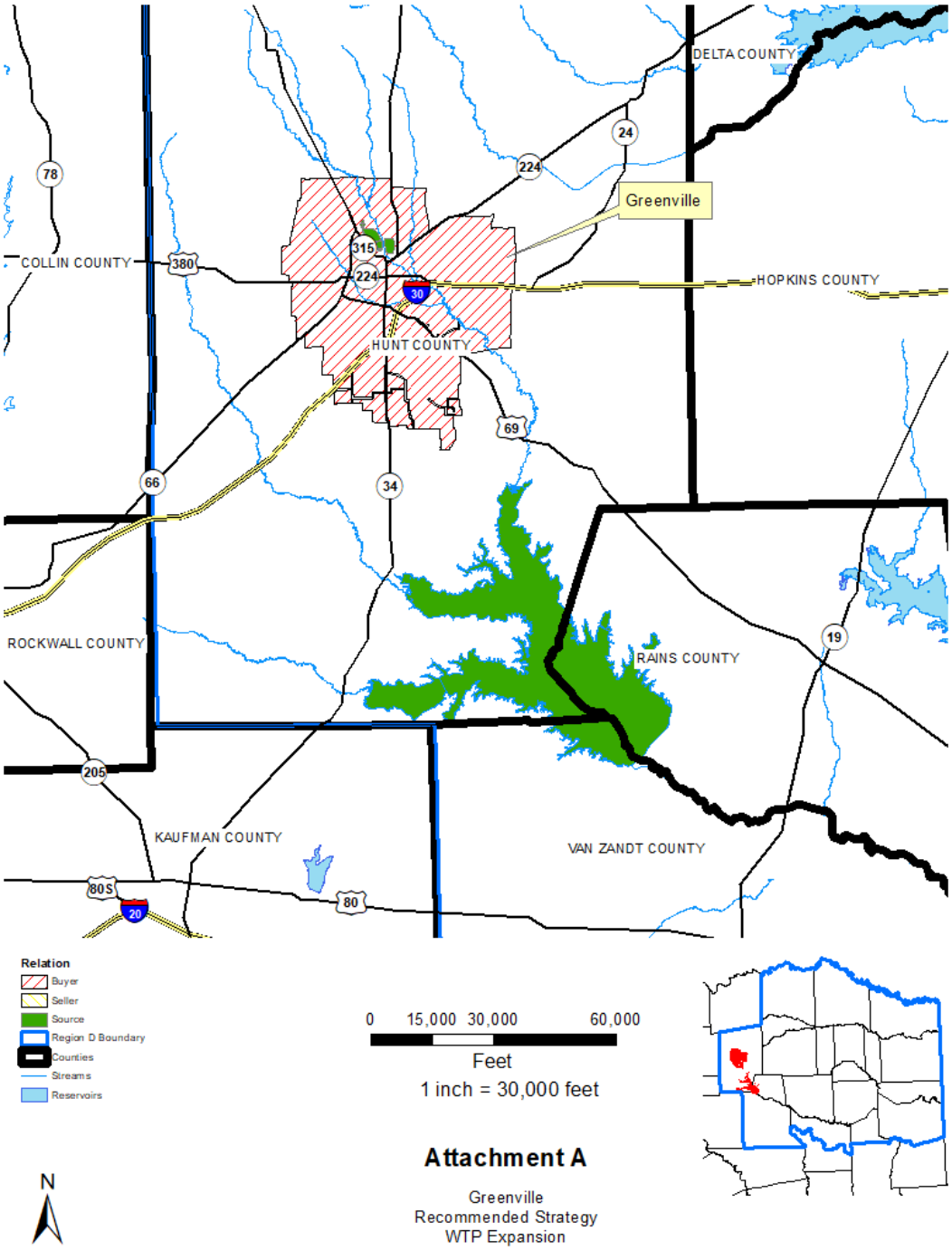
Strategy	Firm Yield (ac-ft)	Start Year	Total Capital Cost	Total Annualized Cost	Unit Cost	Env. Impact
Advanced Water Conservation	**9,741**	**2020**	**0**	**$6,633,000**	**$681**	
Water Reuse						
Ground Water						
Voluntary Reallocation of Hunt County Other Surplus purchased from Greenville (purchased from SRA Tawakoni; ac-ft/yr)	354	2020	$0	$0	$0	1

Voluntary Reallocation of Hunt Manufacturing Surplus purchased from Greenville (purchased from SRA Tawakoni; ac-ft/yr)	455	2070	$0	$0	$0	1
WTP Expansion (15 MGD)	9,335	2030	$43,955,000	$5,309,000	$569	1
New WTP (15 MGD)	9,335	2070	$81,786,000	$9,880,000	$1,058	1
Chapman Intake, Pump Station, and Raw Water Pipeline (contingent on City of Sulphur Springs Strategies)	500	2070	$60,235,000	$4,851,000	$9,702	3
Toledo Bend Tie-In Pipeline	500	2070	$12,559,000	$1,112,000	$2,224	3
Chapman Raw Water Tie-In Pipeline (purchase from NTMWD)	500	2070	$10,389,000	$945,000	$1,890	2
Wood County Pipeline Tie-in	6,491	2020	$0	$9,360,000	$1,442	2

Recommendations:

	2020	2030	2040	2050	2060	2070
Advanced Water Conservation	**4,051**	**4,486**	**5,140**	**6,124**	**7,593**	**9,741**
Voluntary Reallocation of Hunt Manufacturing Surplus purchased from Greenville (purchased from SRA Tawakoni; ac-ft/yr)	**0**	**0**	**0**	**0**	**0**	**455**
WTP Expansion (15 MGD)	**0**	**9,335**	**9,335**	**9,335**	**9,335**	**9,335**
New WTP (15 MGD)	**0**	**0**	**0**	**0**	**0**	**9,335**

The recommended strategies to meet the projected demands of the City of Greenville and its wholesale customers (both existing and identified potential future customers) first includes advanced water conservation efforts to reduce projected demand rate from 277 gpcd to 156 gpcd. Also by 2030, the existing 13 MGD water treatment plant should be expanded by 15 MGD. This will allow the provision of additional treated supply up to 9,335 ac-ft/yr. By 2070, voluntary reallocation of Hunt Manufacturing surplus supply is recommended as well as the construction of an additional 15 MGD WTP to provide additional treatment capacity.



Attachment A

Greenville
Recommended Strategy
WTP Expansion

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Greenville - 15 MGD WTP Expansion

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Water Treatment Plant (15 MGD)	$31,653,000
TOTAL COST OF FACILITIES	**$31,653,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$11,079,000
Environmental & Archaeology Studies and Mitigation	$22,000
Land Acquisition and Surveying (8 acres)	$24,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$1,177,000
TOTAL COST OF PROJECT	**$43,955,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$3,093,000
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$2,216,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$5,309,000**
Available Project Yield (acft/yr)	9,335
Annual Cost of Water ($ per acft), based on PF=1	$569
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$237
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$1.75
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.73

JMP *10/5/2019*

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Greenville - New 15 MGD WTP

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Water Treatment Plant (15 MGD)	$58,927,000
TOTAL COST OF FACILITIES	**$58,927,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$20,624,000
Environmental & Archaeology Studies and Mitigation	$22,000
Land Acquisition and Surveying (8 acres)	$24,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$2,189,000
TOTAL COST OF PROJECT	**$81,786,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$5,755,000
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$4,125,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$9,880,000**
Available Project Yield (acft/yr)	9,335
Annual Cost of Water ($ per acft), based on PF=1	$1,058
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$442
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$3.25
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.36

JMP *10/5/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF HICKORY CREEK SUD IN HUNT COUNTY

Description of Water User Group:

Hickory Creek SUD provides water in northwestern Hunt County and small areas of eastern Collin and southern Fannin counties from four wells in the Woodbine Aquifer in Hunt County, having a total rated capacity of 1402 gpm, or 754 ac-ft/yr. The projected water groundwater availability limits this supply to approximately 349 ac-ft/yr based on Modeled Available Groundwater (MAG) results. Over 90% of the SUD's demand is located in Region D (Hunt County), with less than 10% in Region C (Collin and Fannin Counties). In both regions, the system is projected to serve a total of 4,673 people in 2020 and 26,582 people by the year 2070. The population and demand projections for the system are shown in the table below. In Hunt County, Hickory Creek SUD is projected to have a water supply deficit of 105 ac-ft/yr by 2020 increasing to 2,030 ac-ft/yr by 2070 In Collin and Fannin Counties the projected deficit totals 11 ac-ft in 2020 increasing to 85 ac-ft by 2070.

Water Supply and Demand Analysis:

	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Population	4,673	6,721	9,477	13,289	18,715	26,582
Projected Water Demand	465	641	888	1,234	1,735	2,463
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	369	368	369	368	369	368
Projected Supply Surplus (+) / Deficit (-)	**-96**	**-273**	**-519**	**-866**	**-1,366**	**-2,095**

Projected Supply Surplus (+) / Deficit (-) by Basin	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Sabine	-32	-114	-228	-393	-629	-977
Sulphur	-36	-91	-172	-285	-451	-692
Trinity	-17	-45	-85	-142	-223	-341
Total	**-96**	**-273**	**-519**	**-866**	**-1,366**	**-2,095**

Evaluation of Potentially Feasible Water Management Strategies:

The multiple alternative strategies considered to meet Hickory Creek SUD's water supply shortages are listed in the table below. Advanced conservation was not selected since per capita use is less than 140 gpcd. There are no significant current water needs that could be met by water reuse. Groundwater from the Woodbine Aquifer was considered because the SUD is currently using this aquifer as the source of supply for the system. Although the MAG indicates limited supply (349 ac-ft/yr by 2020), the existing production capacity of the Hickory Creek SUD is 810 ac-ft/yr (502 gpm as noted in the TCEQ PWS database). Full use of the existing system (up to an additional 462 ac-ft/yr) could meet projected demands through 2030; however, due to the limited availability of this groundwater source and lack of supporting available technical information, this aquifer is not projected to have sufficient supply to meet all of Hickory Creek SUD's shortage over the 2040-2070 period. Similarly, there are potentially available supplies from the Nacatoch Aquifer, however supplies are limited and insufficient considering other WUG's which may also seek to develop the supply. Additional supplies are limited from the Trinity Aquifer in Hunt County to satisfy the remainder of Hickory Creek SUD's needs.

Although the SUD has previously indicated that it would continue adding wells to meet future demands, given the aforementioned present limitations regarding groundwater source availability, surface water sources were investigated to meet long-term projected water needs for the SUD. Another potentially feasible regional groundwater strategy evaluated herein is the Wood County Pipeline, which could supply groundwater from Wood County.

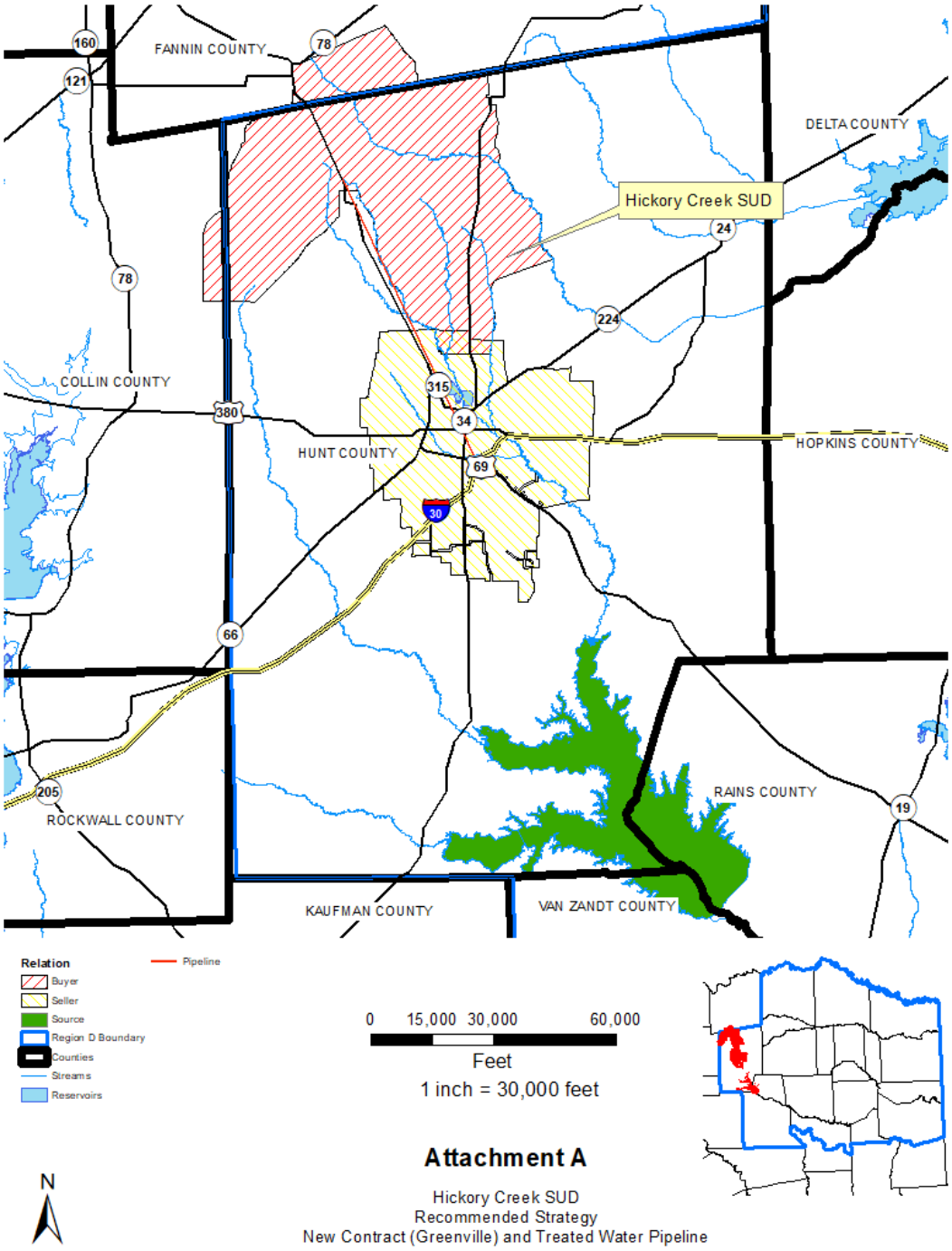
Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annual Cost	Unit Cost	Environmental Impact
Advanced Water Conservation			-		
Water Reuse					
Drill New Wells (Woodbine Aquifer, Sabine Basin)	**75**	**$763,000**	**$120,000**	**$1,600**	**1**
Drill New Wells (Woodbine Aquifer, Trinity Basin)	**230**	**$2,358,000**	**$348,000**	**$1,513**	**1**
Greenville Tie-In Pipeline	**2,095**	**$8,553,000**	**$2,595,000**	**$1,239**	**2**
Wood County Pipeline Tie-in	**2,095**	**$11,862,000**	**$4,030,000**	**$1,924**	**2**

Recommendations:

	2020	2030	2040	2050	2060	2070
Greenville Tie-In Pipeline	**96**	**273**	**519**	**866**	**1,366**	**2,095**

Given the present lack of information to support additional pumping from the Woodbine Aquifer in Hunt County, it is recommended that by 2020 Hickory Creek SUD purchase treated water supply from the City of Greenville, and by 2020 construct a pipeline connecting the SUD's system to the City of Greenville's system. This strategy is contingent upon the City of Greenville's recommended seller strategies, which have been sufficiently sized to accommodate the needs identified for Hickory Creek SUD from 2020 through 2070. It is recognized, however, that given the fact that there are no GCDs in Region D, the SUD has the legal capability to construct additional groundwater supplies.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed. The NETRWPG supports any efforts and/or studies to further evaluate and characterize groundwater availability in Hunt County, and such efforts should be considered consistent with the purposes of the 2021 Region D Plan.



Attachment A

Hickory Creek SUD
Recommended Strategy
New Contract (Greenville) and Treated Water Pipeline

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Hickory Creek SUD - Treated Water Line connection to Greenville

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Primary Pump Station (0 MGD)	$1,984,000
Transmission Pipeline (0 in dia., miles)	$4,143,000
TOTAL COST OF FACILITIES	**$6,127,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,937,000
Environmental & Archaeology Studies and Mitigation	$190,000
Land Acquisition and Surveying (22 acres)	$70,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$229,000
TOTAL COST OF PROJECT	**$8,553,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$602,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$41,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$50,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treamtent Facility	$0
Pumping Energy Costs (652716 kW-hr @ 0.08 $/kW-hr)	$52,000
Purchase of Water (2095 acft/yr @ 883 $/acft)	$1,850,000
TOTAL ANNUAL COST	**$2,595,000**
Available Project Yield (acft/yr)	2,095
Annual Cost of Water ($ per acft), based on PF=2	$1,239
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$951
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$3.80
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$2.92

JMP *10/5/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF IRRIGATION IN HUNT COUNTY

Description of Water User Group:

Irrigation in Hunt County has a demand that is projected to remain constant at 355 ac-ft/yr for the planning period. The Irrigation WUG in Hunt County is supplied by groundwater from the Nacatoch Aquifer and run-of-river diversions from the Sabine and Sulphur Rivers. A deficit of 230 ac-ft/yr is projected to occur throughout the planning period.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Projected Water Demand	355	355	355	355	355	355
Current Water Supply	125	125	125	125	125	125
Projected Supply Surplus (+)/Deficit(-)	**-230**	**-230**	**-230**	**-230**	**-230**	**-230**

Projected Supply Surplus (+)/Deficit(-) by Basin	2020	2030	2040	2050	2060	2070
Sabine	-151	-151	-151	-151	-151	-151
Sulphur	-79	-79	-79	-79	-79	-79
Trinity	0	0	0	0	0	0
Total	**-230**	**-230**	**-230**	**-230**	**-230**	**-230**

Evaluation of Potentially Feasible Water Management Strategies:

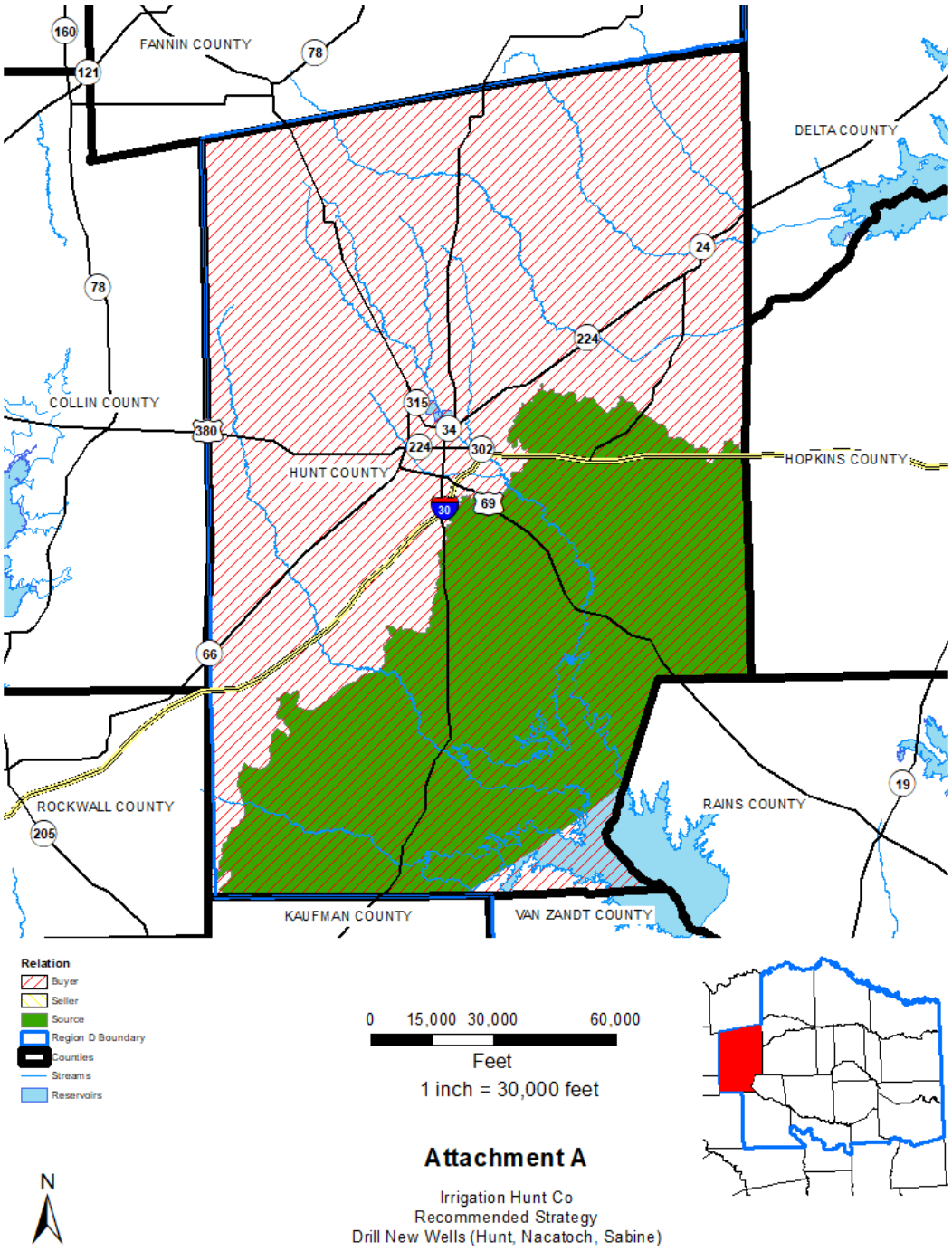
Three alternative strategies were considered to meet the Hunt County Irrigation WUG's water supply shortages. Advanced water conservation for irrigation practices were not considered in this planning effort, as present irrigation practices likely already incorporate many BMPs to extend water supplies, thus no additional conservation would be feasible. The use of reuse water from nearby municipalities is not considered feasible as it would not be effective to deliver reuse water to farm irrigation systems. Groundwater has been identified as a potential source of water for irrigation in Hunt County.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Env. Impact
Advanced Water Conservation					
Water Reuse					
Drill New Wells (Nacatoch, Sabine)	**230**	**$1,249,000**	**$226,000**	**$983**	**1**

Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Nacatoch, Sabine; ac-ft/yr)	**230**	**230**	**230**	**230**	**230**	**230**

The recommended strategy for the Hunt County Irrigation to meet their projected deficit of 230 ac-ft/yr from 2020 to 2070 would be to construct three water wells rated at 75 gpm prior to 2020. The recommended supply source will be the Nacatoch Aquifer in Hunt County. The Nacatoch Aquifer in Hunt County, in the Sabine River Basin, is projected to have sufficient supply availability to meet the needs of the Irrigation in Hunt County for the planning period.



Attachment A

Irrigation Hunt Co
Recommended Strategy
Drill New Wells (Hunt, Nacatoch, Sabine)

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Irrigation Hunt County - Drill New Wells (Hunt, Nacatoch Aquifer, Sabine Basin)

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$841,000
TOTAL COST OF FACILITIES	**$841,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$294,000
Environmental & Archaeology Studies and Mitigation	$55,000
Land Acquisition and Surveying (5 acres)	$25,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$34,000
TOTAL COST OF PROJECT	**$1,249,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$88,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$8,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treamtent Facility	$0
Pumping Energy Costs (187561 kW-hr @ 0.08 $/kW-hr)	$15,000
Purchase of Water (230 acft/yr @ 500 $/acft)	$115,000
TOTAL ANNUAL COST	**$226,000**
Available Project Yield (acft/yr)	230
Annual Cost of Water ($ per acft), based on PF=1	$983
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$600
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$3.02
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.84

JMP *9/30/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF LIVESTOCK IN HUNT COUNTY

Description of Water User Group:

Livestock in Hunt County has a demand that is projected to remain constant at 1,095 ac-ft/yr for the planning period. The Livestock WUG in Hunt County is supplied by groundwater from the Trinity Aquifer and local livestock supply in the Sabine, Sulphur, and Trinity basins. A deficit of 2 ac-ft/yr is projected to occur in 2020 decreasing to 1 ac-ft/yr by 2070 in the Trinity basin. No deficits are projected for within the Sabine and Sulphur basins.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Projected Water Demand	1,095	1,095	1,095	1,095	1,095	1,095
Current Water Supply	1,146	1,146	1,146	1,146	1,147	1,147
Projected Supply Surplus (+)/Deficit(-)	**51**	**51**	**51**	**51**	**52**	**52**

Projected Supply Surplus (+)/Deficit(-) by Basin	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Sabine	41	41	41	41	41	41
Sulphur	12	12	12	12	12	12
Trinity	-2	-2	-2	-2	-1	-1
Total	**51**	**51**	**51**	**51**	**52**	**52**

Evaluation of Potentially Feasible Water Management Strategies:

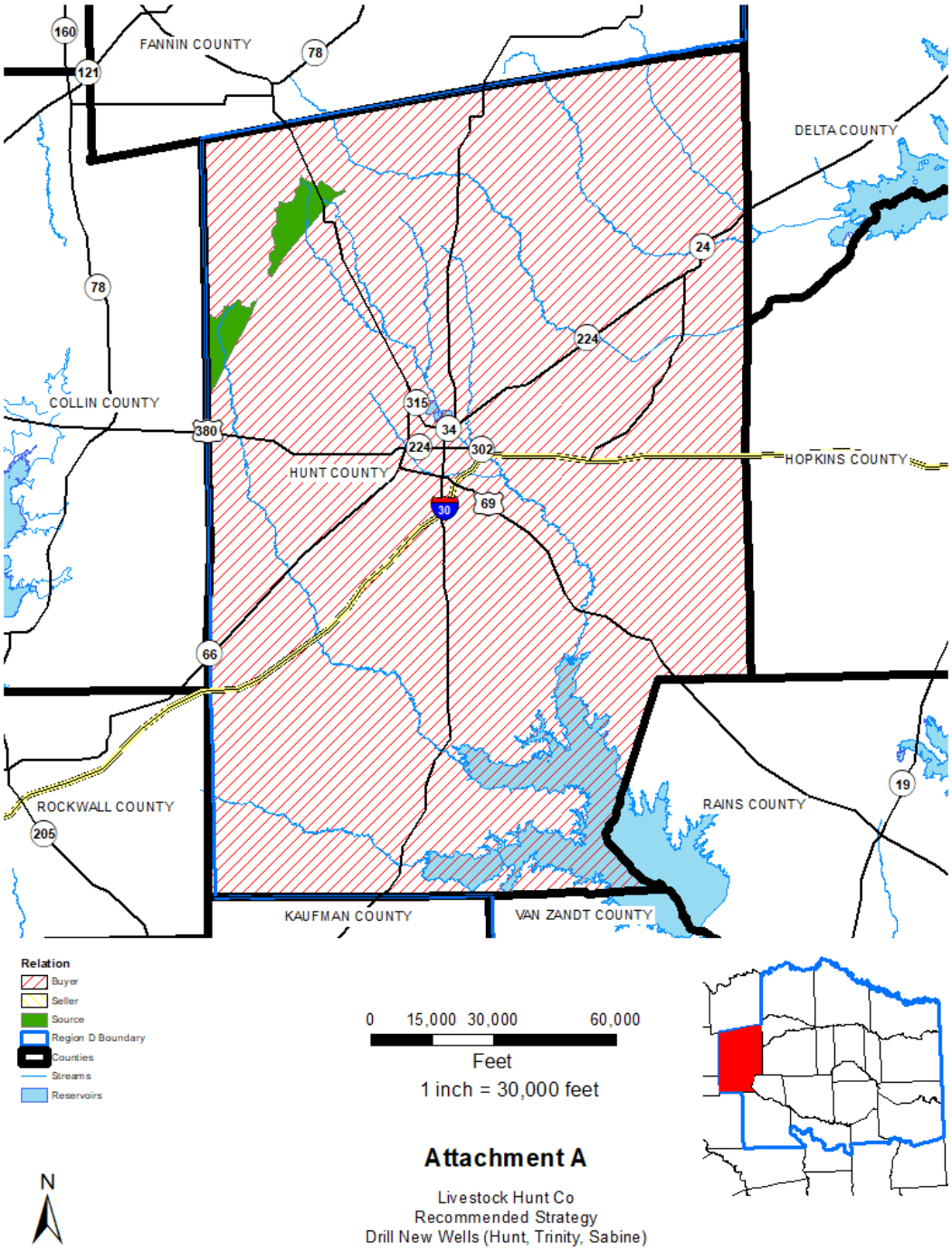
Three alternative strategies were considered to meet the Hunt County Irrigation WUG's water supply shortages. Advanced water conservation for livestock practices was not considered, as present livestock practices likely result in sale of the livestock to reduce demand and extend water supply. The use of reuse water from nearby municipalities is not considered feasible as the water may be used for livestock consumption. Groundwater has been identified as a potential source of water for livestock in Hunt County.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Env. Impact
Advanced Water Conservation					
Water Reuse					
Drill New Wells (Trinity Aquifer, Sabine Basin)	**2**	**$407,000**	**$33,000**	**$16,500**	**1**

Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Trinity Aquifer, Sabine Basin; ac-ft/yr)	**2**	**2**	**2**	**2**	**2**	**2**

The recommended strategy for the Hunt County Livestock to meet their projected deficit of 2 ac-ft/yr from 2020 to 2070 would be to construct one water well prior to 2020. The recommended supply source is the Trinity Aquifer in Hunt County. The Trinity Aquifer in Hunt County, in the Sabine River Basin, is projected to have sufficient supply availability to meet the needs of the Livestock in Hunt County for the planning period.



Attachment A

Livestock Hunt Co
Recommended Strategy
Drill New Wells (Hunt, Trinity, Sabine)

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Livestock Hunt County - Drill New Wells (Hunt, Trinity Aquifer, Sabine Basin)

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$286,000
TOTAL COST OF FACILITIES	**$286,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$100,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (1 acres)	$4,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$11,000
TOTAL COST OF PROJECT	**$407,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$29,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$3,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treamtent Facility	$0
Pumping Energy Costs (1592 kW-hr @ 0.08 $/kW-hr)	$0
Purchase of Water (2 acft/yr @ 500 $/acft)	$1,000
TOTAL ANNUAL COST	**$33,000**
Available Project Yield (acft/yr)	2
Annual Cost of Water ($ per acft), based on PF=1	$16,500
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$2,000
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$50.63
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$6.14

JMP *9/30/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF MINING IN HUNT COUNTY

Description of Water User Group:

Mining in Hunt County has a demand that is projected to decrease from 128 ac-ft/yr in 2020 to 47 ac-ft/yr in 2070. Mining in Hunt County is currently supplied by groundwater from the Nacatoch Aquifer and water purchased from the City of Greenville from Lake Tawakoni.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Projected Water Demand	128	118	88	71	58	47
Current Water Supply	55	54	53	52	51	50
Projected Supply Surplus (+)/Deficit(-)	**-73**	**-64**	**-35**	**-19**	**-7**	**3**

Projected Supply Surplus (+)/Deficit(-) by Basin	2020	2030	2040	2050	2060	2070
Sabine	-41	-35	-16	-5	0	3
Sulphur	-30	-27	-18	-13	-7	0
Trinity	-2	-2	-1	-1	0	0
Total	**-73**	**-64**	**-35**	**-19**	**-7**	**3**

Evaluation of Potentially Feasible Water Management Strategies:

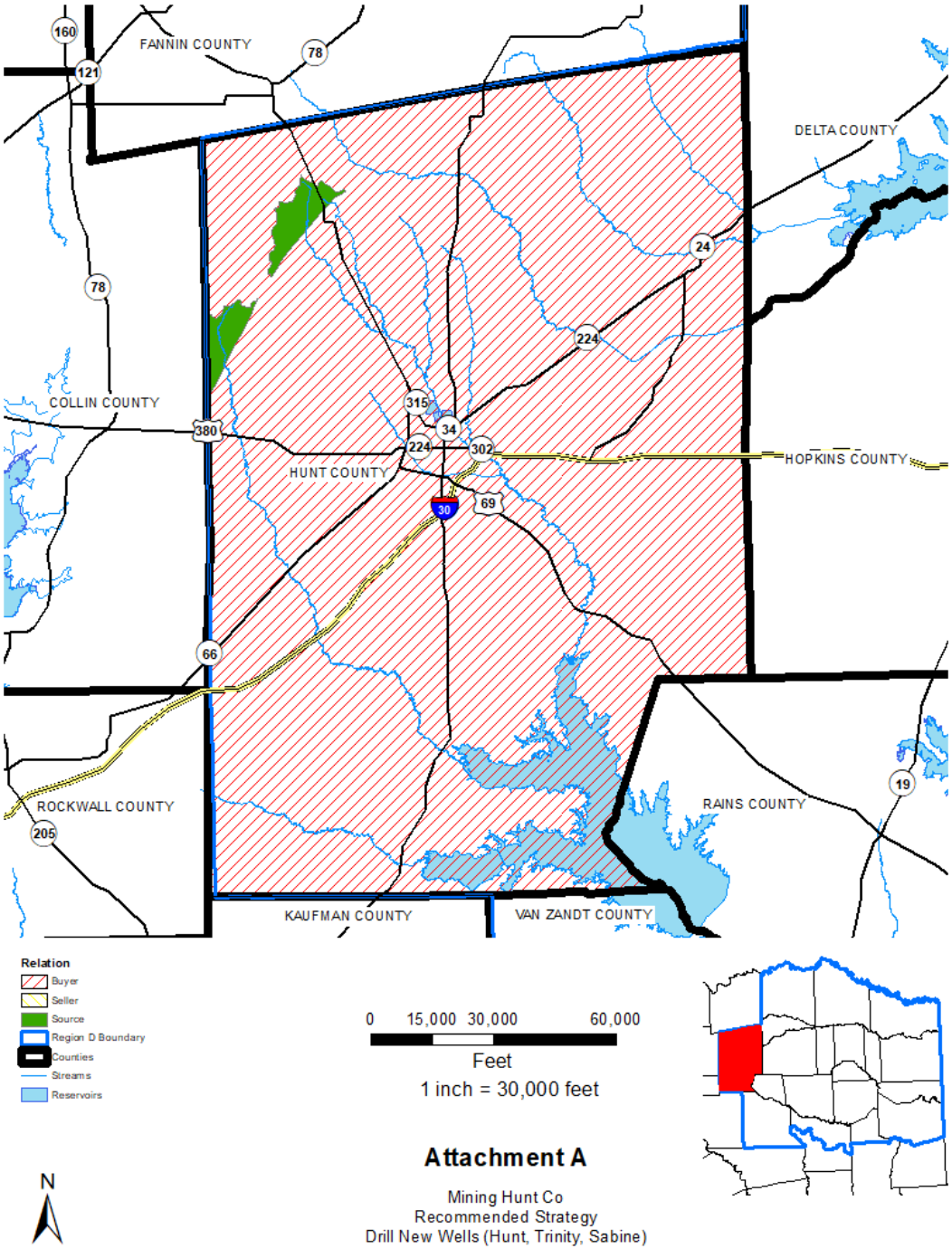
Twelve alternative strategies were considered to meet the Hunt County Mining water supply shortages as summarized in the following table. Advanced conservation and water reuse were not considered because operational procedures for the existing mines are not available. Groundwater has been identified as a potential source of water for mining in Hunt County, with focus given to accessible sources with availability within MAG estimates. Surface water via contracting with the City of Sulphur Springs was also considered as a viable alternative to meet projected demands. Another potentially feasible strategy is the Wood County Pipeline.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Env. Impact
Advanced Water Conservation					
Water Reuse					
Drill New Wells (Nacatoch, Sabine Basin)					
Drill New Wells (Trinity, Sabine Basin)	**73**	**$766,000**	**$101,000**	**$1,384**	**1**
Drill New Wells (Woodbine, Sabine Basin)					
Drill New Wells (Nacatoch, Sulphur Basin)					
Drill New Wells (Trinity, Sulphur Basin)					
Drill New Wells (Woodbine, Sulphur Basin)					
Drill New Wells (Trinity, Trinity Basin)					
Drill New Wells (Woodbine, Trinity Basin)					
New Contract with Sulphur Springs	**73**	**$560,000**	**$133,000**	**$1,822**	**1**
Wood County Pipeline Tie-in	**73**	**$560,000**	**$152,000**	**$2,082**	**2**

Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Trinity, Sabine Basin; (ac-ft/yr)	**73**	**64**	**35**	**19**	**7**	**0**

The recommended strategy for the Hunt County Mining WUG to meet their projected deficit of 73 ac-ft/yr in 2020 is to construct two additional water wells similar to existing wells, with a production capacity of 75 gpm. The recommended supply source is the Trinity Aquifer in Hunt County, Sabine River Basin. The Trinity Aquifer in Hunt County, Sabine River Basin is projected to have sufficient availability to meet mining needs in Hunt County for the planning period.



Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Mining Hunt County - Drill New Wells (Hunt, Trinity Aquifer, Sabine Basin)

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$523,000
TOTAL COST OF FACILITIES	**$523,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$183,000
Environmental & Archaeology Studies and Mitigation	$26,000
Land Acquisition and Surveying (2 acres)	$13,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$21,000
TOTAL COST OF PROJECT	**$766,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$54,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$5,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treamtent Facility	$0
Pumping Energy Costs (58389 kW-hr @ 0.08 $/kW-hr)	$5,000
Purchase of Water (73 acft/yr @ 500 $/acft)	$37,000
TOTAL ANNUAL COST	**$101,000**
Available Project Yield (acft/yr)	73
Annual Cost of Water ($ per acft), based on PF=1	$1,384
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$644
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$4.25
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.98

JMP *9/30/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF NORTH HUNT SUD IN HUNT COUNTY

Description of Water User Group:

North Hunt SUD provides water service in Hunt, Fannin, and Delta counties. It is projected North Hunt SUD will have a shortage in 2020. The WUG population is projected to be 4,333 in 2020 and 16,222 by the year 2070. The SUD has a contract for water supply with the City of Commerce for 147 ac-ft/yr, a well in Hunt County with a rating of 170 gpm, and a well in Fannin County that is rated at 318 gpm. In Hunt County, the SUD is projected to have a deficit of 72 ac-ft in 2020 increasing to 831 ac-ft by 2070. The remainder of the SUD is projected to have a deficit of 17 ac-ft in 2020 increasing to 57 ac-ft by 2070.

Water Supply and Demand Analysis:

North Hunt SUD in Hunt County	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Population	4,333	5,469	6,976	9,035	11,973	16,222
Projected Water Demand	291	367	468	607	805	1,090
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	202	202	202	202	202	202
Projected Supply Surplus (+) / Deficit (-)	**-89**	**-165**	**-266**	**-405**	**-603**	**-888**

Evaluation of Potentially Feasible Water Management Strategies:

The six alternative strategies considered to meet North Hunt SUD's water supply shortages are listed in the table below. Advanced conservation was not selected because the per capita use per day was less than the 140 gpcd threshold set by the water planning group. Reuse is not a feasible option because water supply is mainly used for public consumption. Groundwater from the Woodbine Aquifer was considered because North Hunt SUD is currently using this aquifer as a source of supply for the system. However, due to the limited availability of this groundwater source, this aquifer will not be able to meet all of North Hunt SUD's shortage. Additional groundwater supplies are available from the Nacatoch Aquifer has been evaluated as well.

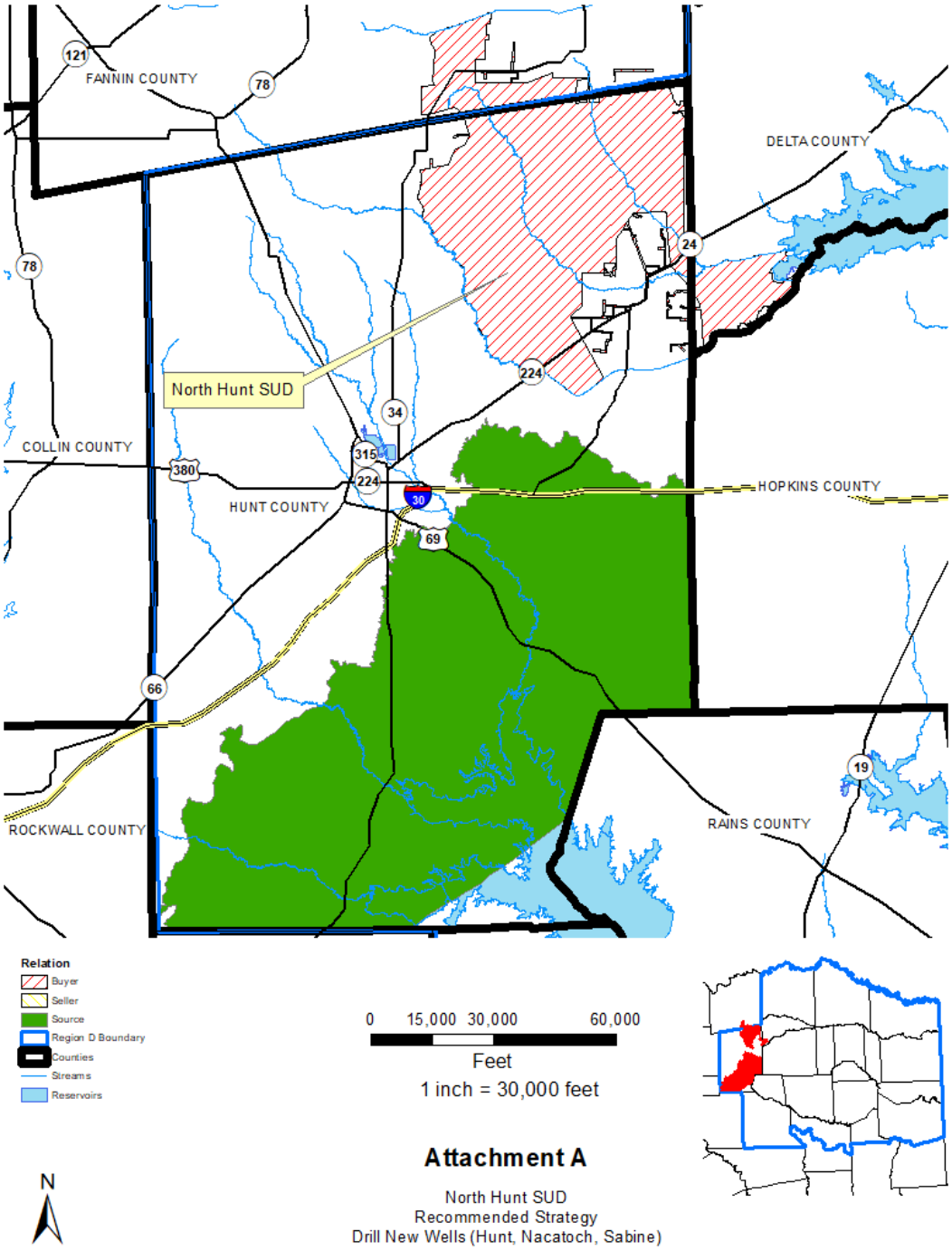
Additional purchase of water from the City of Commerce is another alternative; however, Commerce has only a limited volume, potentially available only if existing supplies to the Manufacturing WUG and the Delta County-Other WUG can be reallocated. A separate feasible strategy was considered to utilize surplus supply from Delta County MUD. The North Hunt SUD service area is contiguous with the service area for Delta County MUD, which purchases Big Creek Lake supply from the City of Cooper. North Hunt SUD could contract with the City of Cooper for water supplies from Big Creek Lake, transported via the existing connection between the City of Cooper and Delta County MUD. This strategy would require a pipeline connecting the two systems of sufficient size to provide available supplies and may require a permit amendment for additional yield potentially available from Big Creek Lake. Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annualized Cost	Unit Cost	Env. Impact
Advanced Water Conservation					
Water Reuse					
Drill New Wells (Nacatoch Aquifer, Sabine Basin)	**888**	**$10,998,000**	**$1,458,000**	**$1,642**	**1**
Increase Contract w/ Commerce contingent on Commerce Seller Strategy	**888**	**$0**	**$963,000**	**$1,084**	**1**
Delta County Pipeline contingent on purchase from Delta County MUD for supply from Big Creek	**100**	**$6,058,000**	**$601,000**	**$6,010**	**3**
Wood County Pipeline Tie-in	**888**	**$6,777,000**	**$1,845,000**	**$2,078**	**2**

Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Nacatoch Aquifer, Sabine Basin; ac-ft/yr)	89	165	266	405	603	888

The recommended strategy to meet North Hunt SUD's needs is to construct twenty three (23) additional groundwater wells sufficient in capacity prior to the projected decadal need. The source of the groundwater supply is the portion of the Nacatoch Aquifer located in the Sabine Basin in Hunt County. Twenty three wells with rated capacity of 75 gpm each would provide approximately 40 acre-feet each. Availability of groundwater supplies in the Nacatoch Aquifer located in the Sabine Basin in Hunt County are projected to be adequate to meet North Hunt SUD's projected needs over the planning period.



Attachment A

North Hunt SUD
Recommended Strategy
Drill New Wells (Hunt, Nacatoch, Sabine)

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

North Hunt SUD - Drill New Wells (Hunt, Nacatoch Aquifer, Sabine Basin)

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$7,440,000
Water Treatment Plant (2.4 MGD)	$162,000
TOTAL COST OF FACILITIES	**$7,602,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,661,000
Environmental & Archaeology Studies and Mitigation	$294,000
Land Acquisition and Surveying (28 acres)	$146,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$295,000
TOTAL COST OF PROJECT	**$10,998,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$774,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$74,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$97,000
Advanced Water Treamtent Facility	$0
Pumping Energy Costs (856999 kW-hr @ 0.08 $/kW-hr)	$69,000
Purchase of Water (888 acft/yr @ 500 $/acft)	$444,000
TOTAL ANNUAL COST	**$1,458,000**
Available Project Yield (acft/yr)	888
Annual Cost of Water ($ per acft), based on PF=1	$1,642
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$770
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$5.04
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$2.36

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF POETRY WATER SUPPLY CORPORATION

Description of Water User Group:

Poetry Water Supply Corporation (WSC) is located in southwestern Hunt County and northern Kaufman County and is situated in the Sabine and Trinity River Basins. Poetry WSC is projected to serve 3,212 people by 2020, and the population is expected to increase to 11,937 by the year 2070. The WSC's current source of supply is treated water purchased from the City of Terrell. Poetry WSC is projected to have a deficit of 4 ac-ft/yr in 2020, up to 564 ac-ft/yr in 2070. There is a small supply that is not utilized by the WSC and could postpone supply deficits until 2030.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	3,212	4,045	5,070	6,595	8,868	11,937
Projected Water Demand	353	430	528	681	913	1,228
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	355	364	413	481	583	718
Projected Supply Surplus (+) / Deficit (-)	**2**	**-66**	**-115**	**-200**	**-330**	**-510**

Evaluation of Potentially Feasible Water Management Strategies:

Listed in the table below are the five strategies that were considered to meet the water supply needs of Poetry WSC. There are no significant current water needs that could be met by water reuse. Advanced conservation was not selected because the per capita use per day was less than the 140 gpcd threshold set by the water planning group; however, preliminary coordination with the Region C Planning Group indicates that conservation is a potential strategy for that portion of the WUG within the Region C planning area, thus conservation amounts identified by the Region C Planning Group have been incorporated herein for this WUG. An identified feasible strategy is to increase the existing contract with Terrell via Sabine River Authority voluntary reallocation of Combined Consumers SUD surplus. The City of Terrell obtains a portion of its supply from Lake Fork via purchase from the Sabine River Authority. Combined Consumers SUD also purchases Lake Fork supply from the Sabine River Authority. A second feasible strategy is that since the City of Terrell also obtains a portion of its supply from the NTMWD reservoir system via purchase from the NTMWD, Cash SUD could increase its contract with the City of Terrell contingent upon a City of Terrell seller strategy to increase its contract with NTMWD, contingent upon recommended Region C NTMWD seller strategies. Development of groundwater supplies from the Nacatoch Aquifer, Sabine River Basin, was evaluated as a potentially cost effective approach for this entity. Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County.

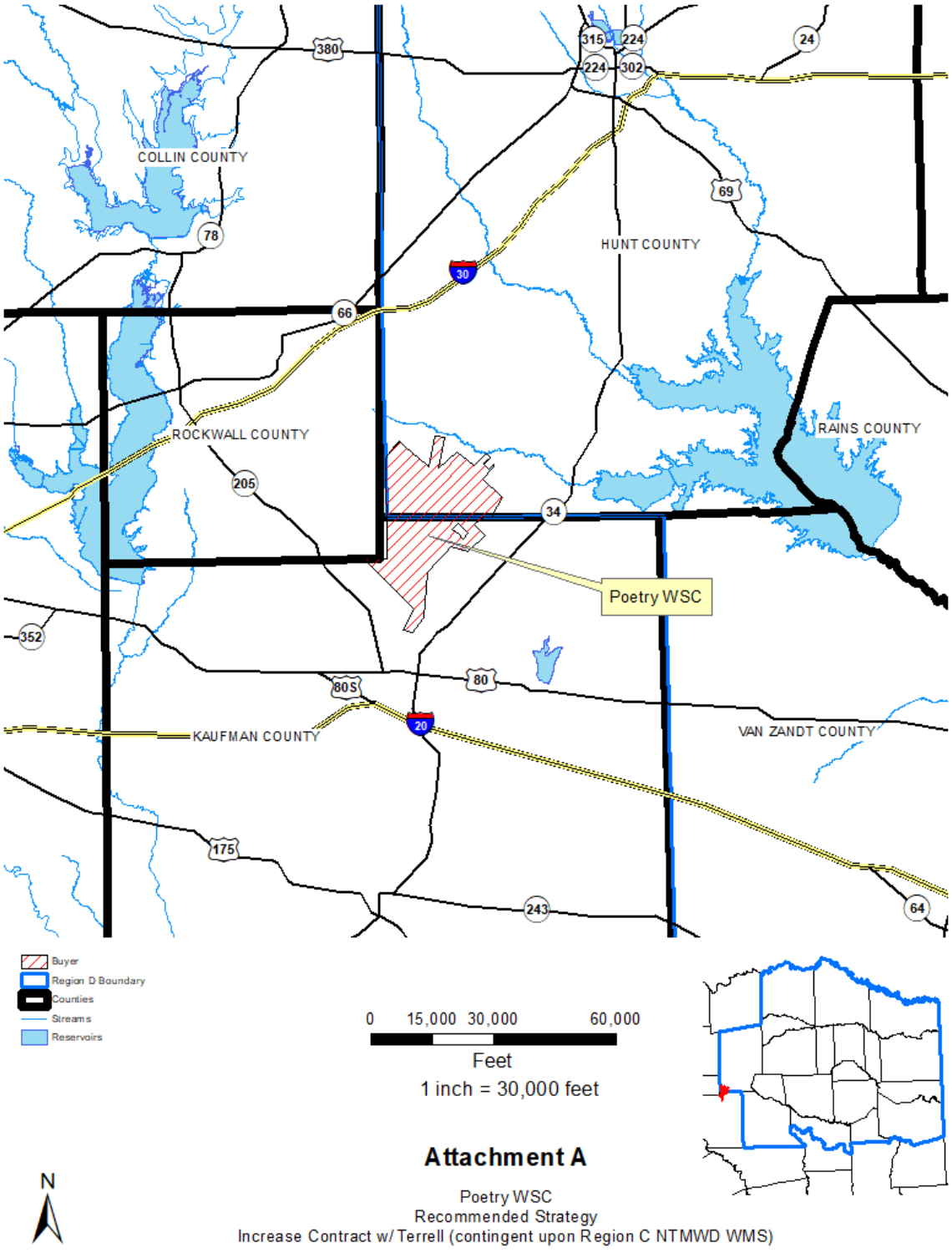
Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annual Cost	Unit Cost	Environmental Impact
Advanced Water Conservation (Region C Portion)	**7**		**$0**	**$0**	**1**
Water Reuse					
Increase contract w/ Terrell (contingent upon Region C NTMWD WMS)	**503**		**$864,000**	**$1,718**	**1**
Increase contract w/ Terrell (contingent upon Voluntary Reallocation of Combined Consumers SUD Surplus)	**503**		**$864,000**	**$1,718**	**1**
Drill Wells (Nacatoch Aquifer, Sabine Basin)	**564**	**$1,689,000**	**$449,000**	**$796**	**1**
Wood County Pipeline Tie-in	**510**	**$5,705,000**	**$1,191,000**	**$2,335**	**2**

Recommendations:

	2020	2030	2040	2050	2060	2070
Advanced Water Conservation	**1**	**2**	**1**	**3**	**4**	**7**
Increase contract w/ Terrell (contingent upon Region C NTMWD WMS)	**0**	**64**	**114**	**197**	**326**	**503**

The recommended strategy for Poetry WSC to meet their projected deficit of 4 ac-ft/yr in 2020 and 534 ac-ft/yr in 2070 would be to implement advanced water conservation at the amounts identified herein. Secondly, it is recommended that Poetry WSC increase their existing contract with the City of Terrell, contingent upon a Region C seller strategy for the City of Terrell to increase its' contract with the NTMWD for supply from the NTMWD System, which would be contingent upon recommended Region C seller strategies for the NTMWD. Preliminary communication with Region C indicates NTMWD WMS will be sufficient to meet the projected needs identified herein for Poetry WSC over the 2020-2070 planning period.

It is noted, however, that the City of Terrell (primarily located in Region C) could elect to increase its contract with SRA utilizing SRA supplies. Such an approach, if implemented by the City of Terrell and the SRA and/or recommended by Region C and/or Region I, should be considered consistent for this recommended WMS for the Poetry WSC for the purposes of the 2021 Region D Plan.



Attachment A

Poetry WSC
Recommended Strategy
Increase Contract w/ Terrell (contingent upon Region C NTMWD WMS)

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Poetry WSC - Increase Contract with NTMWD

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	***Estimated Costs for Facilities***
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treamtent Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr)	$0
Purchase of Water (503 acft/yr @ 1717 $/acft)	$864,000
TOTAL ANNUAL COST	**$864,000**
Available Project Yield (acft/yr)	503
Annual Cost of Water ($ per acft), based on PF=1	$1,718
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$1,718
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$5.27
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$5.27

JMP *10/3/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF THE CITY OF WOLFE CITY

Description of Water User Group:

The City of Wolfe City is located in northern Hunt County and is situated in the Sulphur River Basin. Wolfe City is bound on the west side by the Hickory Creek SUD, and the City of Commerce is located southeast of the City. The system is projected to serve 1,810 people by 2020, and the population is expected to increase to 6,547 by the year 2070. Wolfe City's current source of supply comes from two city lakes located on Turkey Creek in the South Sulphur River Basin. The City also has a 150 gpm well in the Woodbine formation, Sulphur River Basin, which has been brought back for use. Yield from the local lakes is calculated as 200 ac-ft/yr through 2070. Based on these yields, the quantity of water from the lakes will not be sufficient to meet projected demands. Wolfe City is projected to have a deficit of 54 ac-ft/yr in 2050, up to 308 ac-ft/yr in 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	1,810	2,249	2,846	3,669	4,842	6,547
Projected Water Demand	178	209	256	327	431	581
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	274	273	274	273	274	273
Projected Supply Surplus (+) / Deficit (-)	**96**	**64**	**18**	**-54**	**-157**	**-308**

Evaluation of Potentially Feasible Water Management Strategies:

Listed in the table below are the multiple strategies that were considered to meet water supply needs in Wolfe City. Advanced conservation was not selected since per capita use is less than 140 gpcd. There are no significant current water needs that could be met by water reuse. The system has a number of surface water options, including connection to the City of Commerce, City of Greenville, and the proposed Ralph Hall Reservoir in Region C. Groundwater from the Woodbine Aquifer, Sulphur River Basin, was evaluated as a potentially cost effect approach for this entity. Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annual Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Drill New Wells (Woodbine Aquifer, Sulphur Basin)					
Greenville Tie-In Pipeline (contingent on Seller Strategies)	**308**	**$7,124,000**	**$846,000**	**$2,747**	**3**
Wood County Pipeline Tie-In	**308**	**$7,124,000**	**$1,018,000**	**$3,305**	**2**

Recommendations:

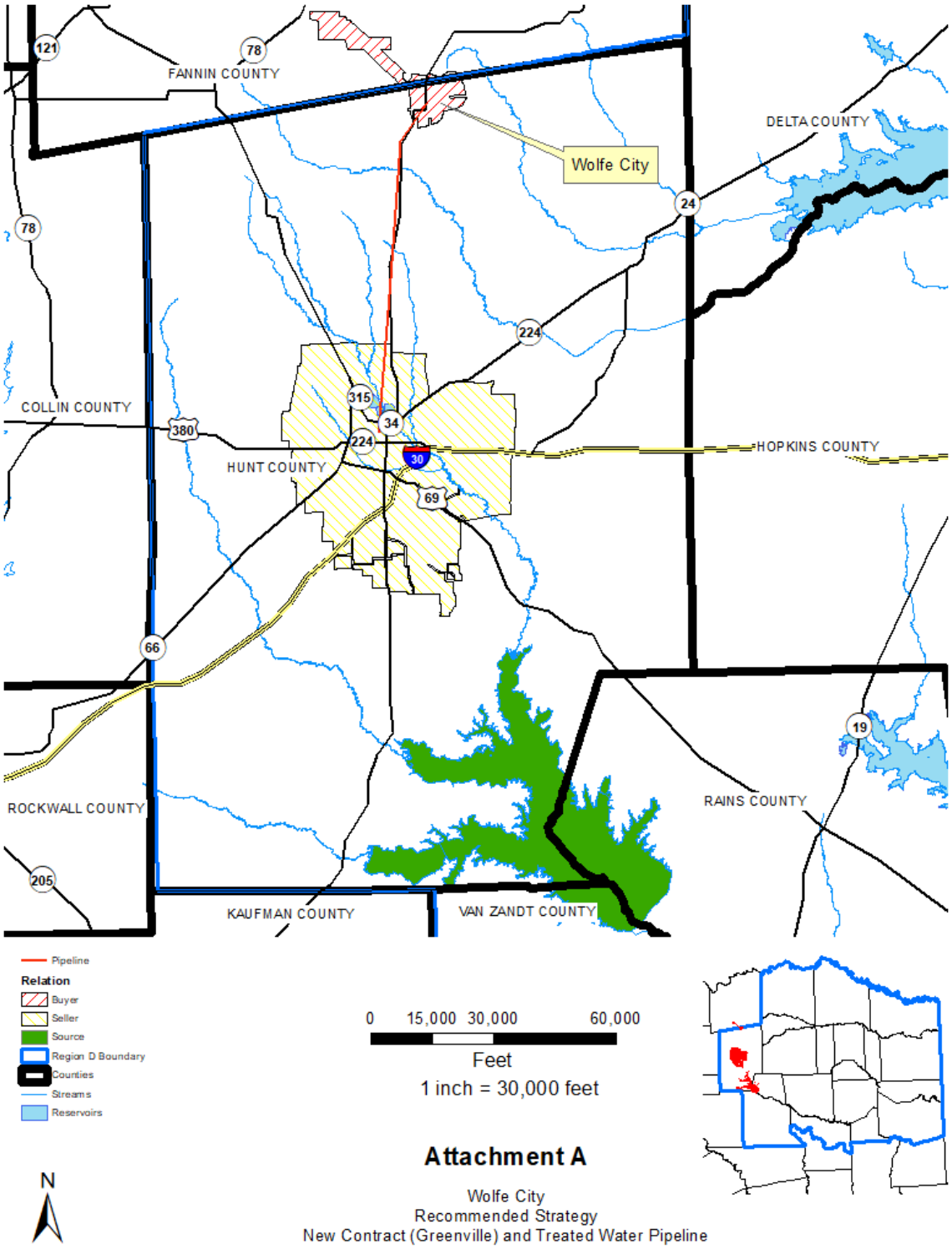
	2010	2020	2030	2040	2050	2060
Greenville Tie-In Pipeline (contingent on Seller Strategies)	0	0	0	54	157	308

The recommended strategy for the City of Wolfe City to meet their projected deficit of 54 ac-ft/yr in 2050 up to 308 ac-ft/yr in 2070 is to secure a contract with the City of Greenville by 2050 and construct a tie-in pipeline for treated supply from the City. This strategy is contingent upon the City of Greenville's recommended seller strategies.

This recommendation is made based on limited knowledge of firm yield of the Wolfe City lakes. No in-depth studies were available indicating either the current firm yield of the reservoirs, or whether dredging or similar enhancements to the storage capacity could improve the firm yield. It is recommended that the City pursue such a study. The City currently operates its own surface water treatment to treat water from the existing local lakes. The

firm yields were calculated using the approved WAM, Run 3, for the Sulphur River Basin, reflecting full demand from existing water rights and no return flows.

Given the increasing costs to comply with more stringent regulations and decreasing reliability of groundwater as a future supply source due to quality issues in this region, the NETRWPG supports efforts for this WUG evaluating the consideration of purchasing treated surface water from regional water providers in the future. Further study of this system is warranted, and supported by the NETRWPG for the purposes of the 2021 Plan.



Attachment A

Wolfe City
Recommended Strategy
New Contract (Greenville) and Treated Water Pipeline

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Wolfe City - Treated Water Line connection to Greenville

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Primary Pump Station (0 MGD)	$987,000
Transmission Pipeline (0 in dia., miles)	$3,881,000
TOTAL COST OF FACILITIES	**$4,868,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,510,000
Environmental & Archaeology Studies and Mitigation	$415,000
Land Acquisition and Surveying (44 acres)	$140,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$191,000
TOTAL COST OF PROJECT	**$7,124,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$501,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$39,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$25,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treamtent Facility	$0
Pumping Energy Costs (113938 kW-hr @ 0.08 $/kW-hr)	$9,000
Purchase of Water (308 acft/yr @ 883 $/acft)	$272,000
TOTAL ANNUAL COST	**$846,000**
Available Project Yield (acft/yr)	308
Annual Cost of Water ($ per acft), based on PF=2	$2,747
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$1,120
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$8.43
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$3.44

JMP *10/5/2019*

REGION D
EVALUATIONS OF WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

LAMAR COUNTY

WUGs:

Lamar County-Other
Lamar County Irrigation
Lamar County Livestock

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF COUNTY-OTHER IN LAMAR COUNTY

Description of Water User Group:

Lamar County-Other is comprised of M-J-C, Pattonville and Petty WSCs. The WUG population is projected to be 3,103 in 2020 and 3,508 by the year 2070. The entities comprising this WUG are supplied by groundwater from the Trinity and Woodbine Aquifers, and purchased surface water from Lamar County WSD. In Lamar County, the County-Other WUG is projected to have a deficit of 204 ac-ft in 2020 and increasing to a deficit of 244 ac-ft by 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	3,103	3,225	3,315	3,395	3,458	3,508
Projected Water Demand	479	485	498	508	516	524
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	275	281	286	284	282	280
Projected Supply Surplus (+) / Deficit (-)	**-204**	**-204**	**-212**	**-224**	**-234**	**-244**

Projected Supply Surplus (+) / Deficit (-) by Basin	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Red	-120	-121	-124	-127	-129	-131
Sulphur	-84	-83	-88	-97	-105	-113
Total	**-204**	**-204**	**-212**	**-224**	**-234**	**-244**

Evaluation of Potentially Feasible Water Management Strategies:

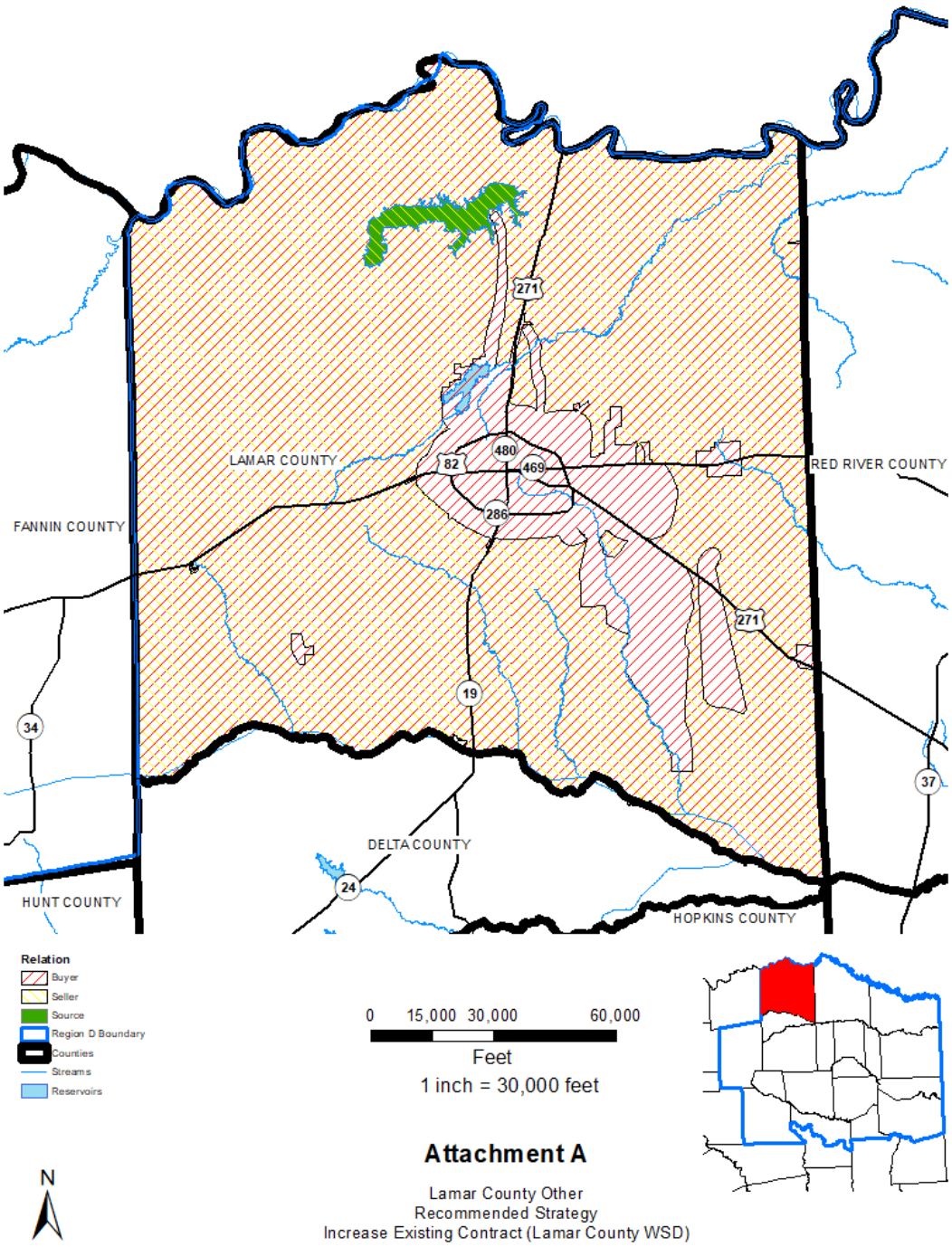
Six alternative strategies were considered to meet the WUG's water supply shortages. Advanced conservation was not selected because the WUG's overall supply is not projected to meet TCEQ regulatory minimums. Reuse is not a feasible option because water supply is mainly used for public consumption. Groundwater from the Trinity and Woodbine Aquifers has been identified as a potential source of water for Lamar County Other, although a local hydrogeological assessment performed by Region D did not identify sufficient available technical information to identify sufficient groundwater availability from these aquifers to meet the projected County-Other needs in Lamar County over the 2020-2070 planning period. The purchase of surface water from Pat Mayse from Lamar County WSD has also been identified as a potential water supply source.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Drill New Wells (Trinity Aquifer, Red Basin)					
Drill New Wells (Trinity Aquifer, Sulphur Basin)					
Drill New Wells (Woodbine Aquifer, Red Basin)					
Increase Existing Contract (Lamar County WSD)	**244**	**$0**	**$398,000**	**$1,631**	**1**

Recommendations:

	2020	2030	2040	2050	2060	2070
Increase Existing Contract (Lamar County WSD; ac-ft/yr)	204	204	212	224	234	244

The recommended strategy to meet Lamar County-Other needs is to increase the existing contract amounts with Lamar County WSD to meet projected Lamar County-Other needs over the 2020-2070 planning period.



Attachment A

Lamar County Other
Recommended Strategy
Increase Existing Contract (Lamar County WSD)

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Lamar County-Other - Increase Existing Contract from Lamar Co WSD

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr)	$0
Purchase of Water (244 acft/yr @ 1629.14 $/acft)	$398,000
TOTAL ANNUAL COST	**$398,000**
Available Project Yield (acft/yr)	244
Annual Cost of Water ($ per acft), based on PF=1	$1,631
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$1,631
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$5.01
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$5.01

JMP *9/27/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF IRRIGATION IN LAMAR COUNTY

Description of Water User Group:

Irrigation WUG in Lamar County is projected to be supplied by surface water from run-of-river diversions from the Red River and groundwater from wells the Trinity and Woodbine Aquifers. Irrigation in Lamar County has a demand that is projected to be a constant 10,126 ac-ft/yr for the planning period 2020 through 2070. A deficit of 18,312 ac-ft/yr is projected to occur in 2020, decreasing slightly to 18,302 ac-ft/yr by 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Projected Water Demand	10,126	10,126	10,126	10,126	10,126	10,126
Current Water Supply	8,658	8,658	8,658	8,658	8,658	8,658
Projected Supply Surplus (+)/Deficit(-)	**-1,468**	**-1,468**	**-1,468**	**-1,468**	**-1,468**	**-1,468**

Projected Supply Surplus (+)/Deficit(-) by Basin	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Red	-1,140	-1,140	-1,140	-1,140	-1,140	-1,140
Sulphur	-328	-328	-328	-328	-328	-328
Total	**-1,468**	**-1,468**	**-1,468**	**-1,468**	**-1,468**	**-1,468**

Evaluation of Potentially Feasible Water Management Strategies:

Multiple alternative strategies were considered to meet the Lamar County Irrigation WUG's water supply shortages. Advanced water conservation for irrigation practices were not considered in this planning effort, as present irrigation practices likely already incorporate many BMPs to extend water supplies, thus no additional conservation would be feasible. The use of reuse water from nearby municipalities is not considered feasible as it would not be effective to deliver reuse water to farm irrigation systems.

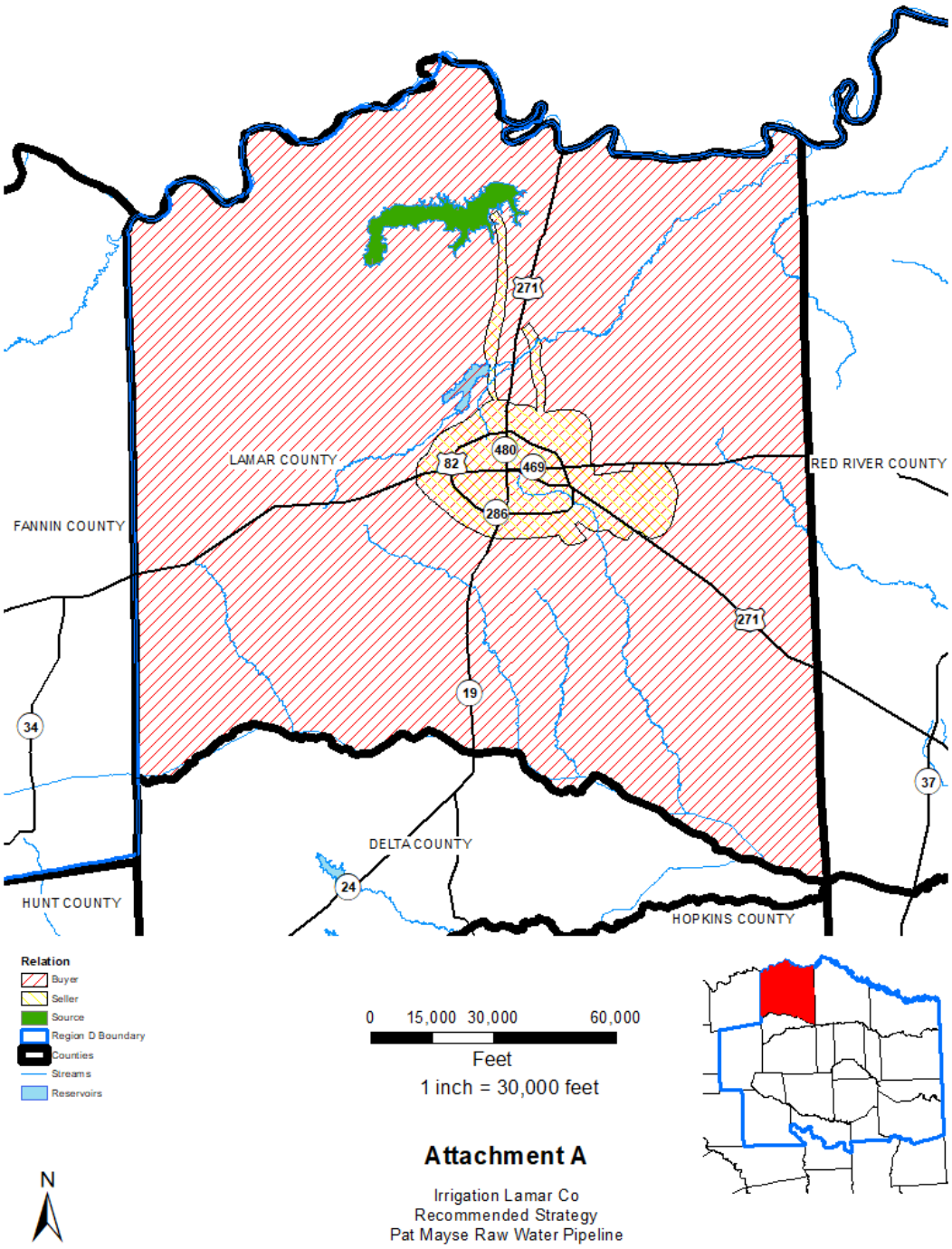
Groundwater was identified as a potential source of water for irrigation in Lamar County. Due to limitations of availability, the Woodbine and Trinity aquifers will not cover all shortages. A local hydrogeological assessment performed by Region D did not identify sufficient available technical information to determine additional groundwater source availability. New surface water rights were also evaluated as a potentially feasible strategy, however no firm supply could be identified. A purchase of raw water from the City of Paris was evaluated as a viable supplement to groundwater in order to meet projected demands. Alternatively, a purchase of all needed water from the City of Paris along with necessary construction of raw water conveyance infrastructure was evaluated as potentially feasible strategy. Lastly, purchase of treated water from surplus supply from Lamar County WSD was identified and evaluated as a potential strategy.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Env. Impact
Advanced Water Conservation					
Water Reuse					
Develop Trinity Aquifer (Red Basin)					
Develop Woodbine Aquifer (Sulphur Basin)					
Develop Woodbine Aquifer (Red Basin)					
New Surface Water Right	**0**				
Pat Mayse Raw Water Pipeline from Paris	**1,468**	**$12,021,000**	**$1,317,000**	**$897**	**1**
Treated Surface Water from Lamar Co WSD	**1,468**	**$12,021,000**	**$3,374,000**	**$2,298**	**1**

Recommendations:

	2020	2030	2040	2050	2060	2070
Pat Mayse Raw Water Pipeline from Paris (ac-ft/yr)	1,468	1,468	1,468	1,468	1,468	1,468

The recommended strategy for the Lamar County Irrigation WUG to meet projected demands during the planning period is to purchase raw water from Pat Mayse and Crook Reservoirs through the City of Paris. Given the distribution of the Irrigation WUG, the recommended raw water pipeline is an assumed 18-mile long 14 inch pipeline from The City of Paris's raw water intake line. Construction of a project for Daisy Farms in southern Lamar County is a development of water supply consistent with this recommended strategy.



Attachment A

Irrigation Lamar Co
Recommended Strategy
Pat Mayse Raw Water Pipeline

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Lamar County Irrigation - Raw Water Pipeline (Paris)

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Primary Pump Station (0 MGD)	$997,000
Transmission Pipeline (0 in dia., miles)	$7,470,000
TOTAL COST OF FACILITIES	**$8,467,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,590,000
Environmental & Archaeology Studies and Mitigation	$481,000
Land Acquisition and Surveying (50 acres)	$161,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$322,000
TOTAL COST OF PROJECT	**$12,021,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$846,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$75,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$25,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (445000 kW-hr @ 0.08 $/kW-hr)	$36,000
Purchase of Water (1468 acft/yr @ 228 $/acft)	$335,000
TOTAL ANNUAL COST	**$1,317,000**
Available Project Yield (acft/yr)	1,468
Annual Cost of Water ($ per acft), based on PF=1	$897
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$321
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$2.75
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.98

JMP *9/27/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF LIVESTOCK IN LAMAR COUNTY

Description of Water User Group:

Livestock WUG in Lamar County is projected to be supplied by groundwater from wells the Trinity and Woodbine Aquifers and local surface water supplies. Livestock in Lamar County has a demand that is projected to be constant demand of 1,469 ac-ft/yr for 2020 through 2070. A deficit of 617 ac-ft/yr is projected to occur throughout the planning period in the Red River Basin. A surplus of 772 ac-ft/yr is projected for the Sulphur Basin throughout the planning period.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Projected Water Demand	1,469	1,469	1,469	1,469	1,469	1,469
Current Water Supply	1,624	1,624	1,624	1,624	1,624	1,624
Projected Supply Surplus (+)/Deficit(-)	**155**	**155**	**155**	**155**	**155**	**155**

Projected Supply Surplus (+)/Deficit(-) by Basin	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Red	-617	-617	-617	-617	-617	-617
Sulphur	772	772	772	772	772	772
Total	**155**	**155**	**155**	**155**	**155**	**155**

Evaluation of Potentially Feasible Water Management Strategies:

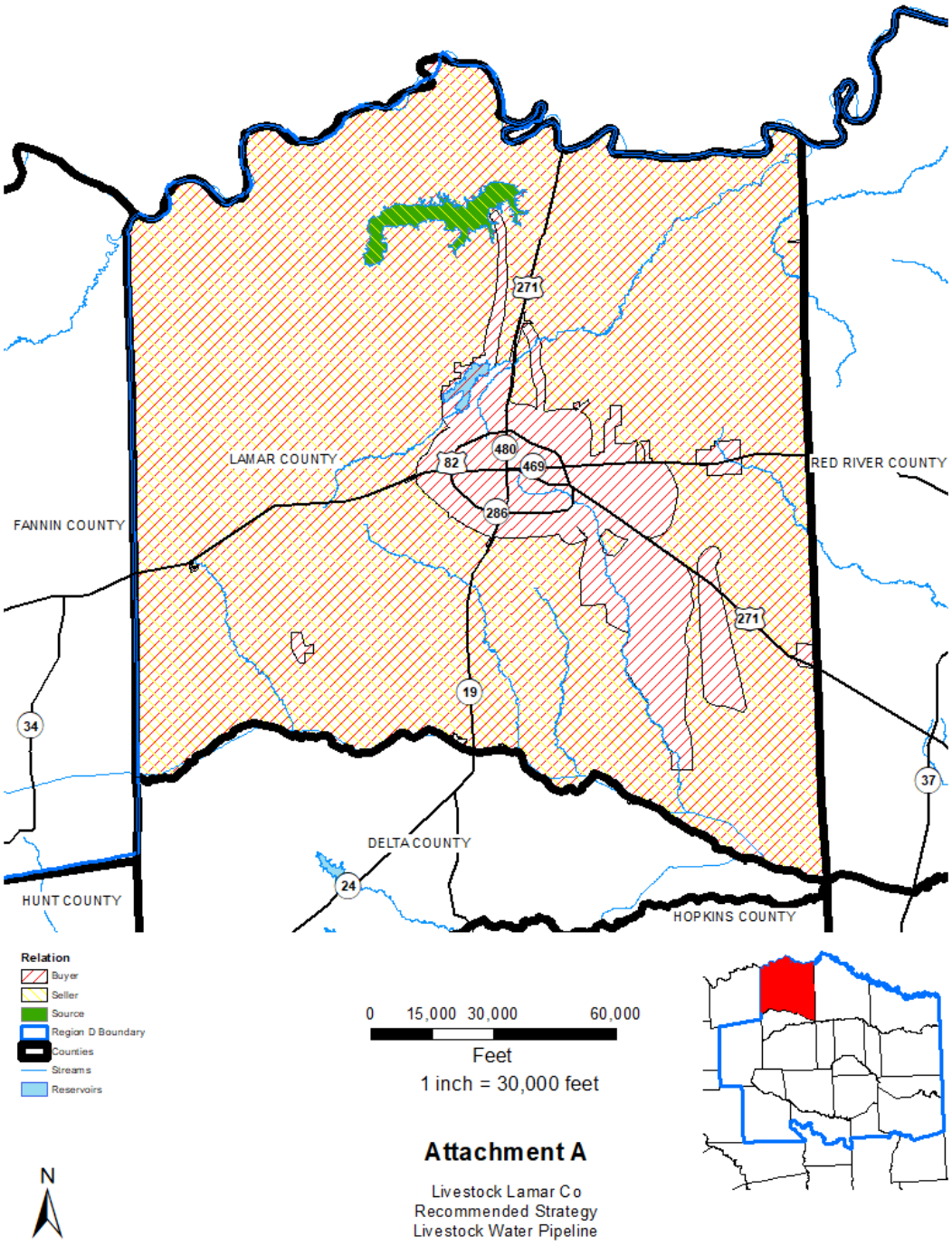
Multiple alternative strategies were considered to meet the Lamar County Livestock WUG's water supply shortages. Advanced water conservation for livestock practices was not considered, as present livestock practices likely result in sale of the livestock to reduce demand and extend water supply. The use of reuse water from nearby municipalities is not considered feasible as the water may be used for livestock consumption. Groundwater was identified as a potential source of water for livestock in Lamar County; however, a local hydrogeologic assessment did not identify sufficient available information to justify additional groundwater source availability in Lamar County in adequate amounts to meet the identified projected needs in the Red River Basin. New surface water rights were also evaluated as a potentially feasible strategy but no firm run-of-river supply was identified. Purchase of raw water from the City of Paris or the Lamar County WSD were evaluated as potentially feasible strategies for the WUG.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Env. Impact
Advanced Water Conservation					
Water Reuse					
Develop Trinity Aquifer (Red Basin)					**1**
Develop Trinity Aquifer (Sulphur Basin)					**1**
Develop Woodbine Aquifer (Red Basin)					**1**
New surface water rights	**0**				**1**
Raw Water Pipeline from Paris	**617**	**$14,574,000**	**$1,373,000**	**$2,225**	**1**
Water Pipeline from Lamar Co WSD	**617**	**$14,574,000**	**$2,237,000**	**$3,626**	**1**

Recommendations:

	2020	2030	2040	2050	2060	2070
Water Pipeline from Lamar Co WSD	**617**	**617**	**617**	**617**	**617**	**617**

The recommended strategy for the Lamar County Livestock WUG to meet projected demands during the planning period is to purchase water from Lamar County WSD. Given the distribution of the Livestock WUG, an assumed 18-mile long 8-inch diameter pipeline to meet the projected needs was developed using the UCM to represent a proximate raw water pipeline. If an alternative characterization of a raw water pipeline for this WUG is contemplated (e.g., alternative location, routing, sizing), it should be recognized as consistent with the 2021 Region D Plan.



Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Lamar County Livestock - Purchase surface water from Lamar Co WSD

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Primary Pump Station (0 MGD)	$3,103,000
Transmission Pipeline (0 in dia., miles)	$3,592,000
Transmission Pump Station(s) & Storage Tank(s)	$3,469,000
TOTAL COST OF FACILITIES	**$10,164,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$3,377,000
Environmental & Archaeology Studies and Mitigation	$481,000
Land Acquisition and Surveying (50 acres)	$161,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$391,000
TOTAL COST OF PROJECT	**$14,574,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,025,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$53,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$122,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treamtent Facility	$0
Pumping Energy Costs (401142 kW-hr @ 0.08 $/kW-hr)	$32,000
Purchase of Water (617 acft/yr @ 1629.14 $/acft)	$1,005,000
TOTAL ANNUAL COST	**$2,237,000**
Available Project Yield (acft/yr)	617
Annual Cost of Water ($ per acft), based on PF=1	$3,626
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$1,964
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$11.12
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$6.03

JMP *9/23/2019*

REGION D
EVALUATIONS OF WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

MARION COUNTY

WUGs:

Marion County Mining

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS MINING IN MARION COUNTY, CYPRESS

Description of Water User Group:

The Mining WUG in Marion County is a split entity and has a demand that is projected to be decreasing from 489 ac-ft/yr in 2020 to 393 ac-ft/yr in 2070. Mining in Marion County has a current water supply consisting of water wells from the Carrizo-Wilcox Aquifer. The total rated available supply from these sources is 116 ac-ft/yr. Mining in Marion County is projected to have a water supply deficit of 373 ac-ft/yr in 2020 increasing to 645 in 2030 then decreasing to a deficit of 265 ac-ft/yr in 2070 for the Marion Cypress.

Water Supply and Demand Analysis:

Mining Marion Cypress	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	489	764	712	595	478	393
Current Water Supply	116	119	122	124	126	128
Projected Supply Surplus (+)/Deficit(-)	-373	-645	-590	-471	-352	-265

Evaluation of Potentially Feasible Water Management Strategies:

Three alternative strategies were considered to meet the Marion County Mining water supply shortages as summarized in the following table. Advanced conservation and water reuse was not considered because operational procedures for the existing mines is not available. Surface water alternatives were omitted since they are currently on groundwater and the demands are manageable. A groundwater worksheet is included as Attachment B.

Strategy	**Firm Yield (AF)**	**Total Capital Cost**	**Total Annualized Cost**	**Unit Cost**	**Environmental Impact**
Advanced Water Conservation					
Water Reuse					
Groundwater	**645**	**$767,000**	**$78,000**	**$121**	**Minimal**
Surface Water					

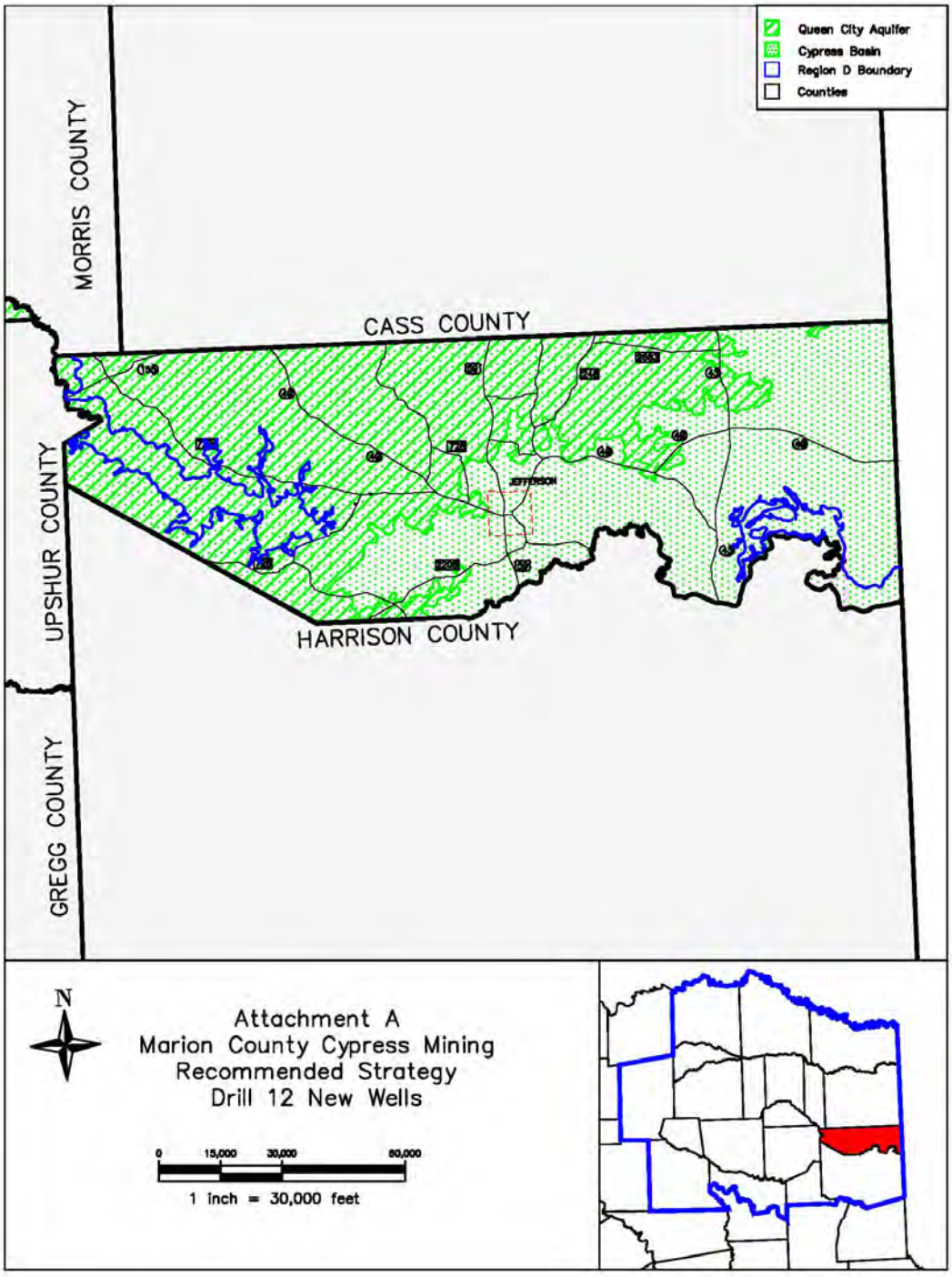
Recommendations:

	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Groundwater (ac-ft/yr)	432	645	645	645	645	645

The recommended strategy for the Marion County Mining to meet their projected deficit of 373 ac-ft/yr in 2020 and 645 ac-ft/yr in 2030 would be to construct four additional water wells similar to their existing wells just prior to each decade as the deficits occur till 2030. The recommended supply source will be the Queen City Aquifer in Marion County Cypress. Four wells with rated capacity of 100 gpm each would provide approximately 161 acre-feet each or 645 ac-ft/yr. The Queen City Aquifer in Marion County Cypress is projected to have a more than ample supply availability to meet the needs of the Mining in Marion County Cypress for the planning period.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices*	
Mining Marion Cypress - Drill New Well Queen City Aquifer Marion Cypress	
Cost based on ENR CCI 11170.28 for September 2018 and	
a PPI of 202.4 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	$0
Terminal Storage (Conservation Pool acft, acres)	$0
Primary Pump Station (0 MGD)	$0
Transmission Pipeline (6 in dia., miles)	$0
Transmission Pump Station(s) & Storage Tank(s)	$0
Well Fields (Wells, Pumps, and Piping)	$551,000
Storage Tanks (Other Than at Booster Pump Stations)	$0
Water Treatment Plant (0 MGD)	$0
Advanced Water Treamtent Facility (MGD)	$0
Conservation (Leaking Pipe/Meter Replacement)	$0
Integration, Relocations, & Other	$0
TOTAL COST OF FACILITIES	**$551,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$193,000
Environmental & Archaeology Studies and Mitigation	$2,000
Land Acquisition and Surveying (2 acres)	$0
Interest During Construction (3% for 1 years with a 0.5% ROI)	$21,000
TOTAL COST OF PROJECT	**$767,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$54,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$6,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (224594 kW-hr @ 0.08 $/kW-hr)	$18,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$78,000**
Available Project Yield (acft/yr)	645
Annual Cost of Water ($ per acft), based on PF=1	$121
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$37
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.37
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.11
Stanley Hayes	*10/3/2019*


Queen City Aquifer
Cypress Basin
Region D Boundary
Counties
MORRIS COUNTY
CASS COUNTY
UPSHUR COUNTY
HARRISON COUNTY
GREGG COUNTY
JEFFERSON
N
Attachment A
Marion County Cypress Mining
Recommended Strategy
Drill 12 New Wells
0
15,000
30,000
60,000
1 inch = 30,000 feet

REGION D
EVALUATIONS OF WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

MORRIS COUNTY

WUGs:

Morris County Livestock

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS LIVESTOCK IN MORRIS COUNTY

Description of Water User Group:

The Livestock WUG in Morris County, Cypress Basin, is a split entity and has a demand that is projected to be a constant 836 ac-ft/yr from 2020 to 2070. Livestock in Morris County, Cypress has a current water supply consisting of water wells from the Carrizo-Wilcox Aquifer, Queen City Aquifer, and Local Supplies. The total rated available supply from these sources is 326 ac-ft/yr in 2020 thru 2070. Livestock in Morris County, Cypress is projected to have a water supply deficit of 510 ac-ft/yr in 2020 thru 2070.

The Livestock WUG in Morris County, Sulphur Basin, is a split entity and has a demand that is projected to be a constant 769 ac-ft/yr from 2020 to 2070. Livestock in Morris County, Sulphur has a current water supply consisting of water wells from the Carrizo-Wilcox Aquifer, Queen City Aquifer, and Local Supplies. The total rated available supply from these sources is 300 ac-ft/yr in 2020 thru 2070. Livestock in Morris County, Sulphur is projected to have a water supply deficit of 469 ac-ft/yr in 2020 thru 2070.

Water Supply and Demand Analysis:

Livestock Morris Cypress	2020	2030	2040	2050	2060	2070
Projected Water Demand						
Cypress	836	836	836	836	836	836
Sulphur	769	769	769	769	769	769
Total	**1,605**	**1,605**	**1,605**	**1,605**	**1,605**	**1,605**
Current Water Supply						
Cypress	326	326	326	326	326	326
Sulphur	300	300	300	300	300	300
Total	**626**	**626**	**626**	**626**	**626**	**626**
Projected Supply Surplus (+)/Deficit(-)						
Cypress	-510	-510	-510	-510	-510	-510
Sulphur	-469	-469	-469	-469	-469	-469
Total	**-979**	**-979**	**-979**	**-979**	**-979**	**-979**

Evaluation of Potentially Feasible Water Management Strategies:

Five alternative strategies were considered to meet the Morris County, Livestock water supply shortages as summarized in the following table. Advanced conservation and water reuse were not considered because the demands are very rural in nature. Surface water alternatives were not utilized due to the rural nature of livestock demands. Local supply was used because it is available. Groundwater wells in the Queen City Aquifer (Cypress Creek River basin) were identified as a potentially feasible strategy for the WUG.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Local Supply, Sulphur Basin					
Groundwater Queen City Cypress Basin	**483**	**$ 539,000**	**$ 47,000**	**$ 97**	**1**
Groundwater Queen City Cypress Basin	**644**	**$ 767,000**	**$ 78,000**	**$ 121**	**1**
Surface Water					

Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Queen City, Sulphur Basin; ac-ft/yr)	483	483	483	483	483	483
Drill New Wells (Queen City, Cypress Creek Basin; ac-ft/yr)	644	644	644	644	644	644

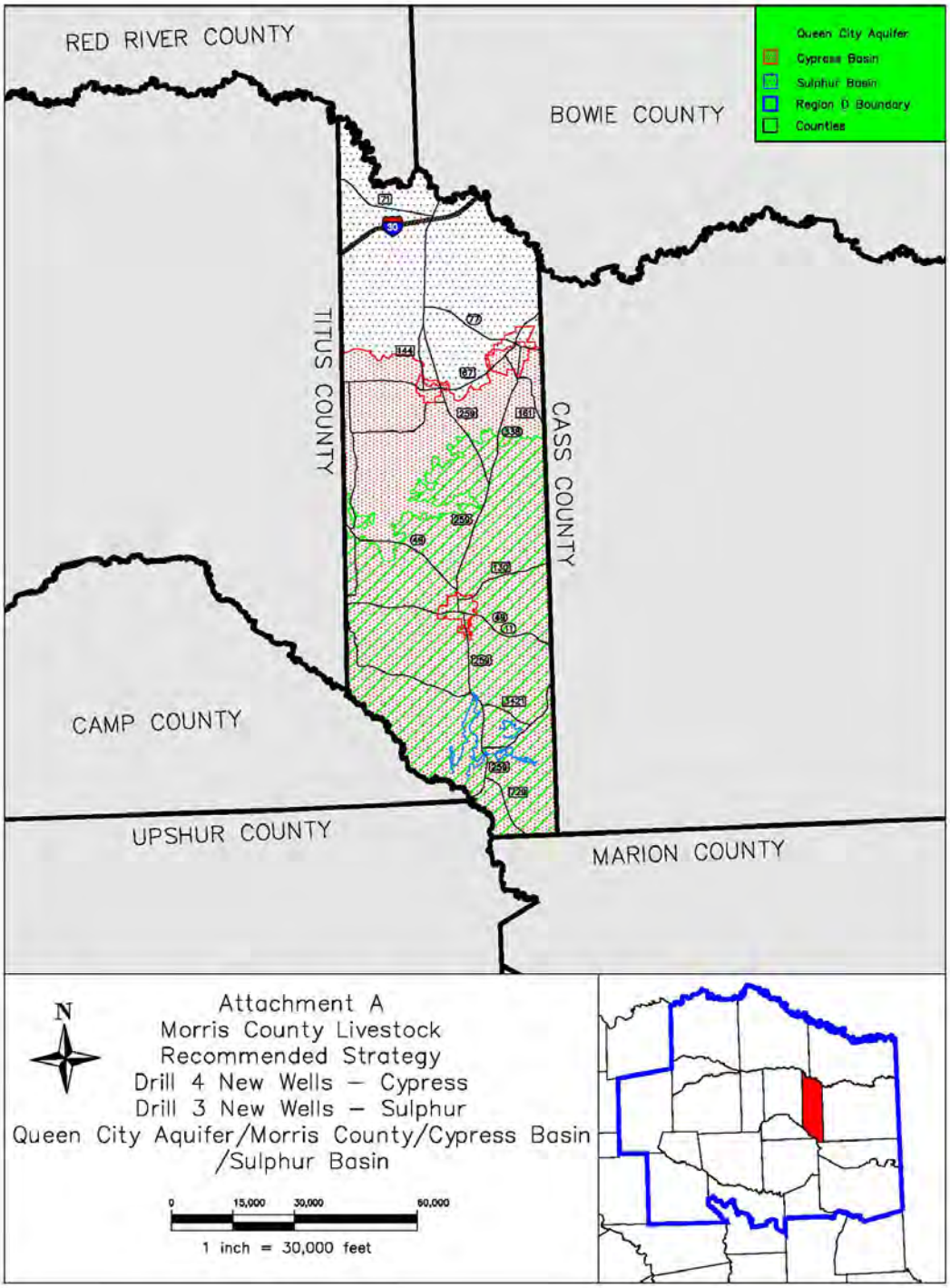
The recommended strategy for the Morris County, Livestock, Cypress to meet their projected deficit of 510 ac-ft/yr in 2020 thru 2070 would be to construct four water wells prior to 2020. The recommended supply source will be the Queen City in Morris County Cypress Basin. One well with rated capacity of 100 gpm would provide approximately 161 ac-ft/yr. Four new wells will be needed to provide the 510 ac-ft/yr needed.

The recommended strategy for the Morris County, Livestock, Sulphur to meet their projected deficit of 469 ac-ft/yr in 2020 thru 2070 would be to construct three water wells prior to 2020. The recommended supply source will be the Queen City Aquifer in Morris County Cypress Basin. One well with rated capacity of 100 gpm each would provide approximately 161 ac-ft/yr. Three new wells will be needed to provide the 469 ac-ft/yr needed. The Queen City Aquifer in Morris County Cypress is projected to have a more than ample supply availability to meet the needs of the Livestock in Morris County for the planning period.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices*	
Livestock Morris Cypress - Drill New Well Queen City Aquifer Morris Cypress	
Cost based on ENR CCI 11170.28 for September 2018 and	
a PPI of 202.4 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	$0
Terminal Storage (Conservation Pool acft, acres)	$0
Primary Pump Station (0 MGD)	$0
Transmission Pipeline (6 in dia., miles)	$0
Transmission Pump Station(s) & Storage Tank(s)	$0
Well Fields (Wells, Pumps, and Piping)	$551,000
Storage Tanks (Other Than at Booster Pump Stations)	$0
Water Treatment Plant (0 MGD)	$0
Advanced Water Treamtent Facility (MGD)	$0
Conservation (Leaking Pipe/Meter Replacement)	$0
Integration, Relocations, & Other	$0
TOTAL COST OF FACILITIES	**$551,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$193,000
Environmental & Archaeology Studies and Mitigation	$2,000
Land Acquisition and Surveying (2 acres)	$0
Interest During Construction (3% for 1 years with a 0.5% ROI)	$21,000
TOTAL COST OF PROJECT	**$767,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$54,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$6,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (224177 kW-hr @ 0.08 $/kW-hr)	$18,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$78,000**
Available Project Yield (acft/yr)	644
Annual Cost of Water ($ per acft), based on PF=1	$121
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$37
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.37
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.11
Stanley Hayes	*10/4/2019*

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices*	
Livestock Morris Sulphur - Drill New Well Queen City Aquifer Morris Sulphur	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	$0
Terminal Storage (Conservation Pool acft, acres)	$0
Primary Pump Station (0 MGD)	$0
Transmission Pipeline (6 in dia., miles)	$0
Transmission Pump Station(s) & Storage Tank(s)	$0
Well Fields (Wells, Pumps, and Piping)	$385,000
Storage Tanks (Other Than at Booster Pump Stations)	$0
Water Treatment Plant (0 MGD)	$0
Advanced Water Treamtent Facility (MGD)	$0
Conservation (Leaking Pipe/Meter Replacement)	$0
Integration, Relocations, & Other	$0
TOTAL COST OF FACILITIES	**$385,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$135,000
Environmental & Archaeology Studies and Mitigation	$4,000
Land Acquisition and Surveying (2 acres)	$0
Interest During Construction (3% for 1 years with a 0.5% ROI)	$15,000
TOTAL COST OF PROJECT	**$539,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$38,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$4,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (56392 kW-hr @ 0.08 $/kW-hr)	$5,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$47,000**
Available Project Yield (acft/yr)	483
Annual Cost of Water ($ per acft), based on PF=1	$97
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$19
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.30
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.06
Stanley Hayes	*10/4/2019*


RED RIVER COUNTY
BOWIE COUNTY
TITUS COUNTY
CASS COUNTY
CAMP COUNTY
UPSHUR COUNTY
MARION COUNTY
Queen City Aquifer
Cypress Basin
Sulphur Basin
Region D Boundary
Counties
N
Attachment A
Morris County Livestock
Recommended Strategy
Drill 4 New Wells – Cypress
Drill 3 New Wells – Sulphur
Queen City Aquifer/Morris County/Cypress Basin
/Sulphur Basin
0
15,000
30,000
60,000
1 inch = 30,000 feet

REGION D
EVALUATIONS OF WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

RAINS COUNTY

WUGs:

None

REGION D
EVALUATIONS OF WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

RED RIVER COUNTY

WUGs:

The City of Clarksville
Red River County Irrigation
Red River County Livestock

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF CITY OF CLARKSVILLE

Description of Water User Group:

The City of Clarksville is located in Red River County. The system is projected to serve 3,315 people through the planning period. The current sources of supply are wells into the Blossom Aquifer. Groundwater had previously been mixed with surface water from Langford Lake, however sedimentation has hindered its use as a water supply. Water quality issues with the groundwater (TDS) and surface water (turbidity) necessitate mixing of the supplies to meet Texas drinking water standards. The groundwater has over 1,000 ppm of dissolved solids including high levels of sodium, sulfate, and chloride. The City provides water to its own customers in the Sulphur basin and is projected to have a water supply deficit of 237 ac-ft/yr in 2020, due to sedimentation issues in Langford Lake. As the surface water supply for the City diminishes, the capability to mix the surface supply with the groundwater supply commensurately diminishes as well. Thus as surface supply diminishes, so too does the capability to utilize the City's existing groundwater supply. As noted in a 4 October, 2013 memorandum from the City's consultant, Murray, Thomas & Griffin, Inc. (MTG):

> "Clarksville has no available surface water when a water level of 417.0 (2006 low water level) and a sediment level at 415.0 (2013 lake bottom) are considered. Each of these conditions has occurred during the past ten years. The surface water is necessary to address total volume needs as well as for blending with the ground water."

For the current regional plan the City's water supply is solely from groundwater, thus the estimated deficit is reflective of the current groundwater production and treatment capacity without mixing of surface water. The system does have a water conservation and drought management plan in place.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	3,315	3,315	3,315	3,315	3,315	3,315
Projected Water Demand	620	602	593	592	590	590
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	383	371	371	371	371	371
Projected Supply Surplus (+) / Deficit (-)	**-237**	**-231**	**-222**	**-221**	**-219**	**-219**

Evaluation of Potentially Feasible Water Management Strategies:

The various feasible strategies considered to meet Clarksville's water supply shortages are listed in the table below. Advanced conservation was not selected because Clarksville's supply would not be projected to meet TCEQ regulatory minimums. Furthermore, reduction in demand would not alleviate the aforementioned water quality issues with the City's projected supplies. There are no significant current water needs in Clarksville that could be met by water reuse. Additional groundwater pumping from the Blossom Aquifer in the Sulphur River Basin and Reverse Osmosis treatment of all of the City's existing groundwater supplies has also been considered. The City's existing surface water supply has been made unavailable due to sedimentation issues in Langford Lake, the City's sole existing surface water supply. The City has requested the consideration of multiple potential surface water strategies to meet Clarksville's water supply needs. Potentially feasible strategies evaluated include:

- Treated Water Pipeline to DeKalb - purchasing water from the City of Texarkana's available supply from Wright Patman Reservoir;
- Dredging of sediment from Langford Lake;
- Construction of a new surface water reservoir, Dimple Reservoir;
- Construction of a raw water pipeline tying into to Region C's proposed Marvin Nichols Reservoir.

- Treated Water Pipeline to Detroit - purchasing water from the City of Paris (via Lamar County WSD) from Paris available supply.

The projected amount of firm supply necessary to meet the above projected demands differ due to the City's current methodology of mixing their surface and groundwater supplies at a ratio of 51%.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annual Cost	Unit Cost (During Debt Service)	Unit Cost (After Debt Service	Env. Impact
Advanced Water Conservation						
Water Reuse						
Drill Additional Wells and RO Treatment	**388**	**$10,537,000**	**$1,673,000**	**$4,312**	**$2,402**	**1**
Raw Water Pipeline to Marvin Nichols Reservoir (ac-ft/yr)						
Contract with Lamar County WSD	**303**	**$12,255,000**	**$1,518,000**	**$5,010**	**$2,165**	**2**
Contract with Riverbend WRD and Treated Water Pipeline to DeKalb (ac-ft/yr)	**303**	**$11,702,000**	**$1,171,000**	**$3,865**	**$1,149**	**2**
Dredge Langford Lake (ac-ft/yr)	**303**	**$36,200,000**	**$2,807,000**	**$5,398**	**$0**	**5**
Dimple Reservoir (ac-ft/yr)	**303**	**$38,489,000**	**$2,415,000**	**$7,970**	**$1,099**	**5**

Description of evaluated projects

Raw Water Pipeline to Marvin Nichols Reservoir – The City of Clarksville has requested that their top priority for consideration as a water management strategy be a pipeline tying into Region C's water management strategy for the construction of Marvin Nichols Reservoir (as it is reported in the Sulphur River Basin Feasibility Study, SRBA 2014, that 20% of the water potentially available from Marvin Nichols Reservoir would be available for local use in Region D). Preliminary communications with Region C have indicated that this strategy is currently under consideration as a Proposed or Alternative Water Management Strategy for implementation by the year 2060 in the 2021 Region C Water Plan. As Region D has identified that the City of Clarksville has needs as early as 2020, Marvin Nichols as currently envisioned by Region C would not be available to meet the City's identified needs. Furthermore, the North East Texas Regional Water Planning Group opposes the construction of any reservoir in the Sulphur River Basin, and does not recommend this as a Recommended or Alternative Water Management Strategy. However, the City of Clarksville has noted that should this source be available during the planning period, it has reserved the right to work with the Sulphur River Basin Authority and to utilize this source once available.

New Groundwater Wells and Treatment Facility – A planning level analysis was performed to evaluate a strategy including the addition of new wells into the Nacatoch Aquifer, Sulphur River Basin, in Red River County, and additional treatment of all of the City's groundwater supplies to address the aforementioned water quality issues. The available yield from the project was determined to be 237 ac-ft/yr. This was the amount calculated to be necessary to meet the projected future demands for the City, once added to Clarksville's existing groundwater supplies. It is thus critical to note that consideration of this strategy is

for the entire 620 ac-ft/yr of supply necessary to meet the City's projected demands. The planning process strictly considers the amount of supply necessary to meet the projected shortage, i.e., 237 ac-ft/yr, and uses this amount as the basis for cost estimation purposes. Nevertheless, the strategy would be for the development of sufficient groundwater sources to meet the full 620 ac-ft/yr of projected City demands. It has been assumed for this strategy that existing groundwater wells of the City's are maintained.

Additional assumptions for this analysis included assuming Total Dissolved Solids (TDS) of 1,275 mg/L, and that two Reverse Osmosis (RO), Level 4 treatment plants would be located at the end of a 5-mile, 8-inch transmission line sized sufficiently to carry the full flow of pre-treated water, since when brackish water is treated, approximately 20% of the supply is lost as concentrate. An average of nearby depth (650 ft.) and head (250 ft.) of wells was utilized to calculate the potential number of wells needed (six new wells). For an assumed distance between wells of 1,500 ft., a total length of 7,500 ft. of 6-in. diameter well field piping was estimated. For the pipeline, 30 psi was assumed for the residual head at the end of the pipe, with a maximum pipeline pressure of 150 psi. Difference in elevation was assumed to be 50 ft. The treatment facilities would be of sufficient size (0.7 mgd) to treat the entirety of Clarksville's groundwater supply, both existing and proposed wells.

The TWDB's Unified Costing Model (UCM) was used to develop costs for this strategy. The total capital cost of the project is calculated to be approximately $10,537,000, with an annual cost of $1,598,000, for a unit cost during debt service of $2,577 per ac-ft ($7.91 per 1,000 gallons). After debt service, the unit cost would be approximately $1,382 per ac-ft.

Contract with Lamar County WSD and Treated Water Pipeline to Detroit - A strategy requested by the City of Clarksville is the construction of a 16" diameter pipeline from Clarksville to Detroit, and the purchase of up to 2 MGD of treated water from the Lamar County WSD. This strategy would be contingent upon the Lamar County WSD purchase of equivalent supply from the City of Paris. Cost estimates are based upon the TWDB's Unified Costing Model (UCM). The project is estimated to provide 303 ac-ft/yr by constructing a pipeline to Detroit, whereby the City of Clarksville would enter into a contract with the Lamar County WSD (contingent upon the District contracting for available supply from the City of Paris). This amount provides the surface water supply necessary for mixing with the City's existing groundwater supply, for a total project cost of $12.3 million, an annual cost of $1.5 million, and a unit cost for the additional supply of $5,010 per ac-ft. during debt service and $2,165 per ac-ft after debt service. Identifying uses for the additional production capability of the pipeline (up to 2 MGD) would likely lower the unit cost for this strategy.

Contract with Texarkana and Treated Water Pipeline to De Kalb – Another strategy previously requested by the City of Clarksville is the construction of a 16" diameter pipeline from Clarksville to De Kalb, and the purchase of up to 2 MGD of treated water from Texarkana. This project is based on a cost estimate developed by Riverbend Water Resources District, along with a similar project cost estimate from MTG Engineers. The total cost, annual cost, and unit cost of water from the project has been estimated based upon the results of these studies, as entered into the TWDB's Unified Costing Model (UCM). The project is estimated to have a total yield of 2,240 ac-ft/yr of supply by constructing a pipeline to De Kalb, whereby the City of Clarksville would enter into a contract with the City of Texarkana (or alternatively Riverbend Water Resources District) for up to 593 ac-ft/yr (0.53 MGD). The amount necessary to meet Clarksville's projected needs is 303 ac-ft/yr (0.27 MGD). This amount provides the surface water supply necessary for mixing with the City's existing groundwater supply, for a total project cost of $11.7 million, an annual cost of $1.2 million, and a unit cost for the additional supply of $3,865 per ac-ft. during debt service and $1,149 per ac-ft after debt service. Identifying uses for the additional production capability of the pipeline (up to 2 MGD) would likely lower the unit cost for this strategy.

Concerns about this strategy are with regard to present issues entailing the supply of Wright Patman Reservoir to Texarkana and the remaining Member Cities of Riverbend Water Resources District. Concerns regarding the priority of a new contract for Clarksville for treated water supply from Texarkana/Riverbend are somewhat ameliorated due to the fact that in times of drought, Texarkana's 2012 Water Conservation & Drought Contingency Plan specifies that curtailment of water deliveries to wholesale customers will be done by a pro-rata method as provided in Texas Water Code, §11.039.

Furthermore, the amounts of supply considered within the 2021 North East Texas Regional Water Plan are based upon firm yields developed employing the TCEQ Water Availability Model, and reflect legal and infrastructure constraints to identify the amount of available supply. It is expected that costs associated with this strategy would be negotiated between the City of Clarksville and Texarkana/Riverbend WRD, as the City of Clarksville has expressed a potential interest in entering into a water supply relationship as a partner with these entities. This strategy, if implemented, would be contingent upon water management strategies identified for Riverbend WRD and its Member Entities.

Dredge Langford Lake – The firm yield of Langford Lake decreases over time due to sedimentation in the reservoir reducing the total volume of conservation capacity. This strategy would entail the dredging of sediment from Langford Lake to restore storage capacity within the reservoir which has been lost due to this sedimentation. This project utilizes a 24" dredge to remove an estimated 3,000 ac-ft of sediment over a one-year calendar period. The unit cost of reservoir dredging, in units of dollars per ac-ft of sediment removed, has been calculated based upon a formula from the World Bank, as presented in the TWDB Report *Dredging vs. New Reservoirs* (2004). The resultant calculated cost was entered into the UCM to determine the debt service cost. The project is estimated to yield 520 ac-ft of firm supply by dredging an estimated total of 3,000 ac-ft of sediment from Langford Lake over one year, for a total project cost of $36.2 million, an annual cost of $2.8 million, and a unit cost of $5,398 per ac-ft. during debt service and $0 per ac-ft after debt service.

Concerns with this strategy include the location and impacts from disposition of dredged material, the efficiency of removal of the dredged material, and the potential need to repeat the effort in the future since dredging does not remove the source of sedimentation issues in the contributing watershed. As noted in TWDB (2005), issues with regard to dredging fall into four general categories: removal of the sediment, transportation, disposal, and re-use.

For the removal of sediment, dredging reservoirs, particularly at the shallow headwaters and reservoir margins can destroy habitats and affect wetland birds, etc. If the water sustains flora or fauna of particular value, or if fish issues are important, then issues exist regarding lowering the water level. Dredging may also result in a temporary loss of reservoir water quality, through removal of organic material, although there may be long-term improvements in the reservoir water quality through removal of such organic material. Downstream water quality may also be temporarily impacted due to dredging. There may also be a loss of land for containment areas to drain/treat the sediment.

Regarding transportation, reservoirs are often in remote areas. The impact of additional transportation during dredging can place pressure on local communities (e.g., noise/air pollution and physical damage to roads), although these impacts may be reduced if the sediment can be effectively dewatered at or near the reservoir site using, for example, a hydrocyclone and/or a filter bed press. The viability of disposal to land depends on the level of contaminants, whereby there may be risks to groundwater supplies from contamination by leaching.

Opportunities for the re-use of dredged material include sand/gravel/bricks for the construction industry, fertilizer, usage for filling abandoned quarry areas or mines, and usage for capping landfill sites.

Dimple Reservoir – The City has also identified a feasible strategy to meet future water supply needs as being the construction of a new 28,541 ac-ft reservoir with a projected surface are of 2,230 acres on White Oak Bayou, a tributary of Pecan Bayou, to be utilized as an interbasin transfer from the Red River Basin to the Sulphur River Basin. This reservoir project was originally described in a 1986 report from HDR to the Red River Authority and project participants, entitled *Preliminary Engineering Report for Proposed Dimple Reservoir Project on White Oak Bayou*. The 1986 report identified a potential project site, reservoir area capacity, drainage area, and estimated construction costs for the reservoir and intake structure without equipment. Intake structure equipment and water pipelines from the reservoir were not included in the report, nor was a cost estimate. This site is described in Section 8.9.5 of the 2021 Region D Plan, although it has not been recommended as a unique reservoir site by the NETRWPG for the present round of regional planning.

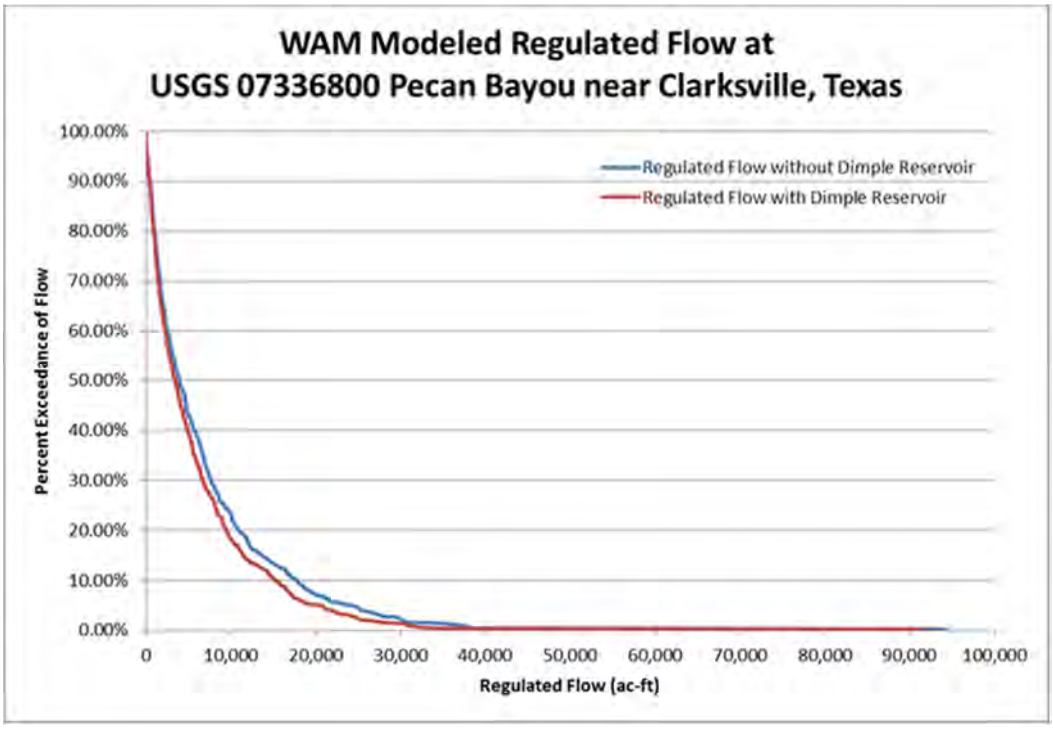
The reservoir construction costs from the 1986 report have been adjusted to September 2018 costs using the ENR Construction Cost Index (CCI) and entered into the UCM. Intake equipment and a raw water pipeline from the reservoir to the City of Clarksville's water treatment plant have also been preliminarily identified and included in the UCM. The raw water pipeline in the UCM is modeled to deliver the estimated firm yield with a peaking factor of 2. The project pipeline is 8" diameter, and approximately 8 miles long, following existing roadways with an elevation increase of 40 feet. The pipeline costing utilizes the UCM's assumption of 15 psi for the residual head at End of Pipe for raw water and assumes a maximum pipeline pressure of 250 psi. UCM calculations for pump and power requirements provide the cost estimate for the intake equipment. For the 2021 planning process, the reservoir has been modeled in the Red River WAM (Run 3), subject to consensus environmental criteria at a junior priority date, and modeled considering the full demand of existing water rights in the Red River Basin. The results of this WAM analysis indicate the project has a firm yield of 10,200 ac-ft per year, although Clarksville needs only 303 ac-ft/yr to have adequate supply to mix with the City's groundwater supplies to meet its projected needs beyond 2020. However, the City intends to use up to 593 ac-ft/yr to meet its full projected demands. This strategy includes constructing a new 28,541 ac-ft reservoir and 8" pipeline to Clarksville's WTP, for a total project cost of $38.5 million with an annual cost of $2.4 million and a unit cost for the needed supply of $7,970 per ac-ft. with debt service and $1,099 per ac-ft without debt service. It should be noted, however, that Dimple Reservoir, as envisioned herein, is based on existing studies (from 1986) and characterizations of the impoundment. Studies investigating alternative configurations, perhaps using a smaller footprint, are encouraged. Furthermore, needs from additional entities, if identified as willing participants to such an effort, could improve the unit costs calculated for Clarksville herein.

Concerns with this strategy include the potential need for obtaining a surface water permit for an interbasin transfer from the Red River Basin to the Sulphur River Basin. However, there is the potential that this could be waived given the project is located within the same county as the proposed use. The Texas Water Code §11.085 identifies factors to be considered in the applicable regional water plans to address the following:

(A) the availability of feasible and practicable alternative supplies in the receiving basin to the water proposed for transfer;
(B) the amount and purposes of use in the receiving basin for which water is needed;
(C) proposed methods and efforts by the receiving basin to avoid waste and implement water conservation and drought contingency measures;
(D) proposed methods and efforts by the receiving basin to put the water proposed for transfer to beneficial use;
(E) the projected economic impact that is reasonably expected to occur in each basin as a result of the transfer; and
(F) the projected impacts of the proposed transfer that are reasonably expected to occur on existing water rights, instream uses, water quality, aquatic and riparian habitat, and bays and estuaries that must be assessed under Sections 11.147, 11.150, and 11.152 of this code in each basin. If the water sought to be transferred is currently authorized to be used under an existing permit, certified filing, or certificate of adjudication, such impacts shall only be considered in relation to that portion of the permit, certified filing, or certificate of adjudication proposed for transfer and shall be based on historical uses of the permit, certified filing, or certificate of adjudication for which amendment is sought;

The other alternatives considered herein present available alternatives in the receiving basin to the water proposed for transfer. The water would be used for municipal purposes. The City maintains its Water Conservation and Drought Contingency Plan, implementing measures identified therein to avoid waste and conserve water during times of drought. Minimal economic impact is expected in the Red River Basin, whereas positive economic benefits may occur by maintaining the City's municipal supply. As noted above, minimal impacts are expected on existing water rights, as the WAM has been utilized to maintain priorities of these water rights. There exists significant concern with regard to potential environmental impacts of the proposed reservoir considering that the reservoir's contributing watershed represents approximately 25% of the watershed contributing to Pecan Bayou, a stream segment conditionally recognized in the 2021 Region D Plan and by the Texas Parks and Wildlife Department as being an

ecologically unique stream segment in the North East Texas Region. Presented below is a monthly flow frequency chart depicting the variation in flows in Pecan Bayou for with- and without project conditions. Significant impacts to agricultural and natural resources would also be expected within the footprint of the reservoir as well. Furthermore, mitigation and compensation may be necessary to the basin of origin.



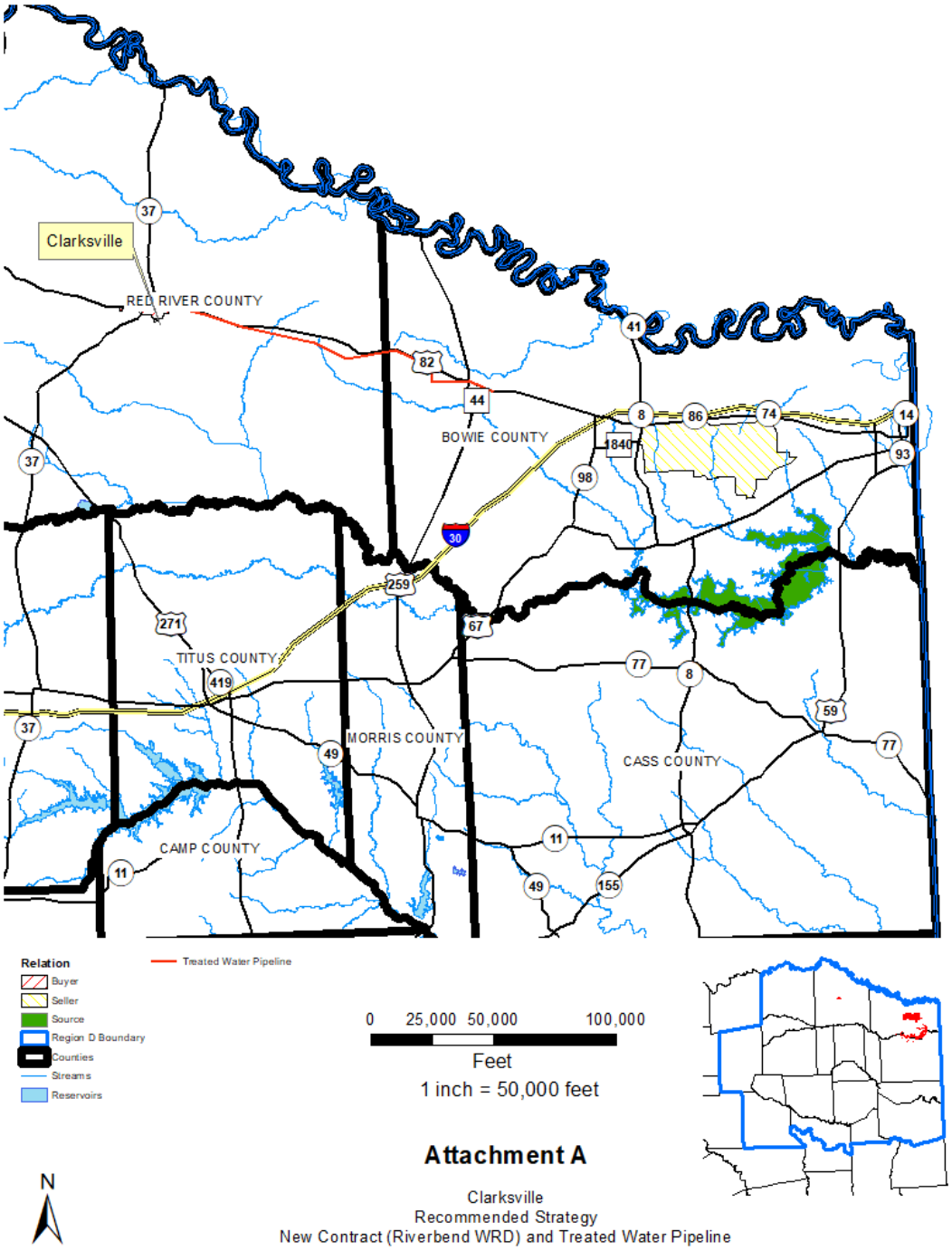
Flow Frequency Distribution of Regulated Flows at USGS Gage #07336800, Pecan Bayou near Clarksville, Texas, with- and without Dimple Reservoir.

Recommendations:

	2020	2030	2040	2050	2060	2070
Contract with Riverbend WRD and Treated Water Pipeline to DeKalb (ac-ft/yr)	303	303	303	303	303	303

To meet the City's projected deficit in 2020 it is recommended that Clarksville contract with the Riverbend WRD for treated supply from Lake Wright Patman, which includes the development of a Treated Water Pipeline tying into the Riverbend WRD system in DeKalb to provide 303 ac-ft/yr for the projected needs of the City of Clarksville, although Clarksville has indicated their intent, if this strategy were to be implemented to contract additional supply as necessary to meet their full projected demands. This strategy provides a reliable supply without construction of a new reservoir, thus minimizing potential impacts to the agricultural and natural resources within the Region. Further, this amount allows for the continued use of the City's existing groundwater supplies via mixing. Thus, this recommended strategy is contingent upon the City's use of its existing groundwater supplies, as well as contingent upon recommended strategies for the Riverbend Water Resources District.

At present, considerable uncertainty exists in each of the identified feasible water management strategies for the City of Clarksville. The NETRWPG supports any efforts by the City of Clarksville to further study all potential strategies to identify the best approach for the City to meeting all of its future water supply needs, and such a study should be considered consistent with the 2021 North East Texas Regional Water Plan.



Attachment A

Clarksville
Recommended Strategy
New Contract (Riverbend WRD) and Treated Water Pipeline

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Clarksville - New Contract with Riverbend and pipeline to De Kalb

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Primary Pump Station (0 MGD)	$1,565,000
Transmission Pipeline (0 in dia., miles)	$7,945,000
TOTAL COST OF FACILITIES	**$9,510,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,650,000
Environmental & Archaeology Studies and Mitigation	$15,000
Land Acquisition and Surveying (70 acres)	$213,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$314,000
TOTAL COST OF PROJECT	**$11,702,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$823,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$79,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$39,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (1049911 kW-hr @ 0.08 $/kW-hr)	$84,000
Purchase of Water (303 acft/yr @ 482.23 $/acft)	$146,000
TOTAL ANNUAL COST	**$1,171,000**
Available Project Yield (acft/yr)	303
Annual Cost of Water ($ per acft), based on PF=1	$3,865
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$1,149
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$11.86
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$3.52
Note: One or more cost element has been calculated externally	

JMP *10/5/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF IRRIGATION IN RED RIVER COUNTY

Description of Water User Group:

The Irrigation WUG in Red River County has a demand that is projected to be 3,867 ac-ft/yr in 2020 through 2070. Irrigation in Red River County is projected to be supplied by existing surface water from run-of-river diversions from the Red and Sulphur Rivers. A deficit of 2,154 ac-ft/yr is projected to occur in 2020 through 2070 in the Sulphur Basin. In the Red River Basin, a surplus of 810 ac-ft/yr is projected for the planning period of 2020 through 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Projected Water Demand	3,867	3,867	3,867	3,867	3,867	3,867
Current Water Supply	2,523	2,523	2,523	2,523	2,523	2,523
Projected Supply Surplus (+)/Deficit(-)	**-1,344**	**-1,344**	**-1,344**	**-1,344**	**-1,344**	**-1,344**

Projected Supply Surplus (+)/Deficit(-) by Basin	2020	2030	2040	2050	2060	2070
Sulphur	-2,154	-2,154	-2,154	-2,154	-2,154	-2,154
Red	810	810	810	810	810	810
Total	**-1,344**	**-1,344**	**-1,344**	**-1,344**	**-1,344**	**-1,344**

Evaluation of Potentially Feasible Water Management Strategies:

Multiple alternative strategies were considered to meet the Red River County Irrigation WUG's water supply shortages. Advanced water conservation for irrigation practices were not considered feasible, as amounts potentially saved would not provide sufficient savings to meet the projected needs over the planning period. The use of reuse water from nearby municipalities is not considered feasible as it would not be effective to deliver reuse water to farm irrigation systems.

Groundwater was identified as a potential source of water for irrigation in Red River County. A local hydrogeologic assessment was performed by Region D to assess source groundwater availability, as there is no GCD located within the Region. The assessment is based on source availabilities identified using availabilities identified and approved by the TWDB and the NETRWPG. Based on a relatively low average annual water level decline and the potential for high-productivity wells in the portion of the Nacatoch Aquifer located in the Sulphur River Basin in Red River County, it has been determined that most of the future projected needs can likely be met with additional irrigation wells. For the portion of the Trinity Aquifer located in the Sulphur River Basin in Red River County, the local hydrogeologic assessment did not identify sufficient available data to determine potential productivity.

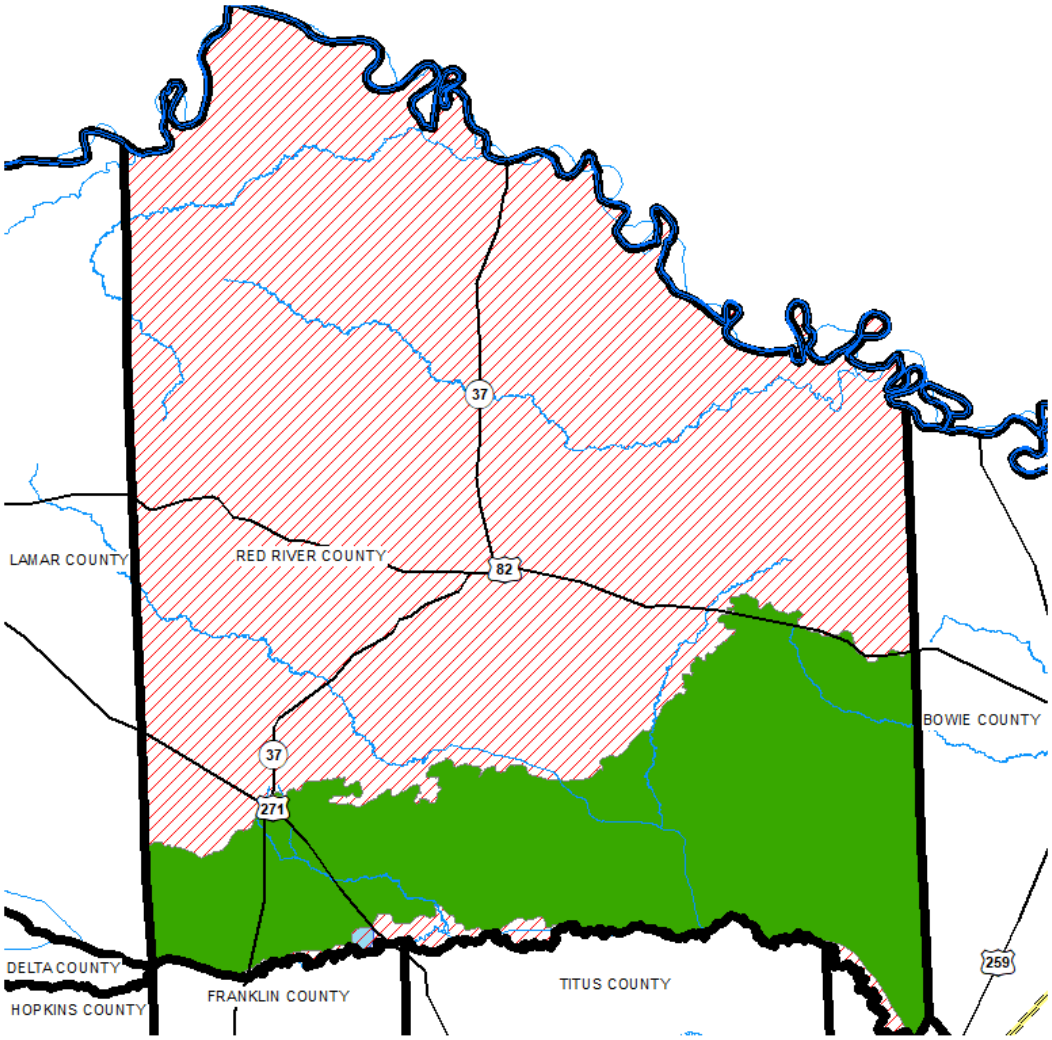
Treated surface water purchased from Lamar County WSD was considered as a viable supplement to the additional groundwater in order to meet projected demands. Thus, purchasing sufficient treated surface water from Lamar County WSD to meet the entirety of the need was also considered as a possible strategy. Purchasing raw water from the City of Paris has also been considered as a possible strategy, with a higher capital cost but an anticipated lower annual cost. The City's surface water permit for Pat Mayse Reservoir, as amended, allows for the interbasin transfer and use of water in both the Red and Sulphur River basins. However, the use of water via this permit would require a minor amendment to add irrigation as a permitted use.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Env. Impact
Advanced Water Conservation					
Water Reuse					
Drill New Wells (Blossom Aquifer, Red Basin)					
Drill New Wells (Nacatoch Aquifer, Red Basin)					
Drill New Wells, (Nacatoch Aquifer, Sulphur Basin)	**2,057**	**$6,551,000**	**$1,709,000**	**$831**	**1**
Drill New Wells (Trinity Aquifer, Red Basin)					
Drill New Wells (Trinity Aquifer, Sulphur Basin)	**97**	**$425,000**	**$88,000**	**$907**	**1**
Pat Mayse Treated Water Pipeline from Lamar County WSD	**2,154**	**$23,769,000**	**$5,619,000**	**$2,609**	
Pat Mayse Raw Water Pipeline from Paris	**2,154**	**$45,682,000**	**$4,535,000**	**$2,105**	

Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Nacatoch Aquifer, Sulphur Basin)	**2,057**	**2,057**	**2,057**	**2,057**	**2,057**	**2,057**
Unmet Need	**97**	**97**	**97**	**97**	**97**	**97**
Total	**2,154**	**2,154**	**2,154**	**2,154**	**2,154**	**2,154**

As no regulatory entity exists within Region D to enforce the MAG limitations, and no Groundwater Conservation District presently exists within the Region D planning area, Region D performed a local hydrogeologic assessment to determine availability. The assessment is based on source availabilities identified using availabilities identified and approved by the TWDB and the NETRWPG. Based on this assessment, it is recommended that by 2020 the Red River County Irrigation WUG drill new wells in the portions of the Nacatoch Aquifer in Red River County located in the Sulphur River Basin to meet 2,057 ac-ft/yr of projected needs for the WUG over the planning period. The Region D analysis indicates that 2,057 ac-ft/yr is available from the Nacatoch Aquifer in the Sulphur Basin in Red River County. In the Nacatoch Aquifer, it is recommended that nine wells with a rated capacity of 200 gpm to meet most of the needs, while the remaining 97 ac-ft remains unmet. Construction of wells with the capability to produce these amounts would be sufficient to meet the majority of projected needs for the WUG. An alternative strategy reflecting more groundwater wells to access the additional supply beyond the source availability determined by the MAG has been developed to meet the remaining 97 ac-ft/yr for the purposes of the 2021 Region D Plan.



Attachment A

Irrigation Red River Co
Recommended Strategy
Drill New Wells (Red River, Nacatoch, Sulphur)

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Irrigation Red River - Drill New Wells (Red River, Nacatoch Aquifer, Sulphur Basin)

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$4,580,000
TOTAL COST OF FACILITIES	**$4,580,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,603,000
Environmental & Archaeology Studies and Mitigation	$131,000
Land Acquisition and Surveying (12 acres)	$61,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$176,000
TOTAL COST OF PROJECT	**$6,551,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$461,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$46,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treamtent Facility	$0
Pumping Energy Costs (2158148 kW-hr @ 0.08 $/kW-hr)	$173,000
Purchase of Water (2057 acft/yr @ 500 $/acft)	$1,029,000
TOTAL ANNUAL COST	**$1,709,000**
Available Project Yield (acft/yr)	2,057
Annual Cost of Water ($ per acft), based on PF=1	$831
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$607
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$2.55
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.86

JMP *10/5/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF LIVESTOCK IN RED RIVER COUNTY

Description of Water User Group:

The Livestock WUG in Red River County has a demand that is projected to be constant at 1,532 ac-ft/yr for the period 2020 through 2070. Livestock in Red River County is projected to be supplied by groundwater from the Blossom, Nacatoch, and Woodbine Aquifers and surface water supply from local livestock supplies in the Red and Sulphur river basins. A deficit of 184 ac-ft/yr is projected to occur in 2020 through 2070 in the Red River Basin. In the Sulphur Basin, a surplus of 179 ac-ft/yr is projected to occur in 2020 through 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Projected Water Demand	1,532	1,532	1,532	1,532	1,532	1,532
Current Water Supply	1,527	1,527	1,527	1,527	1,527	1,527
Projected Supply Surplus (+)/Deficit(-)	**-5**	**-5**	**-5**	**-5**	**-5**	**-5**

Projected Supply Surplus (+)/Deficit(-) by Basin	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Sulphur	179	179	179	179	179	179
Red	-184	-184	-184	-184	-184	-184
Total	**-5**	**-5**	**-5**	**-5**	**-5**	**-5**

Evaluation of Potentially Feasible Water Management Strategies:

Multiple alternative strategies were considered to meet the Red River County Livestock WUG's water supply shortages. Advanced water conservation for livestock practices were not considered as present livestock practices likely result in sale of the livestock to reduce demand and extend water supply. The use of reuse water from nearby municipalities is not considered feasible as the water may be used for livestock consumption. Groundwater was identified as a potential source of water for livestock in Red River County.

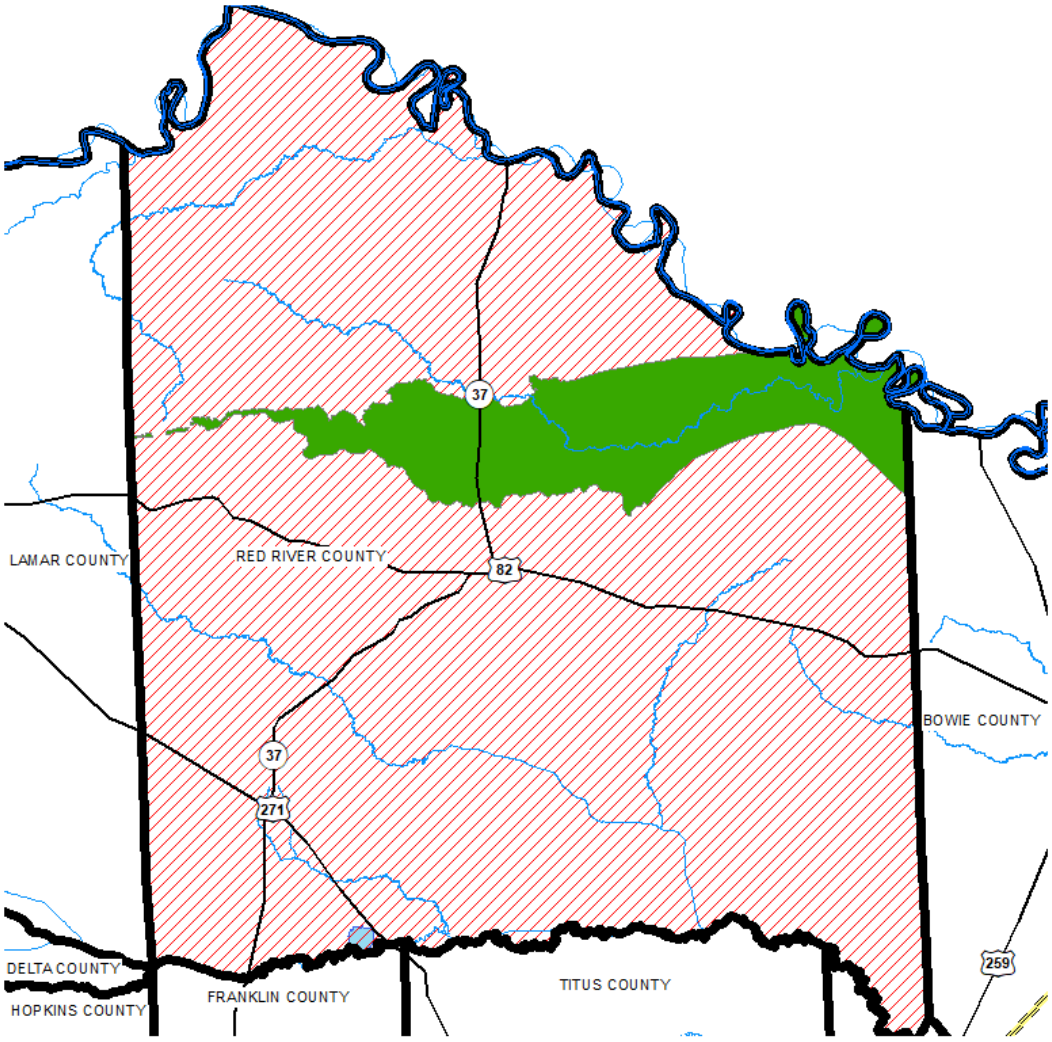
Treated surface water purchased from Lamar County WSD was considered as a potential supplement to the additional groundwater in order to meet projected demands. Purchasing sufficient treated surface water from Lamar County WSD to meet the entirety of the need was also considered as possible strategy. Purchasing raw water from the City of Paris has also been considered as a possible strategy, with a higher capital cost but an anticipated lower annual cost. The City's surface water permit for Pat Mayse Reservoir, as amended, allows for the interbasin transfer and use of water in both the Red and Sulphur River basins. However, the use of water via this permit could require a minor amendment to add livestock as a permitted use.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Env. Impact
Advanced Water Conservation					
Water Reuse					
Drill New Wells (Blossom Aquifer, Red Basin)	**11**	**$425,000**	**$40,000**	**$3,636**	**1**
Drill New Wells (Trinity Aquifer, Sulphur Basin)	**174**	**$1,436,000**	**$210,000**	**$1,207**	**1**
Pat Mayse Treated Water Pipeline from Lamar County WSD	**184**	**$10,147,000**	**$1,143,000**	**$6,212**	
Pat Mayse Raw Water Pipeline from Paris	**184**	**$13,323,000**	**$1,131,000**	**$6,147**	

Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Blossom Aquifer, Red River Basin)	**10**	**11**	**10**	**11**	**10**	**11**
Drill New Wells (Trinity Aquifer, Sulphur Basin)	**174**	**173**	**174**	**173**	**174**	**173**
Total	**184**	**184**	**184**	**184**	**184**	**184**

The recommended strategy for the Red River County Livestock WUG to meet the projected deficit of 184 ac-ft/yr from 2020 - 2070 would be to construct additional water wells similar to existing wells. The recommended supply sources are the portion of the Blossom Aquifer in the Red River Basin, and the portion of the Trinity Aquifer in the Sulphur Basin, both in Red River County. One well in the Blossom Aquifer with rated capacity of 75 gpm would provide approximately 11 ac-ft/yr, while three wells in the Trinity Aquifer with a rated capacity of 75 gpm would provide a combined total of approximately 174 ac-ft/yr. These aquifers are projected to have sufficient supply availability to meet the needs of the Red River County Livestock WUG for the planning period.



Attachment A

Livestock Red River Co
Recommended Strategy
Drill New Wells (Red River, Blossom, Red)

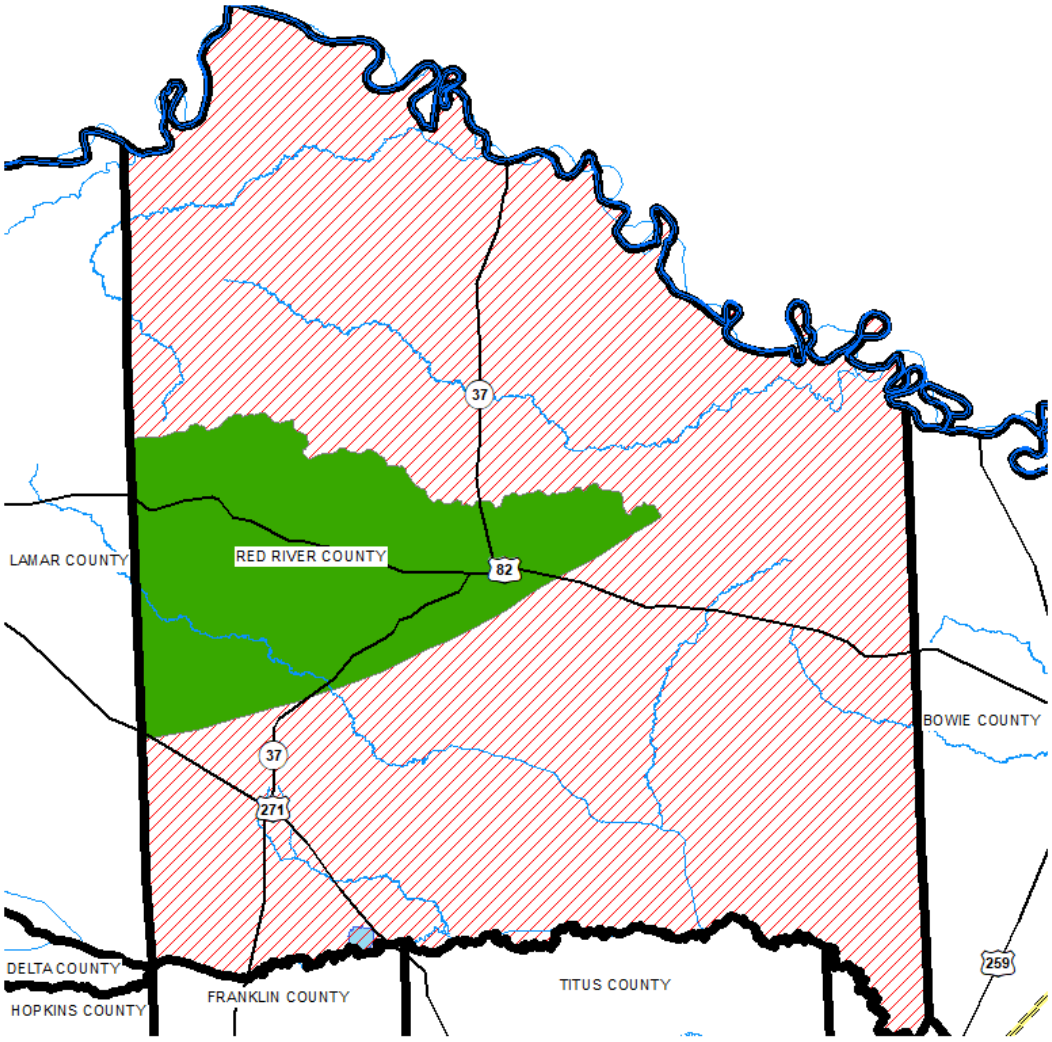
Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Livestock Red River - Drill New Wells (Red River, Blossom Aquifer, Red Basin)

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$298,000
TOTAL COST OF FACILITIES	**$298,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$104,000
Environmental & Archaeology Studies and Mitigation	$8,000
Land Acquisition and Surveying (1 acres)	$3,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$12,000
TOTAL COST OF PROJECT	**$425,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$30,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$3,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (8762 kW-hr @ 0.08 $/kW-hr)	$1,000
Purchase of Water (11 acft/yr @ 500 $/acft)	$6,000
TOTAL ANNUAL COST	**$40,000**
Available Project Yield (acft/yr)	11
Annual Cost of Water ($ per acft), based on PF=1	$3,636
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$909
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$11.16
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$2.79

JMP *9/30/2019*



Attachment B

Livestock Red River Co
Recommended Strategy
Drill New Wells (Red River, Trinity, Sulphur)

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Livestock Red River - Drill New Wells (Red River, Trinity Aquifer, Sulphur Basin)

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$990,000
TOTAL COST OF FACILITIES	**$990,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$347,000
Environmental & Archaeology Studies and Mitigation	$45,000
Land Acquisition and Surveying (5 acres)	$15,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$39,000
TOTAL COST OF PROJECT	**$1,436,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$101,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$10,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (152178 kW-hr @ 0.08 $/kW-hr)	$12,000
Purchase of Water (174 acft/yr @ 500 $/acft)	$87,000
TOTAL ANNUAL COST	**$210,000**
Available Project Yield (acft/yr)	174
Annual Cost of Water ($ per acft), based on PF=1	$1,207
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$626
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$3.70
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.92

JMP *9/30/2019*

REGION D
EVALUATIONS OF WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

SMITH COUNTY

WUGs:

Crystal Systems
The City of Lindale
Smith County MUD 1
Star Mountain WSC
Starrville Friendship WSC
The City of Winona

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF CRYSTAL SYSTEMS TEXAS, INC.

Description of Water User Group:

The Crystal Systems Texas, Inc. system is located in northwestern Smith County and serves the un-incorporated area surrounding Hideaway Lake. In 2018, the system had 2050 residential connections. The population is projected to increase from 4,343 persons in 2020 to 8,881 persons in 2070. The System is included as a W.U.G. in Smith County. The system's current water supply consists of five water wells from the Carrizo-Wilcox Aquifer. The total rated capacity of these wells is 3,560 GPM, or 1,914 ac-ft/yr. The system is bounded on the north and southeast by the Lindale Rural WSC and on the east by the City of Lindale. The System does have a water conservation plan. The System is projected to have a water supply surplus of 558 ac-ft/yr in 2020 decreasing to a deficit of 816 ac-ft/yr in 2070.

Water Supply and Demand Analysis:

Sabine River Basin

	2020	2030	2040	2050	2060	2070
Population	3026	3384	3812	4324	4950	5715
Projected Water Demand	945	1045	1175	1331	1522	1757
Current Water Supply	1334	1285	1256	1236	1230	1232
Projected Supply Surplus (+)/Deficit(-)	**389**	**240**	**81**	**-95**	**-292**	**-525**

Neches River Basin

	2020	2030	2040	2050	2060	2070
Population	1317	1657	2000	2372	2758	3166
Projected Water Demand	411	512	616	730	848	973
Current Water Supply	580	629	658	678	684	682
Projected Supply Surplus (+)/Deficit(-)	**169**	**117**	**42**	**-52**	**-164**	**-291**

Evaluation of Potentially Feasible Water Management Strategies:

Four alternative strategies were considered to meet the Crystal System's water supply shortages as summarized in the following table. Advanced conservation was not considered because the per capita use per day was below the 140 gpcd threshold set by the planning group. Water reuse was not considered because the system does not have a sewer collection system. Surface water alternatives were omitted since there is not a supply source within close proximity to the system and surface water treatment is not economically feasible for a system of this size. Wells in the Carrizo-Wilcox Aquifer (Sabine and Neches River Basins) were identified as a potentially feasible strategy for the WUG.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Groundwater (Sabine)	**538**	**$ 2,531,000**	**$ 231,000**	**$ 429**	**1**
Groundwater (Neches)	**538**	**$ 2,531,000**	**$ 231,000**	**$ 429**	**1**
Surface Water					

Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Carrizo-Wilcox Aquifer, Sabine; ac-ft/yr)	0	0		135	269	538
Drill New Wells (Carrizo-Wilcox Aquifer, Neches; ac-ft/yr)	0	0		135	269	538

The recommended strategy for Crystal Systems to meet their projected deficit of 147 ac-ft/yr in 2050 and 816 ac-ft/yr in 2070 would be to construct four additional water wells similar to their existing wells just prior to each decade as the deficits occur. The recommended supply source will be the Carrizo Wilcox Aquifer in Smith County. Four wells with rated capacity of 500 gpm each would provide approximately

269 acre-feet each. The Carrizo Wilcox Aquifer in Smith County is projected to have a more than ample supply availability to meet the needs of Crystal Systems for the planning period. During the planning period two wells will be drilled in the Carrizo Wilcox formation of the Sabine River Basin while two wells will be drilled into the Carrizo Wilcox formation of the Neches River Basin.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF CITY OF LINDALE

Description of Water User Group:

The City of Lindale is located in northern Smith County and serves the incorporated city limits and an area immediately northwest of the City of Lindale. The population is projected to increase from 5,806 persons in 2020 to 13,985 persons in 2070. The City is included as a W.U.G. in Smith County. The system's current water supply consists of four water wells from the Carrizo-Wilcox Aquifer. The total rated capacity of these wells is 2,320 GPM, or 1,247 ac-ft/yr. The system is bounded on the west, north, and east by the Lindale Rural WSC and on the south by the City of Tyler. The City does have a water conservation plan. The City of Lindale is projected to have a water supply deficit of 70 ac-ft/yr in 2020 increasing to a deficit of 1,833 ac-ft/yr in 2070.

Water Supply and Demand Analysis:

Sabine River Basin	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Population	3707	4499	5396	6107	7280	8674
Projected Water Demand	841	1005	1195	1347	1607	1910
Current Water Supply	796	779	773	756	762	773
Projected Supply Surplus (+)/Deficit(-)	**-45**	**-226**	**-422**	**-591**	**-842**	**-1137**

Neches River Basin	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Population	2099	2704	3311	3964	4629	5311
Projected Water Demand	476	604	733	875	1020	1170
Current Water Supply	451	468	474	491	485	474
Projected Supply Surplus (+)/Deficit(-)	**-25**	**-136**	**-259**	**-384**	**-535**	**-696**

Evaluation of Potentially Feasible Water Management Strategies:

Four alternative strategies were considered to meet the City of Lindale's water supply shortages as summarized in the following table. Advanced conservation was not considered because the per capita use per day was below the 140 gpcpd threshold set by the planning group. Water reuse was not considered because the City does not have a demand for non-potable water. Surface water alternatives were omitted since there is not a supply source within close proximity to the City and surface water treatment is not economically feasible for a system of this size. Groundwater wells in the Carrizo-Wilcox Aquifer in the Neches Basin were identified as a potentially feasible strategy for the City.

Strategy	**Firm Yield (AF)**	**Total Capital Cost**	**Total Annualized Cost**	**Unit Cost**	**Environmental Impact**
Advanced Water Conservation					
Water Reuse					
Groundwater	**1,932**	**$ 7,592,000**	**$ 714,000**	**$ 370**	**1**
Surface Water					

Recommendations:

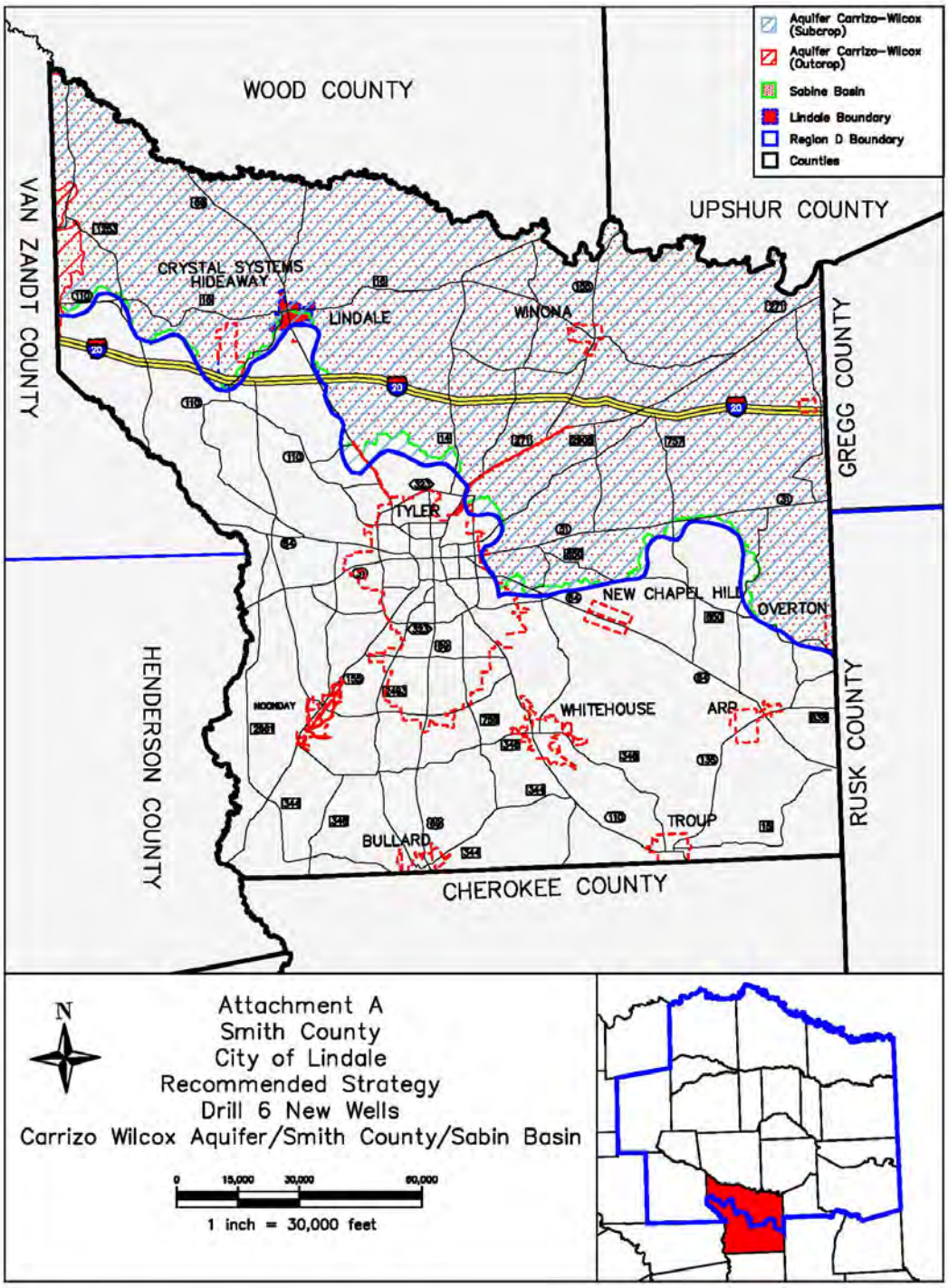
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Drill New Wells (Carrizo-Wilcox Aquifer, Neches; ac-ft/yr)	322	644	966	1288	1610	1932

The recommended strategy for the City of Lindale to meet their projected deficit of 70 ac-ft/yr in 2020 and 1,833 ac-ft/yr in 2070 would be to construct six additional water wells similar to their existing wells just prior to each decade as the deficits occur. The recommended supply source will be the Carrizo Wilcox Aquifer in Smith County. Six wells with rated capacity of 600 gpm each would provide approximately 322 acre-feet each. The Carrizo Wilcox Aquifer in Smith County (Neches River Basin) is projected to have a more than ample supply availability to meet the needs of the City of Lindale for the planning period.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from

neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices*	
Lindale - Drill New Well Carrizo Wilcox Aquifer Smith Sabine	
Cost based on ENR CCI 11170.28 for September 2018 and	
a PPI of 202.4 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	$0
Terminal Storage (Conservation Pool acft, acres)	$0
Primary Pump Station (0 MGD)	$0
Transmission Pipeline (6 in dia., miles)	$0
Transmission Pump Station(s) & Storage Tank(s)	$0
Well Fields (Wells, Pumps, and Piping)	$5,415,000
Storage Tanks (Other Than at Booster Pump Stations)	$0
Water Treatment Plant (0 MGD)	$0
Advanced Water Treamtent Facility (MGD)	$0
Conservation (Leaking Pipe/Meter Replacement)	$0
Integration, Relocations, & Other	$0
TOTAL COST OF FACILITIES	**$5,415,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,895,000
Environmental & Archaeology Studies and Mitigation	$67,000
Land Acquisition and Surveying (3 acres)	$11,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$204,000
TOTAL COST OF PROJECT	**$7,592,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$534,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$54,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (1577898 kW-hr @ 0.08 $/kW-hr)	$126,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$714,000**
Available Project Yield (acft/yr)	1,932
Annual Cost of Water ($ per acft), based on PF=1	$370
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$93
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$1.13
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.29
Stanley Hayes	*10/4/2019*


Aquifer Carrizo-Wilcox (Subcrop)
Aquifer Carrizo-Wilcox (Outcrop)
Sabine Basin
Lindale Boundary
Region D Boundary
Counties
WOOD COUNTY
UPSHUR COUNTY
VAN ZANDT COUNTY
GREGG COUNTY
HENDERSON COUNTY
RUSK COUNTY
CHEROKEE COUNTY
CRYSTAL SYSTEMS HIDEAWAY
LINDALE
WINONA
TYLER
NEW CHAPEL HILL
OVERTON
MOONDAY
WHITEHOUSE
ARP
TROUP
BULLARD
N
Attachment A
Smith County
City of Lindale
Recommended Strategy
Drill 6 New Wells
Carrizo Wilcox Aquifer/Smith County/Sabin Basin
0
15,000
30,000
60,000
1 inch = 30,000 feet

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF SMITH COUNTY MUD 1

Description of Water User Group:

The Smith County MUD 1 system is located in north Smith County and serves the unincorporated area of the County northeast of the City of Tyler. The population is projected to increase from 2,033 persons in 2020 to 4,008 persons in 2070. The MUD is included as a WUG. in Smith County. The system's current water supply consists of four water wells from the Carrizo-Wilcox Aquifer and two water wells from the Queen City Aquifer. The total rated capacity of these wells is approximately 1,864 GPM, or 1,156 ac-ft/yr. The system is bounded on the north by the Lindale Rural WSC, on the south and west by the City of Tyler, and on the east by the Starrville-Friendship WSC. The System does have a water conservation plan. The System is projected to have a water supply surplus of 246 ac-ft/yr in 2020 decreasing to a deficit of 609 ac-ft/yr in 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	2033	2320	2646	3025	3476	4008
Projected Water Demand	910	1030	1169	1334	1531	1765
Current Water Supply	1156	1156	1156	1156	1156	1156
Projected Supply Surplus (+)/Deficit(-)	**246**	**126**	**-13**	**-178**	**-375**	**-609**

Evaluation of Potentially Feasible Water Management Strategies:

Four alternative strategies were considered to meet the WSC's water supply shortages as summarized in the following table. Advanced conservation was not considered because the per capita use per day was below the 140 gpcd threshold set by the planning group. Water reuse was not considered because the system does not have a demand for non-potable water. Surface water alternatives were omitted since surface water treatment is not economically feasible for a system of this size. Groundwater wells in the Queen City Aquifer (Sabine Basin) were identified as a potentially feasible strategy for the WUG.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Groundwater (Sabine)	**648**	**$ 3,948,000**	**$ 348,000**	**$ 537**	**Minimal**
Surface Water					

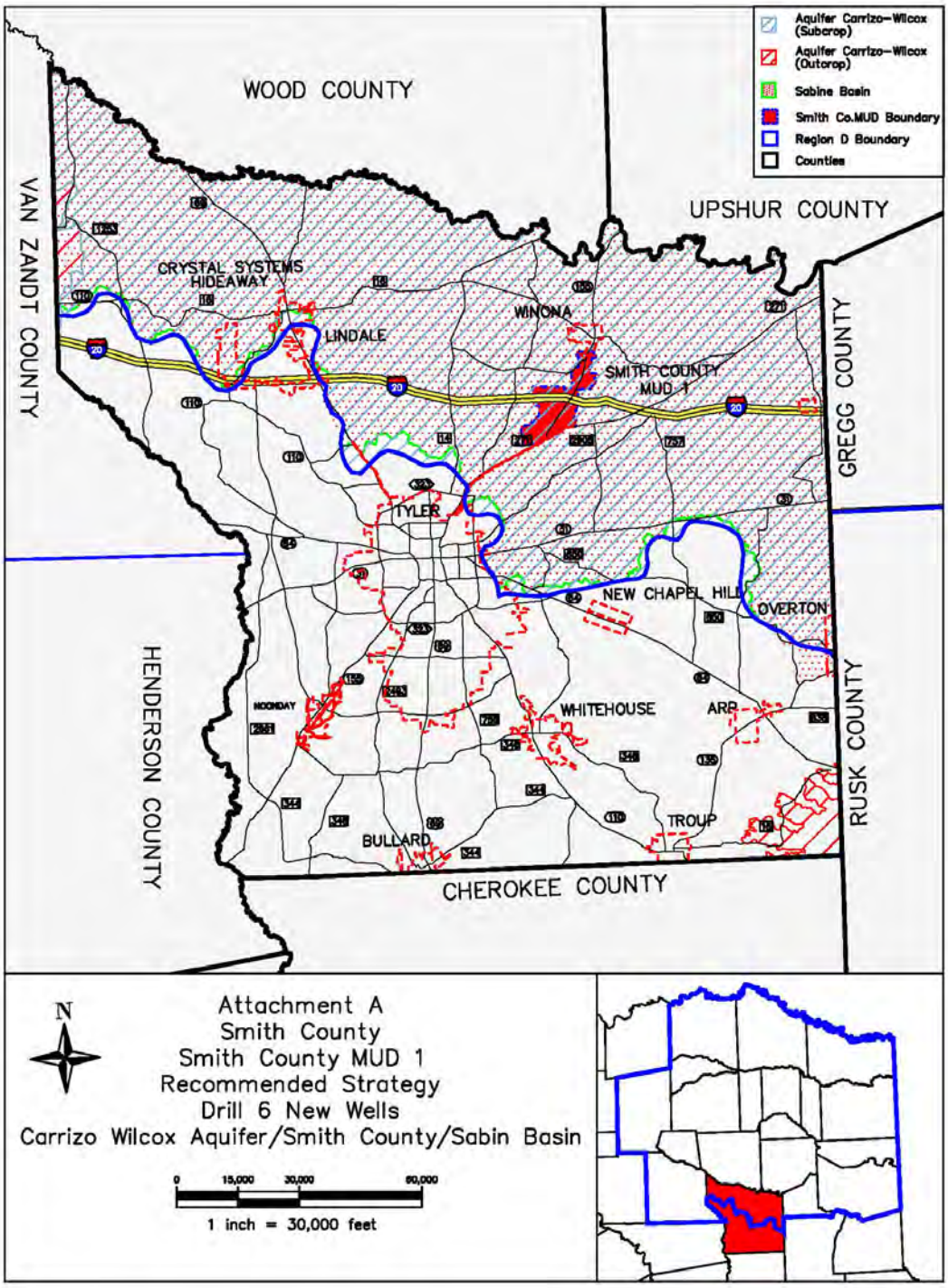
Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Queen City Aquifer, Sabine Basin; ac-ft/yr)	0	0	108	216	432	648

The recommended strategy for the Smith County MUD 1 to meet their projected deficit of 13 ac-ft/yr in 2040 and deficit of 609 ac-ft/yr in 2070 would be to construct six additional water wells similar to their existing wells just prior to each decade as the deficits occur. The recommended supply source will be the Queen City Aquifer in Smith County. One well with rated capacity of 200 gpm each would provide approximately 108 acre-feet each. The Queen City Aquifer in Smith County is projected to have a more than ample supply availability to meet the needs of Smith County MUD 1 for the planning period.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices*	
Smith County MUD 1 - Drill New Well Queen City Aquifer Smith Sabine	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	$0
Terminal Storage (Conservation Pool acft, acres)	$0
Primary Pump Station (0 MGD)	$0
Transmission Pipeline (6 in dia., miles)	$0
Transmission Pump Station(s) & Storage Tank(s)	$0
Well Fields (Wells, Pumps, and Piping)	$2,788,000
Storage Tanks (Other Than at Booster Pump Stations)	$0
Water Treatment Plant (0 MGD)	$0
Advanced Water Treamtent Facility (MGD)	$0
Conservation (Leaking Pipe/Meter Replacement)	$0
Integration, Relocations, & Other	$0
TOTAL COST OF FACILITIES	**$2,788,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$976,000
Environmental & Archaeology Studies and Mitigation	$67,000
Land Acquisition and Surveying (3 acres)	$11,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$106,000
TOTAL COST OF PROJECT	**$3,948,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$278,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$28,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (522832 kW-hr @ 0.08 $/kW-hr)	$42,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$348,000**
Available Project Yield (acft/yr)	648
Annual Cost of Water ($ per acft), based on PF=1	$537
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$108
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$1.65
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.33
Stanley Hayes	*10/4/2019*


Aquifer Carrizo-Wilcox (Subcrop)
Aquifer Carrizo-Wilcox (Outcrop)
Sabine Basin
Smith Co.MUD Boundary
Region D Boundary
Counties
WOOD COUNTY
UPSHUR COUNTY
VAN ZANDT COUNTY
GREGG COUNTY
HENDERSON COUNTY
RUSK COUNTY
CHEROKEE COUNTY
CRYSTAL SYSTEMS HIDEAWAY
LINDALE
WINONA
SMITH COUNTY MUD 1
TYLER
NEW CHAPEL HILL
OVERTON
MOONDAY
WHITEHOUSE
ARP
TROUP
BULLARD
N
Attachment A
Smith County
Smith County MUD 1
Recommended Strategy
Drill 6 New Wells
Carrizo Wilcox Aquifer/Smith County/Sabin Basin
0
15,000
30,000
60,000
1 inch = 30,000 feet

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF STAR MOUNTAIN WSC

Description of Water User Group:

The Star Mountain WSC system is located in northeastern Smith County and serves the unincorporated area of the County northeast of the City of Tyler. The WSC reported 588 connections in 2018. The population is projected to increase from 1,392 persons in 2020 to 2,269 persons in 2070. The WSC is included as a W.U.G. in Smith County. The system's current water supply consists of three water wells from the Carrizo-Wilcox Aquifer. The total rated capacity of these wells is approximately 397 GPM, or 213 ac-ft/yr. The system is bounded on the north by the Sabine River, on the west by the City of Winona, on the south by the City of Tyler and on the east by the Starrville Friendship WSC. The System does not have a water conservation plan. The System is projected to have a water supply deficiency of 20 ac-ft/yr in 2020 decreasing to a deficit of 148 ac-ft/yr in 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	1392	1546	1705	1882	2068	2269
Projected Water Demand	233	252	274	300	329	361
Current Water Supply	213	213	213	213	213	213
Projected Supply Surplus (+)/Deficit(-)	**-20**	**-39**	**-61**	**-87**	**-116**	**-148**

Evaluation of Potentially Feasible Water Management Strategies:

Four alternative strategies were considered to meet the WSC's water supply shortages as summarized in the following table. Advanced conservation was not considered because the per capita use per day was below the 140 gpcd threshold set by the planning group. Water reuse was not considered because the system does not have a central sewer collection system. Surface water alternatives were omitted since there is not a supply source within close proximity to the system and surface water treatment is not economically feasible for a system of this size. Groundwater wells in the Queen City Aquifer (Sabine River Basin) were identified as a potentially feasible strategy for the WUG.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Groundwater (Queen City Aquifer, Sabine Basin)	**216**	**$ 1,521,000**	**$ 132,000**	**$ 611**	**1**
Surface Water					

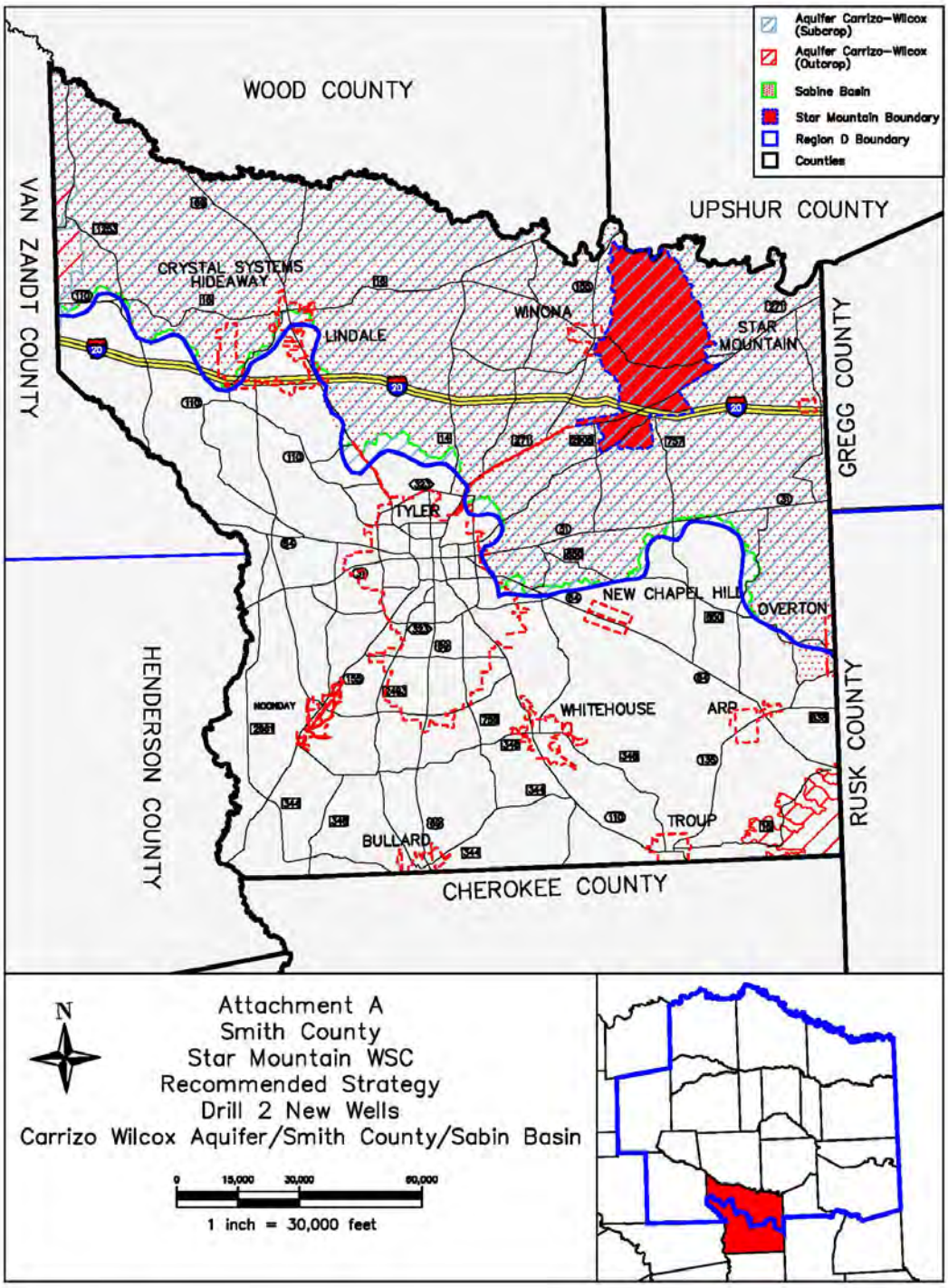
Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Queen City Aquifer, Sabine Basin; ac-ft/yr)	108	108	108	108	216	216

The recommended strategy for the Star Mountain WSC to meet their projected deficit of 20 ac-ft/yr in 2020 and deficit of 148 ac-ft/yr in 2070 would be to construct two additional water well similar to their existing wells just prior to each decade as the deficits occur. The recommended supply source will be the Queen City Aquifer in Smith County (Sabine River Basin). One well with rated capacity of 200 gpm each would provide approximately 108 acre-feet each. The Queen City Aquifer in Smith County (Sabine River Basin) is projected to have a more than ample supply availability to meet the needs of Star Mountain WSC for the planning period.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices*	
Star Mountain WSC - Drill New Well Carrizo Wilcox Aquifer Smith Sabine	
Cost based on ENR CCI 11170.28 for September 2018 and	
a PPI of 202.4 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	$0
Terminal Storage (Conservation Pool acft, acres)	$0
Primary Pump Station (0 MGD)	$0
Transmission Pipeline (6 in dia., miles)	$0
Transmission Pump Station(s) & Storage Tank(s)	$0
Well Fields (Wells, Pumps, and Piping)	$1,077,000
Storage Tanks (Other Than at Booster Pump Stations)	$0
Water Treatment Plant (0 MGD)	$0
Advanced Water Treamtent Facility (MGD)	$0
Conservation (Leaking Pipe/Meter Replacement)	$0
Integration, Relocations, & Other	$0
TOTAL COST OF FACILITIES	**$1,077,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$377,000
Environmental & Archaeology Studies and Mitigation	$22,000
Land Acquisition and Surveying (1 acres)	$4,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$41,000
TOTAL COST OF PROJECT	**$1,521,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$107,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$11,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (174277 kW-hr @ 0.08 $/kW-hr)	$14,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$132,000**
Available Project Yield (acft/yr)	216
Annual Cost of Water ($ per acft), based on PF=1	$611
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$116
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$1.88
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.36
Stanley Hayes	*10/4/2019*


Aquifer Carrizo-Wilcox (Subcrop)
Aquifer Carrizo-Wilcox (Outcrop)
Sabine Basin
Star Mountain Boundary
Region D Boundary
Counties
WOOD COUNTY
UPSHUR COUNTY
VAN ZANDT COUNTY
GREGG COUNTY
HENDERSON COUNTY
RUSK COUNTY
CHEROKEE COUNTY
CRYSTAL SYSTEMS HIDEAWAY
LINDALE
WINONA
STAR MOUNTAIN
TYLER
NEW CHAPEL HILL
OVERTON
MOONDAY
WHITEHOUSE
ARP
TROUP
BULLARD
N
Attachment A
Smith County
Star Mountain WSC
Recommended Strategy
Drill 2 New Wells
Carrizo Wilcox Aquifer/Smith County/Sabin Basin
0 15,000 30,000 60,000
1 inch = 30,000 feet

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF STARRVILLE FRIENDSHIP WSC

Description of Water User Group:

The Starrville Friendship WSC system is located in northeastern Smith County and western Gregg County. The WSC serves the unincorporated area northeast of the City of Tyler and west of the City of Gladewater. The WSC reported 631 connections in 2018. The population is projected to increase from 2,122 persons in 2020 to 3,454 persons in 2070. The WSC is included as a split WUG in Gregg and Smith Counties. The system's current water supply consists of four water wells from the Carrizo-Wilcox Aquifer. The total rated capacity of these wells is approximately 626 GPM, or 337 ac-ft/yr. The system is bounded on the north by the Sabine River, on the west by the Star Mountain WSC, on the south by the Starrville WSC and on the east by the West Gregg SUD. The System does have a water conservation plan. The system is projected to have a water supply surplus of 89 ac-ft/yr in 2020 decreasing to a deficit of 37 ac-ft/yr in 2070.

Water Supply and Demand Analysis:

Starrville Friendship, Gregg, Sabine	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Population	618	684	753	831	915	1,006
Projected Water Demand	72	77	83	90	99	109
Current Water Supply	98	98	98	98	98	98
Projected Supply Surplus (+)/Deficit (-)	**26**	**21**	**15**	**8**	**-1**	**-11**

Starrville Friendship, Smith, Sabine	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Population	1,504	1,665	1,834	2,023	2,226	2,448
Projected Water Demand	176	187	202	220	241	265
Current Water Supply	239	239	239	239	239	239
Projected Supply Surplus (+)/Deficit (-)	**63**	**52**	**37**	**19**	**-2**	**-26**

Evaluation of Potentially Feasible Water Management Strategies:

Four alternative strategies were considered to meet the WSC's water supply shortages as summarized in the following table. Advanced conservation was not considered because the per capita use per day was below the 140 gpcpd threshold set by the planning group. Water reuse was not considered because the system does not have a central sewer collection system. Surface water alternatives were omitted since there is not a supply source within close proximity to the system and surface water treatment is not economically feasible for a system of this size. Groundwater wells in the Carrizo-Wilcox Aquifer (Sabine Basin) in Gregg County were identified as a potentially feasible strategy for the WSC.

Strategy	**Firm Yield (AF)**	**Total Capital Cost**	**Total Annualized Cost**	**Unit Cost**	**Environmental Impact**
Advanced Water Conservation					
Water Reuse					
Groundwater (Carrizo-Wilcox, Sabine Basin)	**108**	**$ 761,000**	**$ 62,000**	**$ 574**	**Minimal**
Surface Water					

Recommendations:

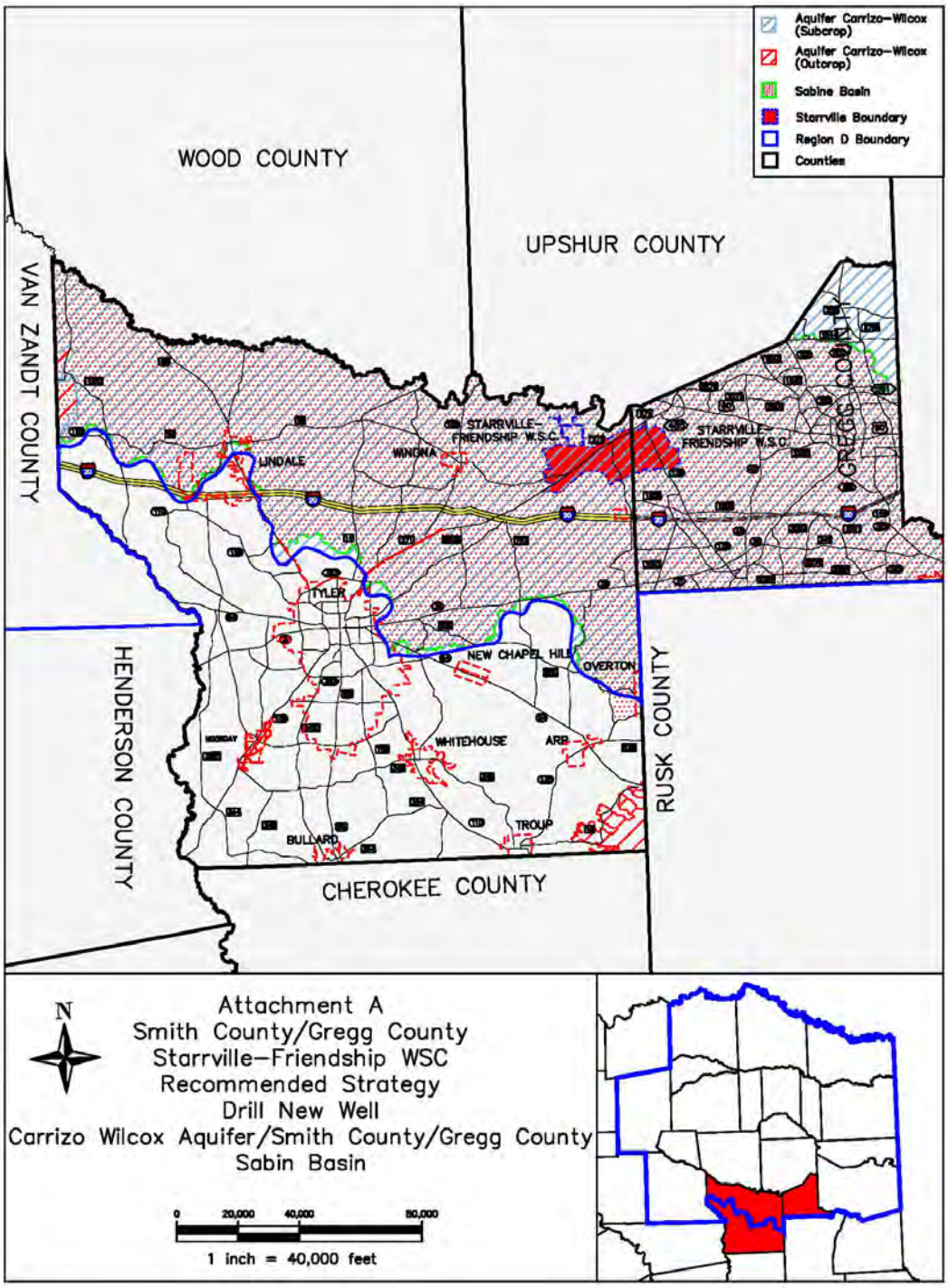
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Drill New Wells (Carrizo-Wilcox Aquifer, Sabine Basin; ac-ft/yr)	0	0	0	0	108	108

The recommended strategy for the Starrville Friendship WSC to meet their projected deficit of 3 ac-ft/yr in 2060 and deficit of 37 ac-ft/yr in 2070 would be to construct one additional water well similar to their existing wells just prior to each decade as the deficits occur. The recommended supply source will be the Carrizo Wilcox Aquifer in Gregg County. One well with rated capacity of 200 gpm would provide

approximately 108 acre-feet. The Carrizo Wilcox Aquifer in Gregg County is projected to have a more than ample supply availability to meet the needs of Starrville Friendship WSC for the planning period.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices*	
Starrville-Friendship WSC - Drill New Well Carrizo Wilcox Aquifer Gregg sabine	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	$0
Terminal Storage (Conservation Pool acft, acres)	$0
Primary Pump Station (0 MGD)	$0
Transmission Pipeline (6 in dia., miles)	$0
Transmission Pump Station(s) & Storage Tank(s)	$0
Well Fields (Wells, Pumps, and Piping)	$539,000
Storage Tanks (Other Than at Booster Pump Stations)	$0
Water Treatment Plant (0 MGD)	$0
Advanced Water Treamtent Facility (MGD)	$0
Conservation (Leaking Pipe/Meter Replacement)	$0
Integration, Relocations, & Other	$0
TOTAL COST OF FACILITIES	**$539,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$188,000
Environmental & Archaeology Studies and Mitigation	$11,000
Land Acquisition and Surveying (1 acres)	$2,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$21,000
TOTAL COST OF PROJECT	**$761,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$54,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$5,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (38784 kW-hr @ 0.08 $/kW-hr)	$3,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$62,000**
Available Project Yield (acft/yr)	108
Annual Cost of Water ($ per acft), based on PF=1	$574
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$74
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$1.76
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.23
Stanley Hayes	*9/30/2019*


Aquifer Carrizo-Wilcox (Subcrop)
Aquifer Carrizo-Wilcox (Outcrop)
Sabine Basin
Starrville Boundary
Region D Boundary
Counties
WOOD COUNTY
UPSHUR COUNTY
VAN ZANDT COUNTY
HENDERSON COUNTY
RUSK COUNTY
CHEROKEE COUNTY
GREGG CO.
STARRVILLE-FRIENDSHIP W.S.C.
STARRVILLE-FRIENDSHIP W.S.C.
LINDALE
WINONA
TYLER
NEW CHAPEL HILL
OVERTON
WHITEHOUSE
ARP
TROUP
BULLARD
WOODBAY
N
Attachment A
Smith County/Gregg County
Starrville-Friendship WSC
Recommended Strategy
Drill New Well
Carrizo Wilcox Aquifer/Smith County/Gregg County
Sabin Basin
0
20,000
40,000
80,000
1 inch = 40,000 feet

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF CITY OF WINONA

Description of Water User Group:

The City of Winona system is located in northeastern Smith County and serves the incorporated area of the City. In 2018, the system had 284 residential connections. The population is projected to increase from 645 persons in 2020 to 1,273 persons in 2070. The City is included as a WUG. in Smith County. The system's current water supply consists of two water wells from the Carrizo-Wilcox Aquifer. The total rated capacity of these wells is approximately 320 GPM, or 169 ac-ft/yr. The system is bounded on the north, west, and south by the Sand Flat WSC and on the east by the Star Mountain WSC. The System does not have a water conservation plan. The system is projected to have a water supply surplus of 36 ac-ft/yr in 2020 decreasing to a deficit of 81 ac-ft/yr in 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	645	737	839	961	1103	1273
Projected Water Demand	133	149	166	189	217	250
Current Water Supply	169	169	169	169	169	169
Projected Supply Surplus (+)/Deficit(-)	**36**	**20**	**3**	**-20**	**-48**	**-81**

Evaluation of Potentially Feasible Water Management Strategies:

Four alternative strategies were considered to meet the City's water supply shortages as summarized in the following table. Advanced conservation was not considered because the per capita use per day was below the 140 gpcd threshold set by the planning group. Water reuse was not considered because the system does not have a demand for non-potable water. Surface water alternatives were omitted since there is not a supply source within close proximity to the system and surface water treatment is not economically feasible for a system of this size. Groundwater wells in the Carrizo-Wilcox Aquifer (Sabine River Basin) were identified as a potentially feasible strategy for the City.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Groundwater (Carrizo-Wilcox Aquifer, Sabine Basin)	**108**	**$ 761,000**	**$ 66,000**	**$ 611**	**Minimal**
Surface Water					

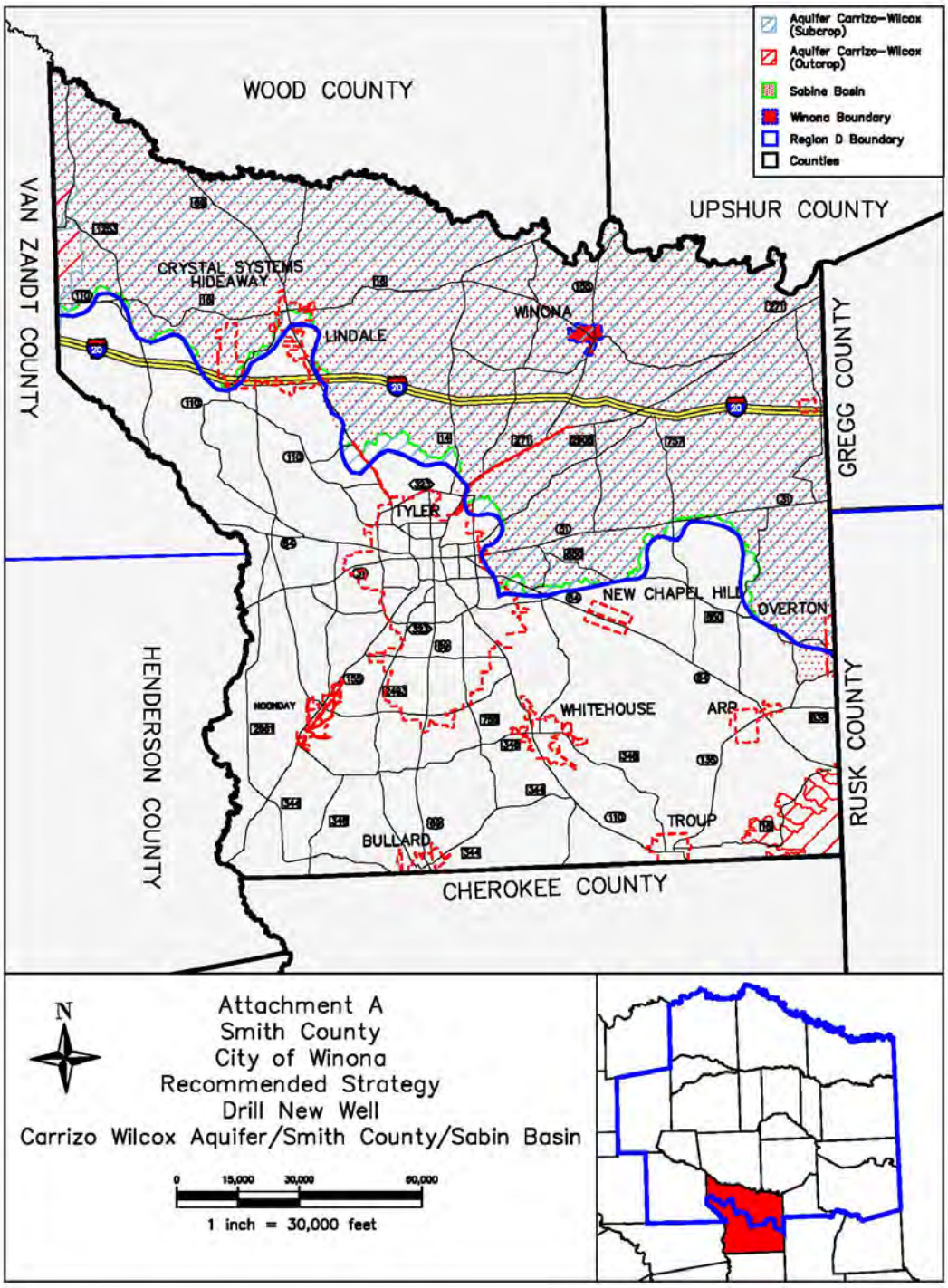
Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Carrizo-Wilcox Aquifer, Sabine Basin; ac-ft/yr)	0	0	0	108	108	108

The recommended strategy for the City to meet their projected surplus of 36 ac-ft/yr in 2020 and deficit of 81 ac-ft/yr in 2070 would be to construct one additional water well similar to their existing wells just prior to each decade as the deficits occur. The recommended supply source will be the Carrizo Wilcox Aquifer in Smith County. One well with rated capacity of 200 gpm each would provide approximately 108 acre-feet each. The Carrizo Wilcox Aquifer (Sabine River Basin) in Smith County is projected to have a more than ample supply availability to meet the needs of Winona for the planning period.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *Winona - Drill New Well Carrizo Wilcox Aquifer Smith Sabine* *Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018*	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	$0
Terminal Storage (Conservation Pool acft, acres)	$0
Primary Pump Station (0 MGD)	$0
Transmission Pipeline (6 in dia., miles)	$0
Transmission Pump Station(s) & Storage Tank(s)	$0
Well Fields (Wells, Pumps, and Piping)	$539,000
Storage Tanks (Other Than at Booster Pump Stations)	$0
Water Treatment Plant (0 MGD)	$0
Advanced Water Treamtent Facility (MGD)	$0
Conservation (Leaking Pipe/Meter Replacement)	$0
Integration, Relocations, & Other	$0
TOTAL COST OF FACILITIES	**$539,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$188,000
Environmental & Archaeology Studies and Mitigation	$11,000
Land Acquisition and Surveying (1 acres)	$2,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$21,000
TOTAL COST OF PROJECT	**$761,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$54,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$5,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (87139 kW-hr @ 0.08 $/kW-hr)	$7,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$66,000**
Available Project Yield (acft/yr)	108
Annual Cost of Water ($ per acft), based on PF=1	$611
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$111
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$1.88
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.34
Stanley Hayes	*10/4/2019*


Aquifer Carrizo-Wilcox (Subcrop)
Aquifer Carrizo-Wilcox (Outcrop)
Sabine Basin
Winona Boundary
Region D Boundary
Counties
WOOD COUNTY
UPSHUR COUNTY
VAN ZANDT COUNTY
GREGG COUNTY
HENDERSON COUNTY
RUSK COUNTY
CHEROKEE COUNTY
CRYSTAL SYSTEMS HIDEAWAY
LINDALE
WINONA
TYLER
NEW CHAPEL HILL
OVERTON
MOONDAY
WHITEHOUSE
ARP
TROUP
BULLARD
N
Attachment A
Smith County
City of Winona
Recommended Strategy
Drill New Well
Carrizo Wilcox Aquifer/Smith County/Sabin Basin
0 15,000 30,000 60,000
1 inch = 30,000 feet

REGION D
EVALUATIONS OF WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

TITUS COUNTY

WUGs:

Titus County Livestock
Titus County Manufacturing
Titus County Steam Electric Power Generation

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF LIVESTOCK IN TITUS COUNTY

Description of Water User Group:

Livestock in Titus County has a demand that is projected to be 2,947 ac-ft/yr in 2020 through 2070. Livestock in Titus County is currently supplied by groundwater from the Carrizo-Wilcox Aquifer and surface water from the Sulphur run-of-river and local supplies. A deficit of 1,939 ac-ft/yr is projected to occur in 2020 and increase to 2,005 ac-ft/yr by 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Projected Water Demand	2,947	2,947	2,947	2,947	2,947	2,947
Current Water Supply	1,008	1,008	1,008	1,008	963	942
Projected Supply Surplus (+)/Deficit(-)	**-1,939**	**-1,939**	**-1,939**	**-1,939**	**-1,984**	**-2,005**

Evaluation of Potentially Feasible Water Management Strategies:

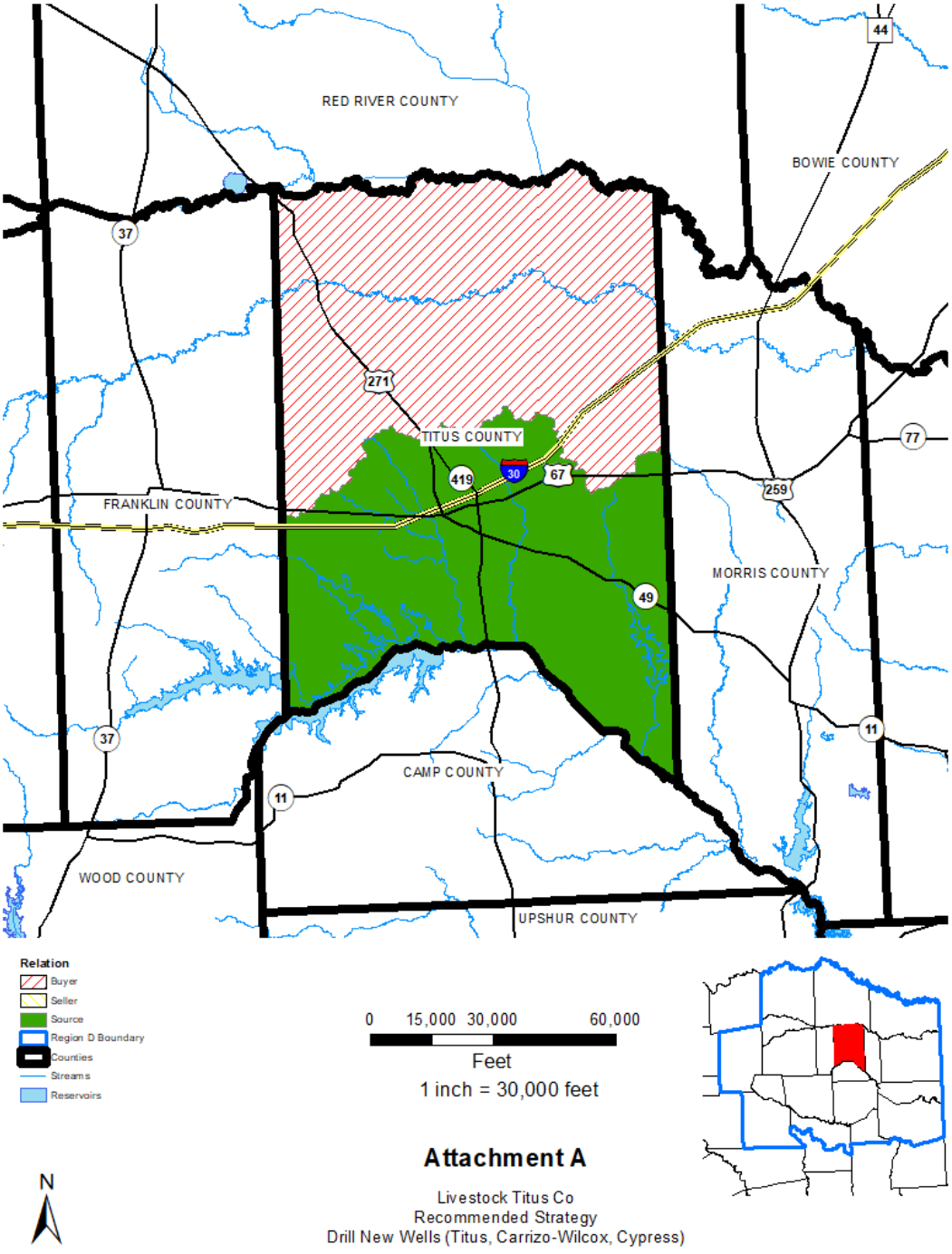
Five alternative strategies were considered to meet the Titus County Livestock WUG's water supply shortages. Advanced water conservation for livestock practices was not considered, as present livestock practices likely result in sale of the livestock to reduce demand and extend water supply. The use of reuse water from nearby municipalities is not considered feasible as the water may be used for livestock consumption. Groundwater has been identified as a potential source of water for livestock in Titus County; however, livestock needs potentially exceed the availability of groundwater in the basin based on the modeled available groundwater estimates by 2060. Purchase of surface from NETMWD was additionally considered as a potential alternative to meet projected demands.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Drill New Wells (Carrizo-Wilcox Aquifer, Cypress Basin)	**560**	**$2,253,000**	**$496,000**	**$886**	**1**
Drill New Wells (Carrizo-Wilcox Aquifer, Sulphur Basin)	**1,664**	**$5,215,000**	**$1,362,000**	**$819**	**1**
New Contract (NETMWD)	**2,005**	**$0**	**$201,000**	**$100**	**1**

Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Carrizo-Wilcox Aquifer , Cypress Basin)	**275**	**334**	**379**	**425**	**517**	**560**
Drill New Wells (Carrizo-Wilcox Aquifer, Sulphur Basin)	**1,664**	**1,605**	**1,560**	**1,514**	**1,467**	**1,445**

The recommended strategies for the Titus County Livestock WUG to meet projected demands starting in 2020 is to construct additional water wells as needed by decade prior to increased needs over the 2020-2070 planning period. The recommended supply source will be the Carrizo-Wilcox Aquifer in Titus County, three wells in the Cypress Basin and seven wells in the Sulphur Basin all rated at 200 gpm. The portion of the Carrizo-Wilcox Aquifer in Titus County within these basins is projected to have adequate supply availability to provide this amount of supply over the planning period.



Attachment A

Livestock Titus Co
Recommended Strategy
Drill New Wells (Titus, Carrizo-Wilcox, Cypress)

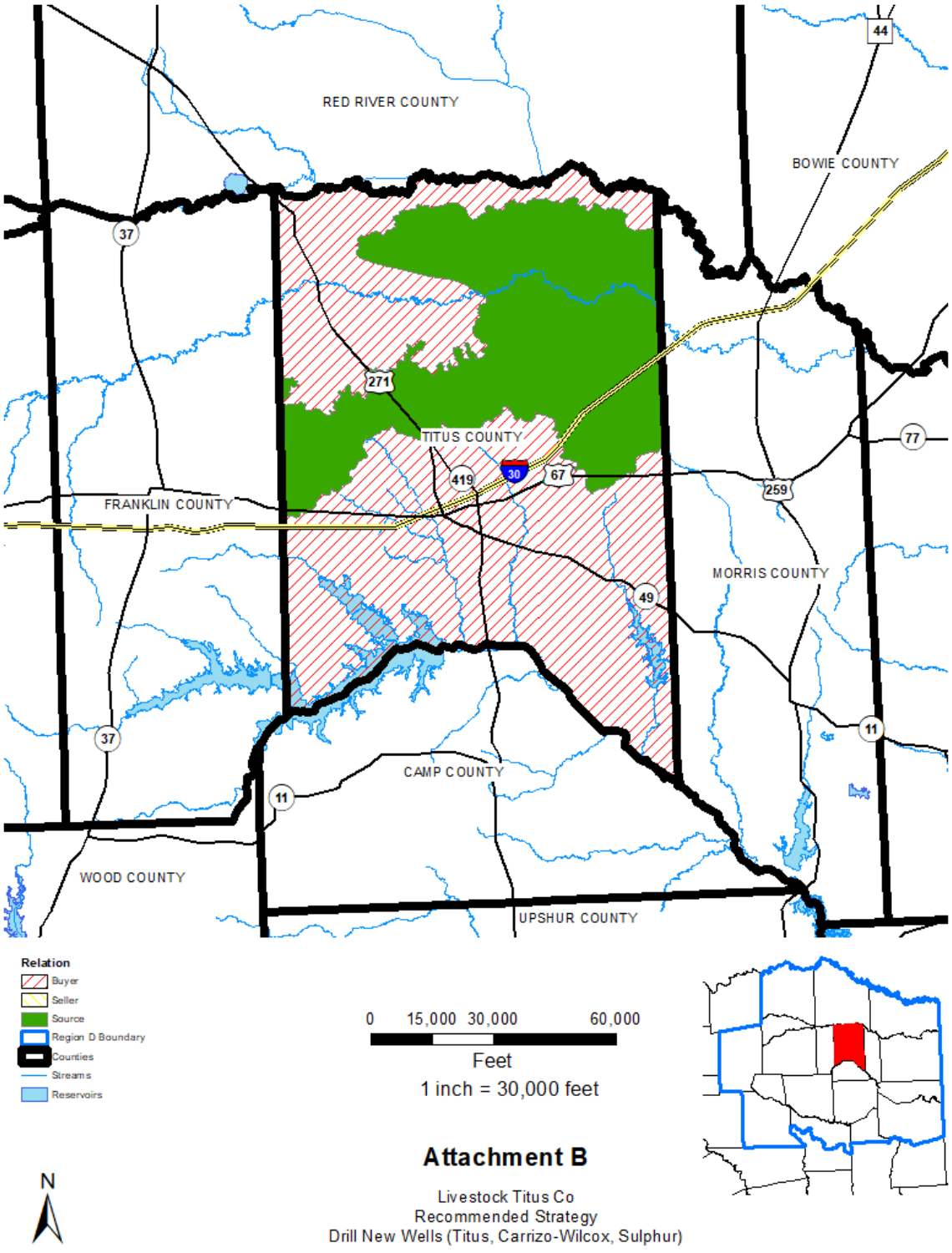
Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Livestock Titus County - Drill New Wells (Titus, Carrizo-Wilcox Aquifer, Cypress Basin)

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$1,566,000
TOTAL COST OF FACILITIES	**$1,566,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$548,000
Environmental & Archaeology Studies and Mitigation	$54,000
Land Acquisition and Surveying (5 acres)	$24,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$61,000
TOTAL COST OF PROJECT	**$2,253,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$158,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$16,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treamtent Facility	$0
Pumping Energy Costs (530935 kW-hr @ 0.08 $/kW-hr)	$42,000
Purchase of Water (560 acft/yr @ 500 $/acft)	$280,000
TOTAL ANNUAL COST	**$496,000**
Available Project Yield (acft/yr)	560
Annual Cost of Water ($ per acft), based on PF=1	$886
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$604
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$2.72
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.85

JMP *10/15/2019*



Attachment B

Livestock Titus Co
Recommended Strategy
Drill New Wells (Titus, Carrizo-Wilcox, Sulphur)

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Livestock Titus County - Drill New Wells (Titus, Carrizo-Wilcox Aquifer, Sulphur Basin)

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$3,639,000
TOTAL COST OF FACILITIES	**$3,639,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,274,000
Environmental & Archaeology Studies and Mitigation	$111,000
Land Acquisition and Surveying (10 acres)	$51,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$140,000
TOTAL COST OF PROJECT	**$5,215,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$367,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$36,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treamtent Facility	$0
Pumping Energy Costs (1581333 kW-hr @ 0.08 $/kW-hr)	$127,000
Purchase of Water (1664 acft/yr @ 500 $/acft)	$832,000
TOTAL ANNUAL COST	**$1,362,000**
Available Project Yield (acft/yr)	1,664
Annual Cost of Water ($ per acft), based on PF=1	$819
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$598
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$2.51
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.83

JMP *10/15/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF MANUFACTURING IN TITUS COUNTY

Description of Water User Group:

Manufacturing in Titus County has a demand that is projected to increase from 4,063 ac-ft/yr in 2020 to 4,155 ac-ft/yr by 2030 remaining constant through 2070. Manufacturing in Titus County is currently supplied by groundwater from the Carrizo-Wilcox Aquifer, direct reuse, and surface water from Tankersley and Bob Sandlin purchased from the City of Mount Pleasant. A deficit of 1,418 ac-ft/yr is projected to occur in 2030 and increase to 1,694 ac-ft/yr by 2070. The water supply contract with the City of Mount Pleasant for water from Bob Sandlin expires in 2028.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Projected Water Demand	4,063	4,155	4,155	4,155	4,155	4,155
Current Water Supply	5,392	2,737	2,860	2,850	2,591	2,461
Projected Supply Surplus (+)/Deficit(-)	**1,329**	**-1,418**	**-1,295**	**-1,305**	**-1,564**	**-1,694**

Evaluation of Potentially Feasible Water Management Strategies:

Multiple alternative strategies were considered to meet the Titus County Manufacturing WUG's water supply shortages. Advanced water conservation for manufacturing was considered in this planning effort to reduce overall demands; however, it does not resolve all identified needs. The use of reuse water from nearby municipalities was not considered in this planning period beyond those amounts currently reported by manufacturing entities in the county. Groundwater has been identified as a potential source of water for manufacturing in Titus County; however, manufacturing needs exceed the availability of groundwater in the basin based on the modeled available groundwater estimates. Surface water was considered as a potential alternative to meet projected demands, both individually, and in conjunction with drilling new wells.

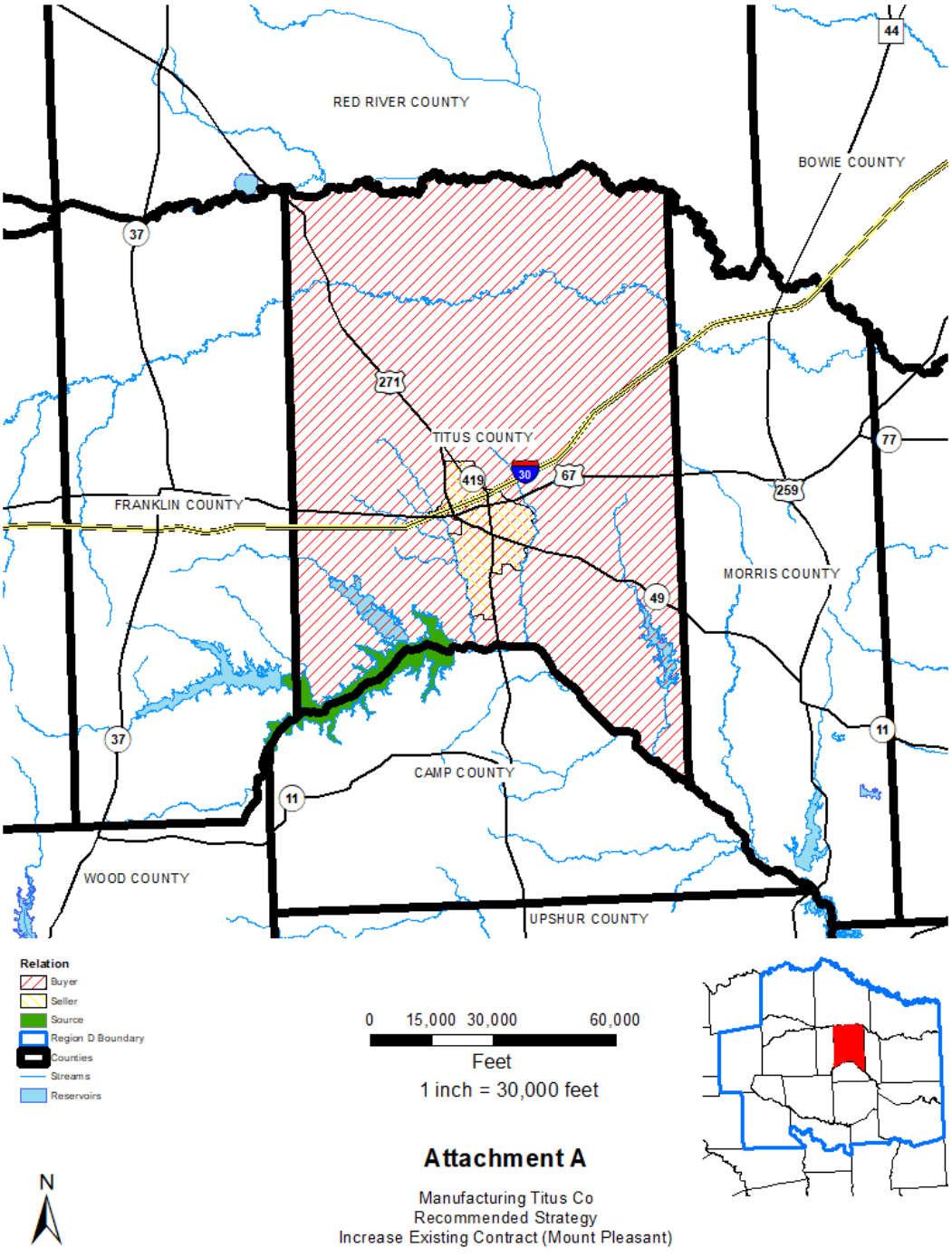
Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation	**415**	**$0**	**$0**	**$0**	**1**
Water Reuse					
Drill New Wells (Carrizo-Wilcox Aquifer, Cypress Basin)					
Drill New Wells (Carrizo-Wilcox Aquifer, Sulphur Basin)	**1,279**	**$3,679,000**	**$1,006,000**	**$787**	**1**
Renew and Increase Existing Contract (Mount Pleasant)	**1,279**	**$0**	**$1,000,000**	**$782**	**1**

Recommendations:

	2020	2030	2040	2050	2060	2070
Advanced Water Conservation (ac-ft/yr)	**0**	**415**	**415**	**415**	**415**	**415**
Renew and Increase Existing Contract (ac-ft/yr)	**0**	**1,003**	**880**	**890**	**1,149**	**1,279**

The recommended strategies for the Titus County Manufacturing WUG to meet projected demands starting in 2030 is to implement advanced conservation measures (via industrial water audits). It is projected that advanced conservation could produce up to 415 ac-ft of savings by the year 2070. The other recommended strategy, and most

significant in terms of supply, is for the renewal and increase of the existing contract(s) with the City of Mount Pleasant for raw water supply from Bob Sandlin Reservoir.



Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Titus County Manufacturing - Renew Contract with Mount Pleasant

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr)	$0
Purchase of Water (1279 acft/yr @ 782 $/acft)	$1,000,000
TOTAL ANNUAL COST	**$1,000,000**
Available Project Yield (acft/yr)	1,279
Annual Cost of Water ($ per acft), based on PF=1	$782
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$782
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$2.40
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$2.40

JMP *9/23/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF STEAM ELECTRIC POWER IN TITUS COUNTY

Description of Water User Group:

Steam Electric Power in Titus County has a demand that is projected to be a constant 61,931 ac-ft/yr for 2020 through 2070. Steam Electric Power in Titus County is currently supplied by groundwater from the Carrizo-Wilcox Aquifer, and surface water from Monticello, Lake O' the Pines, and Welsh purchased from Northeast Texas MWD and surface water from Bob Sandlin purchased from Titus County FWD #1. A deficit of 30,066 ac-ft/yr is projected to occur in 2020 and increase to 33,083 ac-ft/yr by 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Projected Water Demand	61,931	61,931	61,931	61,931	61,931	61,931
Current Water Supply	31,865	31,065	30,165	29,365	29,117	28,848
Projected Supply Surplus (+)/Deficit(-)	**-30,066**	**-30,866**	**-31,766**	**-32,566**	**-32,814**	**-33,083**

Evaluation of Potentially Feasible Water Management Strategies:

Five alternative strategies were considered to meet the Titus County Steam Electric Power WUG's water supply shortages. Advanced water conservation for steam electric power was considered in this planning effort to reduce overall demands, assuming conservation amounts based on the available literature for Business as Usual (BAU) for power generation derived from a BEG study. The use of reuse water from nearby municipalities was not considered in this planning period beyond those amounts currently reported by manufacturing entities in the county. It is assumed that reuse from the steam electric power WUG is already utilized. Groundwater has been identified as a potential source of water for steam electric power in Titus County; however, steam electric power needs significantly exceed the availability of groundwater in the basin based on the modeled available groundwater estimates. While historical water levels have remained relatively stable, and the MAG values may be conservative estimates, there is not enough data available to determine whether the aquifer can sustain a yield that is 14 to16 times greater than the MAG without additional modeling. Surface water from increasing existing contracts was considered as a potential alternative to meet projected demands.

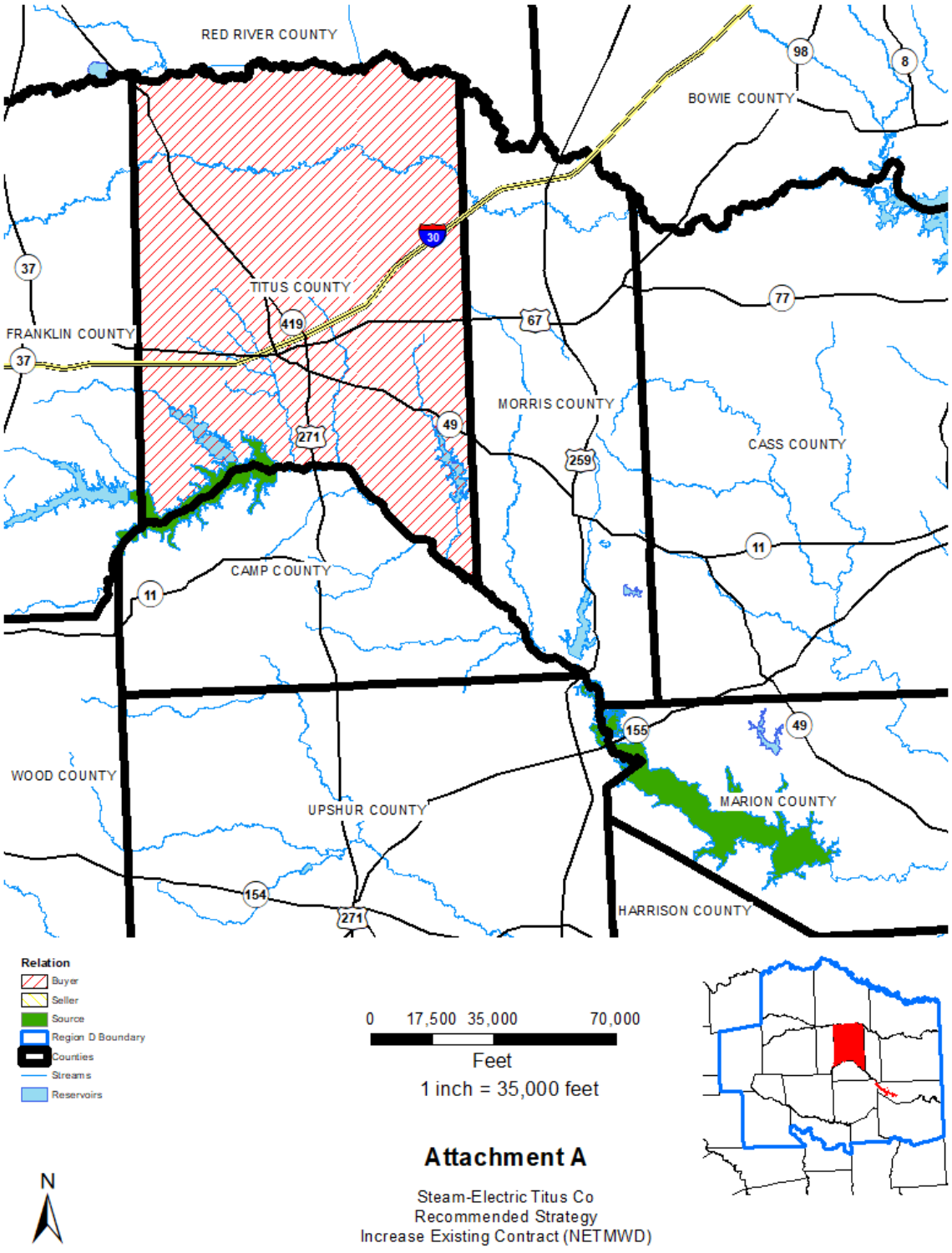
Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation	**33,083**	**$0**	**$0**	**$0**	**1**
Water Reuse					
Drill New Wells (Carrizo-Wilcox Aquifer, Cypress Basin)					
Increase Existing Contract (NETMWD)	**33,083**	**$0**	**$3,308,000**	**$100**	**1**
Increase Existing Contract (Bi County)					

Recommendations:

	2020	2030	2040	2050	2060	2070
Increase Existing Contract (NETMWD)	**30,066**	**30,866**	**31,766**	**32,566**	**32,814**	**33,083**

The recommended strategies for the Titus County Steam Electric WUG to meet projected demands starting in 2020 is to purchase additional supply from the NETMWD, which has sufficient surplus supplies in excess of existing and projected customer demands to meet these projected needs. Existing generation facilities in Titus County are presently served by Lake Bob Sandlin and Lake O' the Pines, so major infrastructure is already in place. Unit costs

have been calculated for the purchase of these supplies based on presently available information, and are utilized herein to present an order of magnitude estimation of present potential cost.



Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Titus County Steam Electric Power - Increase Existing Contract with NETMWD

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr)	$0
Purchase of Water (33083 acft/yr @ 100 $/acft)	$3,308,000
TOTAL ANNUAL COST	**$3,308,000**
Available Project Yield (acft/yr)	33,083
Annual Cost of Water ($ per acft), based on PF=1	$100
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$100
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.31
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.31

JMP *10/5/2019*

REGION D
EVALUATIONS OF WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

UPSHUR COUNTY

WUGs:

The City of Gilmer
Upshur County Livestock
Upshur County Manufacturing

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF CITY OF GILMER

Description of Water User Group:

The City of Gilmer system is located in central Upshur County and serves the incorporated area of the City. In 2018, the City had 2529 residential connections. The population is projected to increase from 5,695 persons in 2020 to 7,673 persons in 2070. The City is included as a W.U.G. in Upshur County. The system's current water supply consists of seven water wells from the Carrizo-Wilcox Aquifer. The total rated capacity of these wells is approximately 2280 GPM, or 1,226 ac-ft/yr. The system is bounded on the west and south by the Pritchett WSC, the east by Bi-County WSC, and the north by Sharon WSC. The System does have a water conservation plan. The System is projected to have a water supply surplus of 103 ac-ft/yr in 2020 decreasing to a deficit of 206 ac-ft/yr in 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	5695	6154	6548	6953	7325	7673
Projected Water Demand	1123	1184	1237	1301	1368	1432
Current Water Supply	1226	1226	1226	1226	1226	1226
Projected Supply Surplus (+)/Deficit(-)	**103**	**42**	**-11**	**-75**	**-142**	**-206**

Evaluation of Potentially Feasible Water Management Strategies:

Four alternative strategies were considered to meet the City's water supply shortages as summarized in the following table. Advanced conservation was not considered because the per capita use per day was below the 140 gpcpd threshold set by the planning group. Water reuse was not considered because the system does not have a demand for non-potable water. Surface water alternatives were omitted since surface water treatment is not economically feasible for a system of this size with available groundwater. Groundwater wells in the Carrizo-Wilcox Aquifer (Cypress Creek River Basin) were identified as a potentially feasible strategy for the City.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Groundwater (Carrizo-Wilcox Aquifer, Cypress Basin)	**216**	**$ 801,000**	**$ 69,000**	**$ 319**	**Minimal**
Surface Water					

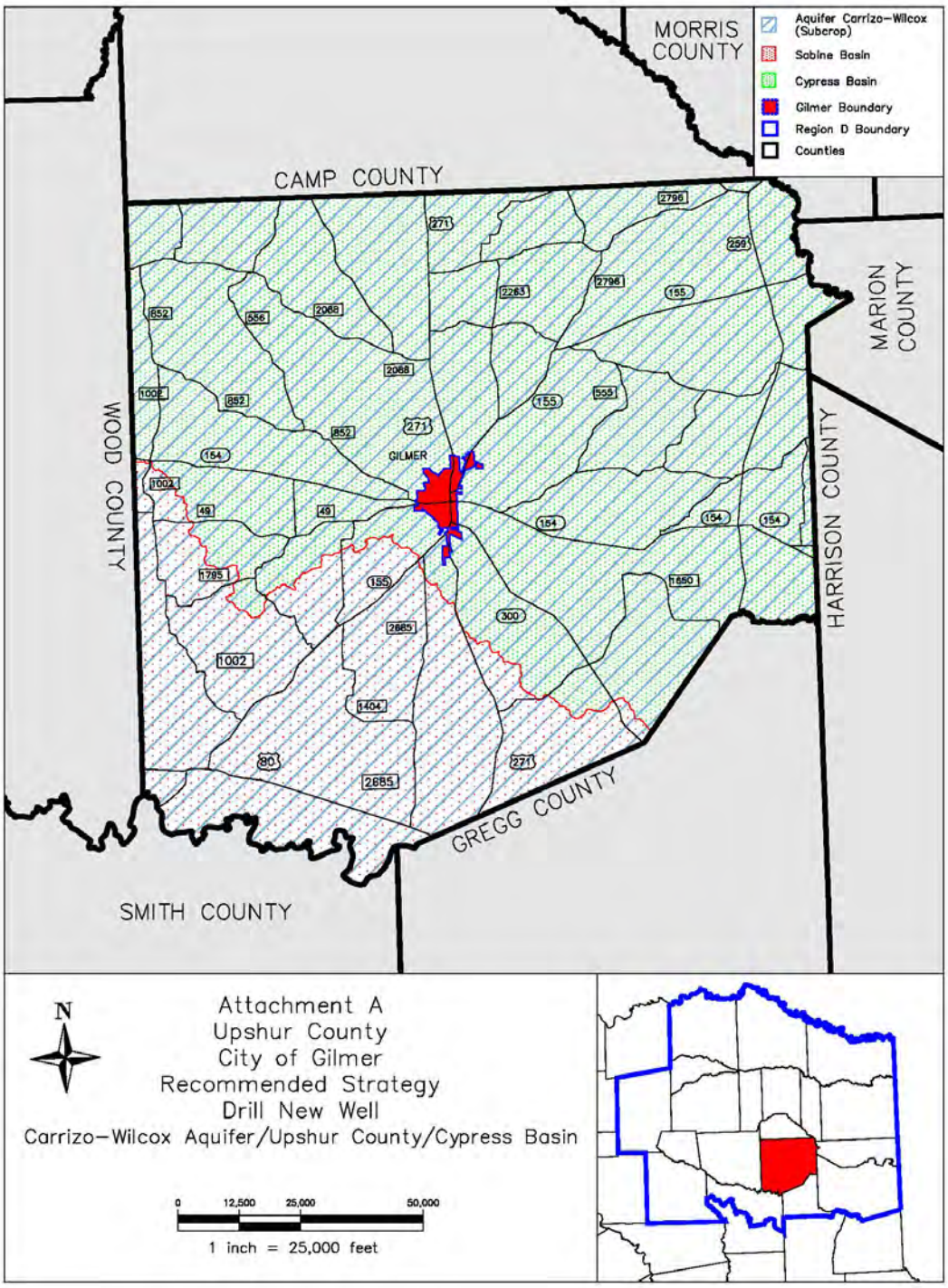
Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Carrizo-Wilcox Aquifer, Cypress Creek River Basin; ac-ft/yr)	0	0	216	216	216	216

The recommended strategy for the City to meet their projected deficit of 11 ac-ft/yr in 2040 and deficit of 206 ac-ft/yr in 2070 would be to construct one additional water well similar to other wells within their system just prior to each decade as the deficits occur. The recommended supply source will be the Carrizo Wilcox Aquifer in Upshur County. One well with rated capacity of 400 gpm would provide approximately 216 acre-feet/yr. The Carrizo Wilcox Aquifer (Cypress Creek River Basin) in Upshur County is projected to have a more than ample supply availability to meet the needs of Gilmer for the planning period.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices*	
Gilmer - Drill New Well Carrizo Wilcox Aquifer Uoshur Cypress	
Cost based on ENR CCI 11170.28 for September 2018 and	
a PPI of 202.4 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	$0
Terminal Storage (Conservation Pool acft, acres)	$0
Primary Pump Station (0 MGD)	$0
Transmission Pipeline (6 in dia., miles)	$0
Transmission Pump Station(s) & Storage Tank(s)	$0
Well Fields (Wells, Pumps, and Piping)	$567,000
Storage Tanks (Other Than at Booster Pump Stations)	$0
Water Treatment Plant (0 MGD)	$0
Advanced Water Treamtent Facility (MGD)	$0
Conservation (Leaking Pipe/Meter Replacement)	$0
Integration, Relocations, & Other	$0
TOTAL COST OF FACILITIES	**$567,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$199,000
Environmental & Archaeology Studies and Mitigation	$11,000
Land Acquisition and Surveying (1 acres)	$2,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$22,000
TOTAL COST OF PROJECT	**$801,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$56,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$6,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (87005 kW-hr @ 0.08 $/kW-hr)	$7,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$69,000**
Available Project Yield (acft/yr)	216
Annual Cost of Water ($ per acft), based on PF=1	$319
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$60
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.98
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.18
Stanley Hayes	*10/4/2019*


MORRIS COUNTY
CAMP COUNTY
MARION COUNTY
WOOD COUNTY
HARRISON COUNTY
GREGG COUNTY
SMITH COUNTY
GILMER
Aquifer Carrizo-Wilcox (Subcrop)
Sabine Basin
Cypress Basin
Gilmer Boundary
Region D Boundary
Counties
N
Attachment A
Upshur County
City of Gilmer
Recommended Strategy
Drill New Well
Carrizo-Wilcox Aquifer/Upshur County/Cypress Basin
0 12,500 25,000 50,000
1 inch = 25,000 feet

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS LIVESTOCK IN UPSHUR COUNTY

Description of Water User Group:

The Livestock WUG in Upshur County is a split entity and has a demand that is projected to be a constant 1,222 ac-ft/yr from 2020 to 2070. Livestock in Upshur County, Cypress has a current water supply consisting of water wells from the Carrizo-Wilcox Aquifer and Local Supplies. The total rated available supply from these sources is 1,158 ac-ft/yr in 2020 thru 2070. Livestock in Upshur County, Cypress is projected to have a water supply deficit of 64 ac-ft/yr in 2020 thru 2070. Livestock in Upshur County, Sabine is projected to have a water supply deficit of 76 ac-ft/yr in 2020 thru 2070.

Water Supply and Demand Analysis:

Livestock Upshur Cypress	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	1,222	1,222	1,222	1,222	1,222	1,222
Current Water Supply	1,158	1,158	1,158	1,158	1,158	1,158
Projected Supply Surplus (+)/Deficit(-)	-64	-64	-64	-64	-64	-64

Livestock Upshur Sabine	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	429	429	429	429	429	429
Current Water Supply	353	353	353	353	353	353
Projected Supply Surplus (+)/Deficit(-)	-76	-76	-76	-76	-76	-76

Evaluation of Potentially Feasible Water Management Strategies:

Four alternative strategies were considered to meet the Upshur County, Livestock, Cypress and Sabine water supply shortages as summarized in the following table. Advanced conservation and water reuse were not considered because the demands are very rural in nature. Surface water alternatives were utilized where currently available but increase in permit amounts are not available. Groundwater wells in the Queen City Aquifer (Cypress Creek and Sabine River basins) were identified as a potentially feasible strategy for the WUG.

Strategy	**Firm Yield (AF)**	**Total Capital Cost**	**Total Annualized Cost**	**Unit Cost**	**Environmental Impact**
Advanced Water Conservation					
Water Reuse					
Groundwater (Cypress)	**161**	**$ 172,000**	**$ 17,000**	**$ 106**	**1**
Groundwater (Sabine)	**161**	**$ 172,000**	**$ 17,000**	**$ 106**	**1**
Surface Water					

Recommendations:

	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Drill New Wells (Queen City Aquifer, Cypress Creek Basin; ac-ft/yr)	161	161	161	161	161	161
Drill New Wells (Queen City Aquifer, Sabine Basin; ac-ft/yr)	161	161	161	161	161	161

The recommended strategy for the Upshur County, Livestock, Cypress to meet their projected deficit of 64 ac-ft/yr in 2020 thru 2070 would be to construct one water well prior to 2020. The recommended supply source will be the Queen City Aquifer in Upshur County. Two wells with rated capacity of 100 gpm each would provide approximately 161 ac-ft/yr. One new well will be needed to provide the 64 ac-ft/yr needed. The Queen City Aquifer in Upshur County is projected to have a more than ample supply availability to meet the needs of the Livestock in Upshur County for the planning period.

The recommended strategy for the Upshur County, Livestock, Sabine to meet their projected deficit of 76 ac-ft/yr in 2020 thru 2070 would be to construct one water well prior to 2020. The recommended supply source will be the Queen City Aquifer in Upshur County. One well with rated capacity of 100 gpm each would provide approximately 161 ac-ft/yr. One new well will be needed to provide the 76 ac-ft/yr needed.

The Queen City Aquifer in Upshur County is projected to have a more than ample supply availability to meet the needs of the Livestock in Upshur County Sabine for the planning period.

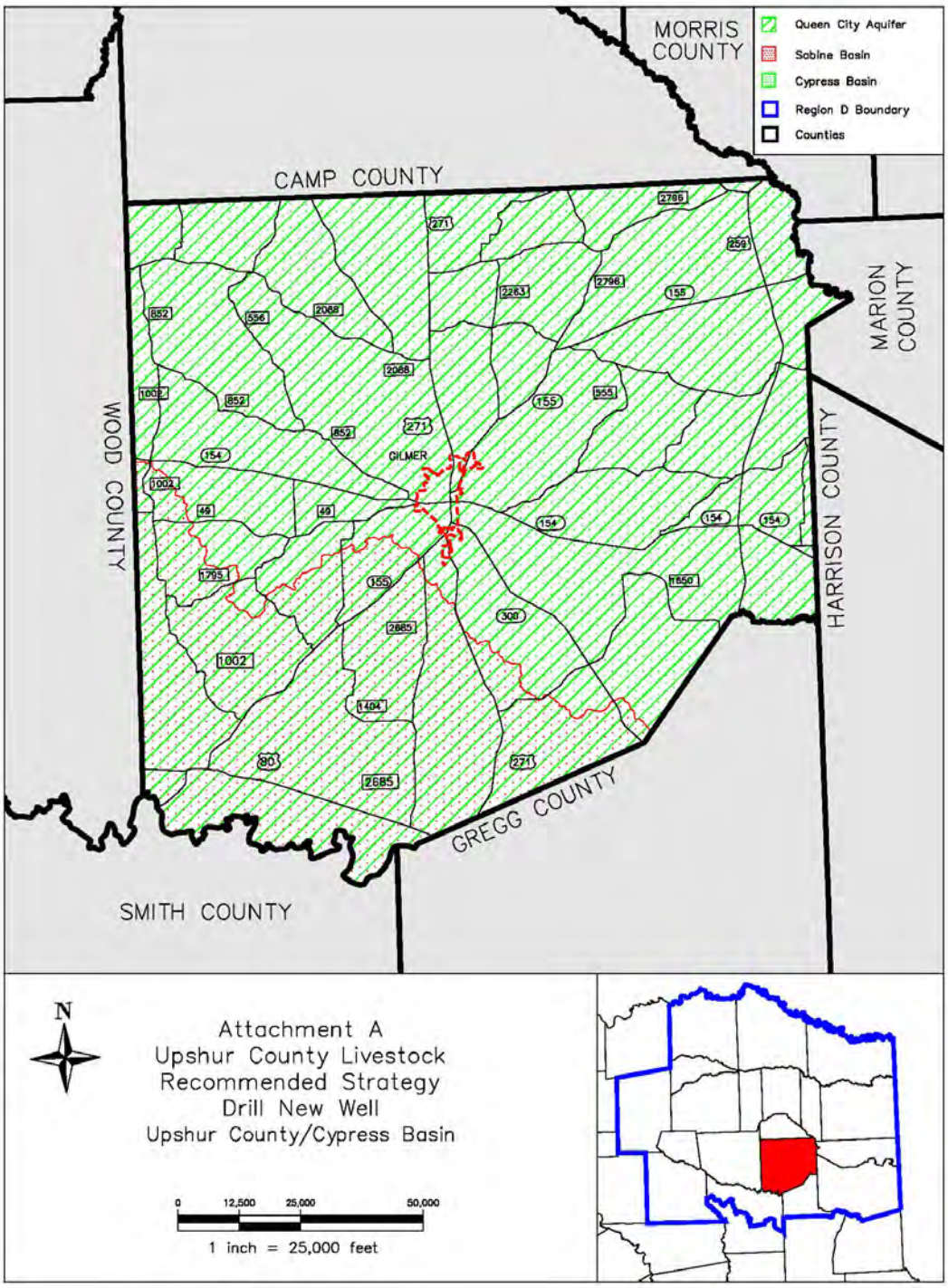
Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

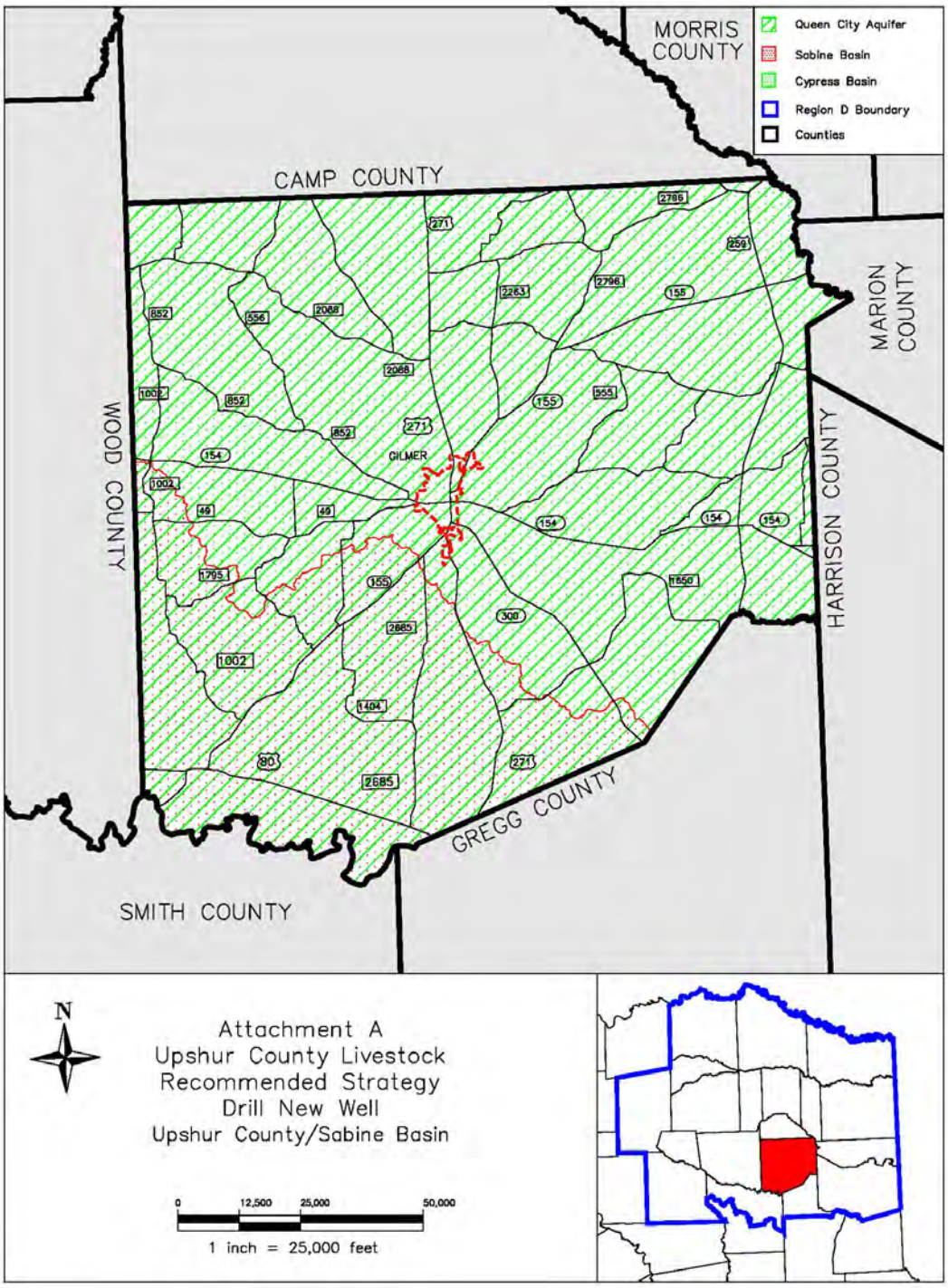
Livestock Upshur Cypress - Drill New Well Queen City Aquifer Upshur Cypress

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 202.4 for September 2018

Item	*Estimated Costs for Facilities*
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	$0
Terminal Storage (Conservation Pool acft, acres)	$0
Primary Pump Station (0 MGD)	$0
Transmission Pipeline (6 in dia., miles)	$0
Transmission Pump Station(s) & Storage Tank(s)	$0
Well Fields (Wells, Pumps, and Piping)	$124,000
Storage Tanks (Other Than at Booster Pump Stations)	$0
Water Treatment Plant (0 MGD)	$0
Advanced Water Treamtent Facility (MGD)	$0
Conservation (Leaking Pipe/Meter Replacement)	$0
Integration, Relocations, & Other	$0
TOTAL COST OF FACILITIES	**$124,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$43,000
Environmental & Archaeology Studies and Mitigation	$0
Land Acquisition and Surveying (1 acres)	$0
Interest During Construction (3% for 1 years with a 0.5% ROI)	$5,000
TOTAL COST OF PROJECT	**$172,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$12,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$1,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (56044 kW-hr @ 0.08 $/kW-hr)	$4,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$17,000**
Available Project Yield (acft/yr)	161
Annual Cost of Water ($ per acft), based on PF=1	$106
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$31
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.32
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.10
Stanley Hayes	*9/30/2019*


MORRIS COUNTY
CAMP COUNTY
MARION COUNTY
WOOD COUNTY
HARRISON COUNTY
GREGG COUNTY
SMITH COUNTY
GILMER
Queen City Aquifer
Sabine Basin
Cypress Basin
Region D Boundary
Counties
N
Attachment A
Upshur County Livestock
Recommended Strategy
Drill New Well
Upshur County/Cypress Basin
0 12,500 25,000 50,000
1 inch = 25,000 feet

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices*	
Livestock Upshur Sabine - Drill New Well Queen City Aquifer Upshur Sabine	
Cost based on ENR CCI 11170.28 for September 2018 and	
a PPI of 202.4 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	$0
Terminal Storage (Conservation Pool acft, acres)	$0
Primary Pump Station (0 MGD)	$0
Transmission Pipeline (6 in dia., miles)	$0
Transmission Pump Station(s) & Storage Tank(s)	$0
Well Fields (Wells, Pumps, and Piping)	$124,000
Storage Tanks (Other Than at Booster Pump Stations)	$0
Water Treatment Plant (0 MGD)	$0
Advanced Water Treamtent Facility (MGD)	$0
Conservation (Leaking Pipe/Meter Replacement)	$0
Integration, Relocations, & Other	$0
TOTAL COST OF FACILITIES	**$124,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$43,000
Environmental & Archaeology Studies and Mitigation	$0
Land Acquisition and Surveying (1 acres)	$0
Interest During Construction (3% for 1 years with a 0.5% ROI)	$5,000
TOTAL COST OF PROJECT	**$172,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$12,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$1,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (43978 kW-hr @ 0.08 $/kW-hr)	$4,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$17,000**
Available Project Yield (acft/yr)	161
Annual Cost of Water ($ per acft), based on PF=1	$106
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$31
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.32
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.10
Stanley Hayes	*10/4/2019*


MORRIS COUNTY
Queen City Aquifer
Sabine Basin
Cypress Basin
Region D Boundary
Counties
CAMP COUNTY
MARION COUNTY
WOOD COUNTY
HARRISON COUNTY
GILMER
GREGG COUNTY
SMITH COUNTY
N
Attachment A
Upshur County Livestock
Recommended Strategy
Drill New Well
Upshur County/Sabine Basin
0
12,500
25,000
50,000
1 inch = 25,000 feet

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS MANUFACTURING IN UPSHUR COUNTY

Description of Water User Group:

The Manufacturing WUG in Upshur County has a demand that is projected to be increasing from 69 ac-ft/yr in 2020 to 76 ac-ft/yr in 2070. Manufacturing in Upshur County has a current water supply consisting of water wells from the Carrizo-Wilcox Aquifer. The total rated available supply from these sources is 6 ac-ft/yr. Manufacturing in Upshur County is projected to have a water supply deficit of 63 ac-ft/yr in 2020 increasing to a deficit of 70 ac-ft/yr in 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Projected Water Demand	69	76	76	76	76	76
Current Water Supply	6	6	6	6	6	6
Projected Supply Surplus (+)/Deficit(-)	-63	-70	-70	-70	-70	-70

Evaluation of Potentially Feasible Water Management Strategies:

Three alternative strategies were considered to meet the Upshur County Manufacturing water supply shortages as summarized in the following table. Advanced conservation and water reuse was not considered because operational procedures for the existing mines is not available. Surface water alternatives were omitted since the deficiency is not significant enough to warrant surface supply. Groundwater wells in the Queen City Aquifer (Cypress Creek River Basin) were identified as a potentially feasible strategy for the WUG.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Groundwater (Queen City Aquifer, Cypress Creek River Basin)	**161**	**$ 172,000**	**$ 17,000**	**$ 106**	**1**
Surface Water					

Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Queen City Aquifer, Cypress Creek River Basin; ac-ft/yr)	161	161	161	161	161	161

The recommended strategy for the Upshur County Manufacturing to meet their projected deficit of 63 ac-ft/yr in 2020 and 70 ac-ft/yr in 2070 would be to construct one additional water well in the area just prior to the deficit. The recommended supply source will be the Queen City Aquifer in Upshur County. One well with rated capacity of 100 gpm would provide approximately 161 ac-ft/yr. The Carrizo Wilcox Aquifer in Upshur County (Cypress Basin) is projected to have a more than ample supply availability to meet the needs of the Manufacturing in Upshur County for the planning period.

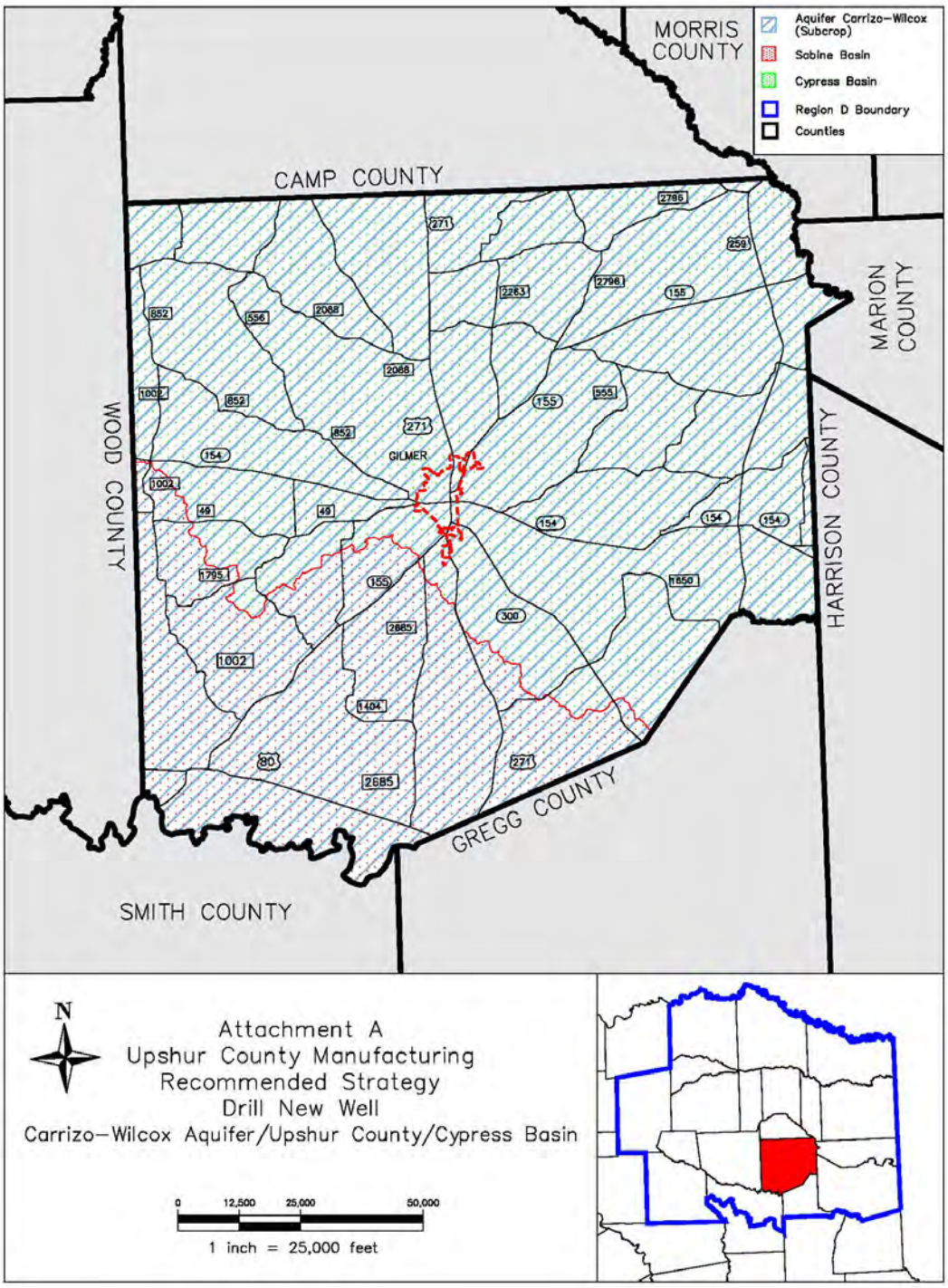
Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Manufacturing Upshur Cypress - Drill New Well Queen City Aquifer Upshur Cypress

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 202.4 for September 2018

Item	*Estimated Costs for Facilities*
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	$0
Terminal Storage (Conservation Pool acft, acres)	$0
Primary Pump Station (0 MGD)	$0
Transmission Pipeline (6 in dia., miles)	$0
Transmission Pump Station(s) & Storage Tank(s)	$0
Well Fields (Wells, Pumps, and Piping)	$124,000
Storage Tanks (Other Than at Booster Pump Stations)	$0
Water Treatment Plant (0 MGD)	$0
Advanced Water Treamtent Facility (MGD)	$0
Conservation (Leaking Pipe/Meter Replacement)	$0
Integration, Relocations, & Other	$0
TOTAL COST OF FACILITIES	**$124,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$43,000
Environmental & Archaeology Studies and Mitigation	$0
Land Acquisition and Surveying (1 acres)	$0
Interest During Construction (3% for 1 years with a 0.5% ROI)	$5,000
TOTAL COST OF PROJECT	**$172,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$12,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$1,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (56044 kW-hr @ 0.08 $/kW-hr)	$4,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$17,000**
Available Project Yield (acft/yr)	161
Annual Cost of Water ($ per acft), based on PF=1	$106
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$31
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.32
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.10
Stanley Hayes	*9/30/2019*


MORRIS COUNTY
CAMP COUNTY
MARION COUNTY
HARRISON COUNTY
WOOD COUNTY
GREGG COUNTY
SMITH COUNTY
GILMER
Aquifer Carrizo-Wilcox (Subcrop)
Sabine Basin
Cypress Basin
Region D Boundary
Counties
N
Attachment A
Upshur County Manufacturing
Recommended Strategy
Drill New Well
Carrizo-Wilcox Aquifer/Upshur County/Cypress Basin
0 12,500 25,000 50,000
1 inch = 25,000 feet

REGION D
EVALUATIONS OF WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

VAN ZANDT COUNTY

WUGs:

The City of Canton
Edom WSC
Van Zandt County Irrigation
Little Hope Moore WSC
Van Zandt County Manufacturing
R-P-M WSC

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF CITY OF CANTON

Description of Water User Group:

The City of Canton provides water service in Van Zandt County. The city's population is projected to be 3,963 by 2020 and increasing to 5,329 by 2070. The City of Canton utilizes groundwater from the Carrizo-Wilcox aquifer, and surface water from Mill Creek Reservoir and a run of river water right for water supplies. The City of Canton is not projected to have a shortage during the planning period.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Population	3,963	4,333	4,616	4,897	5,130	5,329
Projected Water Demand	961	1,032	1,085	1,143	1,196	1,242
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	1,544	1,544	1,544	1,544	1,544	1,544
Projected Supply Surplus (+) / Deficit (-)	**583**	**512**	**459**	**401**	**327**	**281**

Projected Supply Surplus (+) / Deficit (-) by Basin	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Sabine	583	512	459	401	327	281
Trinity	0	0	0	0	0	0
Total	**583**	**512**	**459**	**401**	**327**	**281**

Evaluation of Potentially Feasible Water Management Strategies:

In 2008, the Canton City council authorized the appropriation of $70,000 to prepare a long-term water plan. The project evaluated four (4) reservoir sites in Van Zandt County. Two of the four proved to be feasible from a technical standpoint. The City spent an additional $30,000 in 2009 and 2010 to address questions and provide additional information requested by the committee members. In addition to these two long-term strategies, two additional water wells were included to satisfy short-term needs. These two additional wells have been completed. Additional groundwater supply is a potentially feasible strategy. Water reuse is a potentially feasible water supply strategy, as the City currently has a water rights application pending at the Texas Commission on Environmental Quality for the authorization of indirect reuse. At the request of the City of Canton, the construction of an additional water well by 2020 was identified as a feasible strategy because the City of Canton is planning on developing additional groundwater supply to supplement existing supplies. Also at the request of the City, a potential new reservoir on Grand Saline Creek was also considered as a feasible strategy for the City.

Strategy	Firm Yield (ac-ft)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Indirect/Direct Reuse	**323**	**$8,381,000**	**$1,063,000**	**$3,291**	**2**
Drill New Well (Carrizo-Wilcox, Sabine Basin)	**100**	**$716,000**	**$142,000**	**$1,420**	**1**
New Reservoir on Grand Saline Creek	**1,810**	**$62,966,000**	**$3,896,000**	**$2,152**	**5**

New Reservoir on Grand Saline Creek – The City has identified a feasible strategy to meet future water supply needs as being the construction of a new 1,845 acre (24,980 ac-ft) reservoir on Grand Saline Creek, a tributary of Sabine River. This reservoir project was originally described in a 2008 report from Gary Burton Engineering, Inc. to the City of Canton, entitled *Long-Term Water Study Surface Water Supply.*

The 2008 report identified the project site, reservoir surface area, drainage area, and estimated construction costs for the reservoir, intake structure, transmission pipeline, and water treatment plant expansion.

The construction costs associated with the new reservoir, raw water transmission line, and water treatment plant expansion are based on calculations from the UCM. For the 2021 planning process, the reservoir has been modeled in the Sabine River WAM (Run 3), subject to SB 3 environmental flow criteria at a junior priority date, and modeled considering the full demand of existing water rights in the Sabine River Basin. The results of this WAM analysis indicate the project has a firm yield of 1,810 ac-ft per year. The project is estimated to yield 1,810 ac-ft/yr of supply by constructing a new 24,980 ac-ft reservoir and 14" pipeline to Canton's WTP and expanding the WTP, for a total project cost of $63 million with an annual cost of $3.9 million and a unit cost for the additional supply of $2,152 per ac-ft. with debt service and $265 per ac-ft without debt service.

Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Carrizo-Wilcox, Sabine) (ac-ft/yr)	100	100	100	100	100	100
Indirect/Direct Reuse	256	256	256	256	227	227

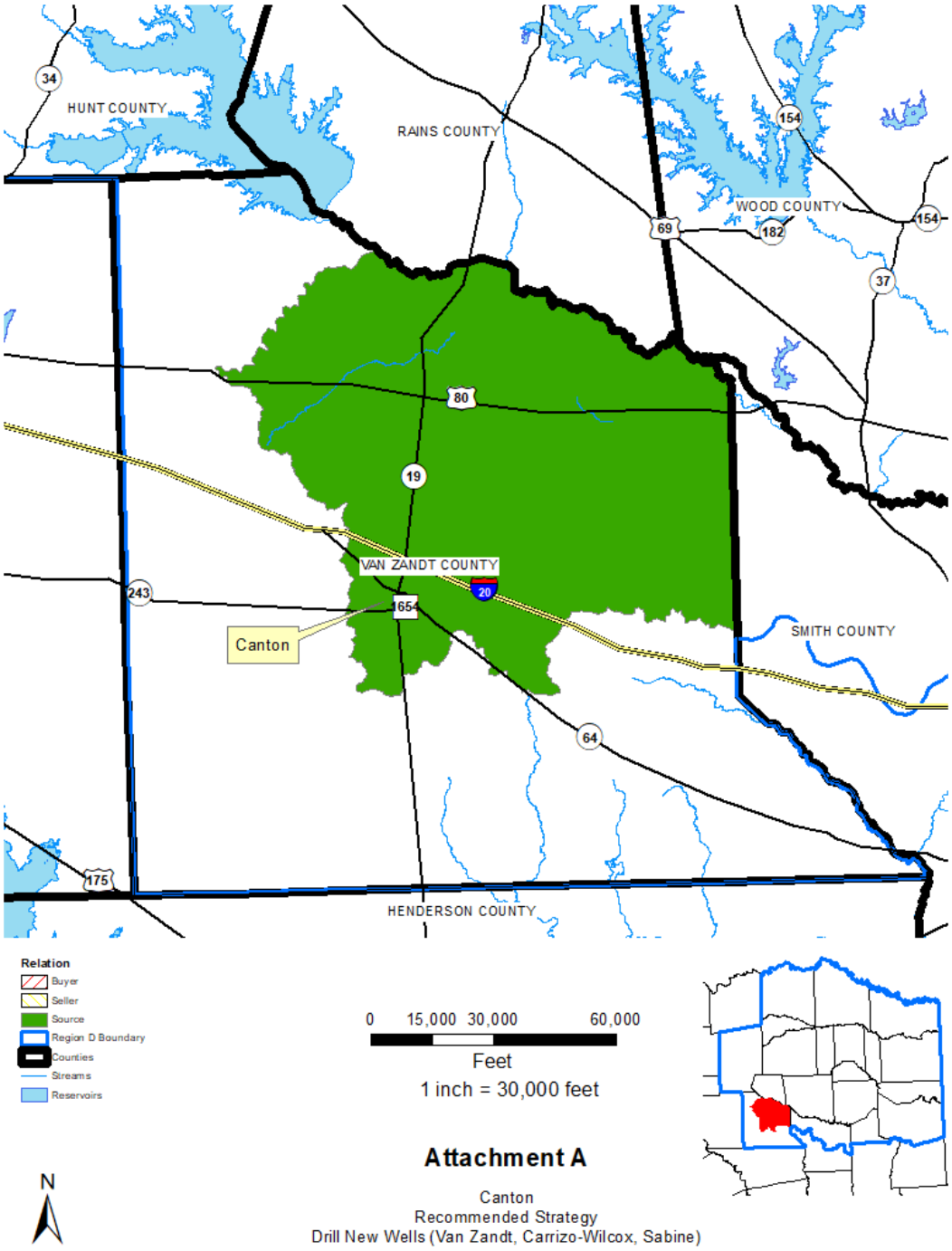
The recommended strategy for the City of Canton is to construct by 2020 an additional water well similar to existing wells in the area. The recommended supply source will be the Carrizo-Wilcox Aquifer in the Sabine Basin in Van Zandt County. One well with rated capacity of 180 gpm would provide approximately 100 ac-ft/yr. The Carrizo-Wilcox Aquifer in Van Zandt County is projected to have sufficient supply availability to provide this supply for the planning period.

A second recommended water conservation strategy option is the utilization of both direct and indirect water reuse. The City of Canton has submitted an application to the TCEQ to secure a water right for indirect reuse and may also seek to secure an authorization for direct reuse. These recommendations are based upon current NETRWPG population projections for the City of Canton.

Because of substantial disagreement over future population and water demands, the City has requested the following alternate strategy:

> The strategy to meet future needs "is with surface water from a proposed reservoir on Grand Saline Creek. The City of Canton has provided to NETRWPG resolutions from three other cities in Van Zandt County supporting the reservoir project. This show of support indicates that a regional surface water reservoir could possibly replace the groundwater strategies for other Van Zandt County public water supplies with projected deficits. However, due to the time typically required to obtain the necessary permits to impound surface water, the City plans to construct one or two additional wells, or implement a reuse option in the interim to meet increasing demands due to population growth and the First Monday influence."

This alternative wording should be considered consistent with this plan in the event that population growth in the potential service area significantly exceeds current NETRWPG projections.



Attachment A

Canton
Recommended Strategy
Drill New Wells (Van Zandt, Carrizo-Wilcox, Sabine)

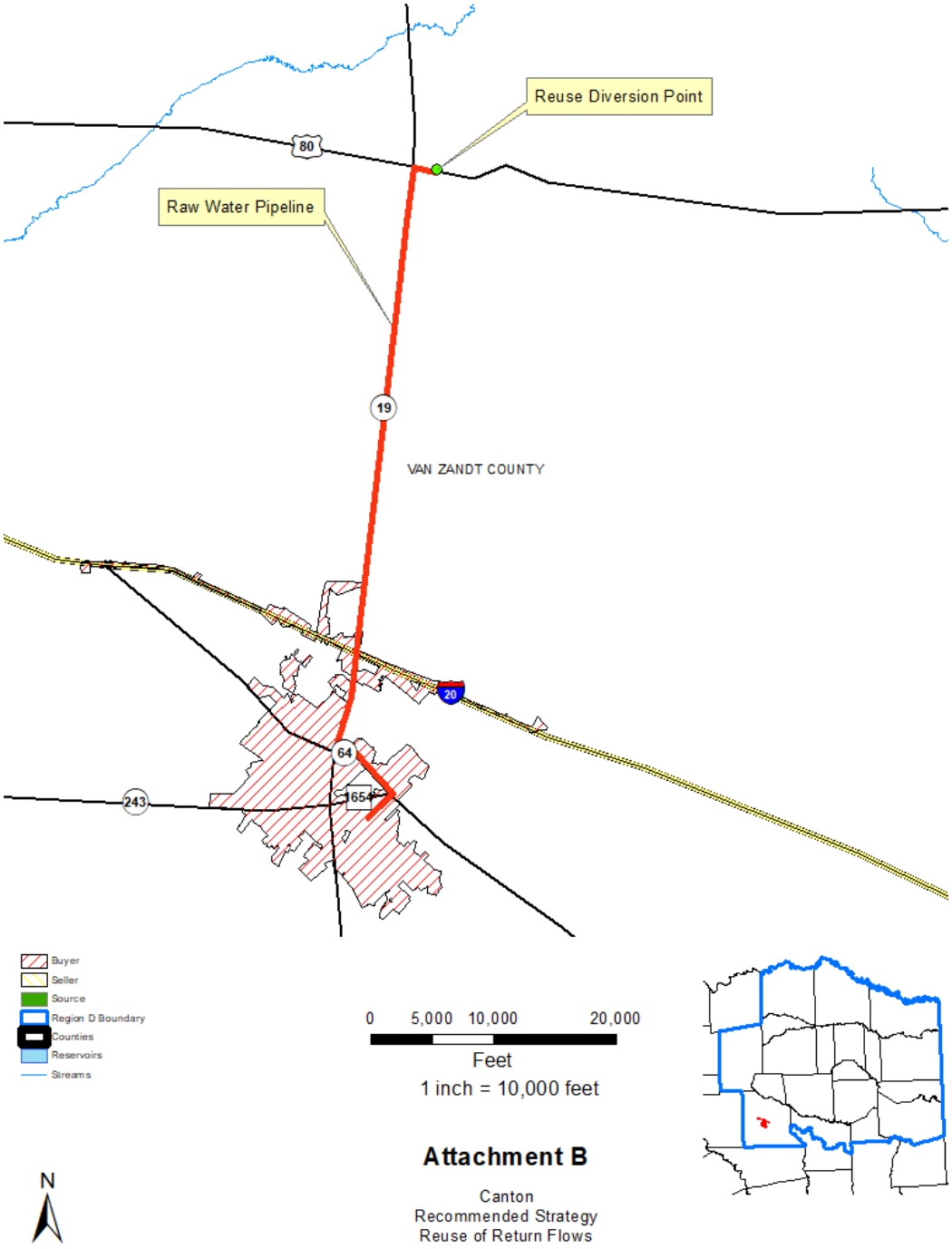
Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Canton - Drill New Wells (Van Zandt Sabine Carrizo Wilcox

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$450,000
Water Treatment Plant (0.5 MGD)	$52,000
TOTAL COST OF FACILITIES	**$502,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$176,000
Environmental & Archaeology Studies and Mitigation	$11,000
Land Acquisition and Surveying (1 acres)	$7,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$20,000
TOTAL COST OF PROJECT	**$716,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$50,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$4,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$31,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (88891 kW-hr @ 0.08 $/kW-hr)	$7,000
Purchase of Water (100 acft/yr @ 500 $/acft)	$50,000
TOTAL ANNUAL COST	**$142,000**
Available Project Yield (acft/yr)	100
Annual Cost of Water ($ per acft), based on PF=1	$1,420
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$920
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$4.36
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$2.82

JMP *10/6/2019*



Attachment B

Canton
Recommended Strategy
Reuse of Return Flows

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Canton - Indirect Reuse

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Primary Pump Station (0 MGD)	$3,437,000
Transmission Pipeline (0 in dia., miles)	$2,336,000
TOTAL COST OF FACILITIES	**$5,773,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,904,000
Environmental & Archaeology Studies and Mitigation	$304,000
Land Acquisition and Surveying (32 acres)	$175,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$225,000
TOTAL COST OF PROJECT	**$8,381,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$590,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$23,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$86,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$356,000
Pumping Energy Costs (99064 kW-hr @ 0.08 $/kW-hr)	$8,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$1,063,000**
Available Project Yield (acft/yr)	323
Annual Cost of Water ($ per acft), based on PF=1.8	$3,291
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.8	$1,464
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.8	$10.10
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.8	$4.49

JMP *11/15/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF EDOM WATER SUPPLY CORPORATION IN VAN ZANDT COUNTY

Description of Water User Group:

Edom WSC provides water service in Van Zandt and Henderson Counties. The WUG population is projected to be 1,395 by 2020 and increases to 2,025 by 2070. Edom WSC supplies its customers with groundwater from the Carrizo-Wilcox aquifer with water wells in Van Zandt County. Edom WSC is projected to have a total deficit of 13 ac-ft/yr in 2020 and increasing to a deficit of 64 ac-ft/yr by 2070; the shortage projected to occur in Van Zandt County is 11 ac-ft/yr in 2020 increasing to 55 ac-ft/yr by 2070. The shortage in Henderson County is 2 ac-ft/yr in 2020, increasing to 9 ac-ft/yr in 2070.

Water Supply and Demand Analysis:

Edom WSC	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Population	1,395	1,526	1,631	1,740	1,878	2,025
Projected Water Demand	152	160	166	176	188	203
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	139	139	139	139	139	139
Projected Supply Surplus (+) / Deficit (-)	**-13**	**-21**	**-27**	**-37**	**-49**	**-64**

Projected Supply Surplus (+) / Deficit (-) by County	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Van Zandt	-11	-18	-23	-32	-42	-55
Henderson	-2	-3	-4	-5	-7	-9
Total	**-13**	**-21**	**-27**	**-37**	**-49**	**-64**

Evaluation of Potentially Feasible Water Management Strategies:

Four alternative strategies were considered to meet the WSC's water supply shortages as summarized in the following table. Advanced conservation was not selected because the per capita use per day was less than the 140 gpcd threshold set by the water planning group. Water reuse was not considered because the WSC does not have a demand for non-potable water. Surface water was not considered because the WSC does not currently have surface water treatment. Groundwater has been identified as a potential strategy for Edom WSC.

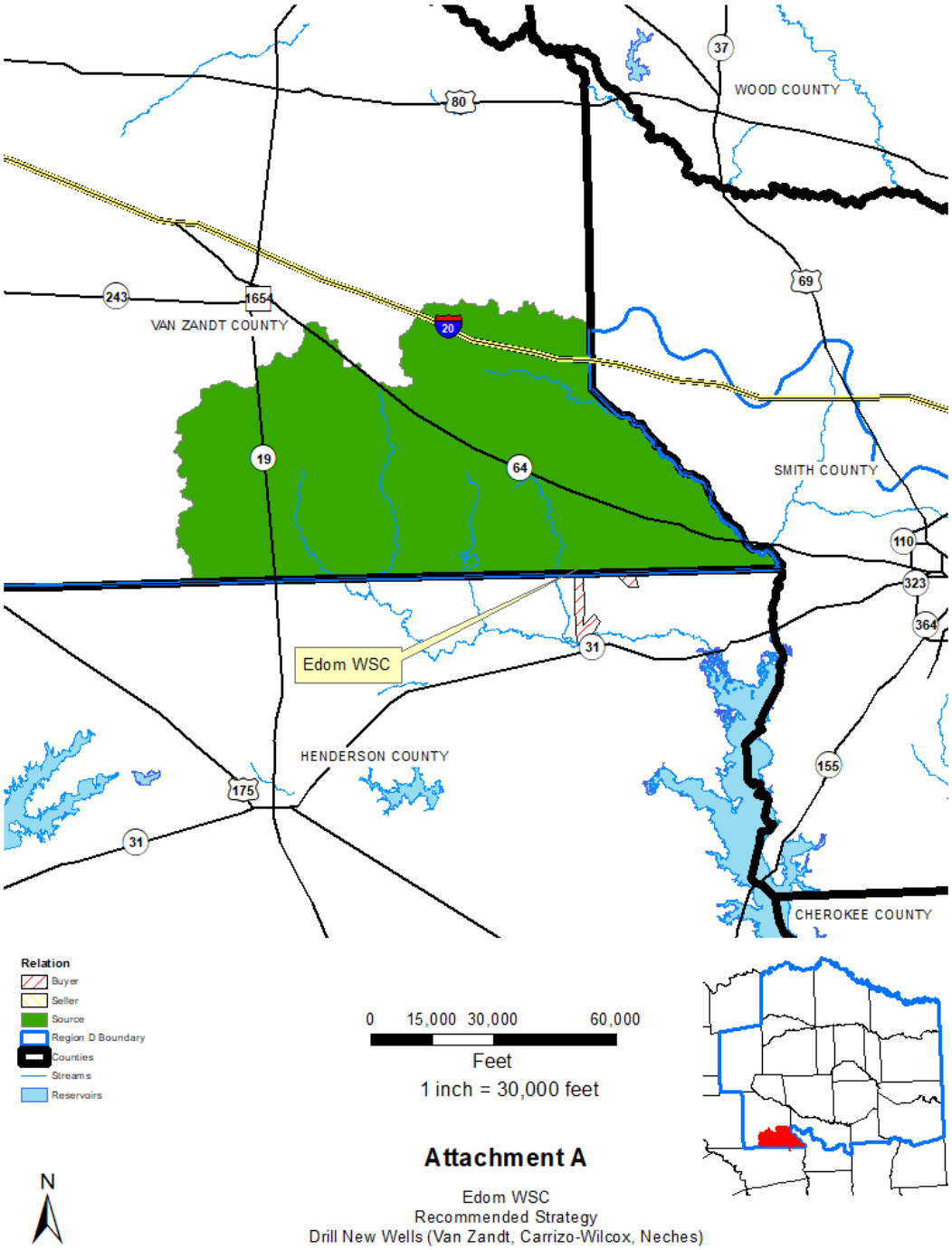
Strategy	**Firm Yield (ac-ft)**	**Total Capital Cost**	**Total Annualized Cost**	**Unit Cost**	**Environmental Impact**
Demand Reduction					
Water Reuse					
Drill New Wells (Carrizo-Wilcox Aquifer, Neches Basin)	**64**	**$1,088,000**	**$136,000**	**$2,125**	**1**
Drill New Wells (Queen City Aquifer, Neches Basin)					

Recommendations:

	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Drill New Wells (Carrizo-Wilcox, Neches Basin; ac-ft/yr)	13	21	27	37	49	64

The recommended strategy for Edom WSC to meet their projected deficit of 13 ac-ft/yr in 2020 up to 64 ac-ft/yr in 2070 would be to construct three additional water wells similar to their existing wells just prior to each decade as the deficits occur. The recommended supply source will be the Carrizo-Wilcox Aquifer

in the Neches Basin in Van Zandt County. One well with rated capacity of 50 gpm each, pumping at an approximately depth of 560 ft., would provide approximately 27 acre-feet each.



Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

EDOM WSC - Drill New Wells (Van Zandt, Carrizo-Wilcox Aquifer, Neches Basin)

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$715,000
Water Treatment Plant (0.2 MGD)	$28,000
TOTAL COST OF FACILITIES	**$743,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$260,000
Environmental & Archaeology Studies and Mitigation	$36,000
Land Acquisition and Surveying (3 acres)	$19,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$30,000
TOTAL COST OF PROJECT	**$1,088,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$77,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$7,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$17,000
Advanced Water Treamtent Facility	$0
Pumping Energy Costs (41446 kW-hr @ 0.08 $/kW-hr)	$3,000
Purchase of Water (64 acft/yr @ 500 $/acft)	$32,000
TOTAL ANNUAL COST	**$136,000**
Available Project Yield (acft/yr)	64
Annual Cost of Water ($ per acft), based on PF=1	$2,125
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$922
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$6.52
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$2.83

JMP *9/30/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF IRRIGATION IN VAN ZANDT COUNTY

Description of Water User Group:

The Irrigation WUG in Van Zandt County has a demand that is projected to remain constant at 500 ac-ft/yr for the planning period. The Irrigation WUG in Van Zandt County is currently supplied by groundwater from the Carrizo-Wilcox Aquifer and run-of-river diversions on the Sabine and Neches Rivers. A deficit of 68 ac-ft/yr is projected to occur in throughout the planning period.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Projected Water Demand	500	500	500	500	500	500
Current Water Supply	457	439	437	436	434	432
Projected Supply Surplus (+)/Deficit(-)	**-43**	**-61**	**-63**	**-64**	**-66**	**-68**

Evaluation of Potentially Feasible Water Management Strategies:

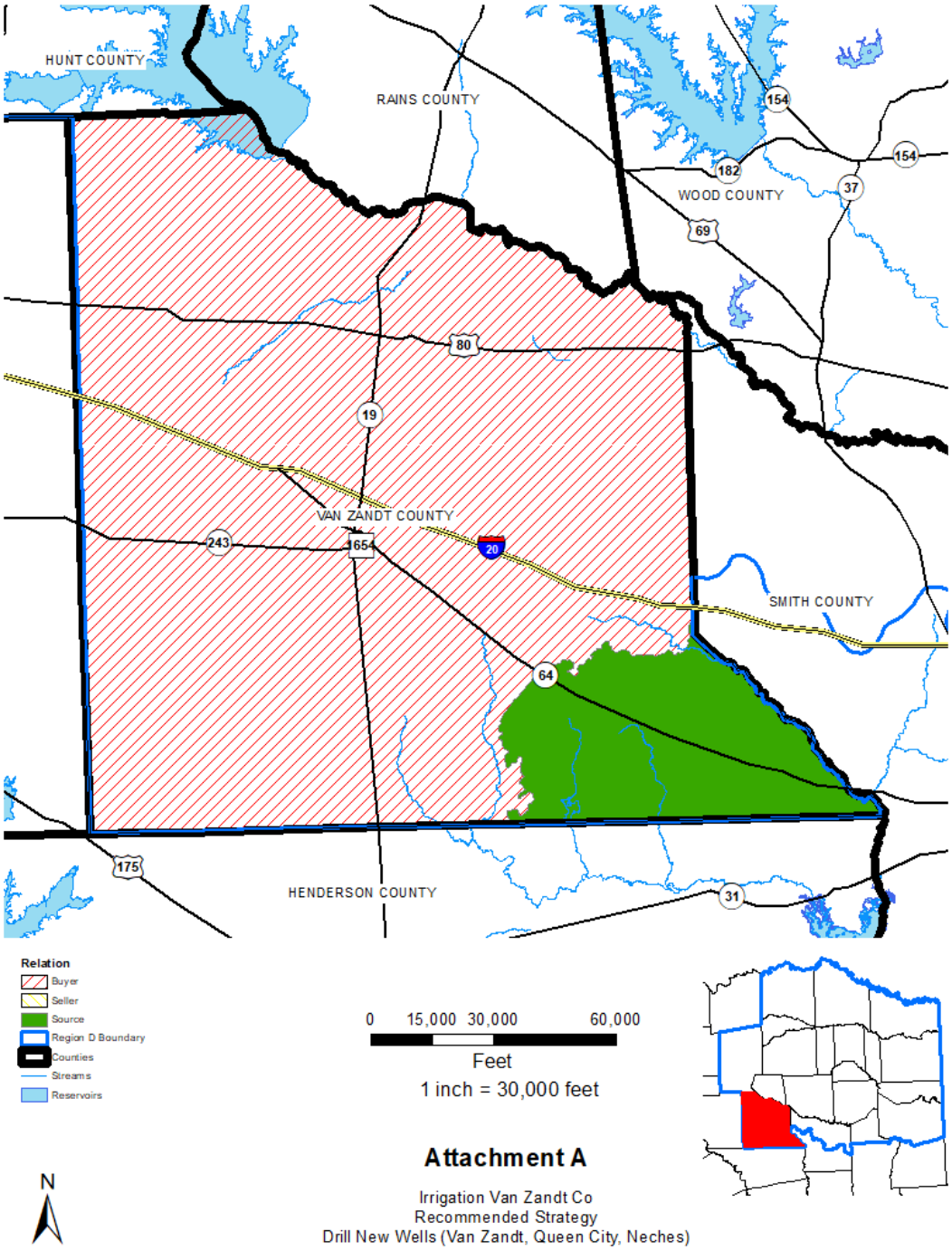
Six alternative strategies were considered to meet the Van Zandt County Irrigation WUG's water supply shortages. Advanced water conservation for irrigation practices were not considered in this planning effort for irrigation. The use of reuse water from nearby municipalities is not considered feasible as it would not be effective to deliver reuse water to farm irrigation systems. Groundwater from the Carrizo-Wilcox and Queen City aquifers has been identified as a potential source of water for irrigation in Van Zandt. Surface water has been evaluated as a potential water source.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Drill New Wells (Carrizo-Wilcox Aquifer, Trinity Basin)					
Drill New Wells (Queen City Aquifer, Neches Basin)	**68**	**$825,000**	**$103,000**	**$1,515**	**1**
New Surface Water Right in Sabine Basin	**0**				
New Surface Water Right in Neches Basin	**0**				

Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Queen City, Neches) (ac-ft/yr)	**43**	**61**	**63**	**64**	**66**	**68**

The recommended strategy for Irrigation in Van Zandt County is to construct by 2020 two additional water wells similar to existing wells in the area. The recommended supply source will be the Queen City Aquifer in the Neches River Basin in Van Zandt County. Two wells with rated capacity of 50 gpm would provide the needed 68 ac-ft/yr. The Queen City Aquifer in Van Zandt County is projected to have sufficient supply availability to provide this supply for the planning period.



Attachment A

Irrigation Van Zandt Co
Recommended Strategy
Drill New Wells (Van Zandt, Queen City, Neches)

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Irrigation Van Zandt - Drill New Wells (Van Zandt, Queen City Aquifer, Neches Basin)

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$562,000
TOTAL COST OF FACILITIES	**$562,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$197,000
Environmental & Archaeology Studies and Mitigation	$29,000
Land Acquisition and Surveying (3 acres)	$14,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$23,000
TOTAL COST OF PROJECT	**$825,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$58,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$6,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (57307 kW-hr @ 0.08 $/kW-hr)	$5,000
Purchase of Water (68 acft/yr @ 500 $/acft)	$34,000
TOTAL ANNUAL COST	**$103,000**
Available Project Yield (acft/yr)	68
Annual Cost of Water ($ per acft), based on PF=1	$1,515
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$662
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$4.65
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$2.03

JMP *9/30/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF LITTLE HOPE MOORE WATER SUPPLY CORPORATION IN VAN ZANDT COUNTY

Description of Water User Group:

Little Hope Moore WSC provides water service in Van Zandt County. The WUG population is projected to be 1,480 by 2020 and increases to 2,012 by 2070. Little Hope Moore WSC supplies its customers with groundwater from the Carrizo-Wilcox aquifer in Van Zandt County. Little Hope Moore WSC is projected to have a total deficit of 3 ac-ft/yr in 2050 and increasing to a deficit of 17 ac-ft/yr by 2070.

Water Supply and Demand Analysis:

Little Hope Moore WSC	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Population	1,480	1,625	1,734	1,843	1,935	2,012
Projected Water Demand	147	155	160	168	176	182
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	165	165	165	165	165	165
Projected Supply Surplus (+) / Deficit (-)	**18**	**10**	**5**	**-3**	**-11**	**-17**

Evaluation of Potentially Feasible Water Management Strategies:

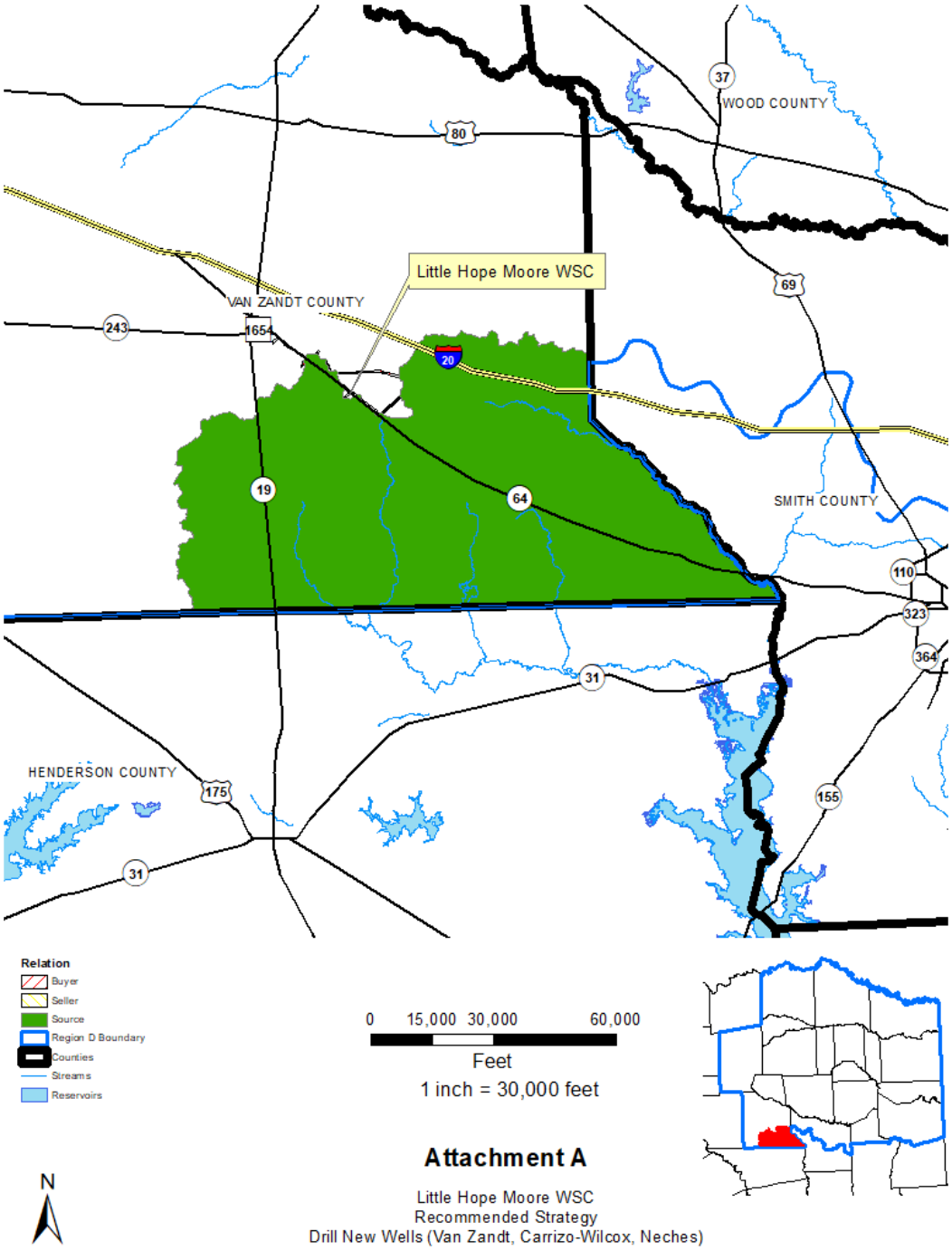
Four alternative strategies were considered to meet the WSC's water supply shortages as summarized in the following table. Advanced conservation was not selected because the per capita use per day was less than the 140 gpcd threshold set by the water planning group. Water reuse was not considered feasible because the WSC does not have a demand for non-potable water. Surface water was not considered cost effective because the WSC does not currently have surface water treatment. Groundwater has been identified as a potential strategy for Little Hope Moore WSC.

Strategy	**Firm Yield (ac-ft)**	**Total Capital Cost**	**Total Annualized Cost**	**Unit Cost**	**Environmental Impact**
Demand Reduction					
Water Reuse					
Drill New Wells (Carrizo-Wilcox Aquifer, Neches Basin)	**17**	**$371,000**	**$44,000**	**$2,588**	**1**
Drill New Wells (Queen City Aquifer, Neches Basin)					

Recommendations:

	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Drill New Wells (Carrizo-Wilcox, Neches Basin; ac-ft/yr)	0	0	0	3	11	17

The recommended strategy for Little Hope Moore WSC to meet their projected deficit of 3 ac-ft/yr in 2050 and 17 ac-ft/yr in 2070 would be to construct an additional water well similar to their existing wells. The recommended supply source will be the Carrizo-Wilcox Aquifer in the Neches Basin in Van Zandt County. One well with rated capacity of 50 gpm each, pumping at an approximately depth of 560 ft., would provide approximately 27 acre-feet each.



Attachment A

Little Hope Moore WSC
Recommended Strategy
Drill New Wells (Van Zandt, Carrizo-Wilcox, Neches)

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Little Hope Moore - Drill New Wells (Van Zandt, Carrizo-Wilcox Aquifer, Neches Basin)

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$249,000
Water Treatment Plant (0 MGD)	$11,000
TOTAL COST OF FACILITIES	**$260,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$91,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (1 acres)	$4,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$10,000
TOTAL COST OF PROJECT	**$371,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$26,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$2,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$6,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (13530 kW-hr @ 0.08 $/kW-hr)	$1,000
Purchase of Water (17 acft/yr @ 500 $/acft)	$9,000
TOTAL ANNUAL COST	**$44,000**
Available Project Yield (acft/yr)	17
Annual Cost of Water ($ per acft), based on PF=1	$2,588
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$1,059
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$7.94
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$3.25

JMP *9/30/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF MANUFACTURING IN VAN ZANDT COUNTY

Description of Water User Group:

The Manufacturing WUG in Van Zandt County has a demand that is projected to increase from 506 ac-ft/yr in 2020 to 757 ac-ft/yr by 2030, remaining constant through 2070. Manufacturing in Van Zandt County is supplied by groundwater from the Carrizo-Wilcox Aquifer, purchased groundwater from Golden WSC and Grand Saline, and surface water from run-of-river permits on the Sabine River, a permit for diversion from Lake Tawakoni. A deficit of 208 ac-ft/yr is projected to occur in 2030, decreasing to 116 ac-ft/yr by 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Projected Water Demand	506	757	757	757	757	757
Current Water Supply	264	264	264	264	253	253
Projected Supply Surplus (+)/Deficit(-)	**-242**	**-493**	**-493**	**-493**	**-504**	**-504**

Projected Supply Surplus (+)/Deficit(-) by Basin	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Sabine	-242	-492	-492	-492	-503	-503
Trinity	0	-1	-1	-1	-1	-1
Total	**-242**	**-493**	**-493**	**-493**	**-504**	**-504**

Evaluation of Potentially Feasible Water Management Strategies:

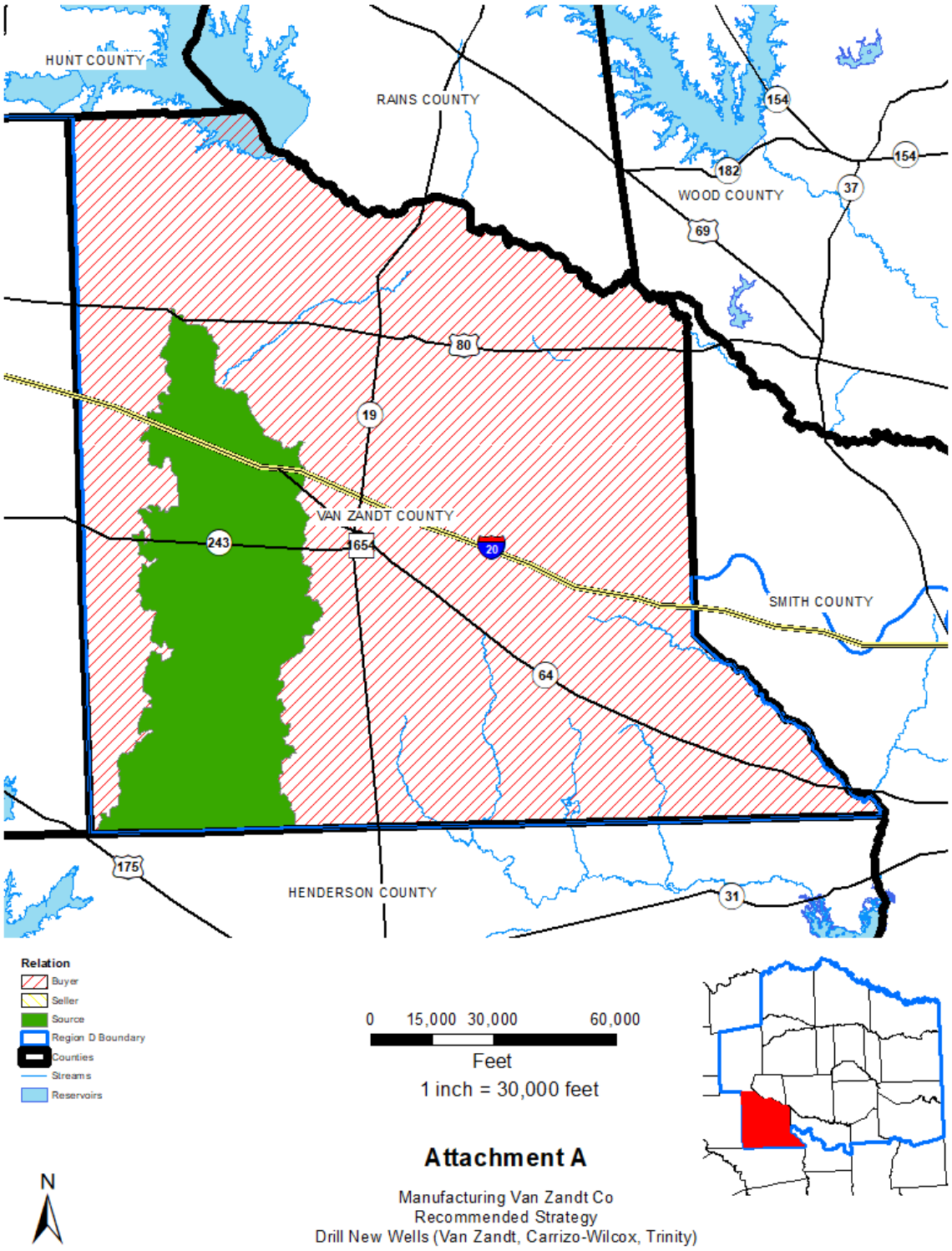
Eight alternative strategies were considered to meet the Van Zandt County Manufacturing WUG's water supply shortages. Advanced water conservation for manufacturing was considered in this planning effort to reduce overall demands; however, it does not resolve all identified needs. The use of reuse water from nearby municipalities was not considered to be feasible at present. Surface water was not considered as a viable alternative to meet projected demands because no supplies are readily available in the proximity of the identified needs. Groundwater has been identified as a potential source of water for manufacturing in Van Zandt County. In addition, groundwater supplies can be contracted from the City of Grand Saline and Golden WSC. Another potentially feasible strategy is the Wood County Pipeline which could supply groundwater from Wood County.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation	**75**	**$0**	**$0**	**$0**	**1**
Water Reuse					
Drill New Wells (Carrizo-Wilcox Aquifer; Trinity Basin)	**504**	**$2,852,000**	**$506,000**	**$1,004**	**1**
Drill New Wells (Carrizo-Wilcox Aquifer; Sabine Basin)	**1**	**$292,000**	**$24,000**	**$24,000**	**1**
Increase Existing Contract for Carrizo-Wilcox from Grand Saline	**72**	**$0**	**$202,000**	**$2,806**	**1**
Increase Existing Contract for Carrizo-Wilcox from Golden WSC	**214**	**$0**	**$279,000**	**$1,304**	**1**
Wood County Pipeline Tie-in	**504**	**$0**	**$619,000**	**$1,442**	**2**

Recommendations:

	2020	2030	2040	2050	2060	2070
Advanced Water Conservation (ac-ft/yr)	0	75	75	75	75	75
Drill New Wells (Carrizo-Wilcox, Trinity) (ac-ft/yr)	242	504	504	356	238	143
Increase Existing Contract for Carrizo-Wilcox from Golden WSC	0	0	0	62	191	214
Increase Existing Contract for Carrizo-Wilcox from Grand Saline	0	0	0	0	0	72

The recommended strategy for Manufacturing in Van Zandt County is implementation of advanced water conservation (via industrial water audits) by 2030. Implementation of this water management strategy is estimated to conserve approximately 75 ac-ft/yr (i.e. 10% of projected demand). Additionally, it is recommended that by 2020 the Manufacturing WUG in Van Zandt County construct an additional six water wells. The recommended supply source will be the Carrizo-Wilcox Aquifer in the Trinity River Basin in Van Zandt County. Six wells with rated capacities of 75 gpm each would provide up to approximately 504 ac-ft/yr. The Carrizo-Wilcox Aquifer in Van Zandt County is not projected to have sufficient supply availability to provide this supply throughout the planning period. Additional groundwater supplies will be needed via increasing existing contracts with Golden WSC by 2050 and Grand Saline by 2070.



Attachment A

Manufacturing Van Zandt Co
Recommended Strategy
Drill New Wells (Van Zandt, Carrizo-Wilcox, Trinity)

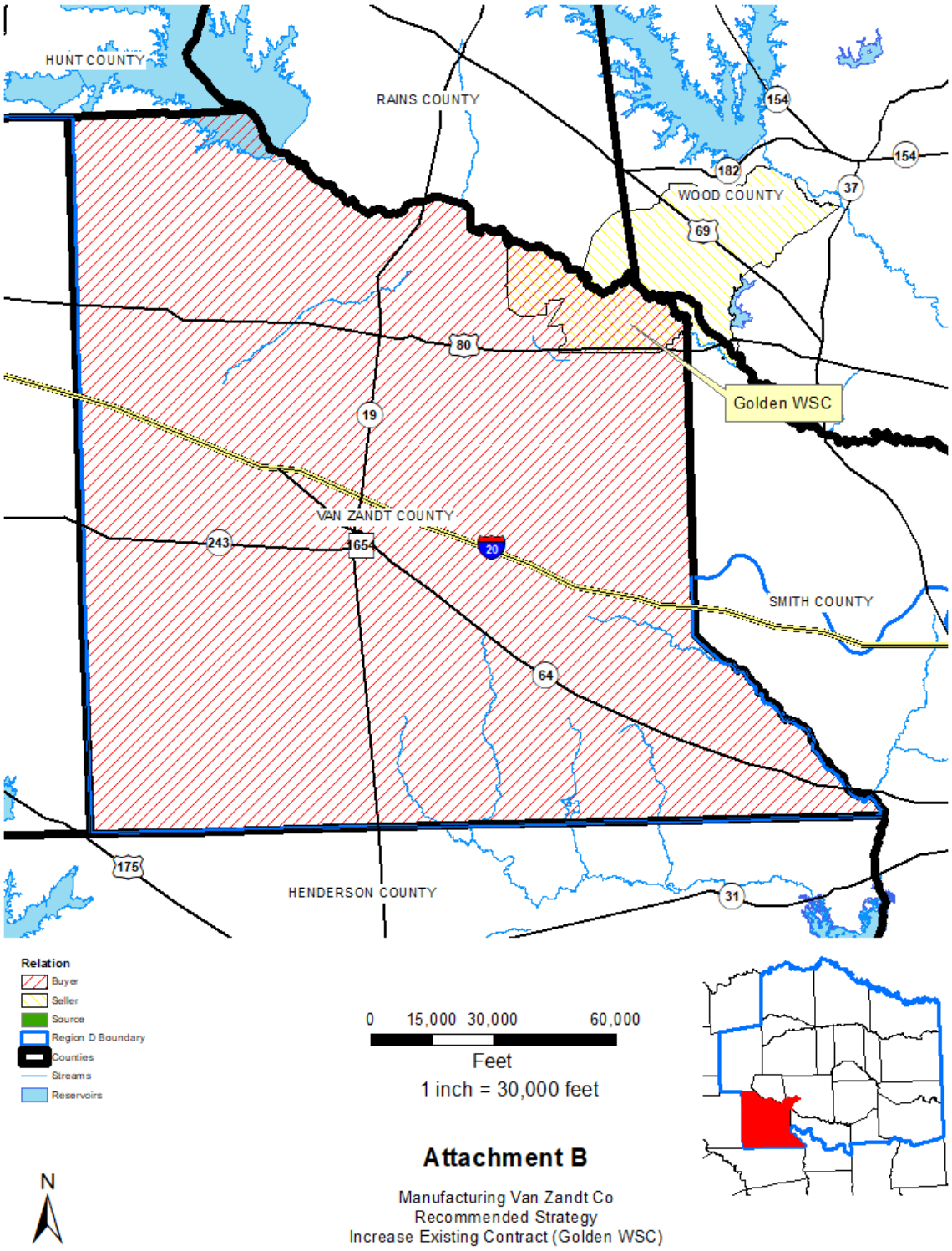
Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Manufacturing Van Zandt - Drill New Wells (Van Zandt, Carrizo-Wilcox Aquifer, Trinity Basin)

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$1,957,000
TOTAL COST OF FACILITIES	**$1,957,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$685,000
Environmental & Archaeology Studies and Mitigation	$90,000
Land Acquisition and Surveying (8 acres)	$43,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$77,000
TOTAL COST OF PROJECT	**$2,852,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$201,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$20,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (416665 kW-hr @ 0.08 $/kW-hr)	$33,000
Purchase of Water (504 acft/yr @ 500 $/acft)	$252,000
TOTAL ANNUAL COST	**$506,000**
Available Project Yield (acft/yr)	504
Annual Cost of Water ($ per acft), based on PF=1	$1,004
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$605
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$3.08
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.86

JMP *9/30/2019*



Attachment B

Manufacturing Van Zandt Co
Recommended Strategy
Increase Existing Contract (Golden WSC)

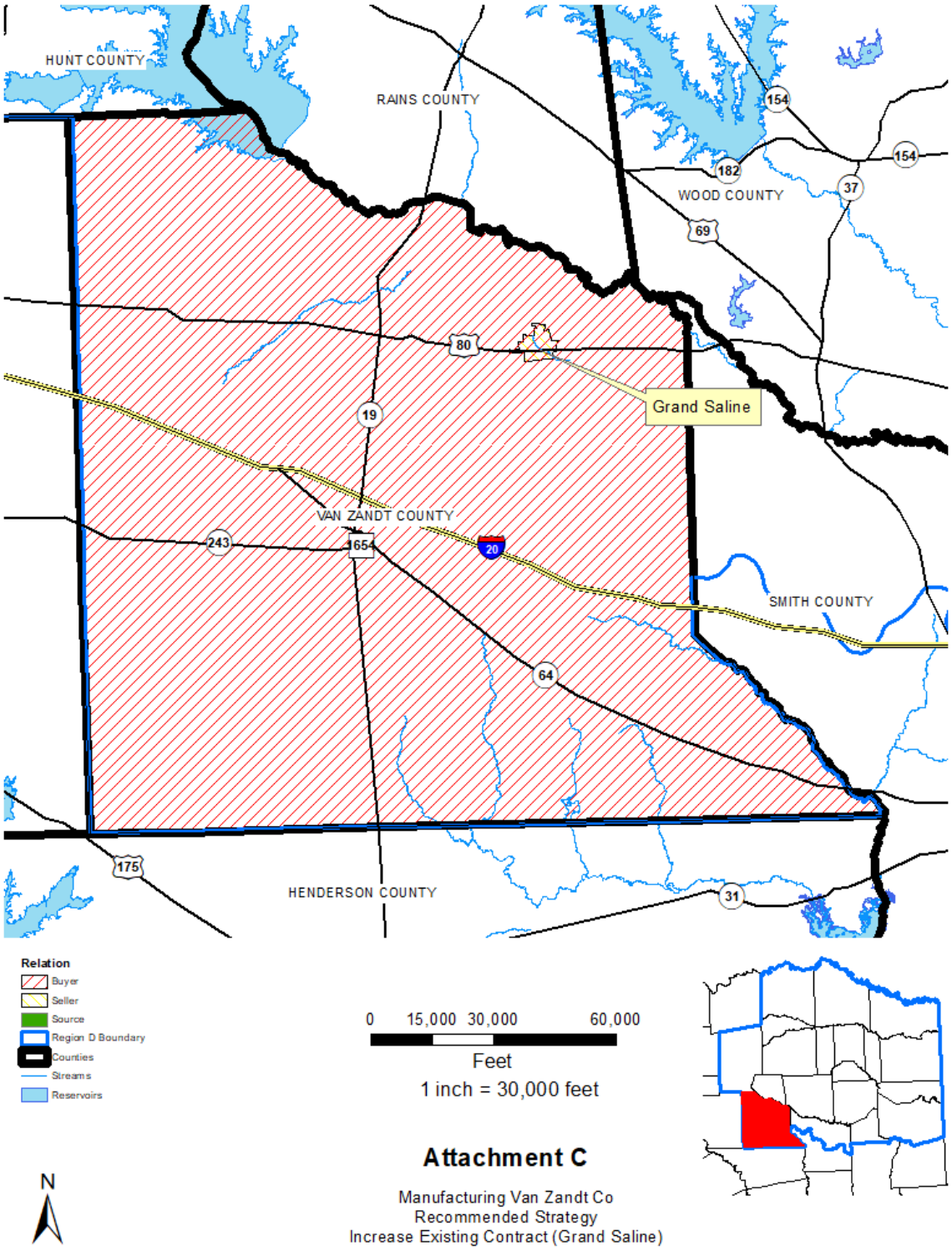
Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Manufacturing Van Zandt - Increase Existing Contract from Golden WSC

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr)	$0
Purchase of Water (214 acft/yr @ 1303 $/acft)	$279,000
TOTAL ANNUAL COST	**$279,000**
Available Project Yield (acft/yr)	214
Annual Cost of Water ($ per acft), based on PF=1	$1,304
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$1,304
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$4.00
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$4.00

JMP *9/20/2019*



Attachment C

Manufacturing Van Zandt Co
Recommended Strategy
Increase Existing Contract (Grand Saline)

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

Manufacturing Van Zandt - Increase Existing Contract from Grand-Saline

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr)	$0
Purchase of Water (72 acft/yr @ 2803 $/acft)	$202,000
TOTAL ANNUAL COST	**$202,000**
Available Project Yield (acft/yr)	72
Annual Cost of Water ($ per acft), based on PF=1	$2,806
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$2,806
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$8.61
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$8.61

JMP *9/20/2019*

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS OF RPM WATER SUPPLY CORPORATION IN VAN ZANDT COUNTY

Description of Water User Group:

R-P-M WSC provides water service in Van Zandt, Henderson and Smith Counties. The WUG population is projected to be 2,957 by 2020 and increases to 5,530 by 2070. R-P-M WSC supplies its customers with groundwater from the Carrizo-Wilcox and Queen City aquifers with five water wells in Van Zandt County. R-P-M WSC is projected to have a total deficit of 34 ac-ft/yr in 2030 increasing to a deficit of 217 ac-ft/yr by 2070; the shortage projected to occur in Van Zandt County is 25 ac-ft/yr in 2030 increasing to 152 ac-ft/yr by 2070. The shortage in Henderson County is 7 ac-ft/yr in 2030, increasing to 48 ac-ft/yr in 2070. Shortages in Smith County range from 2 ac-ft/yr in 2030 up to 17 ac-ft/yr in 2070.

Water Supply and Demand Analysis:

RPM WSC	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Population	2,957	3,602	4,112	4,653	5,116	5,530
Projected Water Demand	323	378	423	475	519	561
Water Demand from other entities	0	0	0	0	0	0
Current Water Supply	344	344	344	344	344	344
Projected Supply Surplus (+) / Deficit (-)	**21**	**-34**	**-79**	**-131**	**-175**	**-217**

Projected Supply Surplus (+) / Deficit (-) by County	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Van Zandt	14	-25	-58	-93	-124	-152
Henderson	5	-7	-16	-27	-38	-48
Smith	2	-2	-5	-11	-13	-17
Total	**21**	**-34**	**-79**	**-131**	**-175**	**-217**

Evaluation of Potentially Feasible Water Management Strategies:

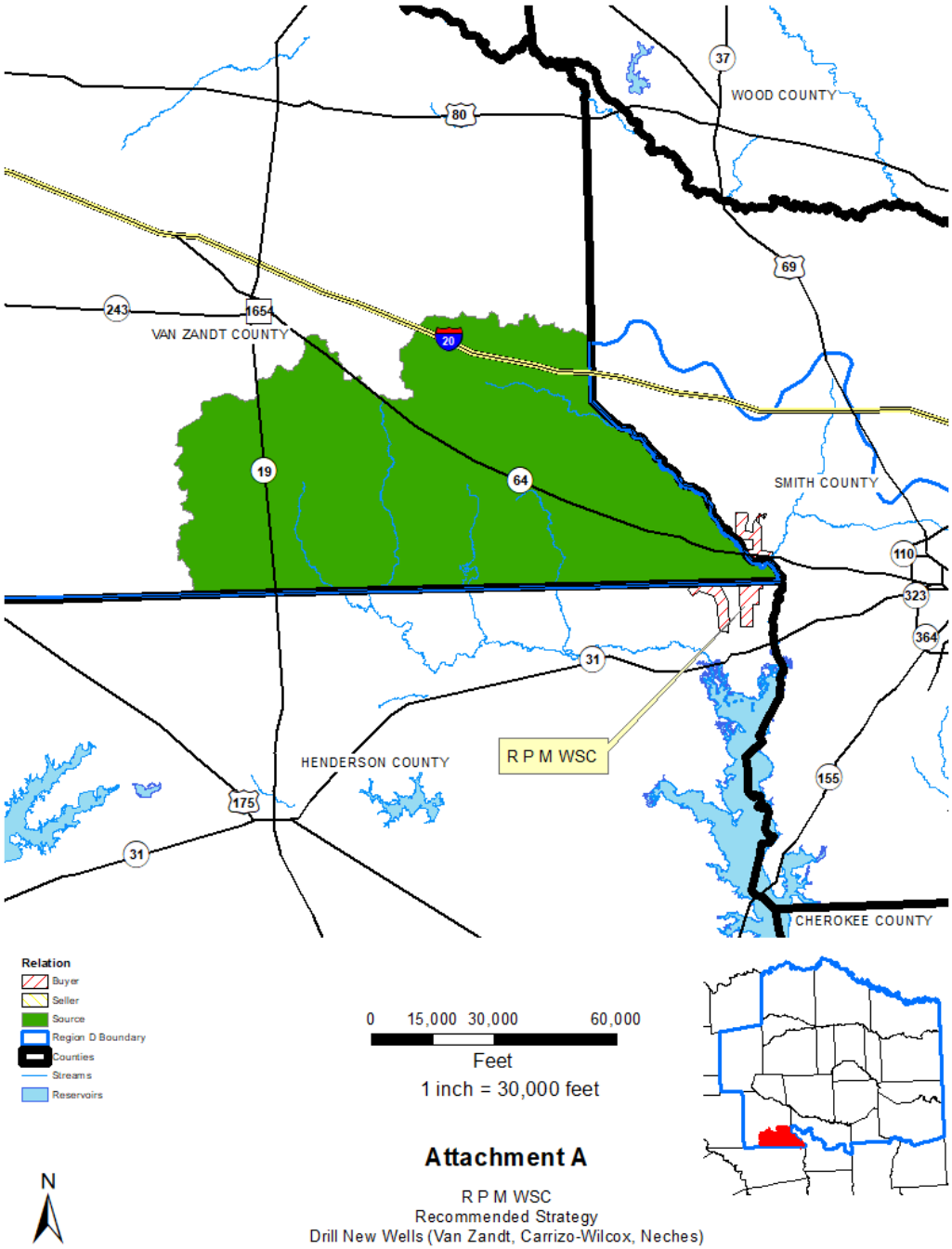
Four alternative strategies were considered to meet the WSC's water supply shortages as summarized in the following table. Advanced conservation was not selected because the per capita use per day was less than the 140 gpcd threshold set by the water planning group. Water reuse was not considered because the WSC does not have a demand for non-potable water. Surface water was not considered because the WSC does not currently have surface water treatment. Groundwater has been identified as a potential strategy for R-P-M WSC.

Strategy	**Firm Yield (ac-ft)**	**Total Capital Cost**	**Total Annualized Cost**	**Unit Cost**	**Environmental Impact**
Demand Reduction					
Water Reuse					
Drill New Wells (Carrizo-Wilcox Aquifer, Neches Basin)	**217**	**$3,469,000**	**$422,000**	**$1,945**	**1**
Drill New Wells (Queen City Aquifer, Neches Basin)					

Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Carrizo-Wilcox, Neches Basin; ac-ft/yr)	0	34	79	131	175	217

The recommended strategy for R-P-M WSC to meet their projected deficit of 34 ac-ft/yr in 2030 and 217 ac-ft/yr in 2070 would be to construct nine additional water wells similar to their existing wells just prior to each decade as the deficits occur. The recommended supply source will be the Carrizo-Wilcox Aquifer in the Neches Basin in Van Zandt County. Nine wells with rated capacity of 50 gpm each, pumping at an approximately depth of 560 ft., would provide approximately 27 acre-feet each.



Attachment A

R P M WSC
Recommended Strategy
Drill New Wells (Van Zandt, Carrizo-Wilcox, Neches)

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices

R P M WSC - Drill New Wells (Van Zandt, Carrizo-Wilcox Aquifer, Neches Basin)

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$2,290,000
Water Treatment Plant (0.6 MGD)	$58,000
TOTAL COST OF FACILITIES	**$2,348,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$822,000
Environmental & Archaeology Studies and Mitigation	$139,000
Land Acquisition and Surveying (12 acres)	$67,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$93,000
TOTAL COST OF PROJECT	**$3,469,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$244,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$23,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$35,000
Advanced Water Treamtent Facility	$0
Pumping Energy Costs (207025 kW-hr @ 0.08 $/kW-hr)	$17,000
Purchase of Water (217 acft/yr @ 500 $/acft)	$109,000
TOTAL ANNUAL COST	**$428,000**
Available Project Yield (acft/yr)	217
Annual Cost of Water ($ per acft), based on PF=1	$1,972
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$848
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$6.05
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$2.60

JMP *9/30/2019*

REGION D
EVALUATIONS OF WATER MANAGEMENT STRATEGIES
FOR MEETING PROJECTED WATER SUPPLY NEEDS
TO YEAR 2070

WOOD COUNTY

WUGs:

Wood County Livestock
Wood County Manufacturing

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS LIVESTOCK IN WOOD COUNTY

Description of Water User Group:

The Livestock WUG in Wood County is a split entity and has a demand that is projected to be a constant 483 ac-ft/yr from 2020 to 2070. Livestock in Wood County, Cypress has a current water supply consisting of water wells from the Carrizo-Wilcox Aquifer and Local Supplies. The total rated available supply from these sources is 449 ac-ft/yr in 2020 thru 2070. Livestock in Wood County, Cypress is projected to have a water supply deficit of 34 ac-ft/yr in 2020 thru 2070.

The Livestock WUG in Wood County Sabine is a split entity and has a demand that is projected to be a constant 2,741 ac-ft/yr from 2020 to 2070. Livestock in Wood County Sabine has a current water supply consisting of water wells from the Carrizo-Wilcox Aquifer and Local Supplies. The total rated available supply from these sources is 1,643 ac-ft/yr in 2020 thru 2070. Livestock in Wood County, Sabine is projected to have a water supply deficit of 1,098 ac-ft/yr in 2020 thru 2070.

Water Supply and Demand Analysis:

Livestock Wood Cypress	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	483	483	483	483	483	483
Current Water Supply	555	555	555	555	555	555
Projected Supply Surplus (+)/Deficit(-)	72	72	72	72	72	72

Livestock Wood Sabine	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	2,741	2,741	2,741	2,741	2,741	2,741
Current Water Supply	1,643	1,643	1,643	1,643	1,643	1,643
Projected Supply Surplus (+)/Deficit(-)	-1,098	-1,098	-1,098	-1,098	-1,098	-1,098

Evaluation of Potentially Feasible Water Management Strategies:

Six alternative strategies were considered to meet the Wood County, Livestock, Sabine water supply shortages as summarized in the following table. Advanced conservation, water reuse, and surface water alternatives were not considered because the livestock demands are very rural in nature. Groundwater from the Queen City Aquifer (Sabine River Basin) was identified as a potentially feasible strategy for the WUG. Groundwater from the Wood County Pipeline has also been identified as a potentially feasible strategy.

Strategy	**Firm Yield (AF)**	**Total Capital Cost**	**Total Annualized Cost**	**Unit Cost**	**Environmental Impact**
Advanced Water Conservation					
Water Reuse					
Groundwater (Sabine)	**1,129**	**$ 1,210,000**	**$ 125,000**	**$ 111**	**1**
Surface Water					
Local Supply					
Wood County Pipeline Tie-in	**1,132**	**$2,479,000**	**$787,000**	**$695**	**2**

Recommendations:

	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Local Supply (ac-ft/yr)	34	34	34	34	34	34
Drill New Wells (Queen City Aquifer, Sabine Basin; ac-ft/yr)	1,129	1,129	1,129	1,129	1,129	1,129

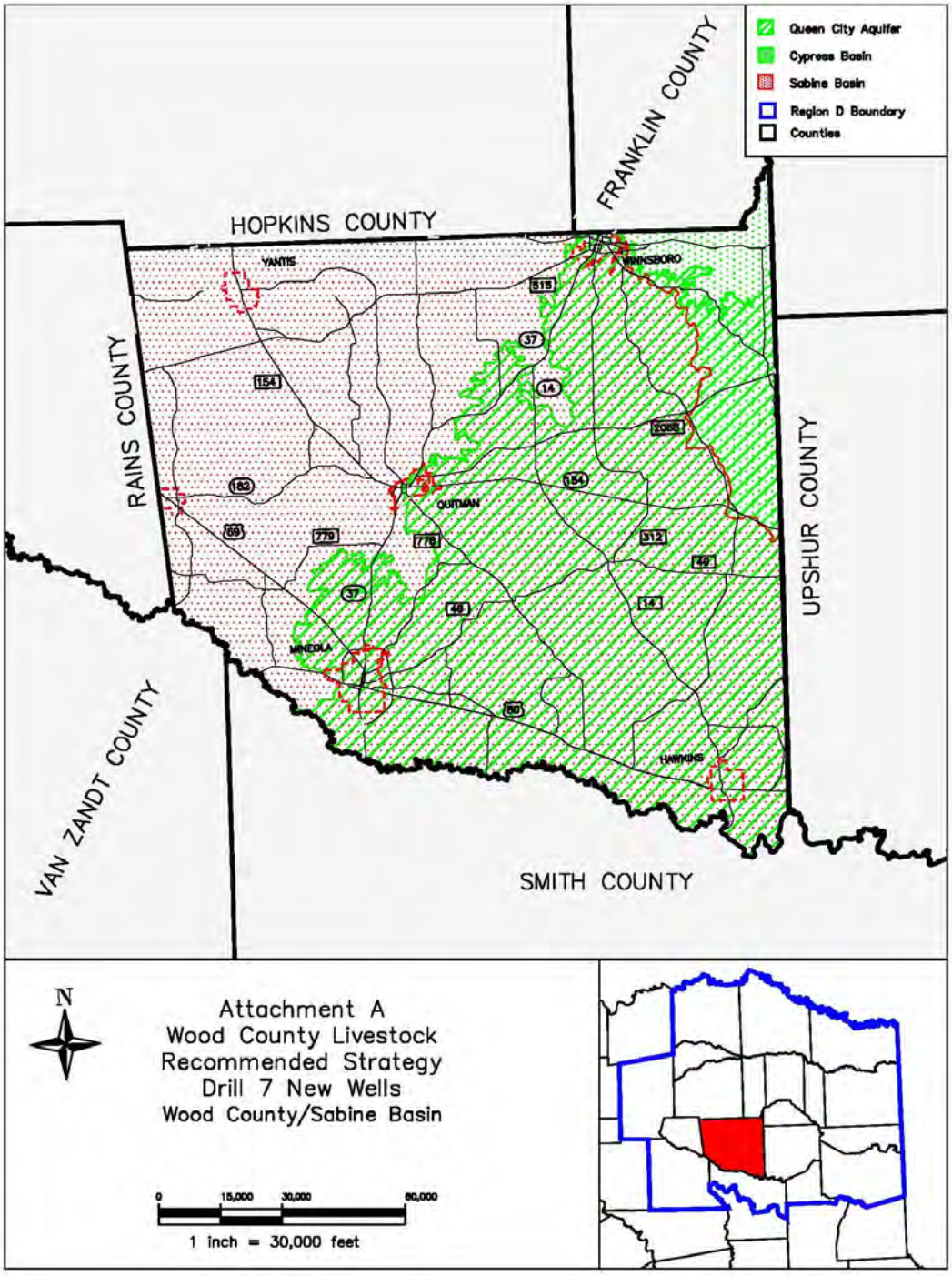
The Wood County, Livestock, Cypress has a surplus of 72 ac-ft/yr in 2020 thru 2070 of existing local supply. The local supply in Wood County Cypress is projected to have a more than ample supply availability to meet the needs of the Livestock in Wood County Cypress for the planning period.

The recommended strategy for the Wood County, Livestock, Sabine to meet their projected deficit of 1,098 ac-ft/yr in 2020 thru 2070 would be to construct seven water wells prior to 2020. The recommended supply source will be the Queen City Aquifer in Wood County. Seven wells with rated capacity of 100 gpm each

would provide approximately 1,129 ac-ft/yr. Seven new wells will be needed to provide the 1,098 ac-ft/yr needed. The Queen City Aquifer in Wood County is projected to have a more than ample supply availability to meet the needs of the Livestock in Wood County Sabine for the planning period.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices*	
Livestock Wood Sabine - Drill New Well Queen City Aquifer Wood Sabine	
Cost based on ENR CCI 11170.28 for September 2018 and	
a PPI of 202.4 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	$0
Terminal Storage (Conservation Pool acft, acres)	$0
Primary Pump Station (0 MGD)	$0
Transmission Pipeline (6 in dia., miles)	$0
Transmission Pump Station(s) & Storage Tank(s)	$0
Well Fields (Wells, Pumps, and Piping)	$870,000
Storage Tanks (Other Than at Booster Pump Stations)	$0
Water Treatment Plant (0 MGD)	$0
Advanced Water Treamtent Facility (MGD)	$0
Conservation (Leaking Pipe/Meter Replacement)	$0
Integration, Relocations, & Other	$0
TOTAL COST OF FACILITIES	**$870,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$304,000
Environmental & Archaeology Studies and Mitigation	$3,000
Land Acquisition and Surveying (4 acres)	$0
Interest During Construction (3% for 1 years with a 0.5% ROI)	$33,000
TOTAL COST OF PROJECT	**$1,210,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$85,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$9,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (392309 kW-hr @ 0.08 $/kW-hr)	$31,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$125,000**
Available Project Yield (acft/yr)	1,129
Annual Cost of Water ($ per acft), based on PF=1	$111
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$35
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.34
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.11
Stanley Hayes	*9/30/2019*


Queen City Aquifer
Cypress Basin
Sabine Basin
Region D Boundary
Counties
FRANKLIN COUNTY
HOPKINS COUNTY
RAINS COUNTY
UPSHUR COUNTY
VAN ZANDT COUNTY
SMITH COUNTY
YANTIS
WINNSBORO
QUITMAN
MINEOLA
HAWKINS
N
Attachment A
Wood County Livestock
Recommended Strategy
Drill 7 New Wells
Wood County/Sabine Basin
0
15,000
30,000
60,000
1 inch = 30,000 feet

EVALUATION OF WATER MANAGEMENT STRATEGIES FOR MEETING THE PROJECTED WATER SUPPLY NEEDS MANUFACTURING IN WOOD COUNTY

Description of Water User Group:

The Manufacturing WUG in Wood County has a demand that is projected to be increasing from 2,532 ac-ft/yr in 2020 to 3,085 ac-ft/yr in 2070. Manufacturing in Wood County has a current water supply from Carrizo-Wilcox Aquifer. The total rated available supply from this source is 1,502 ac-ft/yr. Manufacturing in Wood County is projected to have a water supply deficit of 1,030 ac-ft/yr in 2020 increasing to a deficit of 1,583 ac-ft/yr in 2070.

Water Supply and Demand Analysis:

	2020	2030	2040	2050	2060	2070
Projected Water Demand	2532	2085	3085	3085	3085	3085
Current Water Supply	1502	1502	1502	1502	1502	1502
Projected Supply Surplus (+)/Deficit(-)	**-1,030**	**-1,583**	**-1,583**	**-1,583**	**-1,583**	**-1,583**

Evaluation of Potentially Feasible Water Management Strategies:

Five alternative strategies were considered to meet the Wood County Manufacturing water supply shortages as summarized in the following table. Advanced conservation and water reuse was not considered because operational procedures for the existing mines is not available. Surface water alternatives were omitted since there is not a supply source within close proximity to the county with available supply. Groundwater wells in the Queen City Aquifer (Sabine River Basin) were identified as a potentially feasible strategy for the WUG. Groundwater from the Wood County Pipeline has also been identified as a potentially feasible strategy.

Strategy	Firm Yield (AF)	Total Capital Cost	Total Annualized Cost	Unit Cost	Environmental Impact
Advanced Water Conservation					
Water Reuse					
Groundwater (Queen City Aquifer, Sabine Basin)	**1,610**	**$ 1,210,000**	**$ 125,000**	**$ 78**	**1**
Surface Water					
Wood County Pipeline Tie-in	**1,583**	**$2,722,000**	**$1,038,000**	**$656**	**2**

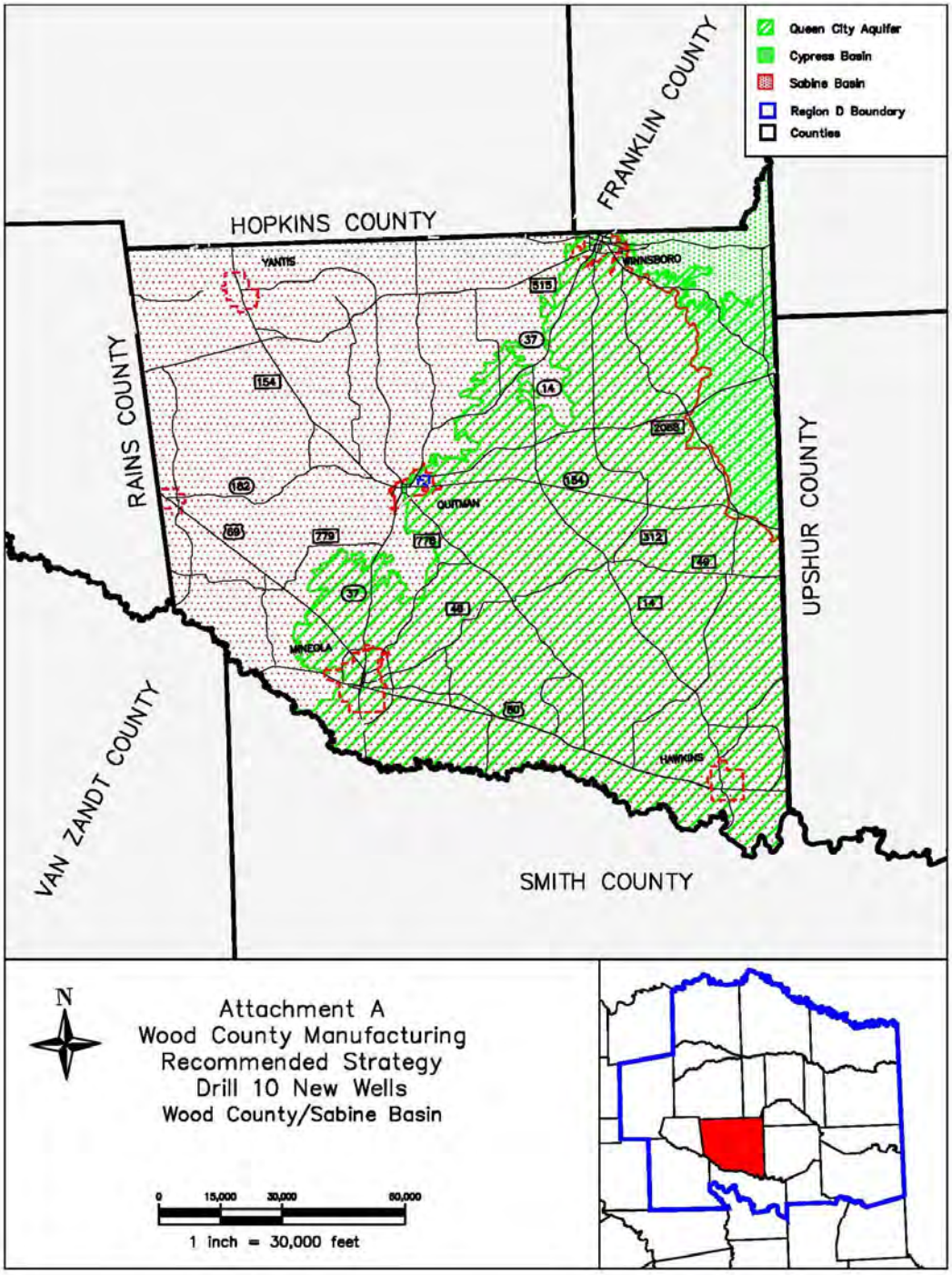
Recommendations:

	2020	2030	2040	2050	2060	2070
Drill New Wells (Queen City Aquifer, Sabine River Basin; ac-ft/yr)	1129	1610	1610	1610	1610	1610

The recommended strategy for the Wood County Manufacturing to meet their projected deficit of 1,030 ac-ft/yr in 2030 and 1,583 ac-ft/yr in 2070 would be to construct ten additional water wells similar to other wells in the area just prior to each decade as the deficits occur. The recommended supply source will be the Queen City Aquifer in Wood County. Ten wells with rated capacity of 100 gpm each would provide approximately 161 acre-feet each or 1,610 ac-ft/yr. The Queen City Aquifer in Wood County is projected to have a more than ample supply availability to meet the needs of the Manufacturing in Wood County for the planning period.

Given the increasing costs to comply with more stringent regulations and the decreasing reliability of groundwater as a future supply source due to quality issues in this region, it is recommended that groundwater supply systems consider combining resources and/or soliciting future water supply from neighboring systems and/or major water providers in the region. If a feasible alternative becomes available, then the recommendations previously discussed should be disregarded and a re-evaluation completed.

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices*	
Manufacturing Wood Sabine - Drill New Well Queen City Aquifer Wood Sabine	
Cost based on ENR CCI 11170.28 for September 2018 and	
a PPI of 202.4 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	$0
Terminal Storage (Conservation Pool acft, acres)	$0
Primary Pump Station (0 MGD)	$0
Transmission Pipeline (6 in dia., miles)	$0
Transmission Pump Station(s) & Storage Tank(s)	$0
Well Fields (Wells, Pumps, and Piping)	$870,000
Storage Tanks (Other Than at Booster Pump Stations)	$0
Water Treatment Plant (0 MGD)	$0
Advanced Water Treamtent Facility (MGD)	$0
Conservation (Leaking Pipe/Meter Replacement)	$0
Integration, Relocations, & Other	$0
TOTAL COST OF FACILITIES	**$870,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$304,000
Environmental & Archaeology Studies and Mitigation	$3,000
Land Acquisition and Surveying (4 acres)	$0
Interest During Construction (3% for 1 years with a 0.5% ROI)	$33,000
TOTAL COST OF PROJECT	**$1,210,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$85,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$9,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (392309 kW-hr @ 0.08 $/kW-hr)	$31,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$125,000**
Available Project Yield (acft/yr)	1,610
Annual Cost of Water ($ per acft), based on PF=1	$78
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$25
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.24
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.08
Stanley Hayes	*10/4/2019*


Queen City Aquifer
Cypress Basin
Sabine Basin
Region D Boundary
Counties
HOPKINS COUNTY
FRANKLIN COUNTY
RAINS COUNTY
UPSHUR COUNTY
VAN ZANDT COUNTY
SMITH COUNTY
YANTIS
WINNSBORO
QUITMAN
MINEOLA
HAWKINS
N
Attachment A
Wood County Manufacturing
Recommended Strategy
Drill 10 New Wells
Wood County/Sabine Basin
0 15,000 30,000 60,000
1 inch = 30,000 feet

Region D 2021 - North Easat Texas Regional Water Planning Group
Alternative WMS Summary

County	Entity	Projected Deficit (-) / Recommendation (ac-ft/yr) by Decade						Strategy	Contingency	Seller (if applicable)	Supply Source				Reliability of Source	Total Capital Cost ($)	Total Annual Cost ($)
		2020	2030	2040	2050	2060	2070				Ground-water	Surface Water	County	Basin			
CASS	MANUFACTURING CASS	0	0	0	0	0	0	VOLUNTARY REALLOCATION (QUEEN CITY)	NEW 2.5 MGD PACKAGE WTP AND TRANSMISSION LINE AND RIVERBEND WMS	RIVERBEND WATER RESOURCES DISTRICT		WRIGHT PATMAN LAKE /RESERVOIR	RESERVOIR	SULPHUR	HIGH	$ -	$ -
		0	251	244	243	243	243										
CASS	QUEEN CITY	0	251	244	243	243	243	NEW CONTRACT	NEW 2.5 MGD PACKAGE WTP AND TRANSMISSION LINE, RIVERBEND WMS, AND VOLUNTARY REALLOCATION (CASS MANUFACTURING)	RIVERBEND WATER RESOURCES DISTRICT		WRIGHT PATMAN LAKE /RESERVOIR	RESERVOIR	SULPHUR	HIGH	$ -	$ 121,000
HOPKINS	BRINKER WSC	0	0	0	-12	-47	-83	DRILL NEW WELLS			CARRIZO-WILCOX AQUIFER		HOPKINS	SULPHUR	HIGH	$ 1,405,000	$ 175,000
		0	0	0	12	47	83										
RED RIVER	CLARKSVILLE	-237	-231	-222	-221	-219	-219	DIMPLE RESERVOIR				DIMPLE RESERVOIR	RESERVOIR	RED	HIGH	$ 38,489,000	$ 2,415,000
		0	0	303	303	303	303										
RED RIVER	CLARKSVILLE	0	0	388	388	388	388	DRILL NEW WELLS AND RO TREATMENT			NACATOCH AQUIFER		RED RIVER	SULPHUR	HIGH	$ 10,537,000	$ 1,673,000
		0	0	303	303	303	303										
RED RIVER	IRRIGATION RED RIVER	-2,154	-2,154	-2,154	-2,154	-2,154	-2,154	DRILL NEW WELLS			TRINITY AQUIFER		RED RIVER	SULPHUR	HIGH	$ 425,000	$ 88,000
		97	97	97	97	97	97										
VAN ZANDT	CANTON	0	0	0	0	0	0	GRAND SALINE RESERVOIR				GRAND SALINE RESERVOIR	VAN ZANDT	SABINE	HIGH	$ 62,966,000	$ 3,896,000
		1,810	1,810	1,810	1,810	1,810	1,810										
WOOD COUNTY PIPELINE (REGIONALIZATION)		0	0	0	0	0	0	WOOD COUNTY PIPELINE			CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ 228,312,000	$ 30,040,000
		8,643	10,091	11,547	13,550	16,691	20,830										
HOPKINS	BRINKER WSC	0	0	0	-12	-47	-83	WOOD COUNTY PIPELINE TIE-IN	WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ 3,567,000	$ 409,000
		0	0	0	12	47	83										
HOPKINS	CUMBY	-13	-29	-44	-58	-77	-88	WOOD COUNTY PIPELINE TIE-IN	WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ 4,809,000	$ 511,000
		13	29	44	58	77	88										
HOPKINS	IRRIGATION HOPKINS	-4,627	-4,627	-4,627	-4,627	-4,627	-4,627	WOOD COUNTY PIPELINE TIE-IN	WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ 13,522,000	$ 7,181,000
		4,627	4,627	4,627	4,627	4,627	4,627										
HOPKINS	LIVESTOCK HOPKINS	-1,068	-1,090	-1,140	-1,143	-1,196	-1,219	WOOD COUNTY PIPELINE TIE-IN	WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SULPHUR	HIGH	$ 8,273,000	$ 706,000
		1,068	1,090	1,140	1,143	1,196	1,219										
HOPKINS	MARTIN SPRINGS WSC	0	0	0	0	0	-29	WOOD COUNTY PIPELINE TIE-IN	WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ 1,574,000	$ 166,000
		0	0	0	0	0	29										
HOPKINS	MILLER GROVE WSC	-8	-16	-23	-29	-40	-52	WOOD COUNTY PIPELINE TIE-IN	WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ 1,587,000	$ 200,000
		8	16	23	29	40	52										
HOPKINS	MINING HOPKINS	-227	-283	-360	-444	-533	-639	WOOD COUNTY PIPELINE TIE-IN	WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ 5,367,000	$ 1,365,000
		227	283	360	444	533	639										
HUNT	B H P WSC	-2	-72	-125	-209	-333	-505	WOOD COUNTY PIPELINE TIE-IN	WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ 1,086,000	$ 823,000
		2	72	125	209	333	505										
HUNT	CADDO BASIN SUD	-7	-220	-406	-722	-1,202	-1,866	WOOD COUNTY PIPELINE TIE-IN	WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ 4,037,000	$ 3,059,000
		7	220	406	722	1,202	1,866										
HUNT	CADDO MILLS	0	-1	-36	-68	-108	-254	WOOD COUNTY PIPELINE, INCREASE CONTRACT	GREENVILLE WMSs, WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ -	$ 366,000
		0	1	36	68	108	254										
HUNT	CASH SUD	419	33	-466	-722	-895	-373	WOOD COUNTY PIPELINE TIE-IN	WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ 1,863,000	$ 1,433,000
		0	0	466	722	895	373										
HUNT	CELESTE	-29	-52	-86	-136	-209	-316	WOOD COUNTY PIPELINE TIE-IN	WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ 5,076,000	$ 867,000
		29	52	86	136	209	316										
HUNT	COUNTY-OTHER, HUNT	862	449	-166	-703	-1,817	-3,834	WOOD COUNTY PIPELINE, INCREASE CONTRACT	GREENVILLE WMSs, WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ -	$ 5,529,000
		0	0	166	703	1,817	3,834										
HUNT	GREENVILLE	-3,239	-4,626	-6,531	-9,183	-12,913	-18,266	WOOD COUNTY PIPELINE TIE-IN	GREENVILLE WMSs, WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ -	$ 9,360,000
		96	274	721	1,691	3,448	6,491										
HUNT	HICKORY CREEK SUD	-96	-273	-519	-866	-1,366	-2,095	WOOD COUNTY PIPELINE TIE-IN	GREENVILLE WMSs, WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ 11,862,000	$ 4,030,000
		96	273	519	866	1,366	2,095										
HUNT	MINING HUNT	-73	-64	-35	-19	-7	0	WOOD COUNTY PIPELINE TIE-IN	WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ 560,000	$ 152,000
		73	64	35	19	7	0										
HUNT	NORTH HUNT SUD	-89	-165	-266	-405	-603	-888	WOOD COUNTY PIPELINE TIE-IN	WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ 6,777,000	$ 1,845,000
		89	165	266	405	603	888										

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Region D 2021 - North Easat Texas Regional Water Planning Group
Alternative WMS Summary

County	Entity	Projected Deficit (-) / Recommendation (ac-ft/yr) by Decade						Strategy	Contingency	Seller (if applicable)	Supply Source				Reliability of Source	Total Capital Cost ($)	Total Annual Cost ($)
		2020	2030	2040	2050	2060	2070				Ground-water	Surface Water	County	Basin			
HUNT	POETRY WSC	2	-66	-115	-200	-330	-510	WOOD COUNTY PIPELINE TIE-IN	WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ 1,103,000	$ 836,000
		0	66	115	200	330	510										
HUNT	WOLFE CITY	0	0	0	-54	-157	-308	WOOD COUNTY PIPELINE TIE-IN	GREENVILLE WMSs, WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ 7,124,000	$ 1,018,000
		0	0	0	54	157	308										
VAN ZANDT	MANUFACTURING VAN ZANDT	-242	-493	-493	-493	-504	-504	WOOD COUNTY PIPELINE TIE-IN	WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ -	$ 619,000
		242	418	418	418	429	429										
WOOD	LIVESTOCK WOOD	-1,132	-1,132	-1,132	-1,132	-1,132	-1,132	WOOD COUNTY PIPELINE TIE-IN	WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ 2,479,000	$ 787,000
		1,132	1,132	1,132	1,132	1,132	1,132										
WOOD	MANUFACTURING WOOD	-1,030	-1,583	-1,583	-1,583	-1,583	-1,583	WOOD COUNTY PIPELINE TIE-IN	WOOD COUNTY PIPELINE		CARRIZO-WILCOX AQUIFER		WOOD	SABINE	HIGH	$ 2,722,000	$ 1,038,000
		1,030	1,583	1,583	1,583	1,583	1,583										

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Region D Alternative Projects Associated with Water Management Strategies

SPONSOR NAME	SPONSOR IS WWP?	ONLINE DECADE	PROJECT NAME	PROJECT DESCRIPTION	CAPITAL COST
BRINKER WSC	NO	2050	DRILL NEW WELLS (BRINKER WSC, CARRIZO-WILCOX, SULPHUR)	MULTIPLE WELLS/WELL FIELD	$1,405,000
CANTON	NO	2020	ALT CANTON GRAND SALINE RESERVOIR	CONVEYANCE/TRANSMISSION PIPELINE; NEW SURFACE WATER INTAKE; NEW WATER RIGHT/PERMIT NO IBT; PUMP STATION; WATER TREATMENT PLANT EXPANSION	$45,373,000
CLARKSVILLE	NO	2020	ALT CLARKSVILLE TREATED PIPELINE PAT MAYSE WATER	CONVEYANCE/TRANSMISSION PIPELINE; NEW CONTRACT; PUMP STATION	$12,255,000
CLARKSVILLE	NO	2040	ALT DRILL NEW WELLS (CLARKSVILLE, NACATOCH, SULPHUR)	MULTIPLE WELLS/WELL FIELD; WATER TREATMENT PLANT EXPANSION	$10,537,000
CLARKSVILLE	NO	2040	DIMPLE RESERVOIR	CONVEYANCE/TRANSMISSION PIPELINE; DIVERSION AND CONTROL STRUCTURE; NEW WATER RIGHT/PERMIT NO IBT; RESERVOIR CONSTRUCTION	$38,489,000
IRRIGATION, RED RIVER	NO	2020	ALT DRILL NEW WELLS (IRRIGATION RED RIVER, TRINITY AQ, SULPHUR)	MULTIPLE WELLS/WELL FIELD	$425,000
				REGION D ALTERNATIVE CAPITAL COST TOTAL	**$108,484,000**

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Region D Alternative Water User Group (WUG) Water Management Strategies (WMS)

						WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	2020	2030	2040	2050	2060	2070
B H P WSC*	D	ALT WOOD COUNTY PIPELINE	D | CARRIZO-WILCOX AQUIFER | WOOD COUNTY	$2345	$1550	2	60	103	177	288	446
BRINKER WSC	D	ALT DRILL NEW WELLS (BRINKER WSC)	D | CARRIZO-WILCOX AQUIFER | HOPKINS COUNTY	N/A	$916	0	0	0	12	47	83
BRINKER WSC	D	ALT WOOD COUNTY PIPELINE	D | CARRIZO-WILCOX AQUIFER | WOOD COUNTY	N/A	$1904	0	0	0	12	47	83
CADDO BASIN SUD*	D	ALT WOOD COUNTY PIPELINE	D | CARRIZO-WILCOX AQUIFER | WOOD COUNTY	$1711	$1486	5	172	315	561	946	1,502
CADDO MILLS	D	ALT WOOD COUNTY PIPELINE	D | CARRIZO-WILCOX AQUIFER | WOOD COUNTY	N/A	$1441	0	1	36	68	108	254
CANTON	D	ALT CANTON GRAND SALINE RESERVOIR	D | GRAND SALINE LAKE/RESERVOIR	$3087	$1264	1,810	1,810	1,810	1,810	1,810	1,810
CASH SUD*	D	ALT WOOD COUNTY PIPELINE	D | CARRIZO-WILCOX AQUIFER | WOOD COUNTY	N/A	$1478	0	0	435	673	834	348
CELESTE	D	ALT WOOD COUNTY PIPELINE	D | CARRIZO-WILCOX AQUIFER | WOOD COUNTY	$2744	$1614	29	52	86	136	209	316
CLARKSVILLE	D	ALT CLARKSVILLE TREATED PIPELINE PAT MAYSE WATER	D | PAT MAYSE LAKE/RESERVOIR	$5010	$2165	303	303	303	303	303	303
CLARKSVILLE	D	ALT DRILL NEW WELLS WITH RO TREATMENT (CLARKSVILLE, NACATOCH)	D | NACATOCH AQUIFER | RED RIVER COUNTY	N/A	$2402	0	0	388	388	388	388
CLARKSVILLE	D	DIMPLE RESERVOIR	D | DIMPLE LAKE/RESERVOIR	N/A	$5789	0	0	303	303	303	303
COUNTY-OTHER, HUNT	D	ALT WOOD COUNTY PIPELINE	D | CARRIZO-WILCOX AQUIFER | WOOD COUNTY	N/A	$1442	0	0	166	703	1,817	3,834
CUMBY	D	ALT WOOD COUNTY PIPELINE	D | CARRIZO-WILCOX AQUIFER | WOOD COUNTY	$5807	$1966	13	29	44	58	77	88
HICKORY CREEK SUD*	D	ALT WOOD COUNTY PIPELINE	D | CARRIZO-WILCOX AQUIFER | WOOD COUNTY	$1924	$1525	88	254	489	822	1,306	2,012
IRRIGATION, HOPKINS	D	ALT WOOD COUNTY PIPELINE	D | CARRIZO-WILCOX AQUIFER | WOOD COUNTY	$1552	$1346	4,627	4,627	4,627	4,627	4,627	4,627
IRRIGATION, RED RIVER	D	ALT DRILL NEW WELLS (IRRIGATION RED RIVER, TRINITY AQ, SULPHUR)	D | TRINITY AQUIFER | RED RIVER COUNTY	$845	$536	97	97	97	97	97	97
LIVESTOCK, HOPKINS	D	ALT WOOD COUNTY PIPELINE	D | CARRIZO-WILCOX AQUIFER | WOOD COUNTY	$2021	$1544	1,068	1,090	1,140	1,143	1,196	1,219
LIVESTOCK, WOOD	D	ALT WOOD COUNTY PIPELINE	D | CARRIZO-WILCOX AQUIFER | WOOD COUNTY	$695	$542	1,132	1,132	1,132	1,132	1,132	1,132
MANUFACTURING, VAN ZANDT	D	ALT WOOD COUNTY PIPELINE	D | CARRIZO-WILCOX AQUIFER | WOOD COUNTY	$1443	$1443	242	418	418	418	429	429

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Region D Alternative Water User Group (WUG) Water Management Strategies (WMS)

						WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
WUG ENTITY NAME	**WMS SPONSOR REGION**	**WMS NAME**	**SOURCE NAME**	**UNIT COST 2020**	**UNIT COST 2070**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
MANUFACTURING, WOOD	D	ALT WOOD COUNTY PIPELINE	D | CARRIZO-WILCOX AQUIFER | WOOD COUNTY	$656	$535	1,030	1,583	1,583	1,583	1,583	1,583
MARTIN SPRINGS WSC	D	ALT WOOD COUNTY PIPELINE	D | CARRIZO-WILCOX AQUIFER | WOOD COUNTY	N/A	$5724	0	0	0	0	0	29
MILLER GROVE WSC	D	ALT WOOD COUNTY PIPELINE	D | CARRIZO-WILCOX AQUIFER | WOOD COUNTY	$3846	$1692	8	16	23	29	40	52
MINING, HOPKINS	D	ALT WOOD COUNTY PIPELINE	D | CARRIZO-WILCOX AQUIFER | WOOD COUNTY	$2136	$1545	227	283	360	444	533	639
MINING, HUNT	D	ALT WOOD COUNTY PIPELINE	D | CARRIZO-WILCOX AQUIFER | WOOD COUNTY	$2082	N/A	73	64	35	19	7	0
NORTH HUNT SUD*	D	ALT WOOD COUNTY PIPELINE	D | CARRIZO-WILCOX AQUIFER | WOOD COUNTY	$2078	$1541	78	148	243	376	567	846
POETRY WSC*	D	ALT WOOD COUNTY PIPELINE	D | CARRIZO-WILCOX AQUIFER | WOOD COUNTY	N/A	$1549	0	47	83	143	236	365
QUEEN CITY	D	ALT RIVERBEND STRATEGY CASS	D | WRIGHT PATMAN LAKE/RESERVOIR	N/A	$483	0	251	244	243	243	243
WOLFE CITY*	D	ALT WOOD COUNTY PIPELINE	D | CARRIZO-WILCOX AQUIFER | WOOD COUNTY	N/A	$1679	0	0	0	51	149	293
REGION D ALTERNATIVE WMS SUPPLY TOTAL						10,832	12,437	14,463	16,331	19,322	23,324

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.