Recommended Alternative for Long-Term Water Supply Community of Catalpa Hills

Prepared for Northwest New Mexico Council of Governments
Gallup, New Mexico

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Recommended Alternative for Long-Term Water Supply
Community of Catalpa Hills

1. Background and Overview

This document summarizes the recommendations for providing long-term public water service to the community of Catalpa Hills in McKinley County, New Mexico (Figure 1). Water service for a number of existing or potential small rural water systems in McKinley County was examined in the report *McKinley County Small Rural Water Systems Appraisal Level Investigation*, prepared by Daniel B. Stephens & Associates, Inc. (DBS&A) in partnership with DePauli Engineering and Surveying Co. The report was published June 9, 2015. The Appraisal Level Investigation was prepared for McKinley County, through the Northwest New Mexico Council of Governments (NWNMCOG) pursuant to the Reclamation Rural Water Supply Act of 2006 (43 USC §§ 2401-2409 (Supp. 2011)) and appraisal criteria included in the U.S. Bureau of Reclamation's (USBR's) Rural Water Supply Program interim final rule (43 CFR Part 404).

2. Existing Conditions

Catalpa Hills is located ½ mile south of the Gallup municipal boundary (Figure 1). It includes an estimated 97 homes located on 4-acre lots within an approximately 1-square-mile area. Catalpa Hills constitutes what is referred to as a non-system community, or an area without a water system in place, in which homes are supplied instead by privately owned domestic wells. The New Mexico Office of the State Engineer (OSE) lists 27 domestic wells totaling 51 acre-feet in water rights drilled between 1981 and 2009 in the Catalpa Hills area (NM OSE, 2014). The estimated current population in Catalpa Hills is 275.

3. Alternatives Examined

Three alternatives were examined for sustainable domestic water service to homes in Catalpa Hills: (1) No Action (Groundwater), (2) Connection to the Navajo Gallup Regional Water Supply Project (NGWSP) with a Master Meter, and (3) Connection to the NGWSP with individual meters.

S:\PROJECTS\WR12.0084_MCKINLEY_COUNTY\GIS\MXDS\APPRAISAL_REPORT\FIG01_WATER_SYSTEMS.MXD

System	Number of Connections	
	2012	2060
Allison	31	38
Catalpa	97	120
Cipriano Lewis	27	33
Crestview	93	115
Coal Basin	34	42
Gamerco WSD	484	598
Twin Buttes	57	70
White Cliffs	48	59
Williams Acres	180	223
Yah ta hey	125	155
	1,176	1,453

Explanation

Catalpa Proposed water lines

Gamerco Existing water lines

Proposed water line

Existing water line

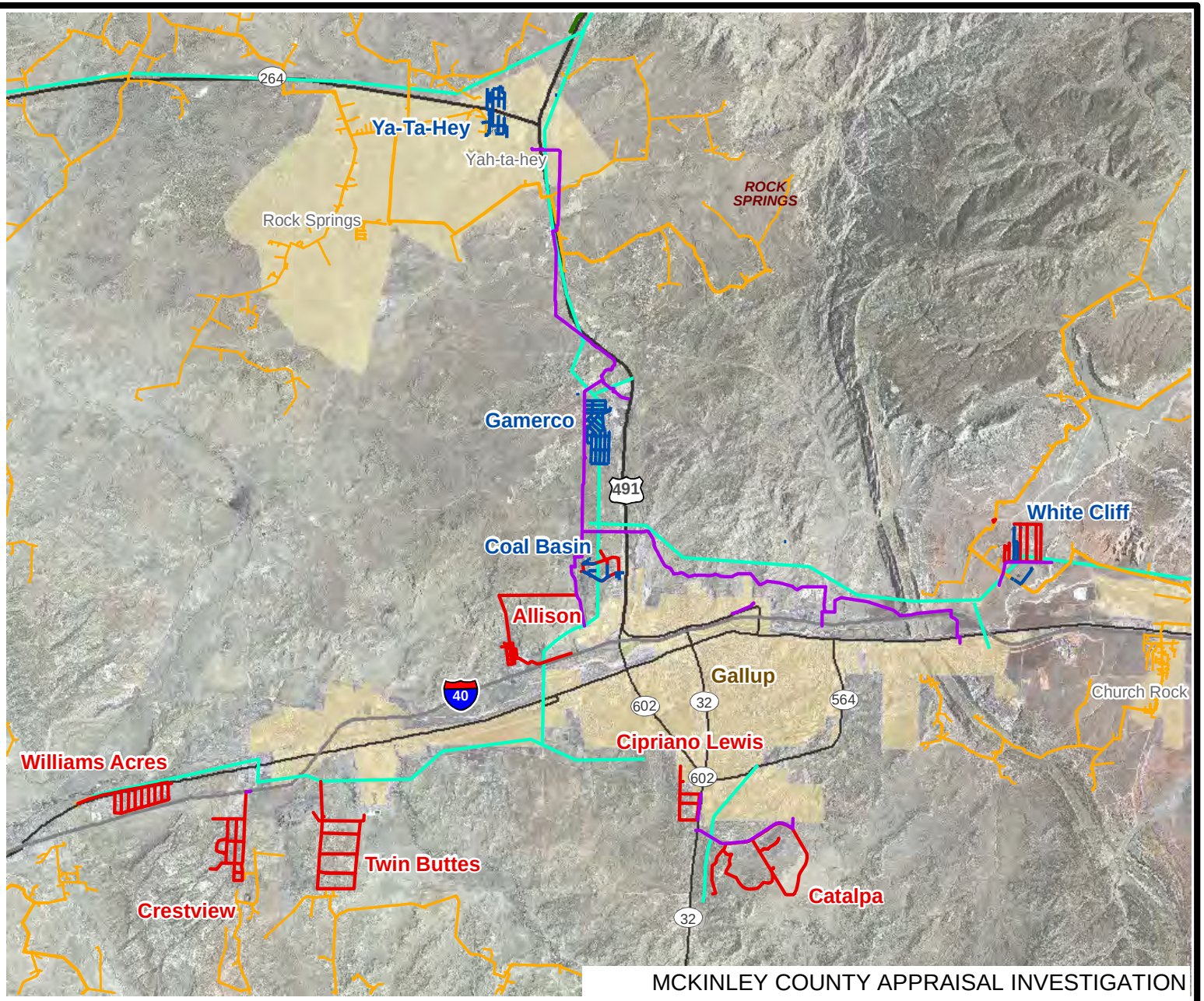
San Juan Lateral

Navajo Tribal Utility Authority pressurized main

Navajo Gallup Water Supply Pipeline water line

N

0 1 2 Miles



MCKINLEY COUNTY APPRAISAL INVESTIGATION

McKinley County Rural Water Systems and Navajo Gallup Water Supply Project

Figure 1

Daniel B. Stephens & Associates, Inc.

4/21/2015

JN WR12.0084

To evaluate future infrastructure needs, population and water demand projections were calculated for the year 2060. It is estimated that in 2060 Catalpa Hills will have 38 households and water demand will reach 23,841 gallons per day (gpd), or 26.7 acre-feet per year (ac-ft/yr).

The distribution system for each alternative would include 23 fire hydrants, 120 service connections, and at least 44 isolation valves.

3.1 No Action Alternative

Instead of continued reliance on individual wells, a community well would be drilled and a water system would be formed. A total of 28,500 feet of new 8-inch C-900 polyvinyl chloride (PVC) pipeline would need to be installed. The storage tank would be designed to have a capacity of 170,000 gallons, and would be located at the far west end of the system. The 1,800-foot-deep well would be centrally located and would feed 22 gallons per minute (gpm) directly into the distribution system using a 10-horsepower pump. Disinfection would be conducted using bulk sodium hypochlorite solution delivered via a dosing pump at the wellhead.

3.2 Connection with Master Meter Alternative

The master meter alternative would include an 8-inch totalizing flow meter and vault at the far northeast connection point to the NGWSP transmission line. The length of the new distribution line under this alternative would total only 27,000 feet, or less than under the No Action Alternative.

3.3 Connection with Individual Meters Alternative

The connection with individual meters alternative would include three connection points to the proposed NGWSP Reach 27.12 along Catalpa Canyon Wash Road, reducing the necessary pipeline for this alternative compared to the other two alternatives. The length of the new distribution line under this alternative would total only 21,000 feet.

4. Recommended Project

The alternatives described in Section 3 were scored based on performance goals that were associated with performance measures and attributes. Scores were assigned from 1 to 100, and criteria were weighted from 1 to 5. The scores for Catalpa Hills alternatives are provided in Appendix A and summarized in Table 1. Based on the scoring, the connection alternative with individual meters is the preferred alternative, as shown in Figure 2.

Table 1. Alternative Scores

Alternative	Score
No action (groundwater)	1,485
Connection with master meter	2,320
Connection with individual meters	2,860

5. Costs

The estimated capital cost of the preferred alternative is $1,647,000. The annual household water cost (which would be billed to households by the City of Gallup) is $414. The operating and maintenance costs have not been calculated, as they are included in the rates the utility company would charge to the individual customers. The detailed capital cost estimate is provided as Appendix B.

6. Permitting and Environmental Compliance

6.1 Biological Setting

The Southwest Regional Gap Analysis Project (SWReGAP) maps the Catalpa Hills area as Colorado Plateau mixed bedrock canyon and tableland, Colorado Plateau pinyon-juniper woodland, inter-mountain basins big sagebrush shrubland, inter-mountain basins greasewood flat, inter-mountain basins mixed salt desert scrub, inter-mountain basins semi-desert grassland, inter-mountain basins semi-desert shrub steppe, and North American warm desert bedrock cliff

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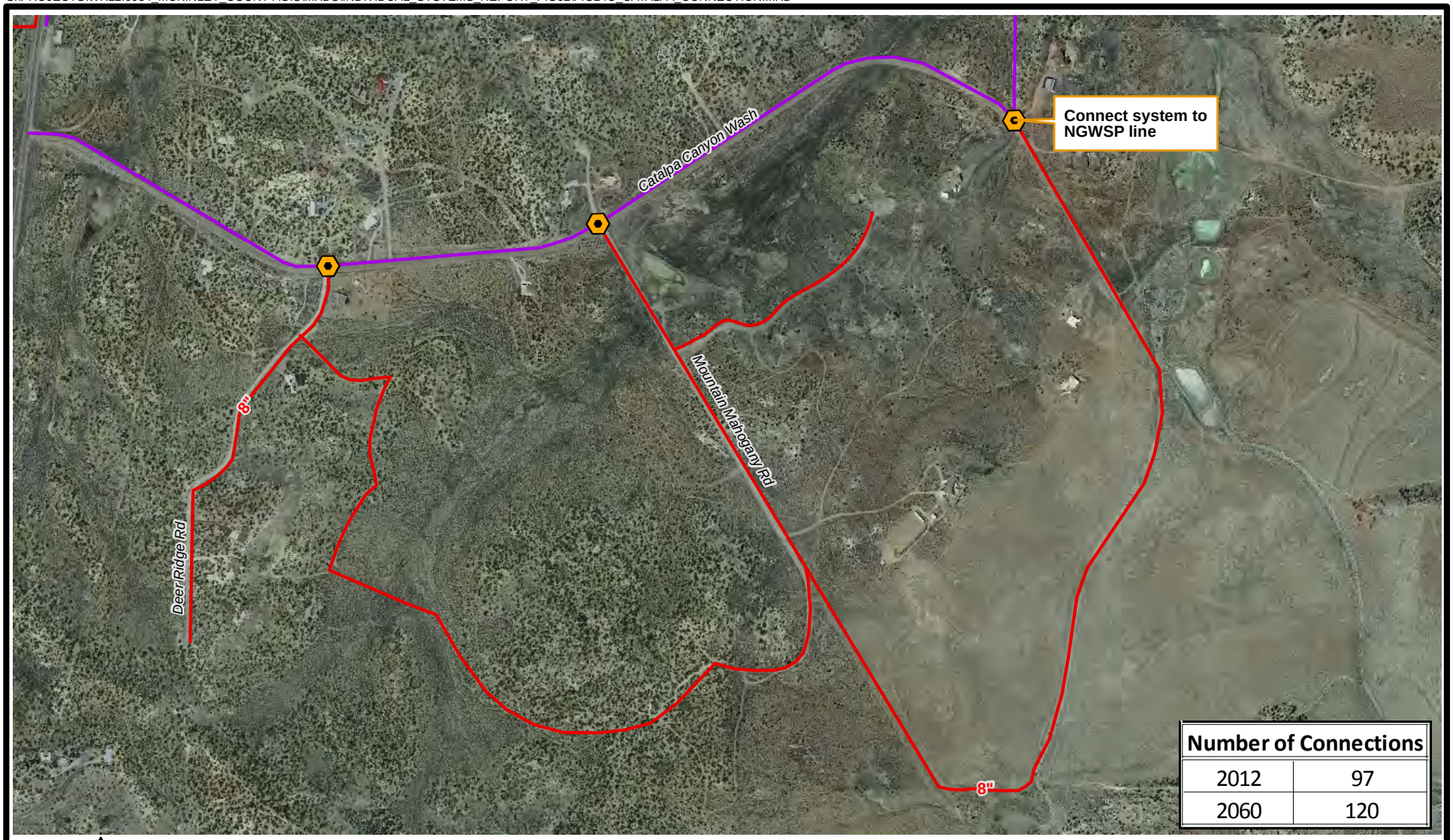

Number of Connections	
2012	97
2060	120

May 2012 aerial photograph from Google Earth

N

0 500 1000 Feet

Explanation

- Proposed water system (21,800 ft total pipe length)
- Proposed Navajo Gallup Water Supply Pipeline water line (Reach 27.12)
- Tie-in

MCKINLEY COUNTY APPRAISAL INVESTIGATION

Catalpa Proposed Water System
Preferred Alternative

Daniel B. Stephens & Associates, Inc.
6/22/2015
JN WR12.0084

Figure 2

and outcrop. These vegetation categories (termed "ecological systems"), together with wildlife, are described in Appendix C.

6.2 Special-Status Species

Federally listed endangered and threatened plant and animal species receive protection under the Endangered Species Act (ESA) of 1973. In McKinley County the black-footed ferret (*Mustela nigripes*), the southwestern willow flycatcher (*Empidonax traillii extimus*), the least tern (*Sternula antillarum athalassos*), and the Zuni bluehead sucker (*Catostomus discobolus yarrowi*) are all listed as endangered, and the Mexican spotted owl (*Strix occidentalis lucida*), yellow-billed cuckoo (*Coccyzus americanus*), and Zuni fleabane (*Erigeron rhizomatus*) are listed as threatened.

Some of the above species, along with others, also receive protection under New Mexico's Wildlife Conservation Act [17-2-37 to 17-2-46 NMSA 1978] or at the Navajo Nation level. All of these species, including the bald eagle (Haliaeetus leucocephalus), peregrine falcon (*Falco peregrinus*), Costa's hummingbird (*Calypte costae*), and gray vireo (*Vireo vicinior*) must be considered for planning purposes.

6.3 Permitting and Compliance

Prior to construction of the preferred alternative, the contractor would be required to address applicable state and federal requirements for construction including right-of-way (ROW) for water lines. Additionally, this community falls within the project area of the NGWSP. Key requirements for that project are included here for reference. *The Record of Decision for the Navajo-Gallup Water Supply Project Planning Report and Final Environmental Impact Statement* (USBR, 2009) indicates steps needed for meeting all environmental compliance regarding final designs. Construction of water lines is expected to create temporary turbidity and other water quality concerns, and USBR is tasked with obtaining required permits under Section 404 of the Clean Water Act (CWA) for impacts associated with jurisdictional waters of the United States. Nationwide permits authorization under Nationwide Permits (NWPs) No. 12 (Utility Line Activities) will be requested for temporary construction disturbances to perennial

and intermittent stream pipeline crossings. Compliance with General Condition 18, Endangered Species, is required for all NWPs.

The New Mexico Wildlife Conservation Act (WCA) (NMSA 17-2-37) authorizes the New Mexico Department of Game and Fish to create a list of endangered or threatened wildlife within the state, and to take steps to protect and restore populations of species on the list. Actions causing the death of a state listed endangered animal are in violation of the WCA. For all of these reasons, in addition to other federal and state regulations and guidelines, the planning phase for any proposed new water line should include a biological survey with the following objectives:

- Determination of the ordinary high water mark at each stream crossing, in order to determine disturbance acreages for jurisdictional waters
- Wetland delineations, as needed
- Identification of noxious weeds along the route of the proposed water line
- Assessment of habitat for federal and state threatened and endangered species, as well as any additional species listed by the Navajo Nation, as needed

The Migratory Bird Treaty Act makes it unlawful to hunt, take, capture, kill, possess, import, or export any migratory birds, their nests, and eggs. Construction of the new water line should therefore occur outside the nesting season or be preceded by nest surveys to locate and protect any active nest at risk from construction activities.

Archaeological surveys are also needed along the route of the proposed new water line to avoid or mitigate losses of cultural resources that could be affected by the construction and operation of the water line. Native American human remains, funerary objects, or objects of cultural patrimony may also be encountered during the construction of new water lines of the NGWSP. Therefore, prior to issuing any approvals or permits for activities related to the NGWSP, USBR is tasked with not just the implementation of a program to avoid and mitigate the loss of cultural resources, but also full compliance with the relevant sections of the Native American Graves Protection and Repatriation Act (NAGPRA) and 43 CFR 10.3 (USBR, 2009).

References

New Mexico Office of the State Engineer (NM OSE). 2014. New Mexico water rights reporting system. <http://nmwrrs.ose.state.nm.us/nmwrrs/index.html> Accessed January 2014.

U.S. Bureau of Reclamation (USBR). 2009. Planning report and final environmental impact statement, Navajo-Gallup Water Supply Project New Mexico – Arizona. July 2009. Available at <http://www.usbr.gov/uc/envdocs/eis/navgallup/FEIS/index.html>.

Appendix A

Alternative Scoring

Alternative Evaluation

Name of System: **Catalpa Hills**

Alternative:

No Connection Alternative: Drill New or Supplemental well with service from small system	X
Connection with master meter to Gallup or NTUA (Water system still responsible for service)	
Connection to Gallup or NTUA, who provides service to individual customers (water system no longer in place)	

Goals	Performance Measures/Attributes	Score (0–100)	Criteria Weight	Evaluation Total
Long-term sustainable supply	Renewable water supply	40	4	160
Implementable	Project complexity	35	3	105
	Water right acquisition or transfer	10	4	40
Cost	Projected capital and O&M costs	40	4	160
Local environmental and health and safety benefits	Environmental considerations	50	4	200
	Health, safety, and welfare	60	4	240
	Watershed and regional approach	20	4	80
Community preference	Reliability of service	60	5	300
	Complexity of managerial and operations and maintenance requirements for systems and communities	50	4	200
			Total	**1485**

Alternative Evaluation

Name of System: **Catalpa Hills**

Alternative:

No Connection Alternative: Drill New or Supplemental well with service from small system	
Connection with master meter to Gallup or NTUA (Water system still responsible for service)	X
Connection to Gallup or NTUA, who provides service to individual customers (water system no longer in place)	

Goals	Performance Measures/Attributes	Score (0–100)	Criteria Weight	Evaluation Total
Long-term sustainable supply	Renewable water supply	70	4	280
Implementable	Project complexity	60	3	180
	Water right acquisition or transfer	50	4	200
Cost	Projected capital and O&M costs	50	4	200
Local environmental and health and safety benefits	Environmental considerations	60	4	240
	Health, safety, and welfare	70	4	280
	Watershed and regional approach	90	4	360
Community preference	Reliability of service	60	5	300
	Complexity of managerial and operations and maintenance requirements for systems and communities	60	4	240
			Total	**2280**

Alternative Evaluation

Name of System: **Catalpa Hills**

Alternative:

No Connection Alternative: Drill New or Supplemental well with service from small system	
Connection with master meter to Gallup or NTUA (Water system still responsible for service)	
Connection to Gallup or NTUA, who provides service to individual customers (water system no longer in place)	X

Goals	Performance Measures/Attributes	Score (0–100)	Criteria Weight	Evaluation Total
Long-term sustainable supply	Renewable water supply	70	4	280
Implementable	Project complexity	80	3	240
	Water right acquisition or transfer	95	4	380
Cost	Projected capital and O&M costs	80	4	320
Local environmental and health and safety benefits	Environmental considerations	60	4	240
	Health, safety, and welfare	70	4	280
	Watershed and regional approach	90	4	360
Community preference	Reliability of service	80	5	400
	Complexity of managerial and operations and maintenance requirements for systems and communities	90	4	360
			Total	**2860**

Appendix B

Preliminary Cost Estimate for Preferred Alternative

COST ESTIMATE SUMMARY

FEATURE:	Catalpa Hills - Connection alternative - Connect to proposed NGWSP line and individual meter	**PROJECT:**	**McKinley County Regionalizaton Planning**
		WOID:	**ESTIMATE LEVEL: Appraisal**
		REGION:	**UNIT PRICE LEVEL: October 1, 2013**
		FILE:	**S:\Projects\WR12.0084_McKinley_County\Engineering\Cost Estimates\Cost Estimate- Improvements.xlsx**

PAY ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	Waterline (8")	21,800	LF	$ 22.24	$ 484,832
2	Fittings	$ 484,832	%	15%	$ 72,725
3	Fire hydrants	23	EA	$ 3,500.00	$ 80,500
4	Water valves (8")	44	EA	$ 875	$ 38,153
5	Service connections, incl. tap	120	EA	$ 1,750.00	$ 209,866
6	Storage tank	0	GAL	$ 1.50	$ -
7	Tie-in 18"	3	EA	$ 3,800	$ 11,400
					$ -
					$ -
					$ -
					$ -
					$ -
					$ -
				SUBTOTAL	$ 897,475
	Contractor Overhead and Administration Costs	12.1%	(%)	$ 897,475	$ 108,325
	SUBTOTAL CONSTRUCTION				$ 1,005,800
	Design Contingency	10.0%	(%)	$ 1,005,800	$ 100,580
	SUBTOTAL WITH DESIGN CONTINGENCY				$ 1,106,380
	Engineering Design	12.0%	(%)	$ 1,106,380	$ 132,766
	QA/QC	6.0%	(%)	$ 1,106,380	$ 66,383
	Construction Administration	6.0%	(%)	$ 1,106,380	$ 66,383
	Environmental Assessment	4.0%	(%)	$ 1,106,380	$ 44,255
	Archaeological Survey	4.0%	(%)	$ 1,106,380	$ 44,255
	Biological Survey	4.0%	(%)	$ 1,106,380	$ 44,255
	SUBTOTAL, PROFESSIONAL SERVICES				$ 398,297
		SUBTOTAL, CAPITAL COSTS			*$ 1,404,097*
	Tax	8.3125%	(%)	$ 1,404,097	$ 116,716
	Contingency, % of capital costs	9%	(%)	$ 1,404,097	$ 126,369
	TOTAL CAPITAL COST				**$ 1,647,182**

QUANTITIES		**PRICES**	
BY:	M. Anderson	**BY:**	M. Anderson
DATE:		**DATE:**	
CHECKED:		**CHECKED:**	
DATE:		**DATE:**	

Appendix C

Vegetation and Wildlife

Appendix C. Vegetation and Wildlife

C.1 Vegetation

The Southwest Regional Gap Analysis Project (SWReGAP) maps the Catalpa Hills area as Colorado Plateau mixed bedrock canyon and tableland, Colorado Plateau pinyon-juniper woodland, inter-mountain basins big sagebrush shrubland, inter-mountain basins greasewood flat, inter-mountain basins mixed salt desert scrub, inter-mountain basins semi-desert grassland, inter-mountain basins semi-desert shrub steppe, and North American warm desert bedrock cliff and outcrop. These vegetation categories (termed "ecological systems") are described in the following subsections.

C.1.1 Colorado Plateau Mixed Bedrock Canyon and Tableland

The distribution of this ecological system is centered on the Colorado Plateau, where it is composed of barren and sparsely vegetated landscapes (generally <10 percent plant cover) of steep cliff faces, narrow canyons, and open tablelands of predominantly sedimentary rocks, such as sandstone, shale, and limestone. Some eroding shale layers similar to inter-mountain basins shale badland (CES304.789) may be interbedded between the harder rocks. The vegetation is characterized by very open tree canopy or scattered trees and shrubs with a sparse herbaceous layer. Common species includes *Pinus edulis*, *Pinus ponderosa*, *Juniperus* spp., *Cercocarpus intricatus*, and other short-shrub and herbaceous species, using moisture from cracks and pockets where soil accumulates. It is geographically restricted and distinct from the related, but broader inter-mountain basins cliff and canyon (CES304.779). Shale areas are not extensive as in shale badlands.

C.1.2 Colorado Plateau Pinyon-Juniper Woodland

The Colorado Plateau pinyon-juniper woodland ecological system occurs in dry mountains and foothills of the Colorado Plateau region, including the western slope of Colorado to the Wasatch Range, south to the Mogollon Rim, and east into the northwestern corner of New Mexico. It is typically found at lower elevations ranging from 4,900 to 8,000 feet above mean sea level

(feet msl). Woodlands of this ecological system occur on warm, dry sites on mountain slopes, mesas, plateaus, and ridges. Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. Soils supporting this system vary in texture, ranging from stony, cobbly, gravelly sandy loams to clay loam or clay.

Twoneedle pinyon (*Pinus edulis*) and/or Utah juniper (*Juniperus osteosperma*) dominate the tree canopy. In the southern portion of the Colorado Plateau in northern Arizona and northwestern New Mexico, oneseed juniper (*Juniperus monosperma*) and hybrids of juniper species (*Juniperus* spp.) may dominate or co-dominate the tree canopy. Rocky Mountain juniper (*Juniperus scopulorum*) may co-dominate or replace Utah juniper at higher elevations. Understory layers are variable and may be dominated by shrubs, graminoids, or be absent. Associated species include greenleaf manzanita (*Arctostaphylos patula*), big sagebrush (*Artemisia tridentata*), littleleaf mountain mahogany (*Cercocarpus intricatus*), alderleaf mountain mahogany (*Cercocarpus montanus*), blackbrush (*Coleogyne ramosissima*), Stansbury cliffrose (*Purshia stansburiana*), antelope bitterbrush (*Purshia tridentata*), Gambel oak (*Quercus gambelii*), blue grama (*Bouteloua gracilis*), James' galleta (*Pleuraphis jamesii*), or muttongrass (*Poa fendleriana*). The Colorado Plateau pinyon-juniper woodland occurs at higher elevations than the Great Basin pinyon-juniper woodland and Colorado Plateau shrubland systems.

C.1.3 Inter-Mountain Basins Big Sagebrush Shrubland

This ecological system occurs throughout much of the western United States, typically in broad basins between mountain ranges, plains, and foothills between 1,500 and 2,300 meters in elevation. Soils are typically deep, well-drained and non-saline. These shrublands are dominated by *Artemisia tridentata* ssp. *tridentata* and/or *Artemisia tridentata* ssp. *wyomingensis*. Scattered *Sarcobatus vermiculatus* and *Atriplex* spp. may be present in some stands. *Ericameria nauseosa* or *Chrysothamnus viscidiflorus* may co-dominate disturbed stands. Perennial herbaceous components typically contribute less than 25 percent vegetative cover. Common graminoid species include *Achnatherum hymenoides, Bouteloua gracilis, Elymus lanceolatus, Festuca idahoensis, Hesperostipa comata, Leymus cinereus, Pleuraphis jamesii, Pascopyrum smithii, Poa secunda*, or *Pseudoroegneria spicata*.

C.1.4 Inter-Mountain Basins Greasewood Flat

This ecological system occurs in intermountain basins throughout much of the western United States and extends onto the western Great Plains. It typically occurs near drainages on stream terraces and flats or may form rings around more sparsely vegetated playas. Sites typically have saline soils and a shallow water table and flood intermittently, but remain dry for most growing seasons. The water table remains high enough to maintain vegetation, despite salt accumulations. This system usually occurs as a mosaic of multiple communities, with open to moderately dense shrublands dominated or co-dominated by greasewood (*Sarcobatus vermiculatus*). Fourwing saltbush (*Atriplex canescens*), shadscale saltbush (*Atriplex confertifolia*), or winterfat (*Krascheninnikovia lanata*) may be present to co-dominant. Occurrences are often surrounded by mixed salt desert scrub. The herbaceous layer, if present, is usually dominated by graminoids. There may be inclusions of alkali sacaton (*Sporobolus airoides*), saltgrass (*Distichlis spicata*) (where water remains ponded the longest), or common spikerush (*Eleocharis palustris*) herbaceous types.

C.1.5 Inter-Mountain Basins Mixed Salt Desert Scrub

This extensive ecological system includes open-canopied shrublands of typically saline desert basins, alluvial slopes, and plains across the Intermountain western United States. This type also extends in limited distribution into the southern Great Plains. Substrates are often saline and calcareous, medium- to fine-textured, alkaline soils, but include some coarser-textured soils. The vegetation is characterized by a typically open to moderately dense shrubland composed of one or more Atriplex species such as *Atriplex confertifolia*, *Atriplex canescens*, *Atriplex polycarpa*, or *Atriplex spinifera*. Other shrubs present to co-dominant may include *Artemisia tridentata* ssp. *wyomingensis*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Ephedra nevadensis*, *Grayia spinosa*, *Krascheninnikovia lanata*, *Lycium* spp., *Picrothamnus desertorum*, or *Tetradymia* spp. *Sarcobatus vermiculatus* is generally absent, but if present does not co-dominate. The herbaceous layer varies from sparse to moderately dense and is dominated by perennial graminoids such as *Achnatherum hymenoides*, *Bouteloua gracilis*, *Elymus lanceolatus* ssp. *lanceolatus*, *Pascopyrum smithii*, *Pleuraphis jamesii*, *Pleuraphis rigida*, *Poa secunda*, or *Sporobolus airoides*. Various forbs are also present.

C.1.6 Inter-Mountain Basins Semi-Desert Grassland

This widespread ecological system occurs throughout the Intermountain western United States on dry plains and mesas, at approximately 1,450 to 2,320 meters (4,750 to 7,610 feet) in elevation. These grasslands occur in lowland and upland areas and may occupy swales, playas, mesa tops, plateau parks, alluvial flats, and plains, but sites are typically xeric. Substrates are often well-drained sandy- or loamy-textured soils derived from sedimentary parent materials, but are quite variable and may include fine-textured soils derived from igneous and metamorphic rocks. When they occur near foothills grasslands they will be at lower elevations. The dominant perennial bunch grasses and shrubs within this system are all very drought-resistant plants. These grasslands are typically dominated or co-dominated by *Achnatherum hymenoides, Aristida* spp., *Bouteloua gracilis, Hesperostipa comata, Muhlenbergia torreyana*, or *Pleuraphis jamesii*, and may include scattered shrubs and dwarf-shrubs of species of *Artemisia, Atriplex, Coleogyne, Ephedra, Gutierrezia*, or *Krascheninnikovia lanata*.

C.1.7 Inter-Mountain Basins Semi-Desert Shrub Steppe

This ecological system occurs throughout the Intermountain western United States, typically at lower elevations on alluvial fans and flats with moderate to deep soils. This semi-arid shrub-steppe is typically dominated by graminoids (>25 percent cover) with an open shrub layer, but includes sparse mixed shrublands without a strong graminoid layer. Characteristic grasses include *Achnatherum hymenoides, Bouteloua gracilis, Distichlis spicata, Hesperostipa comata, Pleuraphis jamesii, Poa secunda*, and *Sporobolus airoides*. The woody layer is often a mixture of shrubs and dwarf-shrubs. Characteristic species include *Atriplex canescens, Artemisia filifolia, Chrysothamnus greenei, Chrysothamnus viscidiflorus, Ephedra* spp., *Ericameria nauseosa, Gutierrezia sarothrae*, and *Krascheninnikovia lanata*. Scattered *Artemisia tridentata* may be present but does not dominate. The general aspect of occurrences may be either open shrubland with patchy grasses or patchy open herbaceous layer. Disturbance may be important in maintaining the woody component. Microphytic crust is very important in some occurrences.

C.1.8 North American Warm Desert Bedrock Cliff and Outcrop

This ecological system is found from subalpine to foothill elevations and includes barren and sparsely vegetated landscapes (generally <10 percent plant cover) of steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock types. Also included are unstable scree and talus slopes that typically occur bellow cliff faces. Species present are diverse and may include *Bursera microphylla, Fouquieria splendens, Nolina bigelovii, Opuntia bigelovii*, and other desert species, especially succulents. Lichens are predominant lifeforms in some areas. May include a variety of desert shrublands less than 2 hectares (5 acres) in size from adjacent areas.

C.2 Wildlife

Mammals occurring in McKinley County and in the Great Basin Conifer Woodland biotic community (Brown and Lowe, 1977; Brown, 1982) typically include small mammals such as squirrels, mice, gophers, rats, rabbits, badgers, raccoon, and skunks, as well as larger mammals such as gray, kit, and red foxes (*Urocyon cinereoargenteus*, *Vulpes macrotis*, *V. vulpes*), coyote (*Canis latrans*), bobcat (*Lynx rufus*), and mule deer (*Odocoileus hemionus*).

Resident and migratory birds expected in the area include western kingbird (*Tyrannus verticalis*), northern mockingbird (*Mimus polyglottos*), broad-tailed and rufous hummingbirds (*Selasphorus platycercus, S. rufus*), black-chinned hummingbird (*Archilochus alexandri*), redheaded woodpecker (*Melanerpes erythrocephalus*), northern flicker (*Colaptes auratus*), dark-eyed junco (*Junco hyemalis*), red-breasted, white-breasted, and pygmy nuthatches (*Sitta canadensis*, *S. carolinensis*, *S. pygmaea*), western meadowlark (*Sturnella neglecta*), pinyon jay (*Gymnorhinus cyanocephalus*), common raven (*Corvus corax*), great horned owl (*Bubo virginianus*), red-tailed hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius*), northern harrier (*Circus cyaneus*), turkey vulture (*Cathartes aura*), several species of warblers, vireos, wrens, swallows, and sparrows, and numerous others.

References

Brown, D. E. 1982. *Desert plants: Biotic communities of the American Southwest-United States and Mexico.* University of Arizona, Superior, Arizona.

Brown, D.E., and C.H. Lowe. 1977. *Biotic communities of the Southwest map.* USDA Forest Service, Ft. Collins, Colorado.