
County of Nevada
950 Maidu Drive
Nevada City, CA 95959

North San Juan Fire Suppression System

**FINAL
PRELIMINARY ENGINEERING AND
DRAFT PROJECT REPORT**

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North San Juan Fire Suppression System

Preliminary Engineering and Draft Project Report

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Introduction

The community of North San Juan is an approximately 480-acre historic townsite located in western Nevada County on State Highway 49, 15 miles northwest of Nevada City and is the largest rural center on the San Juan Ridge. Fire protection services are provided by the North San Juan Fire Protection District (NSJFPD), an all volunteer fire department that includes three fire stations with one located in North San Juan. Because there is no public water supply, there is also no centralized fire suppression system. The NSJFPD relies on on-board tanks on their engines as well as small individual tanks and ponds in various locations for fire suppression water supplies.

The County of Nevada is interested in providing a more robust fire suppression system in the commercial core and surrounding areas of North San Juan in order to help stimulate economic development in the area. Not having the ability to meet California Fire Code requirements is one of the major hurdles to developing the commercially zoned parcels in North San Juan Rural Center area. The County is looking at constructing a new fire suppression system including a water storage tank, pipeline distribution system, fire hydrants, and a source of water supply.

Figure 1 shows the North San Juan Rural Center area and the commercial core.

Fire System Requirements

Required Fire Flow

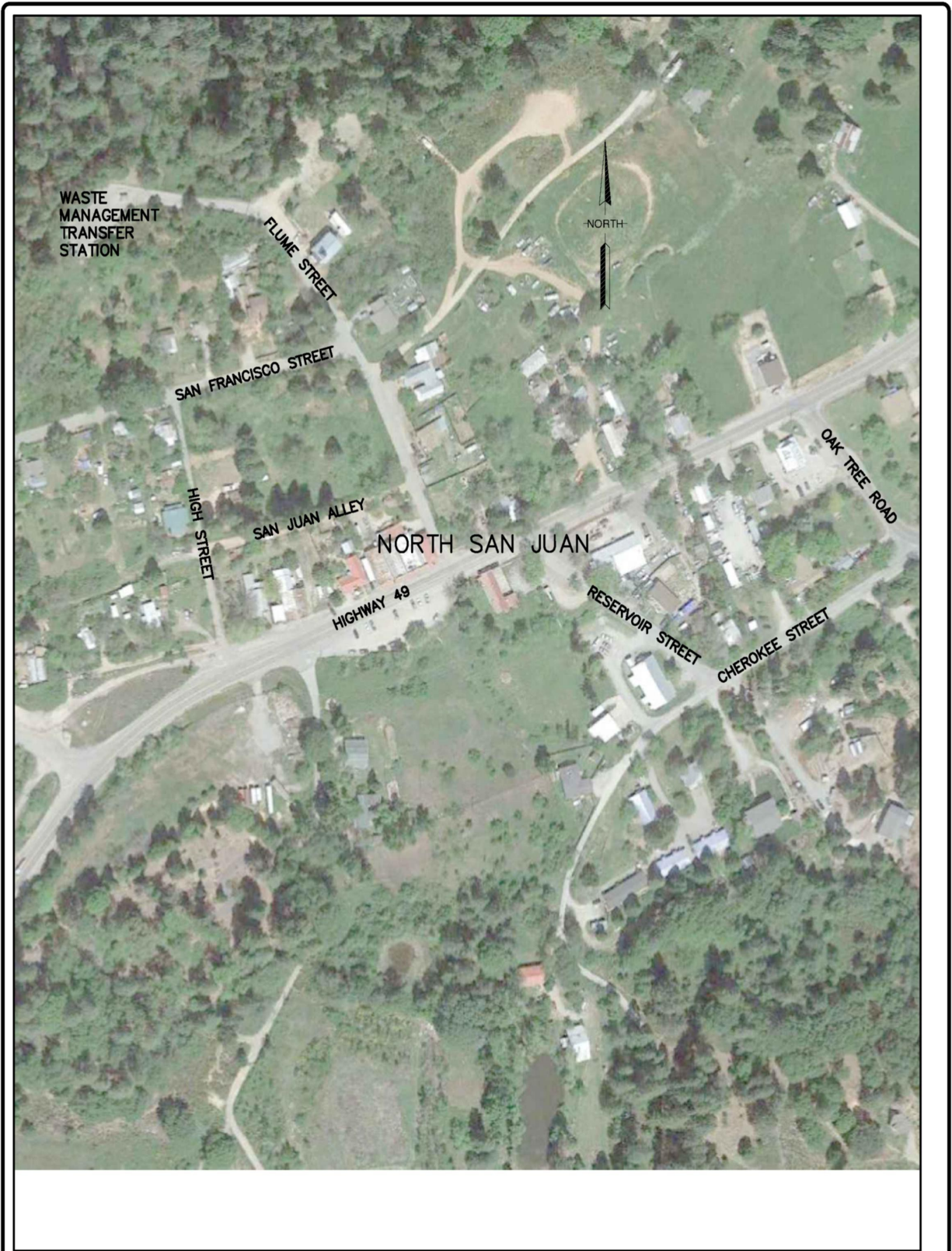
The required design fire flow rate and duration are based on the single largest fire flow demand. Fire flow demands for structures are determined by California Fire Code and National Fire Protection Association standards and are based on building type, construction materials, occupancy, size, exposure, and other factors. According to Tom Browning, NSJFPD Battalion Chief, in working with the Insurance Services Office (ISO), the structure used in determining the fire flow requirements is the combination of historic buildings at the northwest corner of Highway 49 and Flume Street. These are considered Non-Rated Buildings under California Fire Code fire flow calculations, with no fire rated walls between the separate structures. The total area of the combined buildings is 11,200 square feet, and the calculated fire flow demand is 2,750 gallons per minute for a duration of 2 hours.

Required Fire Storage

The amount of fire storage required is based on the required fire flow and duration. In order to provide 2,750 gpm for 2 hours, the minimum required storage would be 330,000 gallons.

Minimum System Pressure

In order to provide an acceptable level of fire protection in a pressurized water system, a minimum pressure is necessary to allow firefighting equipment to maintain continuous operation and avoid delays while on-board tanks refill. In addition, the system will be used to supply building fire sprinkler systems for developments adjacent




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NORTH SAN JUAN
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PROJECT LOCATION
 MAP

Figure
 1

to the pipeline distribution system. The minimum desirable system pressure for fire sprinkler systems is 20 pounds per square inch during maximum flow conditions.

Tank Base Elevation

Based on the results of the hydraulic modeling conducted for the *NSJ Fire Flow Feasibility Study* (Sauers, 2016), the minimum tank base elevation needed to provide the design fire flow and system pressure is approximately 2,175 feet.

Pipeline Distribution System

Pipelines for water distribution systems should be sized to maintain a velocity of less than 10 feet per second (fps) during maximum flow conditions. Maximum flow for the fire suppression system is expected to be 2,750 gpm. For this application, C900 PVC, DR 25 (Pressure Class 165 psi) is recommended as the pipeline material based on the expected system pressures. 12-inch diameter DR 25 has an inside diameter of 12.14 inches which results in a velocity of 7.6 fps which meets the velocity requirement.

Since the emphasis of the project is a fire suppression system for the commercial core area, fire hydrants should be placed along Highway 49 through the North San Juan Rural Center area. However, because of the numerous hurdles associated with pipeline construction along the edge of the Highway, both within the Caltrans right-of-way and on the adjacent privately owned parcels, an alignment along the highway is not considered a preferred alternative. In order to minimize Caltrans encroachment permit requirements as well as the number of easements to be acquired, pipelines should be constructed within County roads as much as possible. Fire hydrants should be placed near the edge of the Highway within County road rights-of-way or County obtained easements. Additional fire hydrants should be installed along the pipeline alignment.

Water Source of Supply

The NSJ Fire Flow Feasibility Study recommended a new well be constructed to provide the water source for filling and maintaining water in the new tank. Concerns have been raised that, based on other wells in the area, it may be impractical rely on a well to provide the needed 330,000 gallons to initially fill the new tank, and to refill the tank following a fire event. Once the tank is full, a typical well should be able to adequately maintain tank levels to account for evaporation, minor pipeline leakage, and periodic fire district uses such as filling water tenders. Depending on the production of the new well, the County may want to consider hiring commercial water trucks to help initially fill the tank and be prepared to hire water trucks to refill the tank in a timely manner following major fire suppression events.

A new well should be constructed near the pipeline distribution system such that it can be constructed and connected to the system with minimal need for additional easements. A review of State Well Completion Reports reveals that some of the best producing wells are in the vicinity of the NSJFPD Fire Station which is located on Reservoir Street. This would be an ideal location as the fire district should be amenable to having a well and pipeline on their property and the distribution system as proposed will include a pipeline in Reservoir Street.

Fire Suppression System Design

The North San Juan Fire Suppression System will be designed to provide a pressurized, gravity fed water supply system, including water supply source, water storage tank, pipeline distribution system, and fire hydrants, serving the North San Juan commercial area. The system will be capable of supplying 2,750 gpm for two hours via multiple fire hydrants located along State Highway 49 and along the distribution pipeline alignment.

Design and Construction Standards

All aspects of the the fire suppression system will be designed and constructed to appropriate standards for the type of construction and location of each system component. These include:

- Nevada County Department of Public Works Standard Drawings for pipeline construction within County right-of-way including trenching, backfill, and surface restoration
- Caltrans Standard Specifications, Standard Drawings, and Encroachment Permit Manual for pipeline construction under State Highway 49
- American Water Works Association - AWWA D103 for design and construction of the steel water storage tank
- Nevada County Environmental Health Department Requirements for New Public Water Wells for the construction of the new well
- California Fire Code for recommended fire hydrant spacing

Although there is no plan to utilize the new system as a public drinking water supply, the County may be well-advised to construct certain aspects of the system, such as the tank and pipelines, to drinking water standards. There may be an increase in cost, but it would allow the system to be converted to a public drinking water system in the future without having to replace those components. Design of the tank and pipelines will also comply with State Waterworks Standards for drinking water.

Water Storage Tank

System design will include a 330,000 gallon steel water storage tank. Typical dimensions would include a tank diameter of ± 50 feet and a wall height of ± 27 feet, however this can be altered to meet specific site conditions.

Steel tanks in this size range are either welded or bolted. Both are covered by AWWA standards, meet fire suppression and drinking water standards, otherwise meet the requirements of this project, and until recently were competitively priced. However, recently the cost of welded steel tanks has become significantly more expensive than bolted. Since there is no perceived added benefit to a welded steel tank in this situation, the design will be based on a bolted tank. If the pricing conditions change significantly by the time the project is put out to bid, the welded option can be added as an alternate.

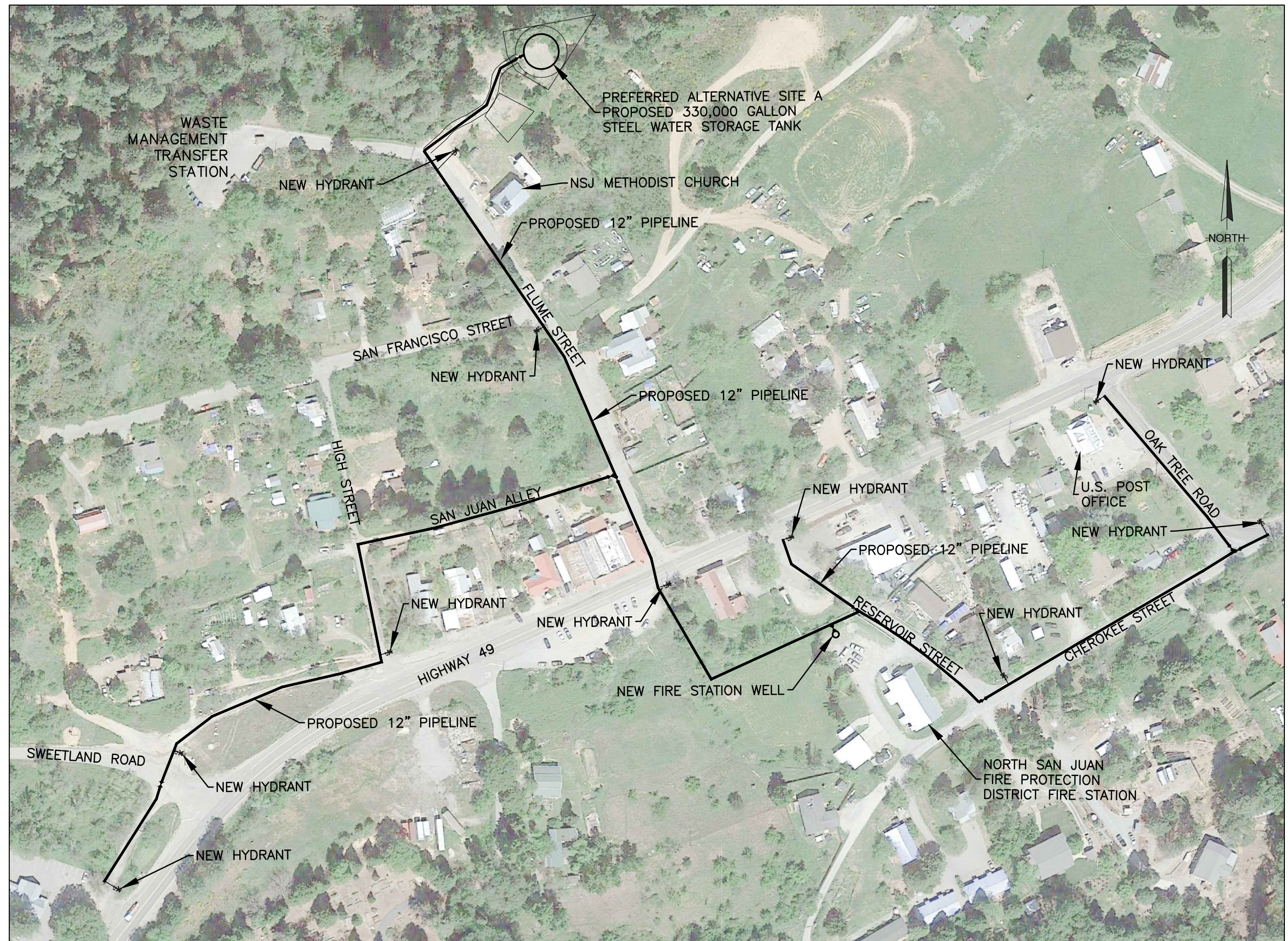
Because of the intended use of the tank as emergency response infrastructure, it should be considered an essential facility. The AWWA D103 standard for bolted steel tanks includes requirements for the tank manufacturer to provide detailed structural design including seismic design based on, among other things, the Importance Factor, which in this case will be the highest. The standard also requires the Owner (the County in this case) to furnish information for use in the design including a Geotechnical Report.

The proposed location for the water storage tank is at the end of Flume Street located on the north side of the North San Juan Rural Center area. There are two sites that were evaluated as the potential tank sites. The first site is adjacent to the North San Juan Methodist Church on church owned property near the top of Flume Street. The second site, which is owned by the Bureau of Land Management (BLM), is adjacent to the refuse transfer station currently being operated by Waste Management under contract with Nevada County. Although the BLM parcel is large, there is a limited area near the transfer station that would be suitable as a tank site. The site is constrained by an irregular property line to the south, and a ravine to the west and north, as well as the transfer station facilities. The church property, on the other hand, has no significant constraints, is easily accessible from Flume Street, and will not disrupt operations at the transfer station during tank construction. Of the two sites, the church site has been determined to be the preferred alternative. Figure 2 shows the preferred tank site on the church property.

Pipeline and Hydrants

The 2016 Feasibility Study focused on providing fire hydrants along the Highway 49 corridor. Following the initial project kick-off meeting, which included discussion of various concerns with respect to pipeline construction along Highway 49, a revised pipeline alignment is proposed which, although longer, would minimize construction in Caltrans right-of-way as well as minimize the number of easements the County would be required to acquire. Figure 3 shows the proposed new alignment. As shown, this alignment relies primarily on County roads with a single transverse crossing of Highway 49 at Flume Street, and acquisition of five easements in order to cross private properties.

As originally proposed, the design would have included three fire hydrants along the Highway 49 corridor; one near the intersection with Sweetland Road to the west, one across from the intersection with Flume Street, and one near the intersection of Oak Tree Road to the east. With the proposed new pipeline alignment, there is opportunity to place additional fire hydrants that would both increase the number of access points to the system and reduce the spacing between hydrants. As a point of reference, the California Fire Code standard for a fire flow requirement of 2,750 gpm is a minimum of 3 hydrants with an average spacing between hydrants of 450 feet. In order to achieve the spacing requirements, seven more hydrants have been added to the design for a total of ten hydrants. The additional hydrants are located at the top of Flume Street and at the intersections of Flume Street and San Francisco Street, Highway 49 and High Street, Highway 49 and Sweetland Road, Highway 49 and School Street, Highway 49



REV	DATE	REVISIONS

North San Juan
Fire Suppression System

PROPOSED PIPELINE LAYOUT
10 FIRE HYDRANTS

County of Nevada

Nevada County

California

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1" = 100' (AS SHOWN) BAR IS ONE INCH ON ORIG. DRAWING IF BAR DOES NOT MEASURE ONE INCH, ADJUST SCALES ACCORDINGLY	
PROJECT NUMBER:	
SURVEY DATE:	
DESIGN BY:	K.S.K.
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FIGURE
3
of X

and Reservoir Street, Reservoir Street and Cherokee Street, and Cherokee Street and Oak Tree Road. A map of the proposed pipeline layout utilizing ten hydrants along with the spacing between the hydrants is shown on Figure 4.

The 12" diameter pipelines will be designed for a maximum capacity of 2,750 gpm. 12" isolation butterfly valves will be installed at locations to allow continued operation of the system when portions are taken out of service for maintenance or repair. Individual fire hydrants are generally rated at a maximum flow rate of 1,500 gpm to 1,750 gpm meaning multiple hydrants would be required for the maximum fire flow. Hydrants will be fed by 6" hydrant laterals including 6" gate valves at the main. Bollards will be installed at each hydrant to protect them from possible traffic impacts.

In order to accommodate possible future pipeline extensions, the system will be designed with fittings installed with blind flanges at intersections and end points which will allow for easy connection of new pipelines.

In compliance with Caltrans requirements, the section of pipeline crossing under Highway 49 will be installed by the bore and jack method. For a 12" carrier pipe, a steel casing pipe of 24" will be installed by boring and jacking, with the carrier pipe pulled through upon completion. For this section of carrier pipe, restrained joint ductile iron pipe is recommended.

Water Supply Well

A new well will be designed to connect to the pipeline distribution system. Pump and motor sizing will be estimated based on the expected depth and production of the well. Once the well is constructed and the capacity determined by the well driller, the pump and motor will be specified.

The well will consist of drilling a borehole and installing a casing, installing a concrete sanitary seal, installing a concrete slab and pedestal at the wellhead, installing the pump and motor, drop pipe, and motor electrical leads down the casing, installing a casing vent, installing the discharge manifold with sample tap and water meter above the wellhead, and connecting the well discharge pipe to the distribution system. Well construction will also include construction of a lockable enclosure for freeze protection and security, and to house the pump controls. A new electrical service with connection to PG&E will be required to provide power for the pump system.

The County may want to consider whether to construct the well to residential/agricultural standards or to public water well standards. The primary differences being the two are the diameter of the bore hole, type of drilling method utilized, and depth of the sanitary seal. For instance, for residential or agricultural wells, the sanitary seal needs to fill a minimum annular space of 3 inches between the bore hole and casing extending a minimum of 20 feet below ground surface whereas a public well sanitary seal needs to fill a minimum annular space of 4 inches and extend a minimum of 50 feet below ground surface. One issue is if there are good water bearing zones between 20 and 50 feet, they would essentially be sealed off with the deeper sanitary seal and the well would be

less productive. If the water bearing zones are below 50 feet and the additional costs are reasonable, the County may want to consider constructing the well to public well standards in the event the system would ever be converted in the future.

Estimated Project Costs

Table 1 shows the estimated construction costs for the proposed North San Juan Fire Suppression System. These estimated costs are based on materials and products that comply with the requirements of the Build American, Buy American Act.

**Table 1
Estimated Construction Costs**

Item	Quantity	Unit Cost	Total
Mobilization	1 Lump Sum	\$90,000	\$90,000
Traffic Control	1 Lump Sum	\$25,000	\$25,000
Erosion Control/BMPs	1 Lump Sum	\$25,000	\$25,000
Shoring/Sheeting/Bracing	1 Lump Sum	\$7,000	\$7,000
Bolted Steel Water Storage Tank	330,000 gallon	\$1.10/gallon	\$363,000
Tank Foundation	1 Lump Sum	\$100,000	\$100,000
Tank Site Piping	1 Lump Sum	\$20,000	\$20,000
12" C900 Pipe and Fittings	3,520 lineal feet	\$190/lineal foot	\$668,800
6" PVC Pipe and Fittings	215 lineal feet	\$150/lineal foot	\$32,250
12" Butterfly Valves	11	\$6,000 each	\$66,000
Bore and Jack 24" Casing with 12" Ductile Iron Carrier Pipe	1 Lump Sum	\$62,000	\$62,000
Boring/Receiving Pits, Shoring	1 Lump Sum	\$25,000	\$25,000
Fire Hydrant Assembly	10	\$10,000 each	\$100,000
Trench Surface Restoration	19,250 square feet	\$8/square foot	\$154,000
Drill/Case Well	360 feet	\$110/foot	\$39,600
Well Pump and Motor	1 Lump Sum	\$3,000	\$3,000
Well/Tank Pump Controls	1 Lump Sum	\$15,000	\$15,000
Well Head and Building	1 Lump Sum	\$30,000	\$30,000
Utility Connection	1 Lump Sum	\$15,000	\$15,000
Estimated Construction Subtotal			\$1,840,650
Construction Contingency, 15%			\$276,100
Total Estimated Construction Costs			\$2,116,750

Table 2 shows the estimated non-construction costs for the proposed North San Juan Fire Suppression System.

**Table 2
Estimated Non-Construction Costs**

Item	Quantity	Unit Cost	Total
Geotechnical Reports			\$32,000
Bidding			\$6,000
Construction Engineering			\$25,000
Construction Survey			\$15,000
Inspection			\$15,000
CEQA/NEPA Review			\$75,000
LAFCo/BOE			\$10,000
Initial Tank Fill			\$83,000
Permitting Services			\$5,000
Caltrans Encroachment Permit			\$3,000
Easements			\$50,000
PG&E Service			\$15,000
Estimated Non-Construction Subtotal			\$334,000
Non-Construction Contingency, 10%			\$33,400
Total Estimated Non-Construction Costs			\$367,400

Table 3 shows the estimated total project cost for the proposed North San Juan Fire Suppression System.

**Table 3
Estimated Total Project Costs**

Total Estimated Construction Costs	\$2,116,750
Total Estimated Non-Construction Costs	\$367,400
Total Estimated Project Costs	\$2,484,150