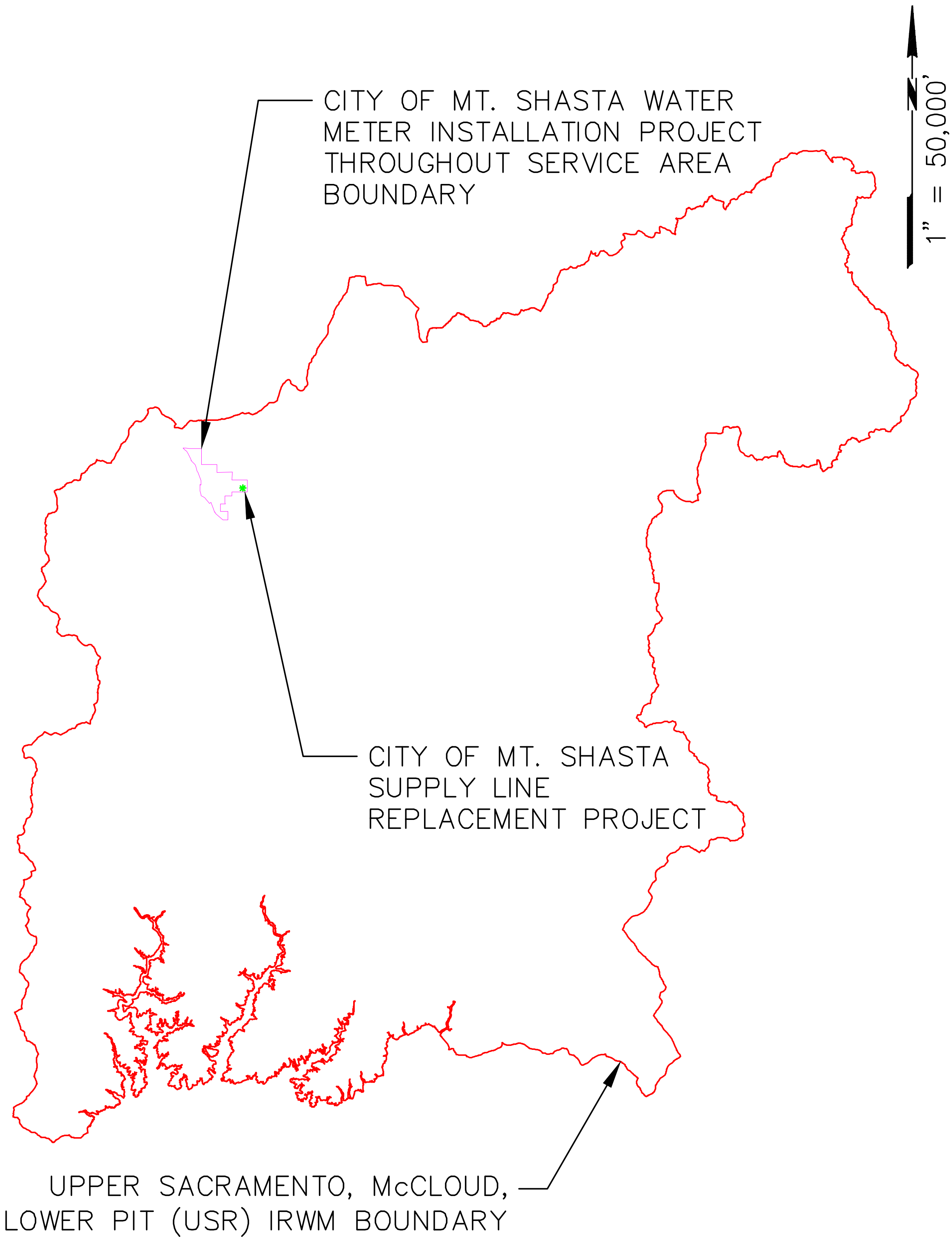
Table 4 – Upper Sacramento, McCloud, Lower Pit IRWM 2014 Drought Grant Proposal Project Summary Table			
Drought Project Element		City of Mt. Shasta Supply Line Replacement	City of Mt. Shasta Water Meter Installation
D.1	Provide immediate regional drought preparedness	1	1
D.2	Increase local water supply reliability and the delivery of safe drinking water	1	1
D.3	Assist water suppliers and regions to implement conservation programs and measures that are not locally cost-effective	1	1
D.4	Reduce water quality conflicts or ecosystem conflicts created by the drought	1	1
IRWM Project Element			
IR.1	Water supply reliability, water conservation, and water use efficiency	1	1
IR.2	Stormwater capture, storage, clean-up, treatment, and management		
IR.3	Removal of invasive non-native species, the creation and enhancement of wetlands, and the acquisition, protection, and restoration of open space and watershed lands		
IR.4	Non-point source pollution reduction, management, and monitoring		
IR.5	Groundwater recharge and management projects		
IR.6	Contaminant and salt removal through reclamation, desalting, and other treatment technologies and conveyance of reclaimed water for distribution to users		
IR.7	Water banking, exchange, reclamation, and improvement of water quality		
IR.8	Planning and implementation of multipurpose flood management programs		
IR.9	Watershed protection and management	1	1
IR.10	Drinking water treatment and distribution	1	1
IR.11	Ecosystem and fisheries restoration and protection	1	1
	Total	8	8

Project Description:
The City of Mt. Shasta Supply Line Replacement Project consists of planning, design, and construction of a water main between Cold Springs and existing reservoirs.

Project Description Discussion:
The proposed project would replace the only supply pipeline from the main water supply source to the City. This line is antiquated, prone to leaks, and in imminent danger of catastrophic failure as it is estimated to be approximately 50 to 80 years old. If this aging supply line were to fail, the City would be cut off from its largest and primary drinking water and fire suppression supply and an interruption in water supply to residents and businesses would result until the line was repaired. If considerable repair time was required, the City would have to rely on a supplemental supply source from two wells which have a combined production capacity of only 1.7 MGD, well below the current maximum day water demand. The existing alignment is located in an easement cross country with very limited access. Thus, repairs are very difficult if not impossible to implement, particularly in snowy winter months. Additionally, full capacity of the existing storage cannot be met during a large fire flow event due to the hydraulic limitations of the existing supply line and valving at the reservoirs. As such, this project is necessary to ensure reliable water supply and storage and the delivery of safe drinking water and fire suppression to the residents and businesses of the City, and adequate fire suppression to protect the ecosystem habitat and water quality and quantity. Another added benefit is that replacement of this supply pipeline will result in water savings by reducing the amount of unaccounted for water due to leaks. A lower amount of water will be needed from the spring source to supply the same demand. As such, an increased water supply will be available for local and downstream beneficial uses.

This project can be considered for all four eligible drought project types. It will provide immediate regional drought preparedness and increase local water supply reliability and the delivery of safe drinking water by implementing infrastructure renovations to a public water supply system necessary to assure continued reliability of the minimum quality and quantity of water required. This will result in long-term drought preparedness and safe drinking water supply and storage availability through a long-term reduction in water usage and unaccounted for water losses. This water conservation measure would not be possible for the City without 2014 Drought Grant funds as it is not locally cost-effective. The City is a DAC, and most of the City water system is not currently metered; therefore, all users are simply charged a flat rate fee to use the water. As such, any water conservation measures will result in no monetary benefit to the City.

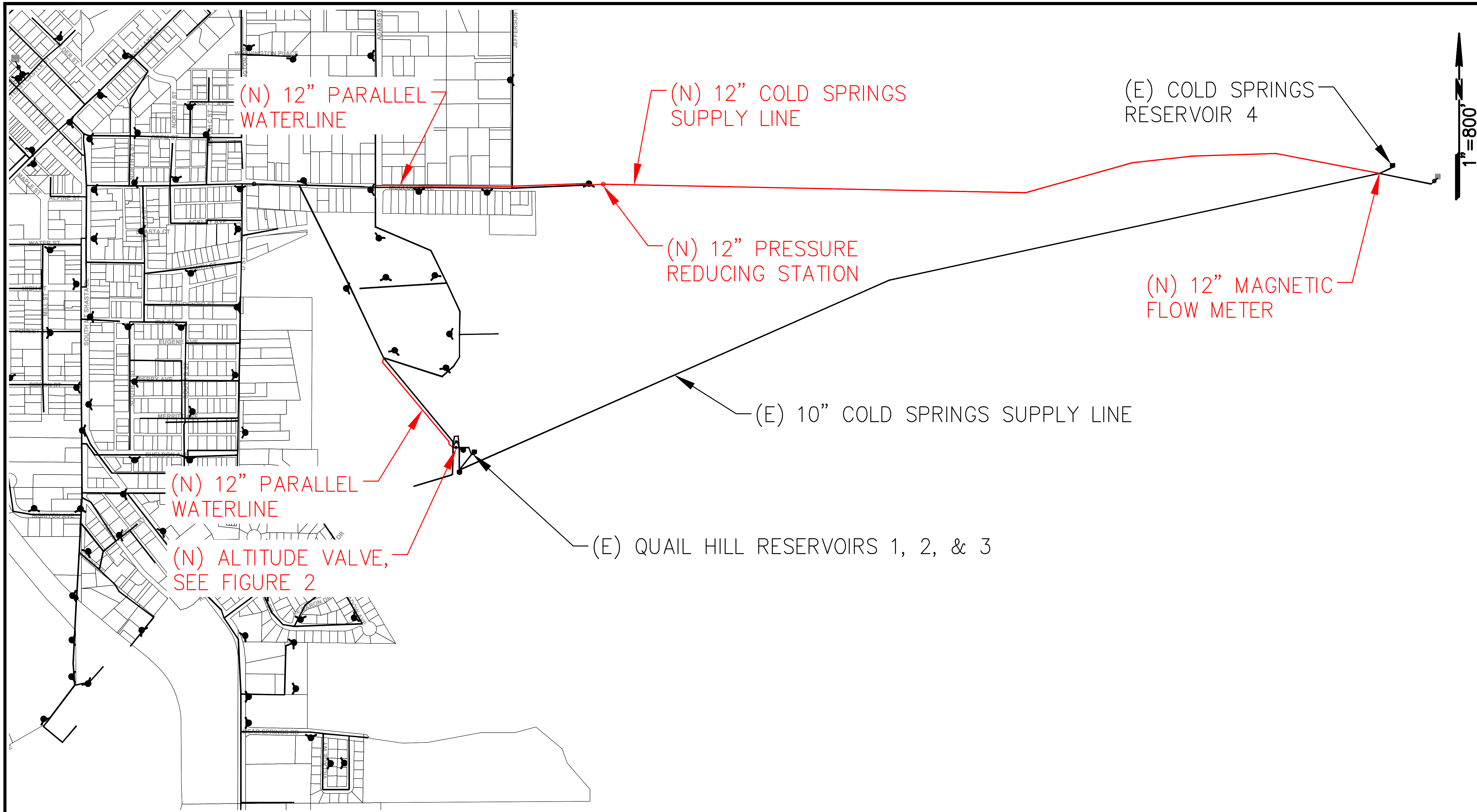
A further step in being prepared for drought impacts is a climate change vulnerability assessment of the water supply that will provide critical information for our immediate regional drought preparedness and understanding of our water supply reliability. As noted in the 2014 Drought Guidelines, studies to identify a project to meet a DAC critical water supply issue that is perceived but not yet determined can meet this program preference. For long-term understanding of a sustainable water supply and reliability during water shortages, it is critical to assess climate impacts on the recharge area and residence time of the City's water supplies. The climate change component of this project will conduct a vulnerability assessment of the water supply to assess risk, and to determine, recommend, and prioritize projects (such as precipitation gages and meters), and/or data management systems (such as real time precipitation and spring discharge correlation systems) are necessary for the City to forecast water supply and adapt to anticipated climate changes such as the change in amount, intensity, timing, quality, and variability of runoff and recharge to the Cold Spring water supply, as well as the City's supplemental wells. This will allow the City to be prepared for drought emergencies due to climate change. Project partner California Trout will implement this portion of the project.



ATT3_DG_ProJust_3of6

DATE	PACE ENGINEERING REDDING, CALIFORNIA	USR IRWM REGIONAL MAP	
06/18/13			JOB #111.31

Plot Date: June 26, 2014 – 11:19 am Login Name: lmccollum
File Name: M:\Land Projects\0111.31\DWG\PLATES2.DWG, Layout: IRWM BDRY

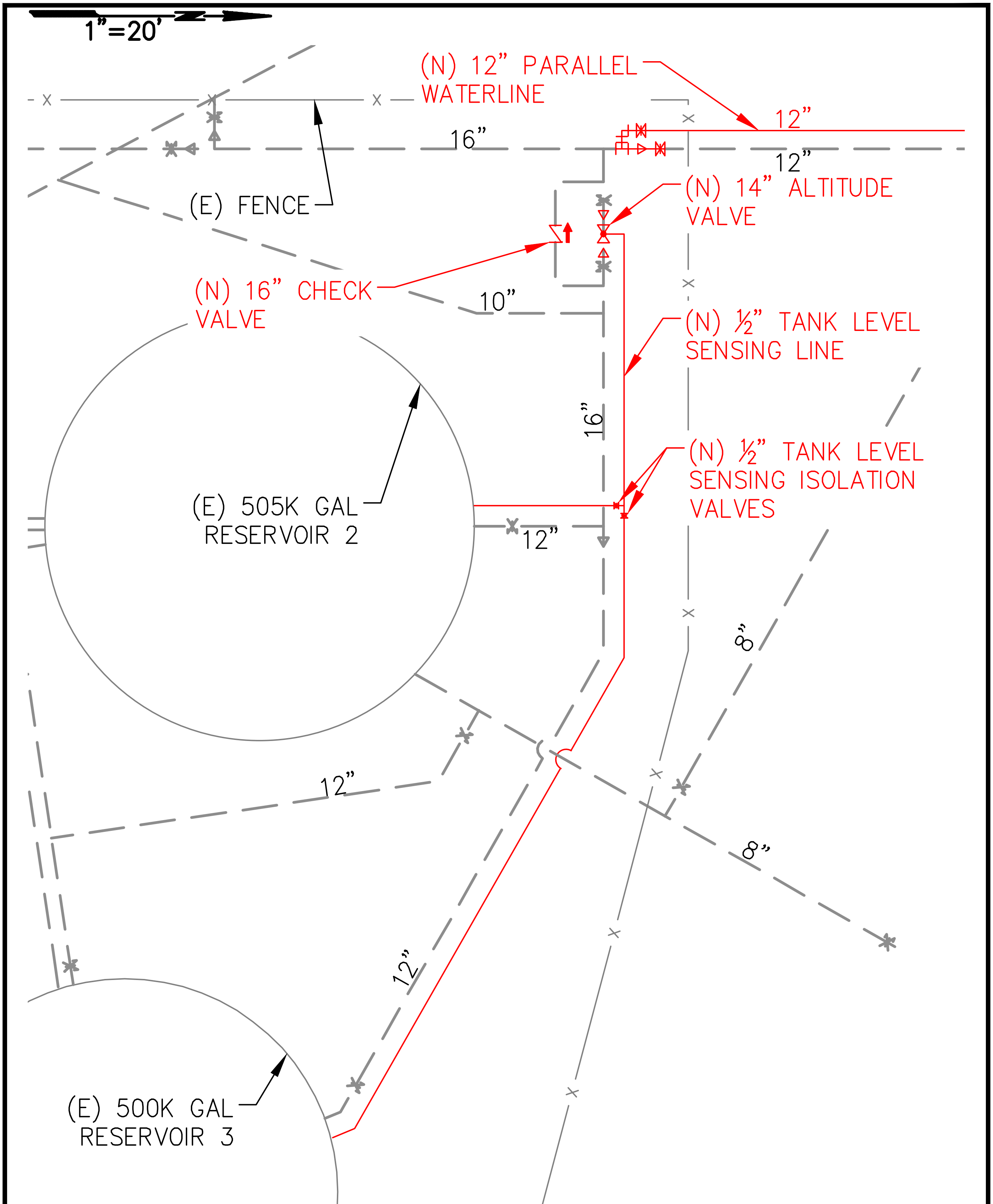


PACE ENGINEERING
REDDING, CALIFORNIA

CITY OF MT. SHASTA
SUPPLY LINE REPLACEMENT PROJECT

FIGURE 1
DATE: 4/14
JOB # 111.31

Plot Date: June 24, 2014 - 3:02 pm Login Name: lmccollum
File Name: M:\Land Projects\0111.31\DWG\Fig 1 - Supply Line Improvements.dwg, Layout: FIGURE 1



DATE 4/14	PACE ENGINEERING REDDING, CALIFORNIA	CITY OF MT. SHASTA SUPPLY LINE REPLACEMENT PROJECT	FIGURE 2
			JOB #111.31

Table 5 – Annual Project Physical Benefits

Project Name: City of Mt. Shasta Supply Line Replacement Project
Type of Benefit Claimed: Increased water storage capabilities
Units of the Benefit Claimed : Gallons per day

Additional Information About this Benefit: The fixing of leaks and an undersized deteriorated pipeline will result in the full use of existing storage capacity.

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	**0**	**0**	**0**
2015	**0**	**300,000**	**300,000**
2016-2065	**0**	**300,000**	**300,000**

Comments: The project will be completed by October 2015. As such, no benefits will be seen until that time. The expected lifetime of a ductile iron pipeline is more than 50 years. As such, benefits will be seen for at least this lifecycle.

Table 5 – Annual Project Physical Benefits

Project Name: City of Mt. Shasta Supply Line Replacement Project
Type of Benefit Claimed: Catastrophic wildfire protection
Units of the Benefit Claimed : Acres

Additional Information About this Benefit: Increased water delivery and storage availability through replacement of an undersized deteriorated pipeline will allow for more reliable protection against wildfire.

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	**0**	**0**	**0**
2015-2065	**0**	**4,015**	**4,015**

Comments: The project will be completed by October 2015. As such, no benefits will be seen until that time. The expected lifetime of a ductile iron pipeline is more than 50 years. As such, benefits will be seen for at least this lifecycle.

Table 5 – Annual Project Physical Benefits

Project Name: City of Mt. Shasta Supply Line Replacement Project
Type of Benefit Claimed: Number of species benefited and protected
Units of the Benefit Claimed : Number of species

Additional Information About this Benefit: More reliable protection against wildfire will protect the ecosystem habitat and water quality for all species present in the area.

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	**0**	**0**	**0**
2015-2065	**0**	**78**	**78**

Comments: The project will be completed by October 2015. As such, no benefits will be seen until that time. The expected lifetime of a ductile iron pipeline is more than 50 years. As such, benefits will be seen for at least this lifecycle.

The primary expected physical benefit of the City of Mt. Shasta Supply Line Replacement Project is that of increased storage capacity for adequate wildfire protection. As described in pages 52 through 54 of the 2010 Master Water Plan (PACE, 2010) (MWP), the City currently has a water storage capacity of 1.7 MG in four water reservoirs as shown in Figure 5 therein. Reservoir Nos. 1, 2, and 3 totaling 1.2 MG are located on the top of Quail Hill. Reservoir No. 3 is a 0.5 MG tank that was constructed in 1972. It is valved such that it remains essentially full at all times to provide water for fire or emergency needs. The outlet valves must be manually opened in order to make full use of the water stored in Reservoir No. 3. Reservoir No. 4, a 0.5 MG painted steel reservoir, was constructed adjacent to Cold Springs in 1980. It functions as a ballast reservoir for Cold Springs if the spring yield is less than the capacity of the 10-inch transmission main during high demand periods. A majority of the time it acts as an equalizing reservoir, but some days it will drain completely in an effort to refill the reservoirs on Quail Hill. However, due to the hydraulic limitations of the existing 10-inch supply line from Cold Springs, the full capacity of Reservoir 4 cannot be taken advantage of; consequently, the effective storage capacity of the Cold Springs Tank is reduced. The effective system storage capacity is approximately 1.4 MG. The City's current storage requirement is about 1.78 MG as determined by the requirements described below.

It is usually more economical and reliable to provide stored water for supply needed during: (1) fire demands, (2) peak demands in excess of maximum daily demand, and (3) in the event of an emergency, such as a power outage that interrupts the normal source of water. The required storage in a typical water system is a function of three quantities as follows:

1. Equalizing storage is the amount of water needed over and above the maximum daily demand rate (24-hour average) to satisfy peak demands of the day. California Waterworks Standard §64554(a)(1) states the system shall store at least four hours of peak hourly demand (PHD). At the current condition, Mt. Shasta requires about 1.15 MG of equalizing storage.

2. Fire storage is usually based on the theoretical amount that could be used to combat a major fire in the high value districts. Fire standards recommend minimum fire flows varying from 1,000 GPM for single-family residential lots to 3,500 GPM or more for multi-family residential, commercial, or industrial, dependent on the size of the structure, its composition, and if the structure has a fire sprinkler system. ISO recommendations range from 500 GPM for single-family residential on large parcels (1,000 GPM if the dwellings have wood shake roofs) to a maximum of 3,500 GPM. Buildings requiring higher flows would not be counted against the community water system if ISO were to rate the system. It seems impractical to design the entire water system to meet every possible fire demand, which can change with building construction, sprinkler installation, or building renovation or replacement. Fire storage requirements are based on being capable of providing the minimum residential fire flow for a period of 2 hours, and up to 3,500 GPM of commercial/industrial fire flow for a period of

3 hours. Therefore, it would require 0.12 MG and 0.63 MG of storage to meet the 1,000 GPM and 3,500 GPM fire flow requirements, respectively. Future large buildings having fire flow demands in excess of what the system can provide, should be encouraged to be sprinklered, which reduces the fire demand flow. The current City system cannot support demands greater than 3,500 GPM. Buildings with demands greater than 3,500 GPM should be independently analyzed.

3. Emergency storage is the amount of water necessary to continue service in the event of power failure or some other failure of the supply system. This is usually assumed to be the maximum daily demand rate times some interval of time such as might occur during a power outage. Six hours is normally used or 25 percent of MDD.

   During normal conditions, a majority of the Mt. Shasta water supply is provided by gravity from Cold Springs. If the proposed water supply pipeline down McCloud Avenue is constructed it will provide some needed redundancy for the existing supply main, therefore making it unwarranted to provide a 6-hour emergency storage capacity. It also appears unreasonable to imagine a major fire coincident with both a total supply system failure and with a period of water consumption equal to the maximum daily demand. For these reasons, the required storage for the next twenty years will be assumed to be equal to the total of the equalizing storage plus fire storage. However, as the water supply becomes more and more dependent on wells, the City should reconsider incorporating an allowance for the emergency storage.

As such, the City's 2010 total storage requirement is 1.78 MG. The current capacity of the existing 10-inch main from Cold Springs to Quail Hill tends to limit the effectiveness of Reservoir No. 4 to provide supplemental fire flow during certain conditions. Therefore, the current effective storage capacity is probably somewhere between 1.2 MG which is the combined capacity of the three reservoirs on Quail Hill and 1.7 MG, which is the current total of all four reservoirs. If the replacement supply pipeline were to be constructed, the existing Reservoir No. 4 becomes more useful and the total effective storage capacity would increase from about 1.4 MG to 1.7 MG. This, together with construction of a 12-inch parallel pipeline from the Quail Hill Tanks and control valves, would convey more peak flows and fire flows into the system in addition to the increased storage capacity further improving fire flow capacity. In addition, the improvements make more efficient use of the City's water supply by utilizing more storage tank volume to meet peak demands rather than taxing the spring source.

As discussed in Attachment 2 of this grant application, the City is located in a primarily forested region with steep terrain and a very active fire regime. The existing water system service area boundary consists of approximately 4,015 acres as shown in the project map. As such, this much area will receive the benefit of more flow available and increased storage capacity for adequate fire protection. The sphere of influence boundary also shown in the project map actually encompasses approximately 15,785 acres. As such, it is possible and likely the existing service area boundary will be expanded to increase this acreage benefit in future years within the project lifecycle time period.

An additional secondary benefit is the protection of water quality and ecosystem habitat of special-status species known to occur in the Upper Sacramento River Watershed. According to section 3.3.4 of the Upper Sacramento River Watershed Assessment and Management Strategy completed for The River Exchange (North State Resources, Inc., 2010) (Watershed Assessment), there are 42 special-status plant species and 36 special-status wildlife species in the watershed. Special status plants are those that are listed or proposed for listing as threatened or endangered under the Federal Endangered Species Act (FESA), listed or proposed for listing by the State of California as threatened or endangered under the California Endangered Species Act (CESA), listed as rare under the California Native Plant Protection Act, or considered by the California Native Plant Society (CNPS) to be rare, threatened, or endangered in California. Special-status fish and wildlife include species listed or proposed for listing as threatened or endangered under FESA, listed or proposed for listing by the State of California as threatened or endangered under CESA, species designated as species of special concern or fully protected by CDFG, species considered sensitive or endemic by the USFS, or birds designated as birds of conservation concern by the USFWS. In all actuality, there are likely many more than just the 78 special-status species in the watershed, as this is simply the number that is known to exist there via sightings and is not a comprehensive list. As previously discussed in Attachment 2 of this grant application, current drought conditions exacerbate the existing erosion issues in the region associated with extreme fire behavior and climate change. All of these problems together significantly affect ecosystem health, water quality, and sediment load, including that of aquatic habitats and threatened species in the region. The more pure, clean water that can be saved at the headwaters in the USR Region, not wasted on unaccounted for losses and used to combat fires, the more functional the local and downstream ecosystems will be at filtering polluted water and maintaining a temperature that is good for aquatic habitants.

Without this project, none of the above described benefits will be seen in the near future. No projects are currently planned if drought funding cannot be obtained, as the City is a DAC and cannot afford to pay with existing funds. In order to achieve these physical benefits, the replacement supply line, parallel pipelines, and control valves must be constructed and put online. No potentially adverse physical effects are expected to result from this project.

SUPPLY LINE REPLACEMENT - REFERENCED DOCUMENTATION

CITY OF MT. SHASTA

2010 MASTER WATER PLAN

PACE ENGINEERING

REDDING, CALIFORNIA

STORAGE RESERVOIRS

It is usually more economical and reliable to provide stored water for supply needed during: (1) fire demands, (2) peak demands in excess of maximum daily demand, and (3) in the event of an emergency, such as a power outage that interrupts the normal source of water. The required storage in a typical water system is a function of three quantities as follows:

1. Equalizing storage is the amount of water needed over and above the maximum daily demand rate (24-hour average) to satisfy peak demands of the day. California Waterworks Standard §64554(a)(1) states the system shall store at least four hours of peak hourly demand (PHD). At the current condition, Mt. Shasta requires about 1.15 MG of equalizing storage. For the Year 2030 condition, the requirement is about 1.4 MG.

2. Fire storage is usually based on the theoretical amount that could be used to combat a major fire in the high value districts. Fire standards recommend minimum fire flows varying from 1,000 GPM for single-family residential lots to 3,500 GPM or more, for multi-family residential, commercial, or industrial, dependent on the size of the structure, its composition, and if the structure has a fire sprinkler system. ISO recommendations range from 500 GPM for single-family residential on large parcels (1,000 GPM if the dwellings have wood shake roofs) to a maximum of 3,500 GPM. Buildings requiring higher flows would not be counted against the community water system if ISO were to rate the system. It seems impractical to design the entire water system to meet every possible fire demand, which can change with building construction, sprinkler installation, or building renovation or replacement. Fire storage requirements are based on being capable of providing the minimum residential fire flow for a period of 2 hours, and up to 3,500 GPM of commercial/industrial fire flow for a period of 3 hours. Therefore, it would require 0.12 MG and 0.63 MG of storage to meet the 1,000 GPM and 3,500 GPM fire flow requirements, respectively.

Future large buildings having fire flow demands in excess of what the system can provide, should be encouraged to be sprinklered, which reduces the fire demand flow. The current City system cannot support demands greater than 3,500 GPM. Buildings with demands greater than 3,500 GPM should be independently analyzed.

3. Emergency storage is the amount of water necessary to continue service in the event of power failure or some other failure of the supply system. This is usually assumed to be the maximum daily demand rate times some interval of time such as might occur during a power outage. Six hours is normally used or 25 percent of MDD.

During normal conditions, a majority of the Mt. Shasta water supply is provided by gravity from Cold Springs. Since the proposed 10-inch main down McCloud Avenue will provide some needed redundancy for the existing supply main, it appears unwarranted to provide a 6-hour emergency storage capacity. It also appears unreasonable to imagine a major fire coincident with both a total supply system failure and with a period of water consumption equal to the maximum daily demand. For these reasons, the required storage for the next twenty years will be assumed to be equal to the total of the equalizing storage plus fire storage. However, as the water supply becomes more and more dependent on wells, the City should reconsider incorporating an allowance for the emergency storage.

The City's 2010 and 2030 total storage requirement is 1.78 MG and 2.03 MG, respectively. The existing and projected storage requirements for the entire City of Mt. Shasta water system are shown on Figure 5. The current capacity of the existing 10-inch main from Cold Springs to Quail Hill tends to limit the effectiveness of Reservoir No. 4 to provide supplemental fire flow during certain conditions. Therefore, the current effective storage capacity is probably somewhere between 1.2 MG which is the combined capacity of the three reservoirs on Quail Hill and 1.7 MG, which is the current total of all four reservoirs. The estimated 2010 storage requirement of approximately 1.4 MG is probably very near the current effective capacity of all four reservoirs.

With the addition of the new water main down McCloud Avenue, the existing Reservoir No.4 becomes more useful and the total effective storage capacity would increase from about 1.4 MG to 1.7 MG. However, since the supply capacity replenishing these existing reservoirs during the off peak hours is limited to Cold Springs and possibly Well No. 2, if operating, it probably would not be possible to refill them each night during a minimum spring yield condition. To overcome this storage deficiency and to simplify operations of the new wells in the Main Pressure Zone, it is recommended that a new 1.0 MG Reservoir No. 5 be constructed at the base of Spring Hill. This would provide a total effective storage capacity of 2.7 MG which is well above the projected 2030 requirements for both the unmetered and future metered conditions. As discussed earlier, Well No. 5 should be constructed such that it would feed the Quail Hill reservoirs and help replenish the storage needed to meet future flow equalizing requirements.

Future development to the north and east of the existing City limits will require creation of new pressures zones. Although initial improvements could consist of booster pump stations capable of providing demands and up to 500 GPM fire flow, it is proposed that reservoirs would eventually be constructed in each zone. This is particularly true for Spring Hill Zone where future commercial/industrial development would result in fire flow demands as high as 3,500 GPM. The future addition of an Upper East Reservoir would provide an additional 0.33 MG of storage for an unmetered system and 0.25 MG of storage for a future metered system. Future storage requirements for the Spring Hill Pressure Zone are estimated at 1.0 MG for an unmetered system and 0.86 MG for a future metered system.

According to the June 2010 CDPH Annual Inspection Report, Reservoir Nos. 2 and 3 are in need of recoating. The CDPH has made note of the reservoirs need for coating restoration in their Annual Inspections Reports since 1990. In February 2011, LiquiVision Technology performed interior and exterior coating inspection on the City's three welded-steel tanks (Tank Nos. 2, 3, and 4), refer to Page 6 under Recommendations for a description of findings and

Upper Sacramento River Watershed Assessment and Management Strategy

Prepared for

The River Exchange
P. O. Box 784
Dunsmuir, California 96025

Prepared by

North State Resources, Inc.
5000 Bechelli Lane, Suite 203
Redding, California 96001

June 2010

private landowner activities that do not require federal funding or permits. The designation of critical habitat is only applicable to federal activities.

3.3.4 Plants, Wildlife, and Fish of Ecological/Cultural Concern

Special-Status Plants

Rare plants are either limited in geographic distribution or they occur in small isolated populations. The reasons for rarity can be natural or anthropogenic; however, only infrequently does a single "cause" by itself truly explain why a species is rare (California Native Plant Society 2001).

California's unique and varied climatic conditions, diverse geological formations, and striking topography contribute to a wealth of variation in present-day local growing conditions. Add to this the state's long geological past, and what has resulted is a high degree of endemism (species that grow only in California and nowhere else) (Nakamura and Nelson 2001). However, many rare and endangered species in California that began as natural rarities have, through one form or another of human-induced detrimental changes in their populations and/or habitat, become anthropogenic rarities (California Native Plant Society 2001).

For the purpose of this analysis, special-status plants are those that are

- listed or proposed for listing as threatened or endangered under FESA;
- listed or proposed for listing by the State of California as threatened or endangered under the California Endangered Species Act (CESA), or listed as rare under the California Native Plant Protection Act; or
- considered by the California Native Plant Society (CNPS) to be "rare, threatened, or endangered in California" (Lists 1B and 2).

The distribution and abundance of rare plants in the watershed is governed by a combination of availability of suitable habitat; connectivity of habitat for dispersal and colonization; and losses of local populations from human impacts, climatic fluctuations, and other environmental events such as floods, fires, and diseases.

Because of the size of the watershed, the following assessment of potentially occurring special-status plants is limited to a search of the CNDDB (California Department of Fish and Game 2008b) within the watershed boundary and information provided by local experts. The CNDDB is a database consisting of historical observations of special-status plant species, wildlife species, and natural communities. It is limited to reported sightings and is not a comprehensive list of special-status species that may occur in a particular area. Therefore, additional special-status plants may occur in the watershed. A list of USFS Sensitive and endemic plants potentially occurring on the STNF is provided as Appendix E.

The CNDDB search yielded 42 special-status plants known to occur in the watershed (Figure 3.2-3). These plants are listed in Table 3.3-2. Information on the habitat requirements of these species was obtained from the CNPS online Inventory of Rare and Endangered Plants (California Native Plant

Society 2008), which features information on the habitats and statewide distribution of special-status plants in California.

Table 3.3-2. Special-Status Plants Known to Occur in the Upper Sacramento River Watershed

SCIENTIFIC NAME COMMON NAME	STATUS*	HABITAT	COMMENTS
Arctostaphylos klamathensis Klamath manzanita	1B.2	Chaparral, lower montane coniferous forest, subalpine coniferous forest, and upper montane coniferous forest/rocky serpentinite or gabbro.	Recorded at several locations in the west-central portion of the watershed
Asarum marmoratum Marbled wild-ginger	2.3	Lower montane coniferous forest.	Recorded at two locations (one historical (1894) and one recent (1993)) along the I-5 corridor in the watershed.
Balsamorhiza lanata Woolly balsamroot	1B.2	Cismontane woodland/rocky, volcanic.	Recorded at one location in the northern-western portion of the watershed.
Botrychium virginianum Rattlesnake fern	2.2	Bogs and fens; lower montane coniferous forest; meadows and seeps; and riparian forest/streams.	Recorded at one location in the north-central portion of the watershed.
Calochortus greenei Greene's mariposa-lily	1B.2	Cismontane woodland; meadows and seeps; pinyon and juniper woodland; and upper montane coniferous forest/volcanic.	Recorded at one location in the north-central portion of the watershed.
Campanula shelteri Castle Crags harebell	1B.3	Lower montane coniferous forest.	Recorded in several locations in the watershed in the vicinity of Castle Crags State Park.
Campanula wilkinsiana Wilkin's harebell	1B.2	Meadows and seeps; subalpine coniferous forest; and upper montane coniferous forest.	Recorded in the northeastern most portion of the watershed near the base of Mt. Shasta.
Carex limosa Mud sedge	2.2	Bogs and fens; lower montane coniferous forest; meadows and seeps; and upper montane coniferous forest.	Recorded at one location along the west-central watershed boundary.
Castilleja miniata spp. *elata* Siskiyou paintbrush	2.2	Bogs and fens and lower montane coniferous forest/often serpentinite.	Recorded at one location in the watershed near the base of Mt. Shasta.
Chaenactis douglasii var. *alpine* Alpine dusty maidens	2.3	Alpine boulder and rock field.	Recorded at one location in the watershed near the base of Mt. Shasta.

Table 3.3-2. Special-Status Plants Known to Occur in the Upper Sacramento River Watershed

SCIENTIFIC NAME COMMON NAME	STATUS*	HABITAT	COMMENTS
Chaenactis suffrutescens Shasta chaenactis	1B.3	Lower montane coniferous forest and upper montane coniferous forest/sandy, serpentinite.	Recorded at three locations in the north-central portion of the watershed. However, all three records are from the early 1900s.
Clarkia borealis ssp. *borealis* Northern clarkia	1B.3	Chaparral; cismontane woodland; and lower montane coniferous forest.	Recorded at several locations in the southern portion of the watershed, around Shasta Lake and along the I-5 corridor.
Cordylanthus tenuis ssp. *pallescens* Pallid bird's-beak	1B.2	Lower montane coniferous forest (gravelly, volcanic alluvium).	Recorded at several locations in the north-central portion of the watershed.
Draba *aureola* Golden alpine draba	1B.3	Alpine boulder and rock field; subalpine.	Recorded at one location along the northwestern watershed boundary.
Draba carnosula Mt. Eddy draba	1B.3	Subalpine coniferous forest and upper montane coniferous forest/serpentinite, rocky.	Recorded at two locations along the northwestern watershed boundary.
Epilobium oreganum Oregon fireweed	1B.2	Bogs and fens/lower montane coniferous forest and upper montane coniferous forest/mesic.	Recorded at two locations along the northern watershed boundary.
Epilobium siskiyouense Siskiyou fireweed	1B.3	Alpine boulder and rock field; subalpine coniferous forest; and upper montane coniferous forest/rocky serpentinite.	Recorded at several locations along the northwestern watershed boundary.
Eriogonum alpinum Trinity buckwheat	1B.2	Alpine boulder and rock field; subalpine coniferous forest; and upper montane coniferous forest/serpentinite, rocky.	Recorded at several locations along the western watershed boundary.
Eriogonum pyrolifolium var. *pyrolifolium* Pyrola-leaved buckwheat	2.3	Alpine boulder and rock field (sandy or gravelly, pumice).	Recorded at three locations in the northeastern-most portion of the watershed.
Erythronium klamathense Klamath fawn lily	2.2	Meadows and seeps; upper montane coniferous forest.	Recorded at one location in the central portion of the watershed.
Eurybia merita Subalpine aster	2.3	Upper montane coniferous forest.	One historical record (1882) along the northern watershed boundary.

Table 3.3-2. Special-Status Plants Known to Occur in the Upper Sacramento River Watershed

SCIENTIFIC NAME COMMON NAME	STATUS*	HABITAT	COMMENTS
Galium serpenticum ssp. *scotticum* Scott Mountain bedstraw	1B.2	Lower montane coniferous forest (serpentinite).	Recorded at two locations along the northwestern watershed boundary.
Aleppo avens Geum aleppicum	2.2	Great Basin scrub; lower montane coniferous forest; and meadows and seeps.	Recorded at two locations in the northern portion of the watershed.
Hierochloe odorata Nodding vanilla-grass	2.3	Meadows and seeps.	Recorded at one location in the north-central portion of the watershed.
Hulsea nana Little hulsea	2.3	Alpine boulder and rock field; subalpine coniferous forest/rocky or gravelly volcanic.	Recorded (1959) in one location along the northwestern watershed boundary.
Ivesia longibracteata Castle Crags ivesia	1B.3	Lower montane coniferous forest (granitic, rocky).	One record in Castle Crags State Park.
Lewisia cantelovii Cantelow's lewisia	1B.2	Broadleafed upland forest; chaparral; cismontane woodland; and lowland montane coniferous forest/mesic, granitic, sometimes serpentinite seeps.	Recorded at five locations in the central watershed.
Meesia uliginosa Broad-leaved hump moss	2.2	Bogs and fens; meadows and seeps; subalpine coniferous forest; and upper montane coniferous forest/damp soil.	One record near the City of Mt. Shasta.
Neviusia cliftonii Shasta snow-wreath	1B.2	Cismontane woodland; lower montane coniferous forest; and riparian woodland/often streamsides; sometimes carbonate, volcanic, or metavolcanic.	One record in the watershed in the Sacramento River Arm of Shasta Lake (Waters Gulch).
Ophioglossum pusillum Northern adder's-tongue	2.2	Marshes and swamps; valley and foothill grassland.	One historical record (1894) near the City of Mt. Shasta.
Parnassia cirrata var. *intermedia* Cascade grass-of-parnassus	2.2	Bogs and fens; meadows and seeps/rocky serpentine soil.	Two records in the central watershed.
Penstemon filiformis Thread-leaved beardtongue	1B.3	Cismontane woodland; lower montane coniferous forest/rocky.	Numerous records in the east-central portion of the watershed.
Phacelia leonis Siskiyou phacelia	1B.3	Meadows and seeps; upper montane coniferous forest (openings)/often serpentinite.	Four records along the western watershed boundary.

Table 3.3-2. Special-Status Plants Known to Occur in the Upper Sacramento River Watershed

SCIENTIFIC NAME COMMON NAME	STATUS*	HABITAT	COMMENTS
Polemonium chartaceum Mason's sky pilot	1B.3	Alpine boulder and rock field; subalpine coniferous forest/rocky, serpentinite, granitic, or volcanic.	Two records along the northwestern watershed boundary.
Potentilla cristae Crested potentilla	1B.3	Alpine boulder and rock field; subalpine coniferous forest/seasonally mesic, often serpentinite seeps, gravelly or rocky.	Two records in the northern portion of the watershed.
Raillardella pringlei Showy raillardella	1B.2	Bogs and fens; meadows and seeps; and upper montane coniferous forest/mesic, serpentinite.	Five records along the western watershed boundary.
Schoenoplectus subterminalis Water bulrush	2.3	Bogs and fens; marshes and swamps (montane lake margins).	One record in the west-central portion of the watershed.
Scutellaria galericulata Marsh skullcap	2.2	Lower montane coniferous forest; meadows and seeps; and marshes and swamps.	One recorded historical occurrence (1894) near the City of Mt. Shasta.
Silene suksdorfii Cascade alpine campion	2.3	Alpine boulder and rock field; subalpine coniferous forest; and upper montane coniferous forest/volcanic, rocky.	One record near the base of Mt. Shasta.
Vaccinium scoparium Little-leaved huckleberry	2.2	Subalpine coniferous forest (rocky).	Two records in the central portion of the watershed.

*CNPS Listing Status
- List 1B 'Plants rare, threatened, or endangered in California and elsewhere.'
- List 2 'Plants rare, threatened, or endangered in California but more common elsewhere.'

Extensions
- .3 Not very endangered in California
- .2 Fairly endangered in California
- .1 Seriously endangered in California

In addition, several populations of an unusual and undescribed huckleberry (*Vaccinium* sp.) have been found in the last decade at several locations around Shasta Lake, including sites within the watershed boundary. The huckleberry most closely fits the description of red huckleberry (*Vaccinium parvifolium*) except that the berries are purple. This undescribed huckleberry is disjunct from the nearest known extant red huckleberry populations by approximately 40 miles, with the Trinity Alps and other Klamath Ranges lying between them. The undescribed inland plants grow in a distinct, much less moist habitat than does the coastal red huckleberry. Most of the known sites for this odd huckleberry are associated with abandoned or active mines in the watershed (Lindstrand personal communication); in some places, the plants grow on acid mine drainage.

Invasive Plants and Other Noxious Weeds

When plants that evolved in one region of the globe are moved to another region, a few flourish, crowding out native vegetation and the wildlife that feeds on the native species. These invasive plants have a competitive advantage because they are no longer controlled by their natural predators and can quickly spread out of control. The scientific community has come to view invasive species as posing serious threats to biological diversity, second only to the threats resulting from habitat loss and fragmentation (Bossard et al. 2000). Invasive species present complex management issues; even when the species are no longer being actively introduced, they continue to spread and invade new areas. Invasive species affect native species and habitats in several ways, including by altering nutrient cycles, fire frequency and/or intensity, and hydrologic cycles; by creating changes in sediment deposition and erosion; by dominating habitats and displacing native species; by hybridizing with native species; and by promoting non-native animal species (Bossard et al. 2000). In California, approximately 3 percent of the plant species growing in the wild are considered invasive, but they inhabit a much greater proportion of the landscape (California Invasive Plant Council 2007).

Plant pests are defined by law, regulation, and technical organizations, and are regulated by many different sources, including the California Department of Food and Agriculture (CDFA) and the United States Department of Agriculture (USDA). The CDFA uses an action-oriented pest-rating system. The rating assigned to a pest by the CDFA does not necessarily mean that one with a low rating is not a problem; rather the rating system is meant to prioritize response by the CDFA and county agricultural commissioner's. The California Invasive Plant Council (Cal-IPC) has developed a list of plant pests specific to California wildlands. The Cal-IPC list is based on information submitted by land managers, botanists, and researchers throughout the state and on published sources. To determine plant pests potentially occurring in the watershed (Appendix F), this list was reviewed and local experts were contacted to gather knowledge of known weed locations.

A "weed management area" (WMA) is a local organization that brings together all interested landowners, land managers, special districts, and the public in a county or other geographical area for the purpose of coordinating and combining their actions and expertise to deal with their common weed control problems.

Two weed management areas operate in the watershed. The Shasta County WMA functions under the authority of a mutually developed memorandum of understanding and is subject to statutory and regulatory requirements. The Siskiyou County WMA is a cooperative task force focused on the control and eradication of noxious weeds. The Siskiyou County Department of Agriculture (SCDA) has a long history of weed management work and has been the main contact for the WMA.

Special-Status Fish and Wildlife

For the purpose of this analysis, special-status fish and wildlife include:

- Species listed or proposed for listing as threatened or endangered under FESA,
- Species listed or proposed for listing by the State of California as threatened or endangered under CESA,

- Species designated as "species of special concern" by CDFG,
- Species designated as "fully protected" by CDFG,
- Species considered sensitive or endemic by the USFS, or
- Birds designated as "birds of conservation concern" by the USFWS.

Table 3.3-3 (Figure 3.2-4) identifies 36 special-status wildlife species that are known to occur or may occur in the watershed. Their distribution, legal status, general habitat requirements, and known occurrences in the watershed (based on CNDDB (California Department of Fish and Game 2008b) and CWRH (California Department of Fish and Game 2008c)) are also provided. Detailed information concerning threatened and endangered species is provided below in "Species Accounts," and information on other special-status species can be found in Appendix G.

Table 3.3-3. Special-Status Wildlife Species Known to Occur in the Upper Sacramento River Watershed

SCIENTIFIC NAME COMMON NAME	STATUS*	HABITAT	COMMENTS
Federally or State-Listed Species			
Cottus asperrimus Rough sculpin	CT FSS	Prefers sand or gravel substrate in cool streams or reservoirs. Spawns in streams.	Occurs in Shasta Lake.
Hydromantes shastae Shasta salamander	CT FSS	Moist limestone fissures and caves in volcanic and other rock outcroppings, and under woody debris in mixed pine-hardwood stands.	Known only from the southeastern Klamath Mountains region. Twenty-five known occurrences in the watershed near Shasta Lake.
Falco peregrinus anatum American peregrine falcon	BCC CP FD	Forages in many habitats; requires cliffs for nesting.	Species has been recorded nesting in the watershed.
Haliaeetus leucocephalus Bald eagle	CE CP FD	Uncommon to common in riverine and open wetland habitats. Perches high in large, stoutly limbed trees, on snags or broken-topped trees or on rocks near water. Roosts communally in winter in dense, sheltered, remote conifer stands.	Common at Shasta Lake, which has the highest density of breeding bald eagles in the continental United States. Nine nesting territories have been recorded in the watershed.
Strix occidentalis caurina Northern spotted owl	FT	In northern California, resides in large stands of old growth, multi-layered mixed conifer, redwood, and Douglas-fir habitats.	Numerous northern spotted owl territories have been recorded in the watershed.† Critical habitat is present in the watershed.

Table 3.3-3. Special-Status Wildlife Species Known to Occur in the Upper Sacramento River Watershed

SCIENTIFIC NAME COMMON NAME	STATUS*	HABITAT	COMMENTS
Coccyzus americanus occidentalis Western yellow-billed cuckoo	BCC CE FC	Nesting habitat is cottonwood/willow riparian forest. Occurs only along the upper Sacramento Valley portion of the Sacramento River, the Feather River in Sutter Co., the south fork of the Kern River in Kern Co., and along the Santa Ana, Amargosa and lower Colorado rivers.	The species was recorded in the watershed in 1951. However, the western yellow-billed cuckoo has been extirpated from this location (California Department of Fish and Game 2008b).
Empidonax traillii Willow flycatcher	CE FSS	Rare summer resident in wet meadow and montane riparian habitats at elevations of 2,000 to 8,000 feet. No longer known to nest in Sacramento Valley but migrates through the north state region in spring and fall.	Willow flycatchers occur as a migrant in riparian habitat; and may nest in suitable habitat in the upper portion of the watershed.
Gulo gulo luteus California wolverine	CT FP	A variety of habitats within the elevations of 1,600 and 14,200 feet. Most commonly inhabits open terrain above timberline.	Species has been recorded within the watershed; however, it is believed extirpated from this region.
Martes pennanti pacifica Pacific fisher	CSC FC FSS	Intermediate to large dense stages of coniferous forests and deciduous riparian habitats with greater than 50 percent canopy closure.	The Pacific fisher has been recorded in numerous locations throughout the entire watershed.
Vulpes vulpes nector Sierra Nevada red fox	CT	Red fir and lodgepole pine forests in the sub-alpine zone and alpine fell-fields of the Sierra Nevada.	The Sierra Nevada red fox has been recorded historically in the vicinity of Mt. Shasta, but is not expected to occur in the watershed.
Other Special-Status Species			
Mylopharodon conocephalus Hardhead	CSC FSS	Prefers deep, rock- and sand-bottomed pools of small to large rivers and impoundments.	Occurs in Shasta Lake.
California floater Anodonta californiensis	FSS	Aquatic mollusk potentially occurring in shallow areas of clean, clear ponds, lakes, and rivers with a silty substrate.	Suitable habitat is present in the watershed.
Hydromantes shastae Shasta hesperian	FSS	Mixed conifer and conifer/woodland habitats (riparian and/or riverine habitats).	Endemic to Klamath Province. The species has been recorded along the Sacramento River in the watershed.

Table 3.3-3. Special-Status Wildlife Species Known to Occur in the Upper Sacramento River Watershed

SCIENTIFIC NAME COMMON NAME	STATUS*	HABITAT	COMMENTS
Monadenia troglodytes troglodytes Shasta sideband	FSS	Mixed conifer and woodland habitats, especially near limestone.	Endemic to Shasta County. Known occurrences in the McCloud Arm of Shasta Lake, but no records within the watershed.
Monadenia troglodytes wintu Wintu sideband	FSS	Mixed conifer and woodland habitats, especially near limestone.	Endemic to Shasta County. Not known to occur in the watershed.
Trilobopsis roperi Shasta chaparral	FSS	Mixed conifer and conifer/woodland habitats.	Endemic to Shasta County. Known to occur near Shasta Lake within the watershed.
Rana cascadae Cascades frog	CSC	Open coniferous forests along the sunny, rocky banks of ponds, lakes, streams, and meadow potholes. From 2,600 to 9,000 feet in elevation in Cascades and Trinity Mountains.	Species has been recorded in the northwestern portion of the watershed.
Rana boylii Foothill yellow-legged frog	CSC FSS	Rocky streams in a variety of habitats. Found in Coast Ranges.	Species has been recorded in numerous locations throughout the watershed.
Ascaphus truei Tailed frog	CSC	Clear, rocky, swift, cool perennial streams in densely forested habitats.	Species has been recorded in numerous locations in the central portion of the watershed.
Actinemys marmorata Western pond turtle	CSC FSS	Slow water aquatic habitat with available basking sites. Hatchlings require shallow water with dense submergent or short emergent vegetation. Require an upland oviposition site near the aquatic site.	Species has been recorded in the central and southern portions of the watershed.
Asio otus Long-eared owl	CSC	Dense riparian and live oak thickets near meadow edges, and nearby woodland and forest habitats; also found in dense conifer stands at higher elevations.	Suitable habitat is present in the watershed.
Otus flammeolus Flammulated owl	BCC	A variety of coniferous habitats from ponderosa pine to red fir forests. Prefers low to intermediate canopy closure.	Occurs as a summer resident in the watershed.
Aquila chrysaetos Golden eagle	BCC CP CSC	Breeds on cliffs or in large trees or electrical towers and forages in open areas.	Suitable habitat is present in the watershed.

Table 3.3-3. Special-Status Wildlife Species Known to Occur in the Upper Sacramento River Watershed

SCIENTIFIC NAME COMMON NAME	STATUS*	HABITAT	COMMENTS
Accipiter gentiles Northern goshawk	BCC CSC FSS	Breeds in dense, mature conifer and deciduous forests, interspersed with meadows, other openings and riparian areas; nesting habitat includes north-facing slopes near water.	Northern goshawks have been recorded in the watershed.
Buteo regalis Ferruginous hawk	BCC	Requires large, open tracts of grasslands, sparse shrub, or desert habitats with elevated structures for nesting.	May occur as winter resident or migrant in the watershed.
Falco mexicanus Prairie falcon	BCC	Uses open terrain for foraging; nests in open terrain with canyons, cliffs, escarpments, and rock outcrops.	May occur as permanent resident in the watershed.
Melanerpes lewis Lewis's woodpecker	BCC	Open, deciduous, and conifer habitats with brushy understory, and scattered snags and live trees for nesting and perching.	May occur as summer resident in the watershed.
Picoides albolarvatus White-headed woodpecker	BCC	Montane coniferous forests up to lodgepole pine and red fir habitats.	Suitable habitat is present in the watershed.
Cypseloides niger Black swift	BCC CSC	Nests in moist crevice or cave or sea cliffs above the surf or on cliffs behind, or adjacent to, waterfalls in deep canyons; forages widely over many habitats.	Species has been recorded near Mossbrae Falls.
Chaetura vauxi Vaux's swift	CSC	Prefers redwood and Douglas-fir habitats. Nests in hollow trees and snags or, occasionally, in chimneys and forages aerially.	Suitable habitat is present in the watershed.
Contopus cooperi Olive-sided flycatcher	CSC, BCC	Wide variety of forest and woodland habitats below 9,000 feet. Preferred nesting habitat includes mixed conifer, montane hardwood-conifer, Douglas-fir, redwood, red fir, and lodgepole pine.	Suitable habitat is present and the species is known to occur in the watershed.

Table 3.3-3. Special-Status Wildlife Species Known to Occur in the Upper Sacramento River Watershed

SCIENTIFIC NAME COMMON NAME	STATUS*	HABITAT	COMMENTS
Progne subis Purple martin	CSC	Breeding habitat includes old-growth, multi-layered, open forest and woodland with snags; forages over riparian areas, forest, and woodlands.	Shasta Lake is one of the few known breeding sites in interior California. However, the species has not been recorded breeding within the portion of Shasta Lake within the watershed.
Dendroica petechia brewsteri California yellow warbler	CSC	Breeds in riparian woodlands, particularly those dominated by willows and cottonwoods.	Suitable habitat is present and the species is known to occur in the watershed.
Icteria virens Yellow-breasted chat	CSC	Breeds in riparian habitats having dense understory vegetation, such as willow and blackberry.	Suitable habitat is present and the species is known to occur in the watershed.
Lanius ludovicianus Loggerhead shrike	BCC CSC	Forages in open grassland habitats in the lowlands and foothills of California. Nests in shrubs and trees.	Suitable habitat is present in the northern portion of the watershed.
Martes americana American marten	FSS	Mixed evergreen forests with abundant cavities for denning and nesting and open areas for foraging.	Species has been recorded in the northern portion of the watershed.
Lepus americanus klamathensis Oregon snowshoe hare	CSC	Montane riparian habitats with thickets of alders and willows and in stands of young conifers interspersed with chaparral.	Species has been recorded just east of the northern watershed boundary.
Corynorhinus townsendii Townsend's western big-eared bat	CSC FSS	Roosts in colonies in caves, mines, bridges, buildings, and hollow trees in a variety of habitats. Forages along habitat edges. Habitat must include appropriate roosting, maternity, and hibernacula sites free from disturbance by humans.	Species has been recorded in a limestone cave on the Big Backbone Creek Arm of Shasta Lake within the watershed.
Antrozous pallidus Pallid bat	CSC FSS	Forages over many habitats; roosts in buildings, large oaks or redwoods, rocky outcrops and rocky crevices in mines and caves.	Suitable habitat is present in the watershed.
Lasiurus blossevillii Western red bat	FSS	Riparian forests	Suitable habitat is present in the watershed.

Table 3.3-3. Special-Status Wildlife Species Known to Occur in the Upper Sacramento River Watershed

SCIENTIFIC NAME COMMON NAME	STATUS*	HABITAT	COMMENTS
Euderma maculatum *Spotted bat*	CSC	Ponderosa pine region of the western highlands. Prefers cracks/crevices of high cliffs and canyons for roosting.	Species has been recorded in the northern half of the watershed.
Eumops perotis Western mastiff bat	CSC	Many open habitats, including conifer and deciduous woodlands, grassland, and chaparral. Roosts in crevices in cliff faces and high buildings.	Species has been recorded in the northern portion of the watershed.
Taxidea taxus American badger	CSC	Herbaceous, shrub, and open stages of most habitats with dry, friable soils.	Suitable habitat is present in the watershed.
Bassariscus astutus Ring-tailed cat	CP	Riparian habitats and brush stands of most forest and shrub habitats. Nests in rock recesses, hollow trees, logs, snags, abandoned burrows, and woodrat nests.	Suitable habitat is present and he species is known to occur in the watershed.

†Northern spotted owl occurrences are considered sensitive. Thus, they are not depicted in Figure 3.2-4.
*Status Codes:
BCC = Bird of Conservation Concern
CE = State listed as endangered
CP = California fully protected
CSC = California species of special concern
CT = California Threatened
FC = Federal candidate for listing
FD = Federally delisted
FPD = Proposed for federal delisting
FSS = Forest Service Sensitive
FT = Federally listed as threatened

Neotropical Migratory Birds

Of the nearly 800 bird species known to occur in the United States, approximately 500 migrate across our borders, with the large majority wintering in Central and South American (U.S. Fish and Wildlife Service 2001). Hemisphere-wide habitat loss due to deforestation and development threaten the future survival of these neotropical migrants. The USFS is actively integrating neotropical migratory bird management into forest management planning and implementation. It conducts a variety of surveys to identify downward population trends; implements actions to reverse these trends; restores and protects key habitats; conducts inventories and long-term population trend monitoring; addresses fragmentation issues; and implements management practices targeted at habitat features limiting bird populations. The USFS is also involved in national programs such as Monitoring Avian Productivity and Survivorship (MAPS) and Breeding Bird Surveys (BBS). Bird monitoring is one aspect of overall monitoring and inventory of habitat conditions, biodiversity, and forest plan implementation used by the USFS. The USFS is also actively engaged in a broad array of research efforts regarding neotropical migrant birds. Some of these efforts include examining the impacts of cowbird parasitism, logging, grazing, fragmentation, and burning on neotropical migrants. Additional efforts are aimed at investigating ecosystem processes and functions within a complete watershed perspective. A list of neotropical migrants known to occur on the STNF is included as Appendix H.

Table 6 – Cost Effective Analysis Project name: City of Mt. Shasta Supply Line Replacement Project	
Question 1	Types of benefits provided as shown in Table 5 include increasing water storage capacity by 300,000 gallons per day, protecting at least 4,015 acres from catastrophic wildfire, and protecting the ecosystem habitat and water quality of at least 78 special-status species.
Question 2	Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified? Yes
	If no, why? N/A
	If yes, list the methods (including the proposed project) and estimated costs. Construction of an additional storage reservoir was a considered alternative as discussed on page 54 of the 2010 Master Water Plan (PACE, 2010) (MWP). In order to meet existing storage demands and provide for future 2030 storage requirements, a 1MG storage reservoir was identified therein as being required. As shown in Table 15 of the MWP, the anticipated cost for this improvement in March 2011 dollars was $1,550,000. Increasing this to current June 2014 dollars using the ENR-CCI results in an amount of approximately $1,686,000. This is more costly than the proposed project cost of $1,577,000; however, more importantly, it also would not provide adequate water supply to meet existing demand should the deteriorated pipeline fail. Due to the location of the USR IRWM Region, only groundwater and spring sources are available for water supply alternatives. As such, the only other method of providing adequate water supply to meet the demand should the primary supply line fail would be that of a groundwater well. A well large enough to meet the equivalent capacity of Cold Springs (3.2 MGD during normal yield periods) would cost approximately $800,000.
Question 3	If the proposed project is not the least cost alternative, why is it the preferred alternative? Provide an explanation of any accomplishments of the proposed project that are different from the alternative project or methods. While the cost to develop an additional well is lower than the proposed project cost, this alternative would put more of a strain and emphasis on the groundwater basin in the area, and that is if a good quality, high producing well can even be found. The effective capacity of the two existing wells together is only 1.7 MGD; therefore, this alternative is likely not possible. Furthermore, the existing gravity water supply source from Cold Springs is a reliable source that does not require increased pumping costs and energy usage. Additionally, construction of a well would not solve the current problem of water losses occurring each year from leaks and breaks in the existing pipeline. As reported by City staff, due to the remote location of the main they are only able to inspect it once a month during the summer and not at all during winter snowfall months. This combined with the fact that there are several sections of less than one foot of cover with just native soil and rocks, combined to result in several leaks near the Springs on two different occasions just last year alone.
Comments:	

SUPPLY LINE REPLACEMENT COST EFFECTIVE ANALYSIS REFERENCED DOCUMENTATI

CITY OF MT. SHASTA

2010 MASTER WATER PLAN

PACE ENGINEERING

REDDING, CALIFORNIA

of approximately 1.4 MG is probably very near the current effective capacity of all four reservoirs.

With the addition of the new water main down McCloud Avenue, the existing Reservoir No.4 becomes more useful and the total effective storage capacity would increase from about 1.4 MG to 1.7 MG. However, since the supply capacity replenishing these existing reservoirs during the off peak hours is limited to Cold Springs and possibly Well No. 2, if operating, it probably would not be possible to refill them each night during a minimum spring yield condition. To overcome this storage deficiency and to simplify operations of the new wells in the Main Pressure Zone, it is recommended that a new 1.0 MG Reservoir No. 5 be constructed at the base of Spring Hill. This would provide a total effective storage capacity of 2.7 MG which is well above the projected 2030 requirements for both the unmetered and future metered conditions. As discussed earlier, Well No. 5 should be constructed such that it would feed the Quail Hill reservoirs and help replenish the storage needed to meet future flow equalizing requirements.

Future development to the north and east of the existing City limits will require creation of new pressures zones. Although initial improvements could consist of booster pump stations capable of providing demands and up to 500 GPM fire flow, it is proposed that reservoirs would eventually be constructed in each zone. This is particularly true for Spring Hill Zone where future commercial/industrial development would result in fire flow demands as high as 3,500 GPM. The future addition of an Upper East Reservoir would provide an additional 0.33 MG of storage for an unmetered system and 0.25 MG of storage for a future metered system. Future storage requirements for the Spring Hill Pressure Zone are estimated at 1.0 MG for an unmetered system and 0.86 MG for a future metered system.

According to the June 2010 CDPH Annual Inspection Report, Reservoir Nos. 2 and 3 are in need of recoating. The CDPH has made note of the reservoirs need for coating restoration in their Annual Inspections Reports since 1990. In February 2011, LiquiVision Technology performed interior and exterior coating inspection on the City's three welded-steel tanks (Tank Nos. 2, 3, and 4), refer to Page 6 under Recommendations for a description of findings and

TABLE 15
PRELIMINARY PROJECT COST ESTIMATES
2010 MASTER WATER PLAN OF IMPROVEMENTS

Item No.	Year	Description	Ident. Points	Unit	Quantity	Project Unit Price	Estimated Project Cost (March 2011 Dollars)	Comments
Near-Term Improvements - 2011 - 2015								
1		**Reservoir Recoating**						
	2011	Reservoir No. 3 & 4 (Interior)	1	LS	--	$245,000	$245,000	Prevent further degredation of water storage tanks
	2012	Reservoir No. 2, 3 & 4 (Exterior)	1	LS	--	$185,000	$185,000	
2		**1 MG Tank No. 5 & Well 3**						
	2012	Tank	3	LS	--	$1,550,000	$1,550,000	Eliminate pressure deficiencies in Big Lakes and Northern downtown. Increases City-wide storage which is currently deficient. Provides additional supply and redundant well. Current supply is being maximized.
	2012	14" PVC Supply Line w/ Class "B" Bkfl	3	LF	700	$133	$93,000	
	2012	Well 3	4	LS	--	$760,000	$760,000	
3	2013	**Quail Hill 12-Inch Parallel Line**	1-2	LF	950	$133	$126,400	Eliminates a bottleneck in existing system. Provides more stable pressures and increased fire flows, especially at higher elevations.
4		**Alma Street Improvements**						
	2013	8" PVC main w/ Class "A1" Bkfl	17-18	LS	1,270	$112	$142,000	Replace old water line in conjunction with Alma Street Improvements.
5		**McCloud Ave Supply Pipeline**						
	2014	12" Pressure Reducing Valve	13	LS	--	$36,000	$36,000	Supply redundancy, increase effective storage of Reservoir 4
	2014	12" PVC Main w/ Class "A1" Bkfl	12-13	LF	7,000	$132	$924,000	
6		**West Jessie Street Improvements**						
	2015	6" PVC Main w/ Class "A1" Bkfl	6	LF	1,850	$90	$170,000	Replace old leaking lines
	2015	8" PVC Main w/ Class "A1" Bkfl	6	LF	1,100	$102	$112,000	
7	2015	**Add Modulating Valve at Quail Hill Tanks**	19	LS	1	$60,000	$60,000	Establish consistant tank level control and prevents overflows and wasted water
						TOTAL PROJECT COSTS	**$4,403,400**	

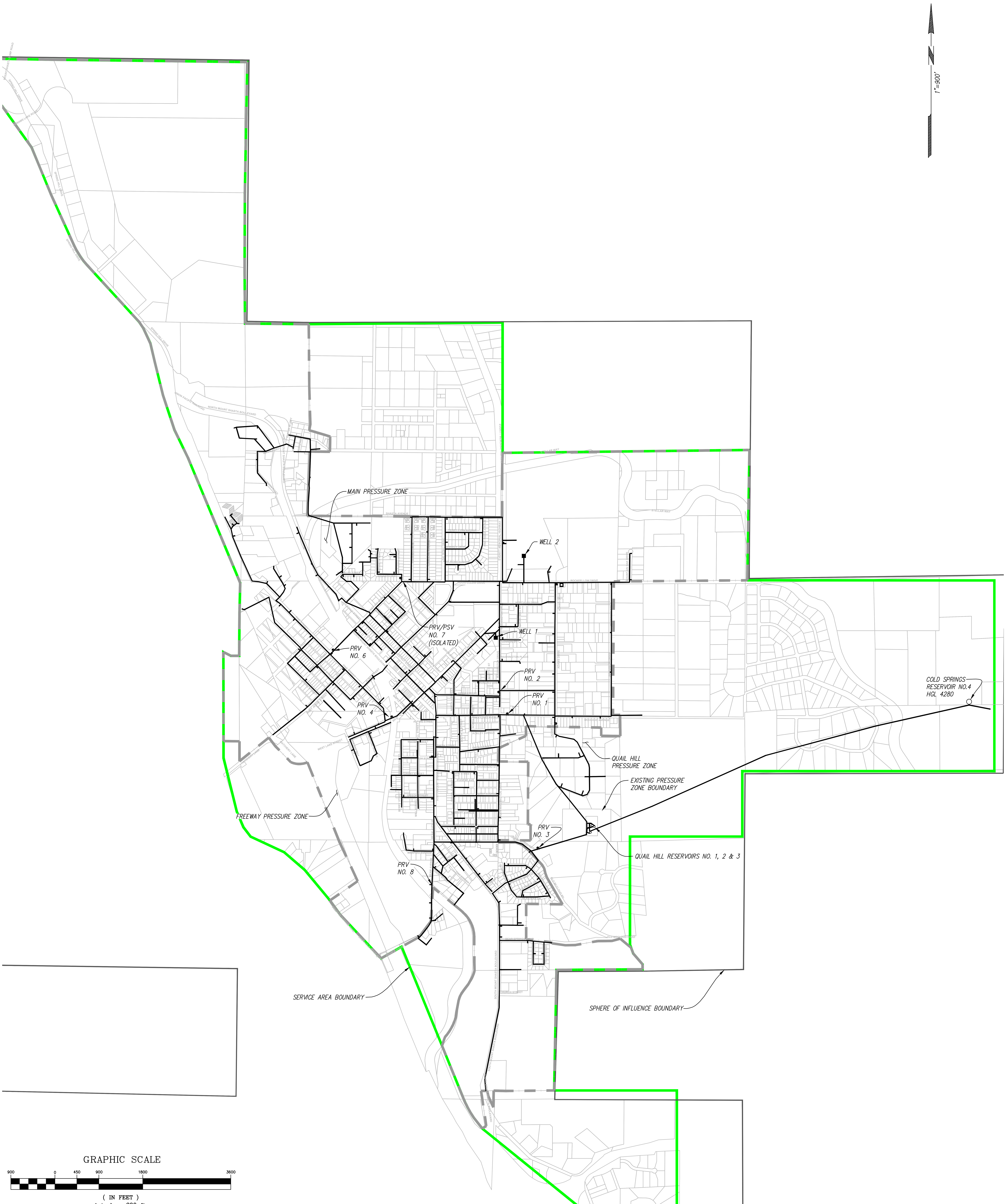
Project Description:
The City of Mt. Shasta Water Meter Installation Project consists of planning, design, and installation of water meters on existing un-metered water services.

Project Description Discussion:
The proposed project would result in installation of water meters within the public right-of-way for all water connections within the City. The City is currently almost exclusively unmetered, with the exception of buildings constructed since 1992, at which time State law required water meters to be installed. The installation of water meters will allow for greater monitoring of water usage, which will help the City inform residents about the necessity of conservation and long-term planning for the reliability of the water supply. Sentiment in the City is one of pride: both that the water is pure and untreated, and also that it is unmetered. There is a distinct lack of awareness that the water supply is limited as shown by the average daily usage in July 2013 being 936 gallons per person per day. With water conservation measures, residents will become aware that reduction of usage has multiple benefits, not just to the City (saving money and energy) but also for downstream beneficial uses.

Water meter installation will also allow for a future usage-based rate structure. This would enable easier implementation and enforcement of water conservation measures as they are needed. Water conservation programs and measures to be implemented as part of the project include a 4-page water conservation education mailer to every city residence, a short “Get to Know Your Water Supply” educational video, and three Water Talks Water conservation workshops: “Preparing our City and Community for Drought”, “Beat the Drought: Water Conservation 101”, and “Drought Data: Findings from Climate Change Vulnerability Assessment of City Water Supplies.” All of these measures will develop public awareness and support for City projects and provide practical tools for City residents to actively conserve water. The goal is to shift the pride residents have in being unmetered, to being aware of and actively protecting the water supply though knowledge and conservation. Project partner, California Trout, will implement these measures.

The DWR has estimated that most water users reduce water use rates up to 50% when water meters are first installed. The California Urban Water Council estimates a continued 20% savings thereafter. As such, a significant water savings will likely result, with a large reduction in unaccounted for water losses and therefore a decrease in existing drinking water demands. This decrease will help alleviate the current risk of the City not meeting existing drinking water demands caused by the 2014 Drought. Additionally, this decrease will mean more water will be available for fire suppression. As such, this project is necessary to ensure reliable water supply and the delivery of safe drinking water and fire suppression to the residents and businesses of the City, and adequate fire suppression to protect ecosystem water quality and quantity. Finally, an increased water supply will be available for local and downstream beneficial uses.

This project can be considered for all four eligible drought project types. It will provide immediate regional drought preparedness and increase local water supply reliability and the delivery of safe drinking water by installing water meters which are critical to maintain water service and minimum system reliability. This will result in long-term drought preparedness and safe drinking water supply availability through a long-term reduction in water usage and unaccounted for water losses. This water conservation measure would not be possible for the City without 2014 Drought Grant funds as it is not locally cost-effective. The City is a DAC, and most of the City water system is not currently metered; therefore, all users are simply charged a flat rate fee to use the water. As such, until water meters are installed, any water conservation measures will result in no monetary benefit to the City. Applicability of how this project will reduce water quality conflicts and ecosystem conflicts created by the drought was discussed above.



LEGEND

- WATER LINE
- CITY LIMITS BOUNDARY
- SERVICE AREA BOUNDARY

NOTE: WATER METER INSTALLATION WILL TAKE PLACE THROUGHOUT THE SERVICE AREA BOUNDARY AT ALL WATER SERVICE LOCATIONS.

Att3_DG_ProJust_3of6

DATE	PACE ENGINEERING REDDING, CALIFORNIA	CITY OF MT. SHASTA WATER METER INSTALLATION PROJECT 2010 EXISTING WATER DISTRIBUTION SYSTEM	PLATE
6/14			1

Plot Date: June 26, 2014 – 11:20 am Login Name: lmccollum
File Name: M:\Land Projects\0111.31\DWG\IRWM GRANT APP.dwg, Layout: PLATE 1 (24X36)

Table 5 – Annual Project Physical Benefits			
Project Name: City of Mt. Shasta Water Meter Installation Project			
Type of Benefit Claimed: Potable water supply savings			
Units of the Benefit Claimed : Million gallons per year			
Additional Information About this Benefit: Installing water meters will save on unaccounted for and wasted drinking water losses each year at the following anticipated estimated amounts.			
(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	**0**	**0**	**0**
2015	**0**	**51.2**	**51.2**
2016	**0**	**307**	**307**
2017-2025	**0**	**180**	**180**
Comments: The project will be completed by October 2015. As such, no benefits will be seen until that time. The expected lifetime of water meters is approximately 10 years. As such, benefits will be seen for at least this lifecycle.			

Table 5 – Annual Project Physical Benefits			
Project Name: City of Mt. Shasta Water Meter Installation Project			
Type of Benefit Claimed: Catastrophic wildfire protection			
Units of the Benefit Claimed : Acres			
Additional Information About this Benefit: Increased water availability through water metering will allow for more reliable protection against wildfire.			
(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	**0**	**0**	**0**
2015-2025	**0**	**4,015**	**4,015**
Comments: The project will be completed by October 2015. As such, no benefits will be seen until that time. The expected lifetime of water meters is approximately 10 years. As such, benefits will be seen for at least this lifecycle.			

Table 5 – Annual Project Physical Benefits			
Project Name: City of Mt. Shasta Water Meter Installation Project			
Type of Benefit Claimed: Number of special-status species benefited and protected			
Units of the Benefit Claimed : Number of special-status species			
Additional Information About this Benefit: More reliable protection against wildfire will protect the ecosystem habitat and water quality for all special-status species present in the area.			
(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	**0**	**0**	**0**
2015-2025	**0**	**78**	**78**
Comments: The project will be completed by October 2015. As such, no benefits will be seen until that time. The expected lifetime of water meters is approximately 10 years. As such, benefits will be seen for at least this lifecycle.			

The primary expected physical benefit of the City of Mt. Shasta Water Meter Installation Project is that of potable drinking water savings. Installing water meters in a currently unmetered water system is widely known to reduce water usage by significant amounts. This will reduce the demand on both groundwater and spring source water supplies. The Department of Water Resources estimated that many users reduce water use rates up to 50% when meters are first installed in a primarily unmetered system. This number is very reasonable to assume in regards to the City of Mt. Shasta where current water usage is significantly higher than similar nearby metered water systems. As described on pages 35 to 41 in the 2010 Master Water Plan (PACE, 2010) (MWP), the average annual water use per unmetered household equivalent (HE) in the City is 1,026 gallons per day (GPD). This is in comparison to the nearby similar sized Cities of Yreka, Weed, and Dunsmuir where the average annual demand in GPD/HE is 610, 360, and 290, respectively.

As indicated on page 37 of the MWP, the average annual demand (AAD) of the City is 614 million gallons (MG). Therefore, it is estimated in the first full year of operation after this project is completed, 307 MG of water savings (either groundwater or spring water depending on the spring capacity each year) could potentially be seen. This equates to approximately 25.6 MG per month. Since the project is scheduled to be completed in October 2015, two months of water savings is anticipated to result in 2015, or 51.2 MG. In 2016, the first full year after project completion, an estimated water savings of approximately 307 MG is expected. Additionally, the California Urban Water Council (CUWCC) estimates a continued 20% savings thereafter when water meters are installed (CUWCC, 2009). As such, 20% of the AAD, or 123 MG per year, is anticipated to be saved each year thereafter the initial first full year of project completion. If demands are decreased enough due to water metering, supplemental groundwater from the two City wells may not even be required, thus increasing groundwater storage for downstream beneficial uses.

Most studies performed by the water industry have concluded that residential water meters should be replaced every 15 to 20 years. At this time, their accuracy will have diminished such that replacement is warranted. Therefore, it is believed meters maintain relatively good accuracy throughout the first 10 years of their lifetime. As such, the 20% water savings resulting from the proposed project is expected to last at least this long, if not longer.

A secondary benefit from this project is that of increased catastrophic wildfire protection that will result from the reduced drinking water demand. As discussed in Attachment 2 of this grant application, the City is located in a primarily forested region with steep terrain and a very active fire regime. The existing water system service area boundary consists of approximately 4,015 acres as shown in the project map. As such, this much area will receive the benefit of more flow available for increased fire protection. The sphere of influence boundary also shown in the project map actually encompasses approximately 15,785 acres. As such, it is possible and likely the existing service area boundary will be expanded to increase this acreage benefit in future years within the project lifecycle time period.

An additional secondary benefit is the protection of ecosystem habitat and water quality of special-status species known to occur in the Upper Sacramento River Watershed. According to section 3.3.4 of the Upper Sacramento River Watershed Assessment and Management Strategy completed for The River Exchange (North State Resources, Inc., 2010) (Watershed Assessment), there are 42 special-status plant species and 36 special-status wildlife species in the watershed. Special status plants are those that are listed or proposed for listing as threatened or endangered under the Federal Endangered Species Act (FESA), listed or proposed for listing by the State of California as threatened or endangered under the California Endangered Species Act (CESA), listed as rare under the California Native Plant Protection Act, or considered by the California Native Plant Society (CNPS) to be rare, threatened, or endangered in California. Special-status fish and wildlife include species listed or proposed for listing as threatened or endangered under FESA, listed or proposed for listing by the State of California as threatened or endangered under CESA, species designated as species of special concern or fully protected by CDFG, species considered sensitive or endemic by the USFS, or birds designated as birds of conservation concern by the USFWS. In all actuality, there are likely many more than just 78 special-status species in the watershed, as this is simply the number that is known to exist there via sightings and is not a comprehensive list. As previously discussed in Attachment 2 of this grant application, current drought conditions exacerbate the existing erosion issues in the region associated with extreme fire behavior and climate change. All of these problems together significantly affect ecosystem health, water quality, and sediment load, including that of aquatic habitats and threatened species in the region. The more pure, clean water that can be saved at the headwaters in the USR Region, not wasted on unaccounted for losses and used to combat fires, the more functional the local and downstream ecosystems will be at filtering polluted water and maintaining a temperature that is good for aquatic habitants.

Without this project, none of the above described benefits will be seen in the near future. No projects are currently planned if drought funding cannot be obtained, as the City is a DAC and cannot afford to pay with existing funds. In order to achieve these physical benefits, water meters must be installed and the City must implement a usage-based rate structure. No potentially adverse physical affects will result from this project other than water bills may increase for residents using large amounts of water. While this may take some time for residents to adjust to, in the long run it will allow for more safe, clean, accessible, and affordable drinking water and sanitation to be distributed to more users.

WATER METER INSTALLATION - REFERENCED DOCUMENTATION

CITY OF MT. SHASTA

2010 MASTER WATER PLAN

PACE ENGINEERING

REDDING, CALIFORNIA

could be used to predict future water consumption, the population growth rate alone tends to neglect other factors that contribute to growth in water consumption. For example, increases in industrial and commercial water use and the current trend for higher-end residential development with higher landscape irrigation needs will tend to accelerate water consumption over time. However, it is believed these increases will be minimal in the City. Therefore, this master plan has been developed based on an average annual increase in water consumption equal to the predicted population growth rate of one percent. If the actual annual increase in water consumption in the future is smaller than one percent, then improvements designed to accommodate growth for the next 20 years will be satisfactory for a longer period of time. If the actual annual increase in water consumption is greater than one percent, then improvements will reach their design capacity sooner than projected.

PAST AND PRESENT WATER USAGE

Currently, the City provides water on an unmetered flat rate basis. The City measures the total production with an in-line manual flowmeter at the springs that is manually read. Meters located at Tank No. 2 and Well Nos. 1 and 2 measure the total consumption in the system.

Table 8, MONTHLY METERED WATER CONSUMPTION from 2007 to 2009, was compiled using City records of metered usage. The ADD for the past three years is approximately 1.7 MGD. The peak year was 2007, when 635 MG of water was consumed. It must be pointed out that because December 2008 and 2009 usage data is not available; the reported total usage is less than actual usage. For the purposes of this report, July 2007 usage data was used as the basis for ADD, MMD, and ADD. The average ratio of MMD to ADD is approximately 1.86, which is similar to the Cities of Red Bluff and Redding, see Table 11.

Table 9, ANNUAL WATER PRODUCTION AND UNACCOUNTED FOR WATER, was compiled using the City water production records over the last three years. It was found that the resulting overall production averaged about 39 percent higher than the actual metered consumption. This unaccounted water is used for fires, street cleaning, flushing distribution lines, and park irrigation usage. It also reflects water lost to distribution system leakage.

Additionally, Cold Springs typically produces more water than what is consumed downstream with the exception of peak demand summer months. When the capacity of the 10-inch main limits the spring's production or when the supply main flows are manually throttled down in response to lower demands, the overflow (unused water) runs out of town via a drainage creek.

It is estimated that the Mt. Shasta water system provided water to about 3,600 people in 2008, according to the City's Impact Fee Report that was adopted January 26, 2009. Therefore, the average annual consumption rate for the existing unmetered system is estimated at about 483 gallons per capita per day (GPCD). However, it should be pointed out that this 483 GPCD figure is based on all City usage, and includes water used for fires, parks, flushing of distribution lines, and losses due to pipeline leakage. Typically, these non-customer type uses can account for 10 to 30 percent of the total water consumption; however, as indicated above, for the last three years, this has actually accounted for an average of 39 percent of the City's total consumption.

The next step in predicting future water demands is to determine the demand rates per household equivalent (HE). The average consumption per HE was determined from the most recent July 2009 MMD billing records and input from City staff. The number of residential services and the total residential usage charges were used to determine a cost per residential user. The water use of the remaining non-residential customers can then be expressed in HEs. In July 2009, the City had a total of 1,531 services, which were equivalent to about 1,974 HEs as shown in Table 10, RATE-BASED HOUSEHOLD EQUIVALENTS DETERMINATION. However, City staff has indicated that in some cases multiple residences are served under a single account. Therefore the actual number of customers is closer to 1,695.

TABLE 8
CITY OF MT. SHASTA
2010 MASTER WATER PLAN
MONTHLY METERED WATER CONSUMPTION

MONTH	2007				2008				2009			
	Spring (MG)	Well 1 (MG)	Well 2 (MG)	Total Monthly Consumption (MG)	Spring (MG)	Well 1 (MG)	Well 2 (MG)	Total Monthly Consumption (MG)	Spring (MG)	Well 1 (MG)	Well 2 (MG)	Total Monthly Consumption (MG)
Jan	27.6	OFF	OFF	27.6	27.4	OFF	OFF	27.4	30.3	OFF	OFF	30.3
Feb	23.6	OFF	OFF	23.6	30.8	OFF	OFF	30.8	24.8	OFF	OFF	24.8
Mar	26.4	OFF	OFF	26.4	29.2	OFF	OFF	29.2	27.0	OFF	OFF	27.0
Apr	36.3	OFF	OFF	36.3	39.6	OFF	OFF	39.6	36.9	OFF	OFF	36.9
May	68.4	OFF	OFF	68.4	62.4	4.9	OFF	67.3	55.3	8.9	OFF	64.2
Jun	77.9	8.0	OFF	86.0	66.0	14.7	2.5	83.1	60.4	5.8	OFF	66.3
Jul	83.9	16.4	OFF	100.3	73.0	21.1	4.9	99.0	80.4	16.6	OFF	96.9
Aug	87.3	12.6	OFF	100.0	80.9	10.5	0.9	92.3	83.6	4.1	OFF	87.7
Sep	73.8	2.1	OFF	75.9	75.4	3.3	OFF	78.7	78.4	OFF	OFF	78.4
Oct	34.7	OFF	OFF	34.7	46.4	OFF	OFF	46.4	41.7	OFF	OFF	41.7
Nov	27.8	OFF	OFF	27.8	29.0	OFF	OFF	29.0	29.8	OFF	OFF	29.8
Dec	27.9	OFF	OFF	27.9	--	--	--	--	--	--	--	--
TOTALS	**596**	**39**	**0**	**635**	**560**	**54**	**8**	**623**	**549**	**35**	**0**	**584**
NO. OF SERVICES	**1773**				**--**				**1,695 (Customers)**			

Notes:
(1) December 2008 and 2009 usage data is unavailable. As a result the reported total flow are less than actual flows.

Avg Annual Consumption (MG) = 614
Avg Day Consumption (MGD) = 1.7

Max Month Consumption (MG) = 100
Max Day Consumption (MGD) = 3.8

TABLE 9
CITY OF MT. SHASTA
2010 MASTER WATER PLAN
ANNUAL WATER PRODUCTION & UNACCOUNTED FOR WATER

YEAR	Spring (MG)	Well 1 (MG)	Well 2 (MG)	Total Annual Production (MG)	Total Annual Consumption (MG)	Unaccounted For Water [1]	
						(MG)	(%)
2007	1,108	39.2	0.0	1,147	635	513	44.7%
2008	925	54.4	8.3	988	623	365	36.9%
2009	869	35.4	0.0	904	584	320	35.4%

Notes:
(1) Unaccounted for water includes uses such as park irrigation, system losses, hydrant flushing, and fire protection.
Unused water from springs continues out of town via creek.

In order to demonstrate the relative change in water consumption rates throughout the day, month, and year, a ratio of maximum month to average annual production was developed from the 2007 consumption records and are shown on Table 11. City staff has indicated that there have been times during peak months when the Well No. 1 has run 12 hours to keep up with demands. Therefore for the MDD was determined to be 3.8 MG, which is the full capacity of the Cold Springs supply line (3.2 MG) with the addition of Well No. 1 running for 12 hours (0.61 MG). The ratio of MDD to ADD is 2.21, which is typical of other water systems in northern California. Although there are no City records available regarding MHD, California Waterworks Standard, Section 64554(b) indicates a system shall determine the average hourly flow during MDD and multiply by a peaking factor of at least 1.5 to obtain MHD. In order to be conservative, a MHD:MDD ratio of 1.8 was used. A resulting MHD:ADD ratio of 3.94 was determined. This is similar to other nearby water systems including the Cities of Weed and Yreka which recently had MHD:ADD ratios of 3.3 and 3.6, respectively. It should be noted that smaller communities tend to have higher MHD:ADD ratios as a result increased overall percentage of the highly variable demands from non-industrial users.

TABLE 10
CITY OF MT. SHASTA
2010 MASTER WATER PLAN
RATE-BASED HOUSEHOLD EQUIVALENTS DETERMINATION

1 HE = Total Residential Usage Charges / Total Residential Services: $25,595.84 / 1287 = $19.89

Housing Class	Usage Charges ($)[1]	Number of Services	HEs
Residential	$25,595.84	1287	1287
Multi-Family	$4,236.43	53	213
Mobile Homes	$181.23	2	9
Churches	$64.26	2	3
Commercial 1	$4,312.31	144	217
Commercial 2	$1,423.26	10	72
Restaurant	$1,500.75	15	75
Other	$524.64	3	26
Schools	$981.80	5	49
Government	$425.59	9	21
Industrial	$18.36	1	1
	Totals:	1,531	1,974

(1) Usage charges from July 2009 billing records.

PROJECTED WATER DEMANDS

It is the general rule that metered water systems consume significantly less water than unmetered systems. The Department of Water Resources (DWR) estimated that most users reduce water use rates up to 50 percent when meters are first installed. However, the installation of water meters on the existing City water system is not anticipated in the foreseeable future. As an alternative, the City should consider requiring meters on all future connections and it is our understanding the City has been requiring this.

TABLE 11
CITY OF MT. SHASTA
2010 MASTER WATER PLAN
SUMMARY OF DESIGN VALUES USED IN WATER SYSTEM ANALYSIS

AVERAGE ANNUAL DEMAND PER HE = 1026 GPD

DESIGN RATIOS

Maximum Month/Average Day	MMD/ADD =	1.86
Maximum Day/Average Day	MDD/ADD =	2.21
Maximum Hour/Average Day	MHD/ADD =	3.94

	YEAR			
	2010	2030	Ult. Unmetered	Ult. Metered
Household Equivalents (1)	1,695	2,068	18312	14650
Net Demand, MG	635	775	6858	5486
Net Demand ADD, MGD	1.74	2.1	19	15
Net Demand MDD, MGD	3.8	4.7	42	33
Net Demand MHD, MGD (2)	6.9	8.4	74	59

1. Average annual growth rate from 2010 to 2030 of one percent per year.
2. MHD is estimated by 1.8 x MDD, similar to other water systems.

As previously mentioned, the average annual consumption rate for the existing unmetered system is estimated at about 483 GPCD. This equates to an average annual water use per unmetered HE of about 1026 GPD. Similarly, the estimated average annual flow per HE for future metered services would be about 820 GPD. This is about 20 percent[1] less than the existing water use.

Table 11, SUMMARY OF DESIGN VALUES USED IN WATER SYSTEM ANALYSIS, also shows the 2030 and ultimate flows computed from the average annual demand rate of 1,026 gallons per HE per day, and the water demand ratios as previously discussed. The future 2030 values were based upon the one percent increase in water consumption discussed in the

1 *Residential Water Demand Management Programs: A Selected Review of the Literature Water Policy Working Paper #2005-002* (Terrebonne, R. Peter., 2005)

GROWTH PROJECTION section of this report. The average annual demand rate for Mt. Shasta is considerably higher than other metered water systems in Siskiyou County as indicated below:

	Mt. Shasta	Yreka	Weed	Dunsmuir
AVERAGE ANNUAL DEMAND PER HE, GPD	1,026	610	360	290

DISTRIBUTION SYSTEM DEMANDS

In performing hydraulic analyses of a water distribution system, it is necessary to use both the MHD and MDD to properly evaluate the system. In this study, existing demands were spread throughout the system assigning flows to the non-residential users and assuming 1 HE per existing parcel for the remaining parcels being served. The 2030 conditions were estimated based on the development of the two potential growth areas shown on Plate 2 in which City staff expects the majority of growth to occur in the next 20 years. Finally, the estimated ultimate demand was determined based on 100 percent build-out of the water service area pursuant to General Plan land use designations shown in Table 12 and the consumption design values established in Table 11, see Plate 3. Since the City's current water usage has surpassed the current supply effective capacity of 2.5 MGD in 2030, it is presumed that increased water supply will come from the new wells. The Ultimate Model supply is based on the development of new wells. The Ultimate Model's distribution system supplies all areas within the City's current water rights service boundary, see Plate 2. The initial Ultimate Model pipe sizes and locations for the future system were based on the 1986 Master Water Plan.

The estimated 2030 HE and demand information, shown in Table 13, was used to allocate the demands to various points on the distribution system computer model. Piping headlosses, pressures, and flows were then generated by the computer model. This procedure provides a means to determine where deficiencies occur and where system improvements are needed.

Table 6 – Cost Effective Analysis Project name: City of Mt. Shasta Water Meter Installation Project	
Question 1	Types of benefits provided as shown in Table 5 include saving up to 307 MG of potable drinking water a year (groundwater and/or spring water), protecting at least 4,015 acres from catastrophic wildfire, and protecting the ecosystem habitat and water quality of at least 78 special-status species.
Question 2	Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified? No
	If no, why? No other methods or alternative projects could be identified that would result in nearly as much annual water savings and reduce the demand of the City that the proposed project will. Additionally, no other project will allow for implementation of a usage-based rate structure and future water conservation measures implementation.
	If yes, list the methods (including the proposed project) and estimated costs. N/A
Question 3	If the proposed project is not the least cost alternative, why is it the preferred alternative? Provide an explanation of any accomplishments of the proposed project that are different from the alternative project or methods. See response to question 2 above.
Comments:	