
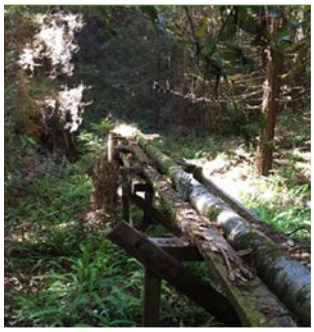

Raw Water Line Replacement Project

City Project No.: 2018-02

PROJECT PRACTICALITY REPORT

COLEMAN ENGINEERING

January 14, 2020

City of Fort Bragg
Raw Water Line Replacement Project
City Project No. 2019-02

FINAL PROJECT PRACTICALITY REPORT

Prepared by:

COLEMAN
ENGINEERING

Project #: FTBG18-001

January 14, 2020

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1 PROJECT BACKGROUND AND DESCRIPTION

1.1 General

The City of Fort Bragg's Water Treatment Plant (WTP) at the intersection of Sherwood Road and Monsen Way receives its raw water supply from three sources via two pipelines. For the first source, raw water from the Madsen Hole on the Noyo River to the east of the WTP is pumped via 10-inch and 14-inch dia. pipe directly to the WTP. This pipeline is not included in this project. The second and third sources of supply are from two raw water sources at Waterfall Gulch and Newman Gulch to the south of the WTP. Water from both sources is conveyed in a single connecting pipeline under pressure to the WTP. The pipeline is a combination of 6, 8, 10 and 12-inch dia. PVC, asbestos cement, ductile iron and steel pipe. It crosses a variety of terrain, including City subdivisions, but significant lengths are in steep, heavily-wooded and landslip-prone gorges that are difficult to access. Sections of the pipeline are also characterized by shallow groundwater, springs, and sensitive riparian environments, with part included within the Coastal Zone. There are crossings of the Noyo River and Hare Creek/Covington Gulch. The elevation at the pipeline's highest point is approximately 335 feet above sea level (Waterfall Gulch intake), while the low point in the profile is at the Noyo River crossing just above sea level.

Sections of this transmission pipe are reaching the end of their service life and pipe failures are becoming more regular and widespread. Portions of the pipeline are partially buried with the pipe crown exposed, while one section is above ground and supported on a deteriorating wooden trestle. As a result, there is a threat to the reliability of a significant portion of the City's water supply. This project is for the replacement of these sections of pipeline to increase that reliability and provide more resilience to the raw water supply system.

This Raw Water Replacement Pipeline Project has been divided into five phases to facilitate implementation, as shown on Figure 1 and detailed below in Table 1. Phase I from the northside of Highway 20 to the Summers Lane Reservoir was constructed in 2013 and is not included in this stage of project implementation. Similarly, the Noyo River and Hare Creek / Covington Gulch crossings, and the section of pipeline from the Waterfall Gulch Intake to Road 450 were constructed relatively recently and replacement is not considered necessary at this time.

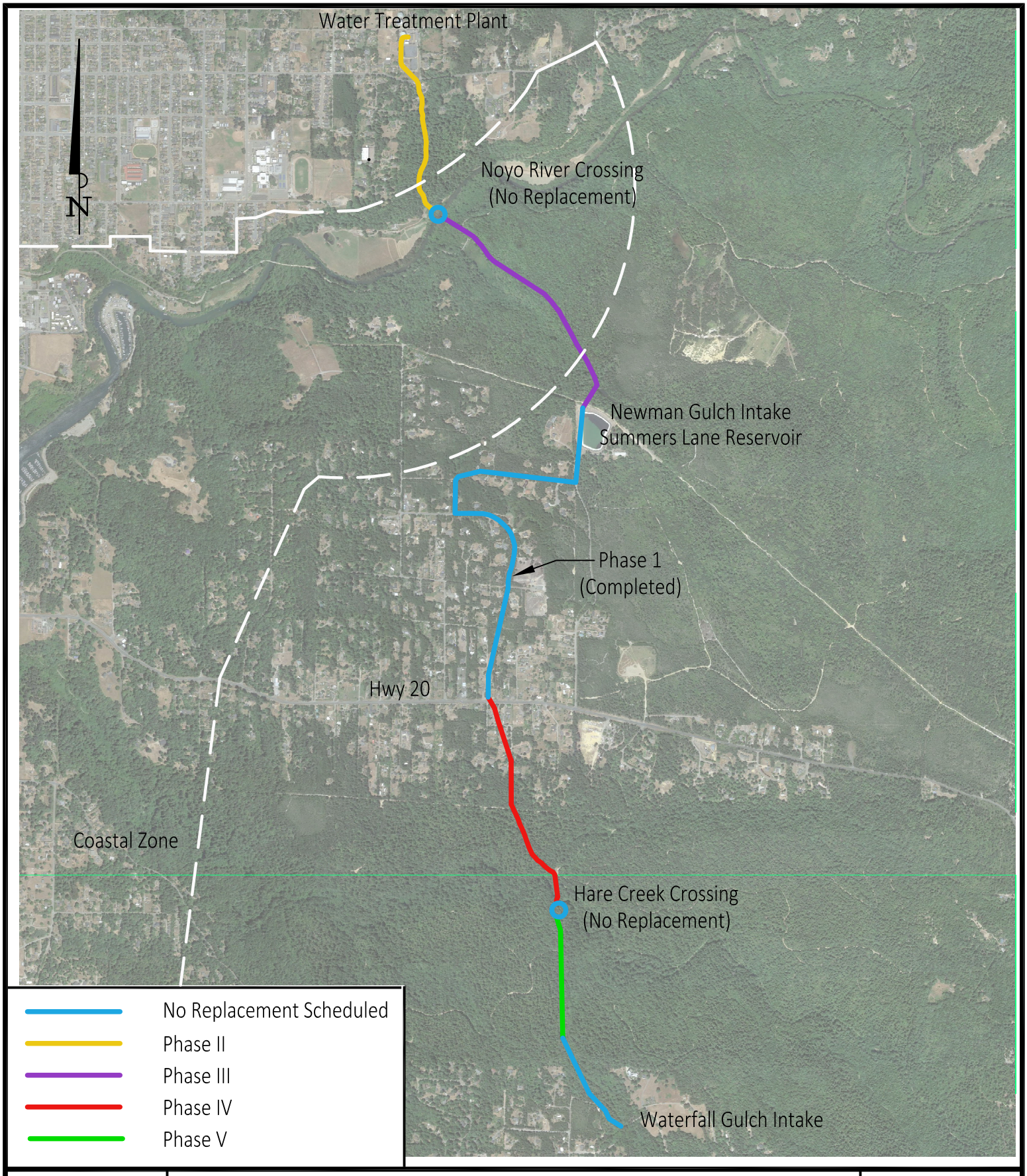

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FIGURE 1: OVERVIEW MAP
RAW WATER PIPELINE REPLACEMENT DESIGN
CITY OF FORT BRAGG

COLEMAN ENGINEERING
1358 Blue Oaks Boulevard, Suite 200, Roseville California (916) 791-1188

DATE: 8/9/2019
DRN: MS
CKD: SNG
SCALE: 1"=2000'
JN: FTBG18-001

Table 1: Raw Water Replacement Project Phases

Phase	Location	Approx. Length, feet	Existing Pipe Dia., Inches	Description of Existing Pipeline Route and Terrain
I	Highway 20 (N) to Summers Lane Reservoir / Newman Gulch Intake	7,000	10	Completed in 2013. No further implementation required.
II	Noyo River Crossing (N) to WTP	3,150	12	Pipeline in slope bench in a heavily-wooded, steep, unstable gorge prone to landslide and slope creep. Previous slope failures and loss of pipeline. Part in Noyo River floodplain and Coastal Zone.
III	Summers Lane Reservoir / Newman Gulch Intake to Noyo River Crossing (S)	3,750	10	Pipeline runs generally across-slope, located at the top of the Newman Gulch gorge eastern slope in very heavily-wooded, inaccessible terrain. Part in the Noyo River floodplain. Most of the alignment is in the Coastal Zone.
IV	Hare Creek Crossing (N) to Highway 20 (N)	3,100	6 & 10	Replacement will include a new crossing of Highway 20. In residential sub-division between Highway 20 and an east-west forest road at the south end of Porterfield Lane. Heavily-wooded, steep downslope from the forest road to the Hare Creek Crossing.
V	Road 450 to Hare Creek Crossing (S)	1,050	6 & 10	Wooded terrain from Road 450, with steep downslope to the Hare Creek Crossing. Wooden trestle support for above ground pipeline north of Road 450.

1.2 Existing Ground Profile, Flows and Hydraulic System

Figures 2 and 3 show the approximate ground profile along the existing pipeline route. The existing transmission main operates as two sections of gravity pressure pipeline, with a hydraulic break at the Summers Lane Reservoir:

- Waterfall Gulch to Summers Lane Reservoir (includes Phases I, IV and V)
- Summers Lane Reservoir to WTP (includes Phases II and III)

Approximate maximum static pressures in the existing pipelines, by phase, are given below in Table 2:

Table 2: Approximate Maximum Static Pressures by Phase

Phase	Approximate max. static pressure (psi)	Location of max. pressure
II, III	140	Adjacent to Noyo River Crossing
IV, V	140	Adjacent to Hare Creek Crossing

The flow rate for the existing raw water pipeline is limited by the water right at Waterfall Gulch. According to information provided by the City, the Waterfall Gulch Appropriate Water Right is limited to a Maximum Annual Diversion of 475 acre-feet per year at a maximum rate of 0.668 cubic feet per second (cfs). This equates to approximately 300 gallons per minute (gpm). The Waterfall Gulch Lake and Streambed Alteration Agreement (LSAA) of April 2018 with the State of California Department of Fish and Wildlife defines a 25% bypass reduction of the maximum diversion. So, while it may be possible for this flow and thus the future design flow for the replacement pipeline to be reduced, it seems unlikely that it would ever be increased. The design flow for the replacement pipeline will thus be set conservatively at 300 gpm.

2 SCOPE AND PURPOSE OF THE REPORT

This Project Practicality Report extends the Project Existing Conditions and Constraints Technical Memorandum (TM) of July 2019 to include an evaluation of the pipeline route alternatives presented in the TM. The content of the TM is also included in this report, including a review of the pipeline's existing conditions and a description of the constraints on its replacement. This includes a review of existing pipe data, information and records made available by the City. The report also documents the findings of a full-day site reconnaissance walk undertaken by the Coleman Engineering team and City staff. The

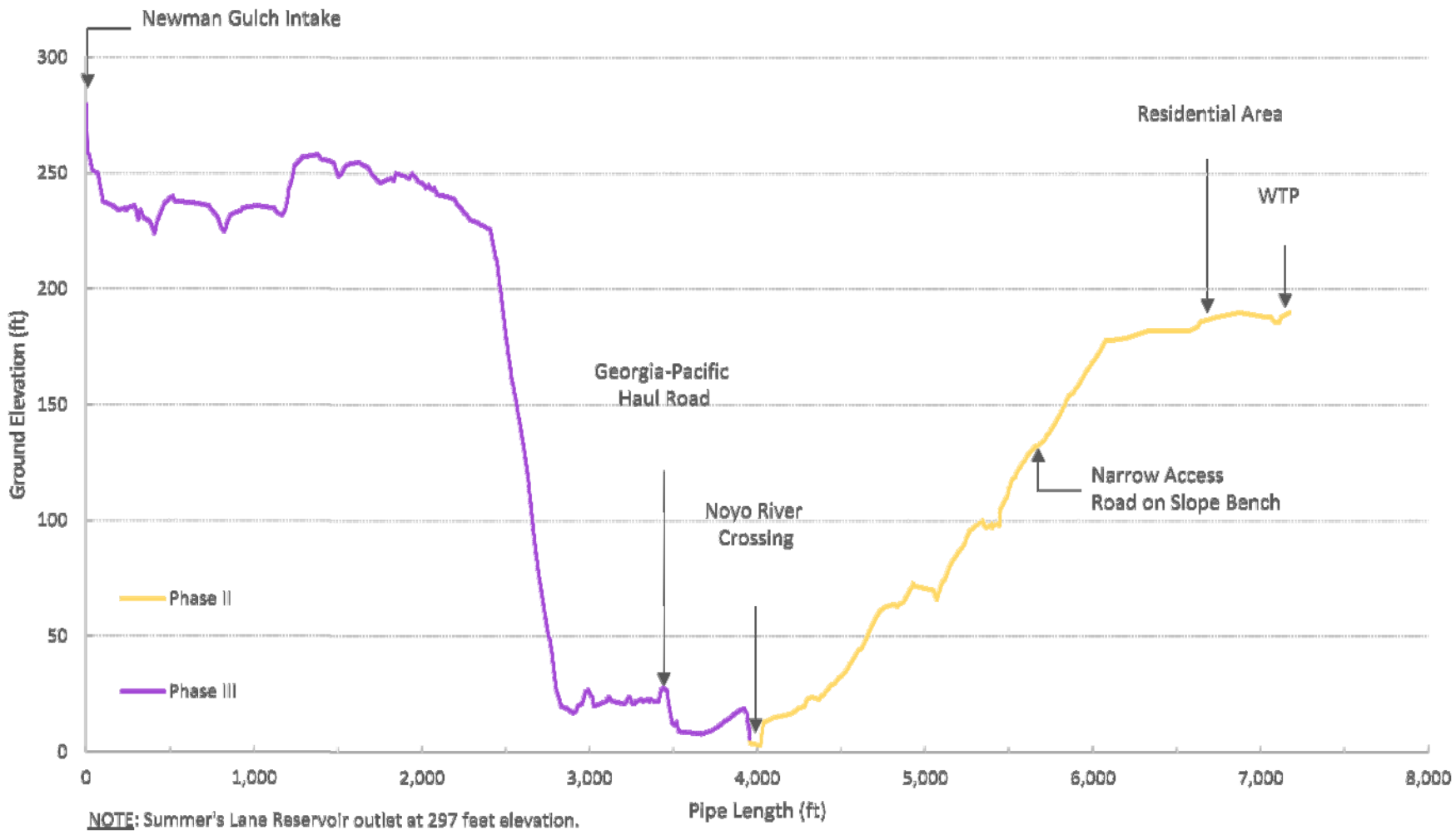

FIGURE 2: GROUND ELEVATION PROFILE OF PHASE II & PHASE III EXISTING PIPELINES

RAW WATER PIPELINE REPLACEMENT DESIGN

CITY OF FORT BRAGG

COLEMAN ENGINEERING
1358 Blue Oaks Boulevard, Suite 200, Roseville California (916) 791-1188

DATE: 7/15/2019
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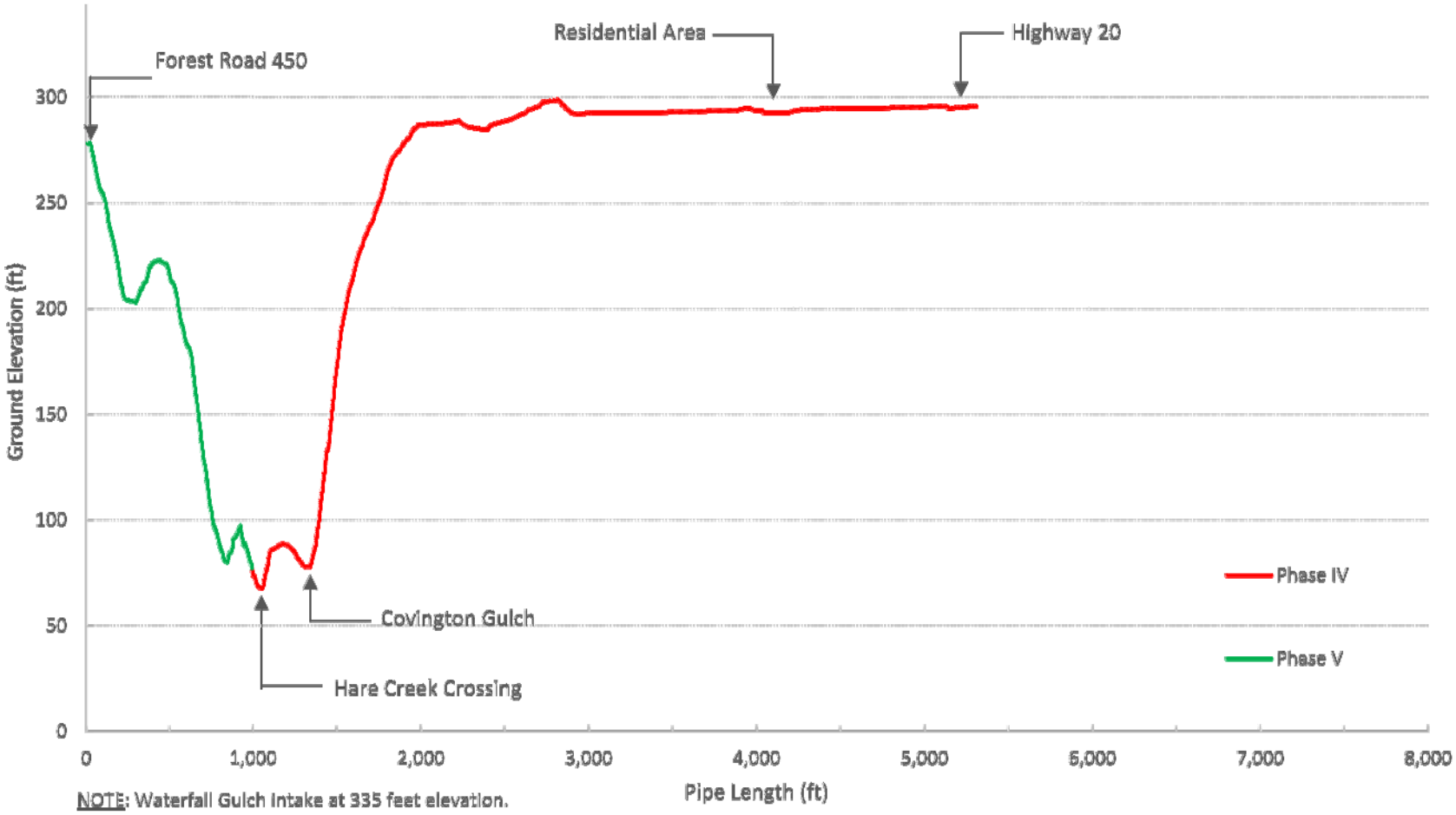

FIGURE 3: GROUND ELEVATION PROFILE OF PHASE IV & PHASE V EXISTING PIPELINES

RAW WATER PIPELINE REPLACEMENT DESIGN

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reconnaissance walk and its findings are detailed below: the site walk was initiated so that key technical issues such as geologic and geotechnical hazards, access constraints, environmental issues, need for tree removal, constructability and applicable construction methods by phase could be identified in the field, examined and then discussed across the full project team. The site walk included not only the existing pipeline corridor, but also portions of other potential alternative alignments.

Noyo River Crossing

Using the data received and the findings of the site reconnaissance walk, a series of alternative alignments by phase are presented in this report. These alignments are defined on topographical base maps created from LiDAR data files generated from aerial mapping in May and June 2019. The City team has provided input on these potential alignments and their comments have been included in the maps presented in the report. These alternative alignments are then carried forward to a two-stage evaluation later in the report. This evaluation consists of an initial 'fatal flaw' analysis that considers factors such as environmental impacts that cannot be mitigated except by re-routing, an inability to obtain easements / right-of-way / permits, and hydraulic inadequacy. Alignments that make it through this 'fatal flaw' analysis are subject to a detailed evaluation that also includes capital and life-cycle costs. At the end of the report is a description and presentation of the results of the evaluations, and recommendation of a preferred pipeline route and project for design.

3 REVIEW OF DATA AND INFORMATION RECEIVED FROM THE CITY

The City provided considerable data and information in digital form on existing pipeline design and construction, parcel information, easements, and relevant past projects at the project kick-off meeting of March 13, 2019. This data and information are listed and reviewed in the following sections:

3.1 List of City-supplied Data and Information

The following data and information were provided to the Coleman Engineering team by the City:

- Noyo River Crossing design plans by Winzler and Kelly for a 1987 project to replace the existing 10-inch dia. steel pipe crossing with a new 12-inch dia. ductile iron pipeline installed in trench (2 plans – site plan and section, and typical details). Also, construction photos at the Noyo River Crossing and location detail annotated plans for the north and south banks.
- Waterline Slope Repair Project design plans by LACO Associates for a 2003 project to re-stabilize the benched slope containing the pipeline north of the Noyo River (2 plans – erosion control plan, and plan view and sections).
- Hare Creek / Covington Gulch Crossing design plans by Winzler and Kelly for the 1990 -1 project (see below) to replace the existing 6-inch dia. asbestos cement crossing with a 10-inch dia. ductile iron pipe (single plan and profile plan with details).
- Design plans and project information for the 1990 -1 Waterfall Gulch / Simpson Pipeline Replacement Project by Winzler and Kelly. Project included replacement of the Waterfall Gulch intake structure and new buried pipeline to Forest Road 450 to eliminate existing trestles. Information includes plans, hydraulic calculations; environmental documents and correspondence with state agencies and the US Forest Service; survey data; easement documents; quitclaim deeds; record-of-survey maps; and construction phase documents.
- 1958 Jackson Pipeline location map, showing the proposed pipeline route from Newman Gulch down towards the Noyo River as it crosses Union Lumber Company property.
- Newman Bypass design plans by Winzler and Kelly for a 1990 project at the Newman Reservoir (3 plans – site plan and two miscellaneous details sheets).
- Waterfall Gulch Transmission Main – State Highway 20 to Brush Creek Road Project - as-built plans and technical specifications from 2016 for Phase I by KASL Consulting Engineers.

- Summers Lane (Newman) Reservoir Project, March 2016, including design plan set (27 plans) by Lawrence and Associates; CEQA biological assessment, Notice of Determination and Mitigated Negative Declaration documents; Timber Harvest Plan (THP) biological and botanical surveys, permits and completion report; 2007 and 2010 geotechnical reports; annotated pond plan; survey reports; technical memo on groundwater table / reservoir base separation; grading permits; and the pygmy cypress mitigation planting plan.
- Phase I Water Facilities Study – Existing Water Collection, Distribution and Capacity Report by KASL Consulting Engineers in 2012 (13 pages).
- 2018 maps and mailing lists for residents within a 300 feet radius of Phases II – V.
- Relevant easement documents from 1905, 1907, 1914, 1933, 1935, 1946 and 1961.
- Jackson quitclaim documents from 1992.
- 1968, 1977 and 2003 Record-of-Survey maps of the existing pipeline easement through the subdivision south of Sherwood Road (near the WTP)
- Record-of Survey map for the Simpson Lane Property from 1940.
- 1977 Parcel Map for the minor subdivision immediately south of Sherwood Road near the WTP.
- City-prepared summaries of easements along the pipeline routes in pdf and PowerPoint formats.
- Photos showing a landslip failure and the exposed water line on the Newman Gulch section of pipeline.

3.2 Review of City-supplied Data and Information

3.2.1 Engineering Design Information

Design and as-built project information is generally available in detail for specific locations rather than for the pipeline route as a whole. As expected, the amount and quality of available data and information improves the more recent the project. This data and information will be used in conjunction with the LiDAR-generated topographical mapping and localized traditional survey to generate the plan and profile and related detail drawings.

The 1968, 1977 and 2003 Record of Survey and Parcel Maps show the existing pipeline easement at the downstream end of the existing Phase II pipeline prior to its connection into the WTP. The easement is shown through the subdivision south of Sherwood Road but north of the wooded gorge in the middle section of Phase II. The Waterline Slope Repair Project plans from 2003 provide useful information on the existing pipeline location and the re-stabilized benched slope work for Phase II in the gorge section south of the Sherwood Road subdivision

and north of the Noyo River Crossing. The 1987 Noyo River Crossing plans provide good details of the crossing location and potential connection points for both the Phases II and III pipelines. There is very limited design or as-built information for the existing Newman Gulch pipeline that will be replaced under Phase III, though the 1958 Jackson Pipeline location map shows a surveyed route for the existing pipeline from the Newman Reservoir towards the Noyo River. At the head of Phase III at the Summers Lane Reservoir and the Newman Gulch intake, the 2016 Summers Lane Reservoir Project documents and the 1990 Newman Bypass plans provide useful as-built information for the start of the Phase III pipeline. The Summers Lane project also provides two geotechnical investigation reports.

For Phase IV, the 2016 Phase I plans and documents from the Waterfall Gulch Transmission Main – State Highway 20 to Brush Creek Road Project provide details of the existing pipeline connection point on the northside of Highway 20. There is little information on the Phase IV pipeline through the wooded areas south of the subdivision to the south of Highway 20. However, the design plans and project information for the 1990 -1 Waterfall Gulch / Simpson Pipeline Replacement Project provide details of the Hare Creek / Covington Gulch Crossings and adjacent pipelines for both Phases IV and V, and also for the existing pipeline for the Phase V route north of Road 450.

3.2.2 Easement Information

The City provided an extensive number of easement, record-of-survey, and parcel map documents for the pipeline route dating from 1905 through 2003. These were summarized by the City and are included in Appendix A of this Report. The graphics show that while there were a number of easements acquired over the lifetime of the previous and current pipelines, the existing pipeline is generally not located within the existing easements. This may be due in part to difficulty in accurately locating the old easements from their plat maps and legal descriptions, but also due to past replacement / relocation of sections of pipeline outside of the original easements. Preliminary studies by our team surveyor has shown that there may be up to 21 private properties, owned by 13 separate owners, that are crossed by the existing pipeline. Counting parcels that the pipeline crosses, or is very near to and may cross, the following parcel ownership has been identified from Mendocino County records:

- City of Fort Bragg – 2 parcels
- Wilson – 1 parcel

- Jackson State Forest – 2 parcels
- Merson Family Real Estate Partnership – 1 parcel
- Merson – 1 parcel
- Mason – 2 parcels
- Peter – 1 parcel
- Felkins – 1 parcel
- Nyren – 1 parcel
- Georgia Pacific Corporation – 1 parcel
- Lyme Redwood Timberlands – 3 parcels
- Peavey – 2 parcels
- Bates – 3 parcels

The future alignment of the pipeline may be considerably different from the existing pipeline route. This is demonstrated by the series of alternative alignments that are subject to detailed evaluation in this report. Once the preferred pipeline route has been selected, easement acquisition will proceed. It may be easier to negotiate a revised easement with those property owners who currently have an existing waterline easement across their property.

3.2.3 Environmental Information

Relevant environmental project documents are available for the 1990 -1 Waterfall Gulch / Simpson Pipeline Replacement Project and the 2016 Summers Lane (Newman) Reservoir Project. Generally environmental documentation needs to be less than about 5 years old in order for its findings and conclusions to be used without further study. The 1990 -1 project documents can thus only be used for reference and potential guidance for potential environmental impacts. The Summers Lane Reservoir Project documentation is recent and, although localized, is highly relevant for preparation of an Initial Study / Mitigated Negative Declaration and THP Plan for this pipeline project. The Summers Lane environmental documentation includes CEQA biological assessments, the Notice of Determination, and Initial Study / Mitigated Negative Declaration documents. The THP data and information includes biological and botanical surveys, permits, and the project completion report.

4 FULL-TEAM SITE RECONNAISSANCE WALK

4.1 Background and Purpose

A key element of the project's preliminary design studies is the full-team, one-day site reconnaissance walk. The site walk was initiated so that key technical impacts such as

geologic hazards, access constraints, environmental issues, need for tree removal, constructability and applicable construction methods by phase could be identified in the field, examined and then discussed across the full project team. The walk included not only the Coleman Engineering team with its specialist subconsultants but also City public works staff and operators responsible for operation of the pipeline and the WTP. The site walk included the existing pipeline corridor and parts of other potential alternative alignments. The intent was for each member of the team to become familiar with, and discuss, all project existing conditions and constraints including those outside of their individual specialty. Site walk attendees were:

- Diane O'Connor (Project Manager), Heath Daniels (Lead WTP Operator), and Chris Brians (WTP Operator) (City of Fort Bragg)
- Chad Coleman and Simon Gray (Coleman Engineering, Lead Designer)
- Jim Dickey (Cinquini & Passarino, Topographical Mapping and Survey)
- Aaron Smud (Alpine Summit Development, Constructability / Cost Estimating)
- Doug Brewer (Brewer Environmental, Environmental Permitting/CEQA)
- Curtis Tyler (Summit Forestry, Environmental/Timber Management)

Findings from the site walk are presented below by discipline.

4.2 Geotechnical and Geologic Conditions and Constraints

4.2.1 General Ground Conditions in the Project Area

Geology: Published geologic mapping (California Geological Survey (CGS) OFR 83-5) shows that the project area consists of Marine Terrace Deposits (generally sand with minor gravel) that are underlain by Coastal Belt Franciscan rock (well-consolidated clastic sedimentary rocks; mostly sandstone and shale). The steep side slopes along the rivers/creeks/gulches in the area generally have the Franciscan rock unit exposed at the surface.

Soils: The USDA-NRCS Soil Survey shows that project area soils are generally clayey/silty sand, with some sandy silt/clay. Soils along Hare Creek and Covington Gulch consist of clayey/silty gravel. The risk of corrosion to steel and concrete is generally rated as moderate to high throughout the project area.

Landslide Potential: Published landslide mapping data (CGS OFR 83-5) indicates that there are no landslides within the project area. However, the steep slopes adjacent to the upper part of Newman Gulch and all of Covington Gulch and Hare Creek are mapped as "inner gorge". This is a geomorphic feature formed by debris slide processes that, over time, are activated periodically by

downcutting of the stream channel, and generally have slopes of 65% or greater. Vegetation is vital in order for these slope-types to maintain stability. Slope cuts have the potential to re-activate downslope movement.

Seismic Activity: The Fault Activity Map of California (2010) shows that there are no faults running through the project area. The nearest mapped fault is a pre-Quaternary-age fault that runs along Simpson Lane between Forest Road 450 and State Highway 1, about 0.8 miles southwest of the Phase V pipeline section. A Quaternary-age trace of the San Andreas Fault Zone (Shelter Cove Section) is located off-shore, about 7.5 miles from the pipeline. Both of these faults are not considered "active" per CGS. The nearest "active" fault is the San Andreas Fault Zone (North Coast Section), which is located about 20 to 25 miles south, near Manchester.

4.2.2 Phase II Pipeline Ground Conditions and Constraints

The existing raw water pipeline crosses under Sherwood Road from the south end of the WTP through private property and along a narrow, unpaved driveway. At the end of this driveway is a narrow access road (with a single chain gate) that descends down to the northern flood plain of the Noyo River. The surrounding slopes along this access road are steep and heavily vegetated, with fern undergrowth and dense tree cover. Water was observed seeping from the slopes at various locations. This is indicative of high groundwater.

Surficial soils appear to be primarily residual soils consisting of clayey sand to sandy clay. Some very intensely weathered to decomposed sandstone (breaking down to a clayey sand and/or sandy clay with finger pressure) was observed within the slopes. A large outcrop of intact rock was observed at the bottom of the access road at the Noyo River floodplain.

City staff have advised that a large amount of stormwater runoff flows down the access road. There is a drainage ditch that runs along the western side of the road in its upper section: the drainage then twice crosses beneath the road as it progresses downslope. In addition, there is a natural drainage inflow from the northeast that combines with the drainage ditch runoff approximately halfway down the access road. Just before the drainages combine is an area of slope instability. The City has advised that this area experienced a significant slope failure in 2003 that damaged the pipeline. The slope was repaired by excavating out the failed material and replacing it with fill. There has been more recent ground movement at this location after winter storms in January and February

2017: the City has advised that this ongoing movement was first noted in March 2017.

Phase II Access Road Exit onto Noyo River

The natural drainage channel flows right below this area of slope instability and is eroding support at the slope toe, initiating the ground movement. Additionally, the slope constituent materials are probably highly saturated in winter, based on evidence of high groundwater in the area. This only increases hydrostatic pressures and forces driving slope movement. Should the raw water replacement pipeline be routed along the access road bench, permanent slope repair will be needed, including erosion protection along the natural drainage channel and re-construction of the embankment with adequate sub-drainage.

4.2.3 Phase III Pipeline Ground Conditions and Constraints

The existing pipeline in Phase III runs from the north side of Summers Lane Reservoir, continues down to the Newman Gulch Intake and then proceeds along the eastern slopes of Newman Gulch to the Noyo River, passing under the Georgia-Pacific Haul Road. Phase III connects to Phase II on the southern side of the Noyo River Crossing.

Phase III is very comparable to Phase II with dense trees and undergrowth, water seepage, evidence of shallow ground water and sandy/clayey residual soils with decomposed sandstone in cut-slopes. The upper portion of the pipeline is aligned along the upper part of the Newman Gulch eastern slope, following a gradual but consistent descending path. The pipeline is generally located on a narrow, flat "ledge" at the top of the Newman Gulch gorge, with apparent 5 to 10-foot wide inboard cut-slopes. Some areas contain cut-slopes on either side of the path: a through-cut. The lower portion of the existing Phase III alignment descends sharply down to the Georgia Pacific Haul Road that runs along the south side of the Noyo River, and to the Noyo River southern floodplain. During the site walk a steep slope recording of about 55% was made in this section. Leaning trees were observed throughout the Phase III area, but there was little evidence of slope stability issues. However, removal of trees and vegetation from the steep slopes during any future pipeline construction may cause slope stability issues: this would have to be evaluated as part of design. Two distinct areas of steep debris slides were also observed along the upper portion of the existing alignment, likely caused by undercutting from Newman Gulch below. One failure area had exposed the pipeline, and may have been caused by a previous pipe failure that washed out the slope. Alignment of any replacement pipeline in this area will require a setback as far as possible from these debris slide areas, due to the steepness and height of the slopes below.

4.2.4 Phase IV Pipeline Ground Conditions and Constraints

The existing water main in Phase IV is aligned from the Hare Creek Crossing, located near the confluence of Covington Gulch and Hare Creek to the northern side of Highway 20. The alignment south of Highway 20 was not examined during the site walk, but it and alternative alignments in this area proposed to run along either Dwyer Lane or Porterfield Lane are in a generally flat-lying, rural residential area. After passing through this residential area, the existing pipeline runs straight down the northern slopes of Covington Gulch/Hare Creek. The pipeline at the bottom of the slope is exposed before it crosses under the streams, where there is also an existing blow-off.

This area in general is similar to that of Phase II and III, with densely vegetated/forested and wet ground conditions. West of the existing pipeline alignment near Gravel Pit Road is a large outcropping of intact rock (sandstone/graywacke), with water seeping out. Some parts of the rock slopes were beyond vertical (overhanging).

The steep slopes of Hare Creek and Covington Gulch form a “inner gorge” feature. The slopes are heavily vegetated and do not show signs of recent debris slide failures. However, the removal of trees and vegetation risks destabilizing the slopes.

4.2.5 Phase V Pipeline Ground Conditions and Constraints

In Phase V, a replacement pipeline is required between Forest Road 450 (where it would connect to the existing water main from the Waterfall Gulch Intake) to the Hare Creek Crossing. There is an initial steep slope down from the Forest Road until an above-ground pipe trestle section is reached. The ground then slopes relatively gently until reaching the southern Hare Creek slopes, which descend steeply down to the creek. The area in general is similar to the other phases: densely vegetated and forested with wet ground conditions.

Steep, Heavily-Wooded Terrain Typical of Phases III, IV and V

The pipeline is exposed at numerous locations: these appear to be either potholes for repairs or caused by erosion. The trench backfill in general sags relative to the surrounding ground. During the site walk it was found that at one location a tree had fallen on an-above ground portion of the pipe. A small ponding of water was observed within a depression about 50 feet from the pipe alignment just downstream of the pipe trestle section: this was identified as a seep or spring and not a pipe leak.

The steep southern slopes of Hare Creek are very similar to the northern slopes (densely vegetated, “inner gorge” slopes with no sign of recent debris slides).

4.3 Environmental Conditions and Constraints

4.3.1 General Environmental Conditions in the Project Area

The project is situated in the Noyo River redwood forest watershed, which has abundant natural resources supporting numerous special status species that are protected under state or federal regulation, including the Coastal Tailed Frog, Red-legged Frogs, Pygmy cypress trees, and the Southern Torrent Salamander. The Noyo River and Hare Creek also support Coho salmon and steelhead. Under a separate task for this project, environmental records research and detailed biological surveys are being used to assess existing habitats and to determine whether the project area supports these species. The findings from these surveys will assist in determining whether a particular pipeline alignment has a fatal environmental flaw that would prevent its implementation, or whether a potential environmental impact can be successfully mitigated. Once a project is defined, Initial Study / Mitigated Negative Declaration documents will be prepared for compliance with the California Environmental Quality Act (CEQA).

There are potential impacts to historical and cultural resources across the project area. The project is located in an area with a local lumber industry history, as well as occupation by Native American Indian Tribes that inhabited the Fort Bragg area. There are several recognized Indian Tribes in the region, including the Noyo Pomo Tribe and the Sherwood, Coyote Valley Band of Pomo Indians.

Wetlands and Waters-of-the-United States have to be delineated and defined as part of the environmental studies for the project. While the raw replacement pipeline project will not include replacement of the existing Noyo River and Hare Creek Crossings at this time, any new pipelines will have to cross their adjacent floodplains. This triggers compliance with the federal Clean Water Act Section

404 and the California Department of Fish and Wildlife (CDFW) Fish and Game Code Section 1600 and associated permits from the US Army Corps of Engineers and CDFW.

There are Coastal Zone impacts on Phases II and III, which are partially located within the regulatory boundaries of the State Coastal Commission Coastal Zone. Permitting is administered locally through the Mendocino Coastal Zone Administrator.

Phase V Trestle

The project will require the removal of secondary growth redwood, alder and other trees to allow pipeline construction, primarily in Phases III, IV and V. This triggers the need for preparation of a THP by a certified forester. This THP is being prepared under a separate task. The THP approval process is administered by the State Department of Forestry under the requirements of the Forest Practices Act and is a separate permitting process. The THP permit application will be supported by the City's project CEQA compliance document: the environmental studies are being prepared with both the requirements of CEQA and the THP permit in mind.

Initial biological studies are currently underway, and will be performed until May 2020. These fauna surveys now underway include those for the Northern Spotted Owl (NSO), raptors and ospreys. Other fauna surveys include the Southern Torrent salamander and Foothill Yellow-Legged Frog. Rare plant surveys are also currently in progress. The results of these studies are used later in the detailed evaluations of pipeline route alternatives presented in this report. Plant and NSO / raptor surveys have had no detections of sensitive species to date (September 2019).

The above environmental conditions and constraints apply to most of the project area. The following sections describe particular local environmental and THP conditions and constraints by phase as determined on the site walk. The results of the more detailed studies and surveys will be presented in later project deliverables.

Above-Ground Ductile Iron Pipe

4.3.2 Phase II Pipeline Environmental Conditions and Constraints

For the existing Phase II water main alignment, it was noted that there may be biological herpetofauna species impacts due to the proximity to the Noyo River and its floodplain, and to the natural discharge channels adjacent to the water main access road. There are also potential impacts on salmonids in and near to the Noyo River. The permitting for this pipeline section will include Clean Water Act Section 404, CDFW Section 1600 and California Coastal Commission development permits. It was noted that as the Section 404 and Section 1600 permitting will be required for crossing the Noyo River floodplains, there may be an advantage in also including a replacement crossing in the permit application.

Such a crossing would probably require horizontal direction drilling installation methods. This idea will be discussed with the City.

There are potential temporary aesthetic, noise and dust impacts associated with construction that will impact the residents in the sub-division south of the WTP and Sherwood Road.

There is likely to be no need for a THP, or an exemption will be acceptable.

4.3.3 Phase III Pipeline Environmental Conditions and Constraints

As with the Phase II alignment, there are likely to be biological herpetofauna issues near Newman Gulch, the Noyo River floodplain, and the existing pond immediately south of the Georgia Pacific Haul Road. The permitting for this pipeline section across the Noyo River floodplain will include Clean Water Act Section 404, CDFW Section 1600 and California Coastal Commission development permits. During the site walk, numerous seeps and springs were observed: these may be classified as Waters-of-the-United States and subject to additional permitting.

There are also potential historical / cultural issues in this phase with evidence of old water management structures and very old redwood pipe. These may require recordation, as the facilities are over 50 years old. Our cultural specialist will examine this issue during later environmental studies.

There is likely to be a need for a THP or a THP Exemption for any pipeline route from the Newman Gulch intake to the Noyo River.

In both biological and THP terms, it appears to be better to realign the Phase III pipeline further away from Newman Gulch, and to intercept the current alignment at the Georgia Pacific Haul Road.

4.3.4 Phases IV and V Pipeline Environmental Conditions and Constraints

The densely-vegetated and forested Phases IV and V will be subject to similar environmental issues and constraints as the downstream phases. Potential biological herpetofauna and salmonid impacts occur at, and in proximity to, Hare Creek and Covington Gulch. Clean Water Act Section 404 and CDFW Section 1600 permits will be required for the pipeline sections in the floodplains of the Covington Gulch and Hare Creek Crossings.

As with Phase III, there are potential historical / cultural issues in these phases, with evidence of old water management structures and very old redwood pipe.

These may require recordation, as the facilities are over 50 years old. Our cultural specialist will again examine this issue during later environmental studies.

A THP Exemption and potentially a special use permit will be needed for any pipeline section through the Jackson State Demonstration Forest from the north end of Phase IV to the Covington Gulch and Hare Creek Crossings.

4.4 Constructability Conditions and Constraints

Our specialty constructability sub consultant attended the site walk and has made the following observations about construction conditions and constraints for each phase of the raw water replacement pipeline project.

4.4.1 Phase II Constructability Conditions and Constraints

The proposed pipeline will probably connect to the existing 10-inch dia. PVC waterline near the existing flow meter vault on the south side of the existing WTP, although there is potential to extend the new main within the WTP site to feed the existing raw water storage basins. The new pipeline would cross Sherwood Road and then follow the existing gravel / dirt road heading south and downhill to Noyo River. The proposed right-of-way (ROW) would be on a narrow, benched access road with some existing culvert crossings. Construction would require minor clearing, tree trimming and improvements to the existing access road. SWPPP and erosion control will be a major consideration for this installation to prevent sediment or other debris from entering existing drainage channels. These measures will need to be installed and maintained during and after construction. Long term revegetation of the ROW or permanent access road construction will also be needed.

Pipeline construction should allow for a traditional open-cut, direct-buried pipeline installation. A minimum 25 to 40-feet wide temporary construction easement will likely be required to string pipe, excavate the trench, store trench soils, install the pipeline, backfill and compact the trench, and restore the ROW. We anticipate that some sections of the pipeline may require restrained joints for both pipe and fittings.

Typical pipeline appurtenances such as blow-off valves and combination air release valves may be required at proposed high and low points, but this phase appears to have a consistent hydraulic profile. Mainline isolation valves may be required at a certain footage frequency to isolate sections of the pipeline. These

valves will need to be protected and clearly marked with bollards or similar for future access.

The geotechnical investigations will determine whether cathodic protection systems or equipment will be required.

The existing crossing of the Noyo River is currently planned to remain in place. However, permits applicable for replacing the crossing will still have to be obtained for crossing the Noyo River floodplain. There may be advantages to the City in replacing the crossing as part of Phases II or III. Trenchless HDD methods would likely be the most economical and constructible for this replacement. The HDD pipeline could be constructed with either HDPE, Fusible PVC or Restrained DIP depending on design considerations. The HDD drilling entry location would likely be on the north side of the river and the pullback pipe string would likely be on the south side. A hydrostatic pre-test of the HDD pipe string would be recommended to verify there are no leaks or defects prior to pullback. It appears that extensive land clearing and timber harvest may be required on the south side of the river to allow for temporary construction workspace.

4.4.2 Phase III Constructability Conditions and Constraints

All Phase III pipeline alternatives would first connect to the existing waterline near the northwest side of the Summers Lane Reservoir. A short section of new pipeline would follow the existing gravel road heading north and downhill to the Newman Gulch Intake. Construction would likely require minor clearing, tree trimming and improvements to the existing gravel access road.

There would also be a second connection to the existing Newman Gulch Intake Pipeline at or near an existing vault. The new pipeline would head northwest and mostly downhill towards the existing Georgia Pacific Haul Road and the Noyo River Crossing.

All alignment alternatives will travel cross-country through heavily - forested ROW with steep cross slopes and downhill sections. The finalized alignment will require extensive land clearing, timber harvest, access road grading and earthwork. A minimum 25 to 40 feet wide temporary construction easement will likely be required for access road grading, pipe stringing, trench excavation, trench soil storage, pipeline installation, trench backfill and compaction, and restoration of the ROW. Setbacks from the top of slopes should be at least 50 yards. As with Phase II, SWPPP and erosion control will be a major consideration for this section to prevent sediment or other debris from entering Newman

Gulch. These measures will need to be installed and maintained during and after construction. Long term revegetation of the ROW, or permanent access road construction, will also be needed.

Newman Gulch Intake

Depending on environmental restrictions and allowed temporary workspace, the pipeline construction could allow for traditional open-cut direct-buried pipeline installation. Some sections of the pipeline may require restrained joints for both pipe and fittings.

Typical pipeline appurtenances such as blow-off valves and combination air release valves may be required at proposed high and low points, but as with Phase II, this phase appears to have a consistent hydraulic grade. Mainline isolation valves may be required at a certain footage frequency to isolate sections of the pipeline. These valves will need to be protected and clearly marked with bollards or similar for future access.

As with Phase II, the need for a cathodic protection system will be determined by further geotechnical investigation and testing.

Utilizing traditional or shallow HDD methods could be the most economical and constructible approach for certain sections of the pipeline if the replacement follows the general existing alignment. However, given steep slopes, unknown soil conditions and limited space to assemble long pull-back pipe strings, further investigation would be needed to determine if this is a viable alternative.

Given the environmentally sensitive ROW, and many of the restrictive conditions listed above, any method of pipeline construction in this area will be very difficult and possibly cost prohibitive. Consideration should be given to other possible alignment options or other design alternatives.

Existing Sunken Pipe Trench

4.4.3 Phase IV Constructability Conditions and Constraints

The northern section of Phase IV will include conventional open trenching along sub-division roads. South of the residential areas, Phase IV incudes an alignment that travels cross-country through heavily forested ROW with steep cross slopes and one very steep downhill section to a connection at, or to the north of, the

Hare's Creek Crossing. The proposed alignment will again require extensive land clearing, timber harvest, access road grading and earthwork. As with the other phases, a minimum 25 to 40-feet wide temporary construction easement will likely be required for access road grading, pipe stringing, trench excavation, trench soil temporary storage, pipeline installation, trench backfill and compaction, and ROW restoration. Setbacks from the top of slopes should be at least 50 yards. SWPPP and erosion control will be a major consideration for this section to prevent sediment or other debris from entering the existing creeks and gulches. These measures will need to be installed and maintained during and after construction. Long term revegetation of the ROW, or permanent access road construction, will also be needed.

Depending on environmental restrictions and allowed temporary workspace, the pipeline construction could allow for traditional open-cut direct buried pipeline installation. Some sections of the pipeline may require restrained joints for both pipe and fittings. Typical pipeline appurtenances such as blow-off valves and combination air release valves may be required at proposed high and low points. Mainline isolation valves may be required at a certain footage frequency to isolate sections of the pipeline. These valves will need to be protected and clearly marked with bollards or similar for future access.

As with the other phases, cathodic protection needs will be determined after the soils investigation is completed.

Based on the initial review from the site walk, HDD construction will probably not be a viable alternate for this segment because of the steep slopes and limited access. Given the environmentally-sensitive ROW, and many of the restrictive conditions listed above, any method of pipeline construction in this area will be very difficult and again possibly cost prohibitive. Consideration should be given to other possible alignment options.

4.4.4 Phase V Constructability Conditions and Constraints

Phase V will start at a connection to the existing pipeline from Waterfall Gulch near Forest Road 450 and travel cross country through heavily- forested ROW, with two steep downhill sections, to a connection at the Hare's Creek Crossing. The proposed alignment will require extensive land clearing, timber harvest, access road grading and earthwork. A minimum 25 to 40 feet wide temporary construction easement will likely be required for access road grading, pipe stringing, trench excavation, trench soils handling, installation of the pipeline,

backfill and compaction, and restoration of the ROW. Setbacks from the top of slopes should be at least 50 yards.

This segment will also require the removal of an existing above-ground wooden trestle pipe bridge. The new pipeline would be open-cut direct buried in this section.

SWPPP and erosion control will again be a major consideration to prevent sediment or other debris from entering existing drainage channels. These measures will need to be installed and maintained during and after construction. Long term revegetation of ROW, or permanent access road construction, will also be needed.

Clamp Repair of Exposed Pipe

Traditional open-cut direct-bury pipeline installation is likely across this section. Some sections of the pipeline may require restrained joints for both pipe and fittings. Typical pipeline appurtenances such as blow-off valves and combination air release valves may be required at proposed high and low points. As with

other phases, mainline isolation valves may be required at a certain footage frequency to isolate sections of the pipeline. These valves will need to be protected and clearly marked with bollards or similar for future access. Cathodic protection needs will be determined after the ground investigation is completed.

Based on the initial review from the site walk, HDD construction will probably not be a viable alternate for Phase V again because of the steep slopes and limited access. Given the environmentally-sensitive ROW, and many of the restrictive conditions listed above, any method of pipeline construction in the area of the existing pipeline will be very difficult and again possibly cost prohibitive. Consideration should be given to other possible alignment options.

4.5 Site Reconnaissance Walk Conclusions and Impacts for Alignment Evaluation and Design

Key conclusions from the site walk that have impacts on the selection and evaluation of alignment alternatives, and then in the design of the selected pipeline, are as follows:

4.5.1 Phase II

- The Phase II replacement pipeline will probably follow the route of the existing water main from the Noyo River Crossing to the WTP, including use of the narrow access road on the benched slope.
- Control of storm water run-off down the narrow access road is needed to prevent slope and access road erosion.
- Installation of the pipeline in the bench needs ongoing slope creep first to be halted and further slope movement prevented for the long-term. Slope stabilization will probably require slope drains to reduce hydrostatic pressures that drive slope movement, and structures to prevent toe erosion and undercutting by the local stream.
- While the Noyo River Crossing isn't due for replacement, the pipelines that connect to it will cross the Noyo River floodplain. This crossing of the floodplain triggers environmental permitting under the Clean Water Act Section 404 and the CDFW Fish and Game Code Section 1600. If permitting is found to be onerous, the option of not replacing the pipe across the floodplain, or sliplining this pipe section and the crossing, will be discussed with the City.
- Coastal Zone permitting is required for part of the Phase II alignment.
- Open-cut trenching will be applicable for the Phase II route. Significant SWPPP and erosion control measures will be needed to prevent sediment discharge into local watercourses.

- There will be temporary construction impacts, including noise and dust, for residents in the sub-division south of Sherwood Road.
- A THP or a THP Exemption is unlikely to be needed for Phase II.

4.5.2 Phase III

- For all potential pipeline alignments in the vicinity of the existing water main at the top of the eastern slopes of Newman Gulch, construction activities that include removal of vegetation and / or trees risk worsening slope stability. If one of these alignments is selected, then sufficient setback (at least 50 yards) from the top of the steep slopes will be needed.
- Construction at the top of the steep slopes also needs to consider those areas of steep slope that are vulnerable to debris slides. These are caused by the creek at the base of Newman Gulch undercutting the slope at its base.
- Extensive land clearing, timber harvest, access road grading and earthwork will probably be needed for most alignment alternatives in Phase III. While open-cut trenching will be feasible in most areas, construction costs will still be prohibitive in the heavily-vegetated / forested and steeply- sloped areas. HDD may be feasible in some areas, but access and staging restrictions will be considerable. The pipeline alignment alternative with the least amount of construction in this terrain will probably be the most practical and have significant cost and schedule advantages as a result.
- Significant SWPPP and erosion control measures will be needed to prevent sediment discharge into local watercourses.
- As with Phase II, the Noyo River Crossing isn't due for replacement. However, the pipelines that connect to it have to cross the Noyo River floodplain. This still triggers environmental permitting under the Clean Water Act Section 404 and the CDFW Fish and Game Code Section 1600. If permitting is found to be onerous, the option of not replacing the pipe across the floodplain, or sliplining this pipe section and the crossing, will be discussed with the City.
- Coastal Zone permitting is required for almost all of the Phase III alignment.
- Environmental impacts on sensitive flora and fauna habitat in Phase III are likely to be lessened the more easterly the alternative.
- A THP or a THP Exemption is very likely for Phase III.
- Historical and cultural recording of water control structures and old redwood pipelines may be needed as some facilities are more than 50 years old.

4.5.3 Phase IV

- For all potential pipeline alignments in the vicinity of the top of the steep slopes of Covington Gulch and the Hare Creek Crossing, construction activities that include removal of vegetation and / or trees risk worsening slope stability. If one of these alignments is selected, then sufficient setback (at least 50 yards) from the top of the steep slopes will be needed.
- Construction at the top of the steep slopes also needs to consider those areas of steep slope that are vulnerable to debris slides. These are caused by the creeks at the bottom of these gorges undercutting the slopes at their bases.
- Extensive land clearing, timber harvest, access road grading and earthwork will probably be needed for most alignment alternatives in Phase IV. While open-cut trenching will be feasible in most areas, construction costs will still be prohibitive in the heavily-vegetated / forested and steeply- sloped areas. HDD is unlikely to be feasible. The pipeline alignment alternative with the least amount of construction in this terrain will probably be the most practical and have significant cost and schedule advantages as a result.
- Significant SWPPP and erosion control measures will be needed to prevent sediment discharge into local watercourses.
- The Hare Creek Crossing isn't due for replacement. However, the pipelines that connect to it have to cross the creek's floodplain. This still triggers environmental permitting under the Clean Water Act Section 404 and the CDFW Fish and Game Code Section 1600. Options that do not require pipe replacement in the floodplain, or sliplining may be considered.
- There will be temporary construction impacts, including noise and dust, for residents in the residential areas south of Highway 20. This impacts about half of the Phase IV alignment.
- A THP or a THP Exemption is very likely for Phase IV.
- Historical and cultural recording of water control structures and old redwood pipelines may be needed as some facilities are more than 50 years old.

4.5.4 Phase V

- As with Phase IV, for all potential pipeline alignments in the vicinity of the top of the steep slopes of the Hare Creek Crossing, construction activities that include removal of vegetation and / or trees risk worsening slope stability. If one of these alignments is selected, then sufficient setback from the top of the steep slopes will be needed.

- Construction at the top of the steep slopes also needs to consider those areas of steep slope that are vulnerable to debris slides. These are caused by the creeks at the bottom of these gorges undercutting the slopes at their bases.
- Extensive land clearing, timber harvest, access road grading and earthwork will probably be needed for most alignment alternatives in Phase V. While open-cut trenching will be feasible in most areas, construction costs will still be prohibitive in the heavily-vegetated / forested and steeply- sloped areas. HDD is still unlikely to be feasible. The pipeline alignment alternative with the least amount of construction in this terrain will probably be the most practical and have significant cost and schedule advantages as a result.
- Significant SWPPP and erosion control measures will be needed to prevent sediment discharge into local watercourses.
- The Hare Creek Crossing isn't due for replacement. However, the pipelines that connect to it have to cross the creek's floodplain. This still triggers environmental permitting under the Clean Water Act Section 404 and the CDFW Fish and Game Code Section 1600. Options that do not require pipe replacement in the floodplain, or sliplining may be considered.
- A THP or a THP Exemption is very likely for Phase V.
- Historical and cultural recording of water control structures and old redwood pipelines may be needed as some facilities may be more than 50 years old.

5 ALTERNATIVE ALIGNMENTS FOR EVALUATION BY PHASE

5.1 General

In this section, we describe a series of alternative alignments and sub-alignments for each phase. These alignments include, for each phase, an alignment in close proximity to the existing water main. Alternative routes were developed from original studies performed by the Coleman Engineering team at the pre-proposal stage, from the results of the site reconnaissance walk, from subsequent work using the results of the LiDAR topographical mapping, and from City input.

Since the water main system operates under gravity surcharge throughout, this allows for more flexibility in selecting route alternatives. Each alignment and sub-alignment for each phase presented in the following sections has been checked to confirm that it will be able to convey the design flow of 300 gpm under continuous gravity surcharge from the Waterfall Gulch Intake to the WTP with just the existing hydraulic break at the Summers Lane Reservoir.

5.2 Phase II

The potential Phase II alignment is shown on Figures 4 and 5.

We do not anticipate any significant deviation from the existing alignment from the Noyo River Crossing and along the narrow access road on the benched slope. Once the pipeline reaches the residential area at Sherwood Road there may be slight adjustments to suit easements and ROW. Within the WTP, the alignment will be to the west of the existing raw water storage ponds – the potential to feed both ponds and facilitate direct discharge into the influent wet well will be considered during the design phase.

5.3 Phase III

Figures 6 and 7 show the potential alignment alternatives for Phase III. The section of pipeline from the southern end of the Noyo River Crossing to the Georgia Pacific Haul Road is common to all alignments.

Phase III.1 follows the existing water main alignment from the Georgia Pacific Haul Road along the eastern side of the pond to its south, and then up onto the top of the Newman Gulch eastern slopes to the Newman Gulch Intake.

Phase III.2 initially follows the Georgia Pacific Haul Road to the west before climbing up onto relatively flatter terrain to the west of Newman Gulch but east of Hanson Road. The alignment continues to the Newman Gulch Intake on the west side of Newman Gulch.

Phase III.3 is a variant on Phase III.1. It takes a more easterly path after diverging from III.1 about halfway between the Newman Gulch Intake and the Georgia Pacific Haul Road. It potentially has easier construction along the haul road to the east, and initial environmental studies have shown that it has potentially less impact on sensitive flora and fauna habitat. There are three sub-alignment alternatives for Phase III.3:

A. A longer, more easterly track that maximizes use of the Georgia Pacific Haul Road.
B. A shorter route that stays at the top of the Newman Gulch eastern slopes as long as possible. This alternative may be impacted by sensitive flora and fauna habitat.
C. The shortest Phase III.3 route that does include some installation on the steep eastern slopes, but may also be impacted by sensitive flora and fauna habitat.

Table 3 below shows the approximate length of pipeline for each alternative.

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FIGURE 4: PHASE II – NORTH

CITY OF FORT BRAGG — **CALIFORNIA**

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CHECKED: SNG	DATE: 7/17/2019

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SCALE 1"=100'

DRAWING NUMBER

SHEET NUMBER

OF SHEETS

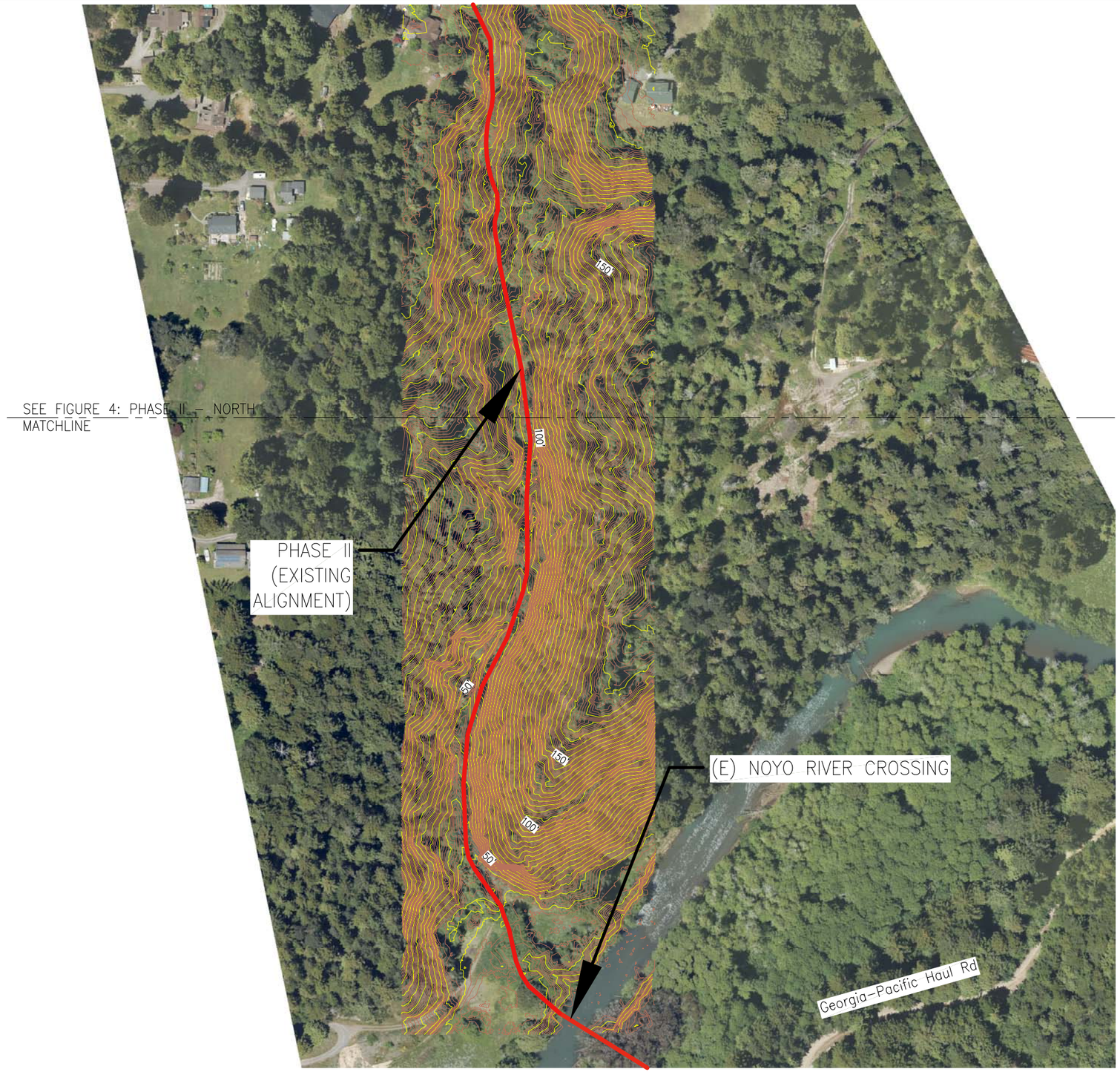

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FIGURE 5: PHASE II – SOUTH

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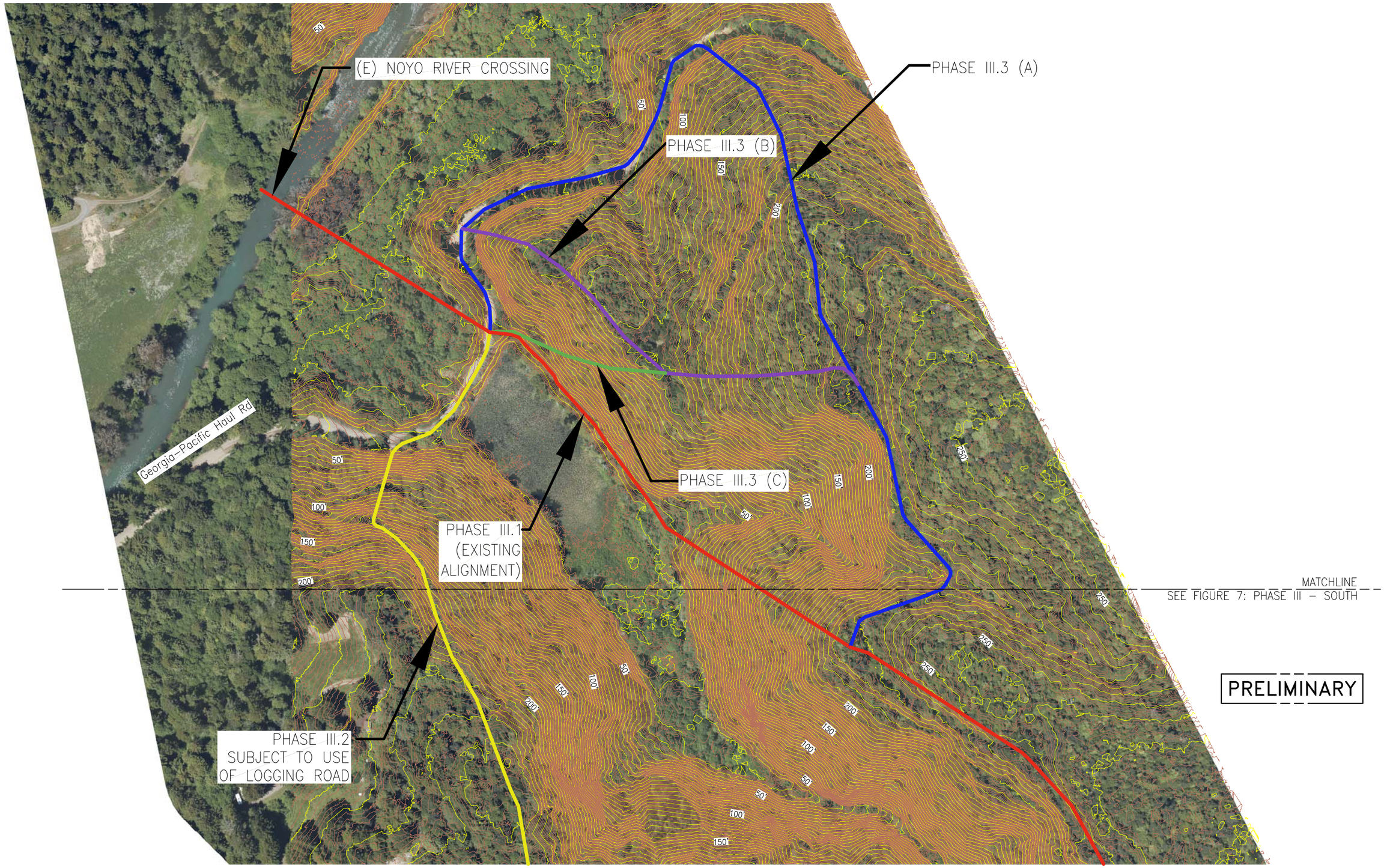

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FIGURE 6: PHASE III – NORTH

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STATE OF CALIFORNIA

SCALE
1"=100'

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SHEET NUMBER
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SEE FIGURE 6: PHASE III – NORTH
MATCHLINE

PHASE III.3(A)

PHASE III.1
(EXISTING
ALIGNMENT)

PHASE III.2

(E) NEWMAN GULCH
INTAKE

Hanson Rd

PRELIMINARY

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FIGURE 7: PHASE III – SOUTH

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Table 3: Approximate Pipeline Lengths for Phase III Alternatives

Alternative	Total Length, LF	Description
Phase III.1	3,750	Noyo River Crossing to Newman Gulch Intake via top of eastern slope of Newman Gulch (existing water main route)
Phase III.2	4,200	Noyo River Crossing to Newman Gulch Intake via Georgia Pacific Haul Road (W), and top of western slopes of Newman Gulch.
Phase III.3A	5,300	Noyo River Crossing to Newman Gulch Intake via Georgia Pacific Haul Road (E), east of Newman Gulch, using part of Phase III.1.
Phase III.3B	4,750	Noyo River Crossing to Newman Gulch Intake via part of Georgia Pacific Haul Road (E), east of Newman Gulch, using part of Phase III.1.
Phase III.3C	4,300	Noyo River Crossing to Newman Gulch Intake, east of Newman Gulch, using part of Phase III.1.

5.4 Phase IV

Phase IV is shown on Figures 8 and 9. There are a number of potential alternatives that make use of alternative routes through the residential areas south of Highway 20, and existing forest and logging roads and trails in the southern, heavily forested sections of this phase.

Phase IV.1 shows the approximate alignment of the existing water main through the residential area and down the steep slopes to the Hare Creek / Covington Gulch crossings.

Phase IV.2 initially runs to the east along the southern boundary of Highway 20 before turning south along Porterfield Lane. After travelling across relatively open ground it reaches a forest road and heads east to connect to Gravel Pit Road. The route then reverts to a westerly path along Gravel Pit Road (an alignment it shares with Phase IV.4 as detailed below) before connecting to the northern end of the Hare Creek Crossing.

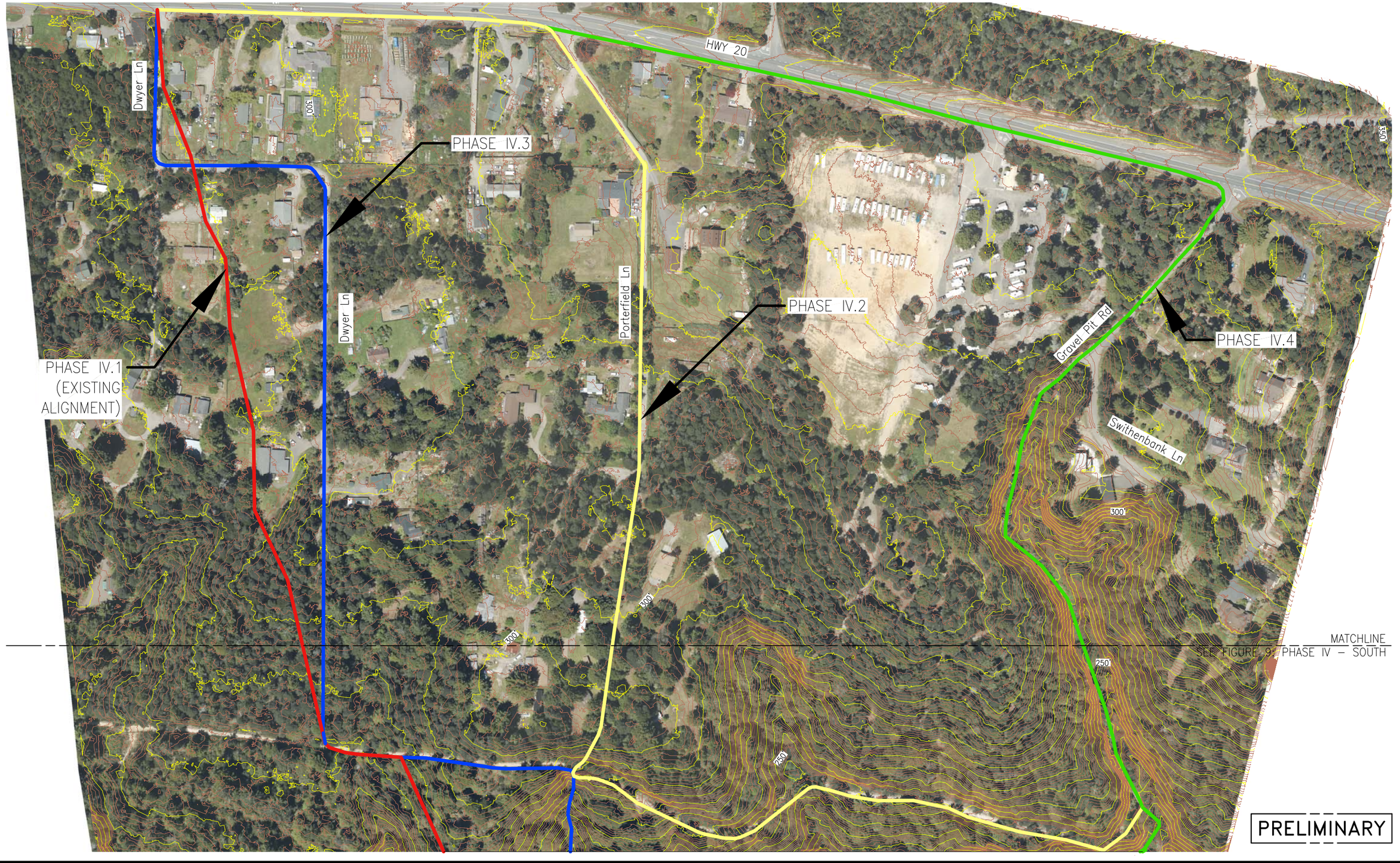

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FIGURE 8: PHASE IV – NORTH

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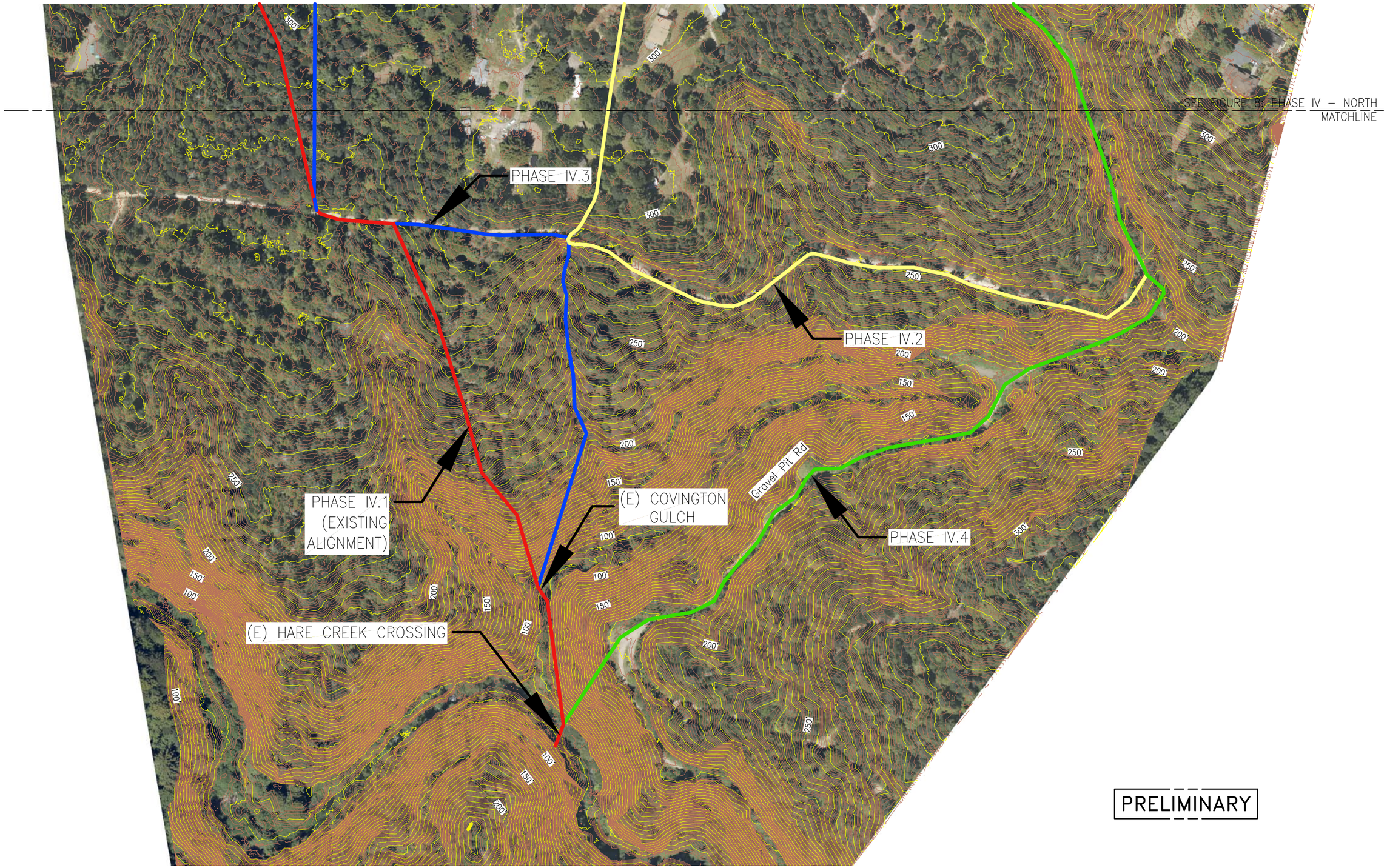

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FIGURE 9: PHASE IV – SOUTH

CITY OF FORT BRAGG — **CALIFORNIA**

DESIGNED UNDER THE DIRECTION OF:

SIMON N GRAY — DATE
R.C.E. No. 60311 - REGISTRATION EXPIRES 06-30-20

DESIGN: MS — DATE: 7/17/2019
DRAWN: WCJ — DATE: 7/17/2019
CHECKED: SNG — DATE: 7/17/2019

REGISTERED PROFESSIONAL ENGINEER — SIMON N. GRAY — No. C60311 Exp. 06-30-20 — CIVIL — STATE OF CALIFORNIA

SCALE 1"=100'

DRAWING NUMBER

SHEET NUMBER

OF SHEETS

9/26/16 S:_PROJECTS\TB018-001 - RAW WATER PIPELINE REPLACEMENT DESIGN\CADD\EXHIBITS\PHASE 4.2.DWG

Phase IV.3 improves on the route through the residential areas from Highway 20 by following Dwyer Lane before rejoining the Phase IV.1 alignment. It makes use of an easterly track along a forest road before heading south to connect again with the Phase IV.1 alignment just north of the Covington Gulch crossing.

Phase IV.4 is the most easterly route that makes extensive use of Gravel Pit Road. It travels east from the existing main crossing of Highway 20 along the southern boundary of the state highway to Gravel Pit Road. The pipeline then leaves the road to connect just north of the Hare Creek Crossing. It also avoids the Covington Gulch Crossing.

For Phases IV.1 and IV.3, the existing pipe segment immediately north of Covington Gulch that runs directly up the steep slope is above ground ductile-iron pipe, and may not need replacement.

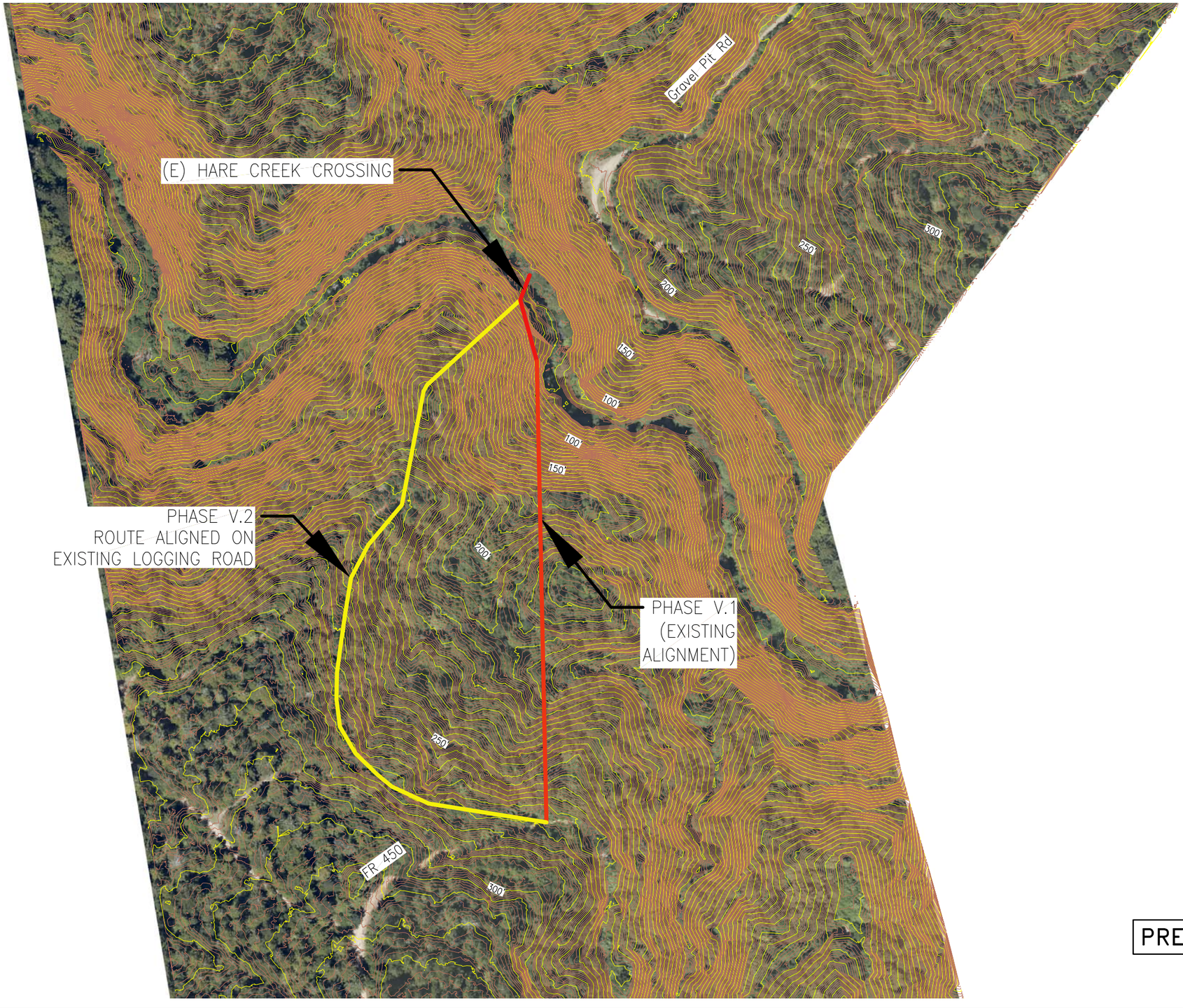
Table 4 below shows the approximate length of pipeline for each alternative.

Table 4: Approximate Pipeline Lengths for Phase IV Alternatives

Alternative	Total Length, LF	Description
Phase IV.1	3,100	Highway 20 crossing to Hare Creek Crossing (existing water main route).
Phase IV.2	5,850	Highway 20 crossing to Hare Creek Crossing via state highway, Porterfield Lane, Forest Road and Gravel Pit Road.
Phase IV.3	3,700	Highway 20 crossing to Hare Creek Crossing via Dwyer Lane and Forest Road.
Phase IV.4	6,000	Highway 20 crossing to Hare Creek Crossing via state highway and Gravel Pit Road.

5.5 Phase V

Figure 10 shows the two Phase V alignment alternatives. Phase V.1 shows the approximate alignment of the existing water main from the Hare Creek Crossing, up its steep western slopes and across heavily forested terrain to the existing above ground pipeline supported by a wooden trestle, and then to Forest Road 450. Phase V.2 is a less direct route to the west of Phase V.1 that aims to follow an existing logging road / trail and a shorter section of steep terrain up from the Hare's Creek Crossing and make use of flatter ground and a forest road to the west.



PRELIMINARY

COLEMAN ENGINEERING	COLEMAN ENGINEERING 1358 BLUE OAKS BOULEVARD SUITE 200 ROSEVILLE, CA 95678 (916) 791-1188	BAR IS ONE INCH AT FULL SCALE 0 — 1" IF NOT ONE INCH ON THIS SHEET SCALE ACCORDINGLY

NO.	REVISIONS	BY	APP	DATE
6				
5				
4				
3				
2				
1				

FORT BRAGG — **RAW WATER PIPELINE REPLACEMENT DESIGN**

FIGURE 10: PHASE V

CITY OF FORT BRAGG — **CALIFORNIA**

DESIGNED UNDER THE DIRECTION OF:

SIMON N GRAY — DATE
R.C.E. No. 60311 - REGISTRATION EXPIRES 06-30-20

DESIGN:	MS	DATE: 7/17/2019
DRAWN:	WCJ	DATE: 7/17/2019
CHECKED:	SNG	DATE: 7/17/2019

REGISTERED PROFESSIONAL ENGINEER — SIMON N. GRAY — No. C60311 Exp. 06-30-20 — CIVIL — STATE OF CALIFORNIA

SCALE 1"=100'

DRAWING NUMBER

SHEET NUMBER

OF SHEETS

9/26/16 S:_PROJECTS\TYBG18-001 - RAW WATER PIPELINE REPLACEMENT DESIGN\CADD\EXHIBITS\PHASE 5.DWG

Table 5 below shows the approximate length of pipeline for each alternative.

Table 5: Approximate Pipeline Lengths for Phase V Alternatives

Alternative	Total Length, LF	Description
Phase V.1	1,050	Hare Creek Crossing to Forest Road 450 (existing water main route).
Phase V.2	1,400	Hare Creek Crossing to Forest Road 450. More westerly route using shorter steep slope section and forest roads.

6 EVALUATION PROCESS AND CRITERIA

6.1 Evaluation Process

The pipeline alignment alternatives for each phase are evaluated in this section so that a recommended pipeline route for all phases is identified and can be carried forward into design. The evaluation is in two stages:

- An initial 'fatal-flaw' analysis to ensure that there are no challenges for each alternative that cannot be overcome (e.g. environmental / THP impacts that cannot be mitigated except by re-routing, an inability to obtain easements / right-of-way / permits, or hydraulic inadequacy), followed by:

- A detailed evaluation that includes:

    - capital costs and life cycle costs;
    - construction schedule;
    - ease of, and costs to, acquire easements / right-of-way;
    - ease of operation and maintenance;
    - constructability;
    - geotechnical and geologic hazard assessment;
    - environmental impacts;
    - ease of permitting;
    - extent of tree removal and THP;
    - pipe hydraulics and pipe sizing; and,
    - public impacts during and after construction.

The detailed evaluation ranks each of the route alternatives on a numerical scale using each of the evaluation criteria. A weighting is applied to each of the criteria depending on its perceived importance. The sensitivity of the selected route is then checked by varying the weightings. This evaluation method is described in detail in the following sub-section.

6.2 Evaluation Criteria

Table 6 below details the evaluation criteria, numerical scale ranges, maximum possible marks, the basis for the scales and assumptions used, and the initial weighting percentages for each criterion. These evaluation criteria, scales, marks and weightings were agreed with the City team prior to performing the evaluation in order to prevent introduction of bias as results were determined. The City's input on the weightings is crucial as it will be their facility and they know what is most important to them.

7 EVALUATION RESULTS

7.1 General

In this section we present the results of the alternative alignments evaluation. In addition, detailed scoring rationales for the key construction cost, construction schedule, constructability, and environmental impacts are also included.

7.2 Ranking of Alternatives

Table 7 shows full details of the ranking of each alternative alignment by phase for all the evaluation criteria detailed above.

Pond on the existing Phase III alignment near the Noyo River

7.3 Scoring Rationale for Key Criteria

Table 6 includes an explanation of the rationale behind the scoring of each criterion. This sub-section includes more detail to explain the rationale adopted for the scoring of

Table 6 - Alternative Alignments Evaluation Criteria

Criterion No.	Criterion	Numerical Scale Range	Maximum Mark	Scale Basis and Assumptions used	Weighting %
1	**Construction Cost**	1 - 10	**10**	*Most expensive is 1 point, cheapest is 10 points. All other alignments pro-rated in-between. Fatal flaw if cost is unreasonable and / or couldn't be grant-funded.	**25**
2	**Construction Schedule**	1 - 10	**10**	Shortest construction period = 10 points, longest = 1 point, pro-rata in-between.	**10**
3	**Life Cycle Cost**	1 - 5	**5**	Lowest NPV is 5 points, highest is 1 point, pro-rated in between. NPV will be calculated using capital and recurrent costs. This factor is also covered by criterion nos. 1 and 4.	**5**
4	**Easement Acquisition**		**10**		**10**
	4.1 - No. of Parcels to be Crossed	1 - 5		Highest number is 1 point, lowest number is 5 points, pro-rated in-between.	
	4.2 - Ease of Acquisition of Easement / ROW	1 - 5		*Willingness of parcel owners to negotiate easement / ROW. Hardest is 1 point, easiest is 5 points. Considers existing easements and relationships with parcel owners. Can be fatal flaw if parcel owner won't negotiate.	
5	**Ease of Operation and Maintenance (O&M)**		**10**		**10**
	5.1 - Alignment Length	1 - 5		Assumes that longer the pipeline the more O&M effort is required. Shortest length is 5, longest length is 1 point, pro-rated in-between.	
	5.2 - Accessibility	1 - 5		Calculated as a function of the proportion of the route in various types of terrain. All in steeply sloped, heavily forested terrain = 1 point, all in roads / trails = 5 points. Pro-rated in-between based on proportions.	
6	**Constructability**	1 - 10	**10**	Constructability will be reflected primarily in the capital and life cycle costs. This factor considers route accessibility, extent of pipe-in-trench vs. trenchless construction, working space, route clearance needs, etc. 1 point = hardest to construct; 10 = easiest to construct.	**5**
7	**Geotechnical and Geologic Hazards**		**10**		**10**
	7.1 - Proximity to Unstable Slopes	1 - 5		Route has significant sections adjacent to, or impacted by steep and unstable slopes = 1 point; none or very little impact from slopes = 5 points	
	7.2 - Ease of Excavation	1 - 5		Significant proportion of the route requires rock excavation = 1 point. Easy trench excavation in soils with very limited shoring need and low water table = 5 points.	
8	**Environmental Impacts**	1 - 10	**10**	*Proportion of the route that is directly impacted by environmentally- sensitive flora and fauna. Significant (> 80%) portion of the route in such habitat = 1 point; no habitat intrusion = 10 points. Fatal flaw if cannot be mitigated.	**10**
9	**Extent of Timber Harvest Plan**	1 - 5	**5**	Based on proportion of route that requires timber harvesting. No THP = 5 points; THP for full route = 1 point.	**5**
10	**Ease of Permitting**	1 - 5	**5**	*Sliding scale based on the number of permits that have to be acquired. 5 points = least; 1 point = most. Fatal flaw if cannot be permitted.	**5**
11	**Public Impacts**	1 - 5	**5**	Sliding scale based on proportion of route in residential areas or public ROW (excluding forest roads). 1 point = fully in residential areas / public ROW; 5 points = no part of route in residential areas / public ROW.	**5**
12	**Pipeline Hydraulics**	0	**0**	*Fatal flaw analysis only. Pipe on route must be able to convey design flow in 10-inch dia. pipeline or smaller.	**0**
TOTAL MAXIMUM POINTS			**90**	**%**	**100**

*** = fatal flaw criterion**

Table 7 : Ranking of Alternative Alignments

Criterion No.	Criterion	Numerical Scale Range	Maximum Mark	Weighting, %	PHASE ALTERNATIVES											
					Phase II	Phase III					Phase IV				Phase V	
					II	III.1	III.2	III.3A	III.3B	III.3C	IV.1	IV.2	IV.3	IV.4	V.1	V.2
1	**Construction Cost***	1 - 10	**10**	**25**	10.0	1.5	10.0	1.0	1.9	3.6	1.0	10.0	5.2	7.8	1.0	10.0
2	**Construction Schedule**	1 - 10	**10**	**10**	10.0	1.5	10.0	1.0	2.4	4.8	1.0	10.0	4.7	7.8	1.0	10.0
3	**Life Cycle Cost**	1 - 5	**5**	**5**	5.0	1.2	5.0	1.0	1.4	2.2	1.0	5.0	3.1	4.0	1.0	5.0
4	**Easement Acquisition**			**10**												
	4.1 - No. of Parcels to be Crossed	1 - 5	**5**		2.5	3.5	1.0	5.0	5.0	5.0	5.0	1.0	3.0	3.0	5.0	5.0
	4.2 - Ease of Acquisition of Easement / ROW*	1 - 5	**5**		4.0	3.0	2.0	3.0	3.0	3.0	3.0	2.0	3.0	2.0	3.0	3.0
5	**Ease of Operation and Maintenance (O&M)**			**10**												
	5.1 - Alignment Length	1 - 5	**5**		2.5	5.0	3.8	1.0	2.4	3.6	5.0	1.2	4.2	1.0	5.0	1.0
	5.2 - Accessibility	1 - 5	**5**		2.5	1.0	2.5	3.0	2.0	2.0	2.5	4.0	2.8	4.5	1.0	3.5
6	**Constructability**	1 - 10	**10**	**5**	3.0	1.0	6.0	5.0	3.0	2.0	3.5	6.0	5.0	7.0	1.0	4.0
7	**Geotechnical and Geologic Hazards**			**10**												
	7.1 - Proximity to Unstable Slopes	1 - 5	**5**		2.0	2.0	3.0	2.0	3.0	3.0	2.0	2.0	3.0	3.0	3.0	3.0
	7.2 - Ease of Excavation	1 - 5	**5**		4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0	2.0	3.0	3.0
8	**Environmental Impacts***	1 - 10	**10**	**10**	7.0	3.0	5.0	6.0	5.0	4.0	3.0	8.0	6.0	8.0	2.0	4.0
9	**Extent of Timber Harvest Plan**	1 - 5	**5**	**5**	5.0	1.0	2.0	3.0	3.0	1.0	2.0	4.0	3.0	4.0	1.0	3.0
10	**Ease of Permitting***	1 - 5	**5**	**5**	2.5	1.0	2.5	2.5	1.5	1.5	1.0	4.0	2.5	4.0	1.0	2.0
11	**Public Impacts**	1 - 5	**5**	**5**	3.0	4.5	2.5	3.0	4.0	4.5	2.0	2.0	3.0	4.0	4.0	4.0
12	**Pipeline Hydraulics (fatal flaw analysis only)***															
TOTAL RAW SCORE WITHOUT WEIGHTING			**90**	**100**	**63.0**	**33.2**	**59.3**	**40.5**	**41.6**	**44.2**	**36.0**	**62.2**	**52.5**	**62.1**	**32.0**	**60.5**
TOTAL SCORE WITH WEIGHTING			**900**	**100**	**688**	**311**	**653**	**348**	**380**	**440**	**328**	**667**	**520**	**623**	**295**	**665**
RANKING BY PHASE					**1**	**5**	**1**	**4**	**3**	**2**	**4**	**1**	**3**	**2**	**2**	**1**

the key criteria of construction and life cycle costs, construction schedule, constructability and estimating contingencies, and environmental impacts.

7.3.1 Construction and Life Cycle Costs

During the initial site reconnaissance walk that primarily examined the existing raw water pipeline route and the surrounding terrain, it was realized that estimating construction cost for all route alternatives would require consideration of the construction contractor's means and methods, rather than simple application of typical unit rates for pipeline trenching. This applied particularly to the heavily-wooded sections in steep terrain at the top of the canyons, where a contractor would have to include for significant temporary works to access the route: timber removal, haul roads for spoil removal and material deliveries, etc.

As a result, our constructability subconsultant (and former contractor) Aaron Smud prepared conceptual design level (10% design level + contingency) construction cost estimates of each alternative so they can be ranked. Aaron participated on the site walk and developed a good feel for the terrain along the existing routes. He developed a standard list of bid items (an unpriced proposal for Phase IV.2 is included as an example in Appendix B) as part of his estimating procedure. The quantities are different for each phase alternative, but for the most part the bid items are the same. They are not fully inclusive, so the cost estimates presented should be considered at this point as relative to one another rather than fully inclusive. For example, the Phase II cost does not yet include for geotechnical slope stabilization work. Relative costs are used to develop the evaluation marks.

Table 8 below details the relative conceptual-level construction cost estimates used in the evaluation:

Table 8: Conceptual-Level Relative Construction Costs by Alternative

Alternative	Construction Cost
Phase II	$1,367,000
Phase III.1	$3,120,000
Phase III.2	$2,533,000
Phase III.3A	$3,156,000
Phase III.3B	$3,093,000
Phase III.3C	$2,974,000

Alternative	Construction Cost
Phase IV.1	$2,824,000
Phase IV.2	$2,114,000
Phase IV.3	$2,445,000
Phase IV.4	$2,293,000
Phase V.1	$1,546,000
Phase V.2	$1,115,000

It has been assumed that:

- All phases will be contracted and constructed separately.
- As such, all estimates have been developed as stand-alone projects.
- The estimates don't include cost or effort for permits, easements, land purchase or other similar scope.
- Any sections of the existing pipeline that include sections of asbestos cement pipe will be abandoned in place.
- No removal, relocation, disposal or abatement has been included for the existing pipeline or its facilities.
- No cost or delays related to weather, environmental mitigation or other restrictions have been included.
- All estimates are based on 2019 labor and equipment rates, and no escalation has been included at this point.
- All estimates include standard overhead and profit of approximately 15%, and a construction contingency allowance that ranges between 50% and 70%, depending on the proposed alignment and risk factors.

Life cycle costs for ranking were calculated using each phase alternative's construction cost and an annual allowance needed for operation, maintenance and minor repairs over a 30-year period (1% of construction cost is assumed to be needed annually). Net Present Values were then calculated using a discount rate of 5%.

7.3.2 Construction Schedule

Construction schedules were developed as part of the construction cost estimating process. Table 9 below shows the anticipated construction schedule for each phase:

Table 9: Conceptual-Level Construction Schedules by Alternative

Alternative	Schedule Working Days
Phase II	58
Phase III.1	112
Phase III.2	94
Phase III.3A	113
Phase III.3B	110
Phase III.3C	105
Phase IV.1	96
Phase IV.2	64
Phase IV.3	83
Phase IV.4	72
Phase V.1	60
Phase V.2	48

7.4 Constructability and Estimating Contingencies

7.4.1 Phase II

The existing alignment for this phase also appears to be the best alignment for the proposed replacement. Given reasonable access, less environmental concerns and the right-of-way mostly follows an existing access road, a 50% construction contingency has been included in this estimate.

7.4.2 Phase III.1

The current existing alignment for this segment presents a number of challenges. Almost all of the pipe right-of-way is located in heavily-forested areas, with steep slopes, cross slopes, and limited work space for staging. It also parallels closely to an existing pond near the Georgia Pacific haul road that will likely create a number of environmental concerns. Given this alignment has the most difficult access, major environmental concerns, and the highest likelihood of landslide mitigation efforts, a 70% construction contingency has been included in this estimate.

7.4.3 Phase III.2

This alignment follows the Georgia Pacific haul road and a short steep slope section to gain the ridge to the east of the current pipeline. It avoids the existing pond, travels mostly on less steep right-of-way and is the second shortest in overall length. Given it has the better access, less environmental concerns, mostly follows flatter terrain, and will have less landslide risk, a 50% construction contingency has been included in this estimate.

7.4.4 Phase III.3A

Phase III.3A follows the Georgia Pacific haul road the furthest to the east and up a slope section to gain the ridge to the east of the current pipeline. It avoids the existing pond, travels mostly on less steep terrain, but it has the longest overall length. It also includes the same steep cross slopes near Newman Gulch that impact the existing alignment. Given the access is a little better, has less environmental concerns by avoiding the pond and will have somewhat less landslide risk, a 60% construction contingency has been included in this estimate.

7.4.5 Phase III.3B

This alternative follows the Georgia Pacific haul road a short distance to the east and up a slope section to the ridge to the east of the current pipeline. It avoids the existing pond, travels mostly on less steep right-of-way, but it has a long overall length. It also has to deal with the same steep cross slopes near Newman Gulch as the existing alignment. Given the access is a little better, there are less environmental concerns by avoiding the pond and it will have less landslide risk, a 60% construction contingency has been included in this estimate.

7.4.6 Phase III.3C

This alignment traverses up a steep cross slope above the existing pond to gain the ridge to the east of current pipeline. It avoids one steep slope section, travels mostly on less steep terrain, and has a somewhat shorter length, but it also has to deal with the same steep cross slopes near Newman Gulch as the existing alignment. Given that access is difficult, the route has increased environmental concerns above the pond, and has more landslide risk, a 70% construction contingency has been included in this estimate.

7.4.7 Phase IV.1

The current existing alignment for this segment presents a number of challenges. Almost all of the pipeline right-of-way is located in heavily forested areas or

private properties, with one very steep slope section. There is limited work space for staging. It has two creek crossings that will likely create a number of environmental concerns. Given this alignment has the most difficult access, major environmental concerns, and a high likelihood of landslide mitigation efforts, a 70% construction contingency has been included in this estimate.

7.4.8 Phase IV.2

The alignment for this alternative follows Highway 20 for a short section to Porterfield Lane, then crosses via another access road to Gravel Pit Road and ends with a short steep slope section down to the Hare Creek Crossing. Almost all of the pipeline route is located in gravel roads, with good access and limited timber harvest. It has only one short section of heavily-forested area and only one creek crossing that will help reduce environmental concerns. Given this alignment has this good access, less environmental concerns, and a low likelihood of landslide mitigation, a 50% construction contingency has been included in this estimate.

7.4.9 Phase IV.3

This alignment avoids private property by following Dwyer Lane, but shortly after that it follows the existing alignment through heavily-forested areas with one very steep slope section. There are limited work areas for staging. It has two creek crossings that will likely create a number of environmental concerns. Given this alignment has better access using Dwyer Lane, but still has major environmental concerns and a high likelihood of landslide mitigation, a 60% construction contingency has been included in this estimate.

7.4.10 Phase IV.4

The alignment for this alternative follows Highway 20 to Gravel Pit Road and ends with a short steep slope section down to the Hare Creek Crossing. Almost all of the pipeline right-of-way is located near paved or in gravel roads with good access. There is only one short section of heavily-forested areas and only one creek crossing that will help reduce environmental concerns. However, it is the longest route and will likely have significant need for traffic control and Caltrans permitting as it parallels Highway 20. Given this alignment has good accessibility, less environmental concerns, and a low likelihood of landslide mitigation, a 50% construction contingency has been included in this estimate.

7.4.11 Phase V.1

The current existing alignment for this segment presents a number of challenges. Most of the pipeline route is located in heavily-forested areas, with one very steep slope section and limited work space for staging. It has one creek crossing that will likely create a number of environmental concerns. Given this alignment has the most difficult access, major environmental concerns, and a high likelihood of landslide mitigation, a 70% construction contingency has been included in this estimate.

7.4.12 Phase V.2

The alignment for this phase alternative mostly follows an existing logging road and ends with a short steep slope section down to the Hare Creek Crossing. Almost all of the pipeline is located in gravel / dirt roads / trails with good access. It only has one short section of heavily forested area and less exposure to landslide risk. Given this alignment has good access, less environmental concerns, and a low likelihood of landslide mitigation need, a 50% construction contingency has been included in this estimate.

7.5 Environmental Impacts

Environmental constraints analysis was used to identify potential environmental issues that could make a particular alignment difficult to process from an environmental impact or trustee agency permitting perspective. Most environmental issues, once clearly defined early on, can be considered during the engineering planning process and assist the planning team in developing alternatives to avoid or reduce environmental impacts. Available environmental information was previously used to develop the evaluation alternatives, and the environmental conditions and constraints were detailed in the Project Existing Conditions and Constraints TM that now forms the first portion of this Practicality Report. The environmental impact marking was based on publicly available information from state or federal sources, previous certified environmental documents for recent projects in the region, and reconnaissance field surveys of some, but not all, of the pipeline alignments under consideration. Not all pipeline alternatives were ground surveyed for this high-level analysis and detailed survey information was not available for all pipeline alternatives.

Potential environmental constraints used in the marking include:

- Presence, extent and proximity of Federal or State jurisdictional wetlands or Waters of the U.S. (springs, seeps etc.) as defined under Clean Water Act.

- Presence, extent and proximity of endangered or threatened species and their habitats listed as defined under federal or state Endangered Species Acts (ESA).
- Presence, extent and proximity of known hazardous waste sites (e.g., Superfund), leaking underground tanks or illegal dumps.
- Presence, extent and proximity of known prehistoric, cultural or historical resources.
- Presence and extent of restricted or incompatible land uses (within Coastal Zone, approved landowner conservation easements, approved ESA mitigation banks, other sensitive land uses.).

Points and scoring are based on our environmental sub consultant Brewer Environmental's professional opinion on the known constraints within each pipeline phase.

7.6 Fatal Flaw Analyses

As shown on Table 6, several of the evaluation criteria were identified as ones to be included in an initial fatal flaw analysis of each phase alternative:

- **Construction cost:** considered fatal only if the cost is unreasonably high/uneconomic and / or could not be funded using state or federal grants and / or loans.
- **Ease of easement acquisition:** considered fatal only if a property owner of a critical parcel refuses to negotiate an easement and there is no available alternative route.
- **Environmental impacts:** considered fatal only if there is a potential environmental impact that cannot be mitigated or the pipeline cannot be re-routed to avoid.
- **Ease of permitting:** considered fatal only if a particular permit cannot be obtained and a re-routing is not possible.
- **Pipeline Hydraulics:** The pipeline alternative must be capable of conveying the design flow of 300 gpm (based on the existing water right and the capacity of other existing phases) as detailed earlier in this report.

In general, the significant number of alternative alignments for Phases III, IV and V means that the likelihood of a fatal flaw is low. In addition, the hydraulics of the system, with its significant available head, are not a constraint and also allow flexibility to adjust pipeline routes. For Phase II, the preferred route follows the existing alignment: the primary effort in implementing this phase will be slope stabilization work along the existing narrow access road.

As was demonstrated above in Table 8, the construction costs for each phase are reasonable, even though the costs presented are not yet fully inclusive of an out-turn cost. Implementation by phase allows for flexibility in capital expenditure and cash flow

for the City, and the level of costs makes funding using state and federal money viable. Thus, construction cost will not be a fatal flaw.

Ease of easement acquisition at this stage is difficult to determine without direct communication with property owners, and it was felt that this first approach should be made immediately after each phase has an identified, City-preferred primary route with a back-up alternative. Instead, the route was assessed by examining if a phase alternative crossed a parcel(s) where there is an existing easement for the existing pipeline. The assumption being that a property owner would be more amenable to a new or revised easement if there was already one across his or her property. The strategy and timing for approaching property owners is discussed in Section 8 – Conclusions and Next Steps. It may be that a particular property owner has significant resistance to providing an easement, such that a preferred route has to be changed or modified, but there is enough flexibility in available alternatives to allow this to take place.

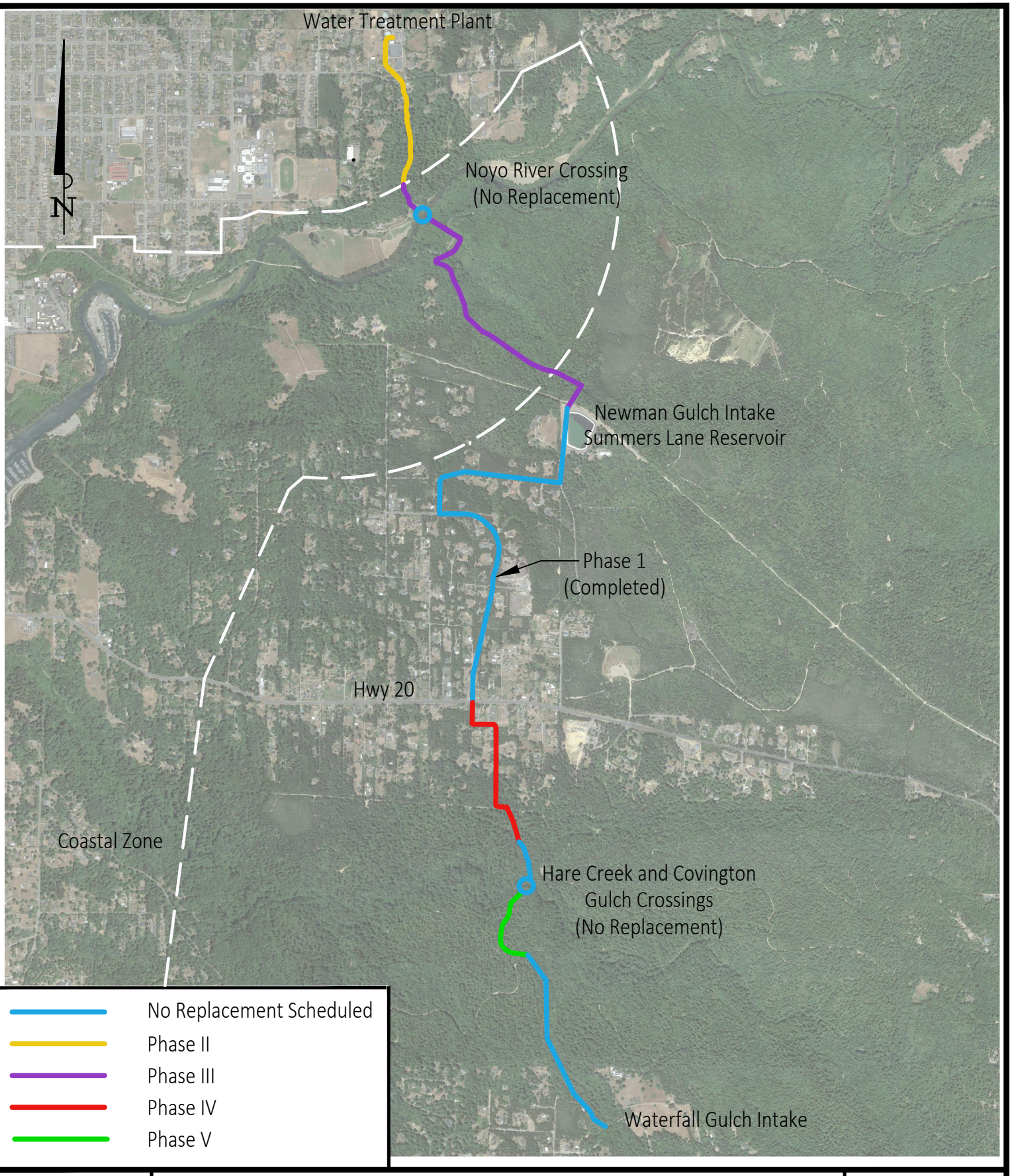
Environmental protocol surveys and environmental records reviews to date have not identified Endangered Species Act habitat, wetlands, or cultural resources, etc., that directly impact a phase alignment. No permits have been identified so far as being critical for route selection, but as with potentially impacted property owners, it will be imperative to approach the Coastal Commission, CalFire and other public agencies (e.g. Caltrans for Phases IV.2 and 4, if selected) immediately after preferred and back-up routes are determined (and before design commences) to see if there are any imposed constraints that will be difficult to mitigate. A decision may have to be made to adopt the back-up route or adjust the preferred alignment. If so, this needs to happen as soon as possible after preferred routes are selected.

A hydraulic review was performed on all phase alternatives, and all were found able to convey the design flows within a 10-inch diameter conduit.

7.7 Recommended Alignments by Phase

Table 7 provides details of the marks and rankings for all phases using the 11 agreed evaluation criteria and weightings. The results are discussed below by phase, and recommended and back-up alignments for each phase determined.

Figure 11 is a modified version of the Figure 1 Overview Map that now shows the proposed recommended route for Phases II through V in relation to the existing sections of raw water pipeline that have been previously replaced.



COLEMAN ENGINEERING

FIGURE 11: UPDATED MAP WITH PREFERRED ALIGNMENTS
RAW WATER PIPELINE REPLACEMENT DESIGN
CITY OF FORT BRAGG

COLEMAN ENGINEERING
1358 Blue Oaks Boulevard, Suite 200, Roseville California (916) 791-1188

DATE: 9/17/2019
DRN: MS
CKD: SNG
SCALE: 1"=2000'
JN: FTBG18-001

7.7.1 Phase II

Only one alignment was considered for Phase II, given the obvious advantages of the use of the existing narrow access road that contains the existing raw water main. Otherwise, there would be significant difficulties creating a new route through the steep Noyo River northern bluffs down to the Noyo River Crossing. We anticipate that there may be minor revisions to the pipeline route within the subdivision roads south of Sherwood Road: this will be addressed early during design. The primary issues to be addressed during the next design effort for Phase II are geotechnical and environmental / permitting: the slope stabilization work needed along the narrow access road and restrictions on construction method when crossing the northern floodplain to the Noyo River Crossing within the Coastal Zone.

Phase II was marked even though there was just one alternative in order to provide a comparison to the other three phases.

7.7.2 Phase III

Phase III.2 was clearly the highest ranked of the five considered alternatives for Phase III. Phase III.2 ranked highest on construction cost and schedule, and constructability, with good scores on the key criteria of geotechnical and geologic hazards, and environmental impacts. This alternative makes use of construction in the Georgia Pacific haul road, has limited work on steep slopes, and avoids the heavily-wooded and unstable steep slopes on the east bank of Newman Gulch that are included in several of the other alignments. Phase III.2 did rank lower on ease of easement acquisition, since it is anticipated that seven parcels will have to be crossed and only three of those have easements for the existing pipeline. If Phase III.2 is confirmed as the City-preferred alignment after Workshop No.1, then an important first task will be to initiate right-of-way discussions with impacted property owners. Phase III.3.C would be the back-up route.

Phase III alignments will be impacted by environmental / permitting restrictions in the Coastal Zone, particularly for construction through the floodplain south of the Noyo River to the Georgia Pacific Haul Road.

7.7.3 Phase IV

For Phase IV, two alternatives ranked clear of the other two alignments. The highest ranked alternative is Phase IV.2. This alternative makes use of Highway 20, Porterfield Lane, an unnamed forest trail and Gravel Pit Road to limit the

amount of construction across heavily forested and steep terrain. The second-ranked alignment, Phase IV.4, is also the longest and is aligned along Highway 20 and Gravel Pit Road. Both these alternatives rank highly on cost and schedule: the construction cost estimates found that the cost and speed of construction in existing roads and trails was significantly better than along alignments through the heavily-wooded, steep and inaccessible locations. Despite the additional lengths, this gave alternatives IV.2 and 4 an advantage in the ranking.

A key initial step if either IV.2 or IV.4 are adopted by the City is to discuss the acceptability to Caltrans of the replacement pipeline running parallel to Highway 20 within the Caltrans right-of-way.

7.7.4 Phase V

Phase V.2 was found to be significantly better than the existing raw water pipeline route designated as Phase V.1. This was caused primarily by the use of an existing logging road for part of the Phase V.2 alignment, leading to quicker and cheaper construction with less environmental impact.

7.8 Sensitivity of the Results

The sensitivity of the rankings was checked with the City team by significantly adjusting the weightings of the key criteria (cost, schedule, easement acquisition and environmental impact) from the initial settings presented in Table 7. Each of these key criteria was set in turn at the high 25% weighting, with the others set at 10%. The sensitivity was then examined and discussed, and it was found that the selections of Phases III.2 and V.2 were robust despite the significant changes in the evaluation criteria weightings. For Phase IV, alternatives IV.2 and IV.4 remained clear of the other two alternatives but marked close to one another as the weightings are adjusted.

8 CONCLUSIONS AND NEXT STEPS

The alternative alignments identification and detailed evaluation studies presented in this Project Practicality Report have recommended preferred alignments for Phases II, III, IV and V of the Raw Water Line Replacement Project.

The City team reviewed these findings and confirmed preferred alignments for each Phase at Workshop No. 1. Definition of preferred projects is needed so that subsequent preparation of the Initial Study / Mitigated Negative Declaration documentation required under CEQA can start in earnest.

8.1 Alignment Adjustments After Workshop No. 1

The following adjustments to the alignments were made at Workshop No. 1 at the City's request:

8.1.1 Phase II

No adjustments to the Phase II alignment were made at Workshop No. 1, noting that during design the choice of which road to use in the subdivision immediately south of Sherwood Road should be confirmed. It was also decided that the project limit for Phase II should be adjusted so that the crossings of the Noyo River floodplain (and possibly a new river crossing) are all in Phase III. This is due to the expected extended environmental permitting in the Coastal Zone / Noyo River floodplain. Administratively it will be easier if just one phase is in the Coastal Zone. This would also facilitate earlier construction of Phase II, which is the City's priority.

8.1.2 Phase III

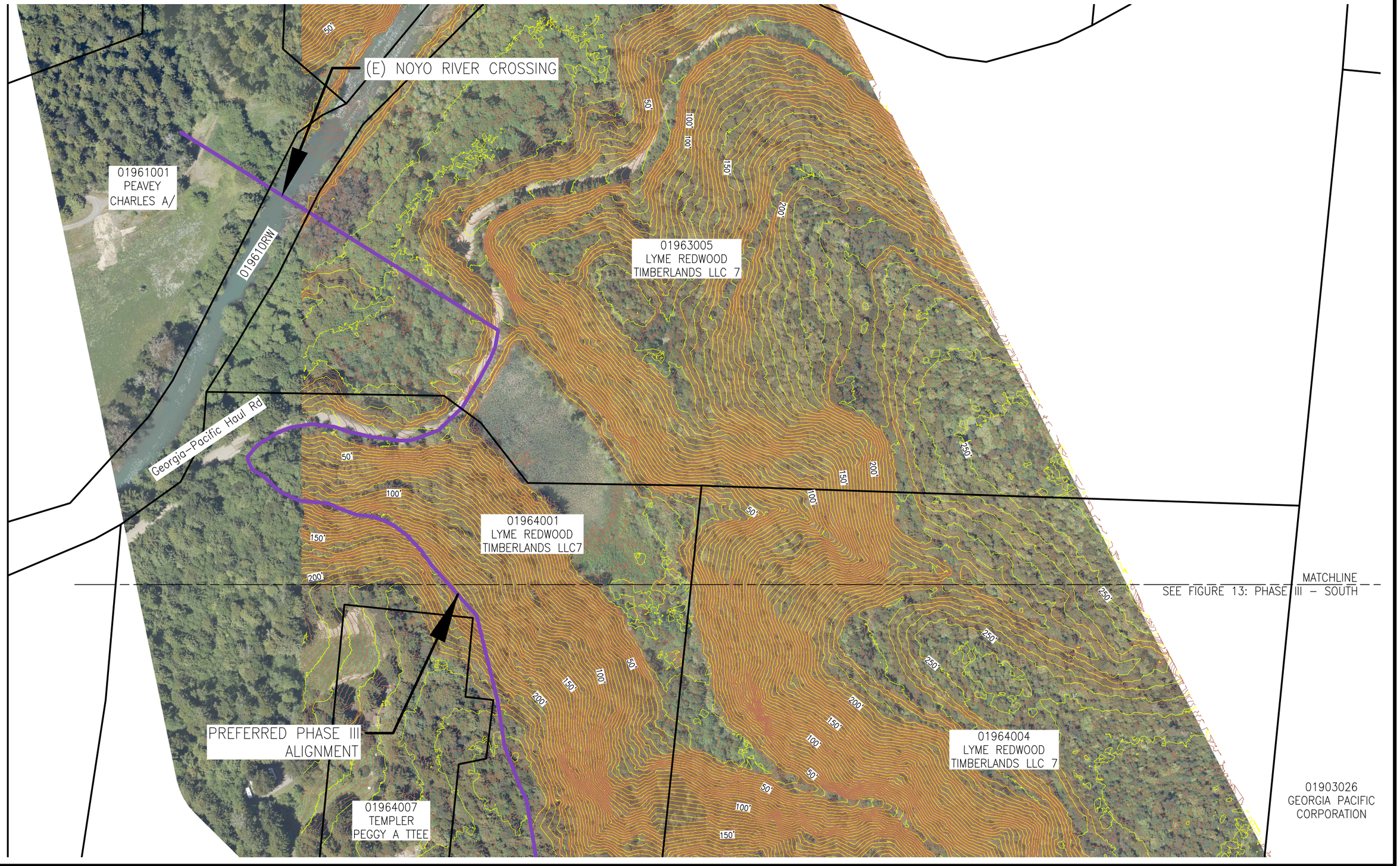
As noted above, Phase III will now include the northern Noyo River floodplain previously in Phase II. After a subsequent meeting with the Lyme Redwood Company, the preferred alignment was extended further to the west along the Georgia Pacific Haul Road to both avoid a steep hillside section and to make use of an old logging skid trail. The preferred alignment is shown on Figures 12 and 13.

8.1.3 Phase IV

The City team advised that they believe that they can continue to use the ductile iron pipe that runs from the Hare Creek Crossing to north of the steep slopes above Covington Gulch. The City will investigate the extent and condition of the pipe, possibly using ultrasonic testing to determine pipe thickness. This use of the ductile iron pipe makes the Phase IV.3 alternative along Dwyer Road the preferred choice over the longer Phases IV.2 and IV.4 alternatives that benefitted in the evaluation from being in forest roads / trails. The Dwyer Road alignment is a better alternative than the Porterfield Road alignment as it would also allow the existing water main to be relocated from beneath houses and other structures. The preferred alignment is shown on Figures 14 and 15.

8.1.4 Phase V

No adjustments were made to the preferred Phase V alignment after Workshop No.1. The Phase V alignment is shown on Figure 16. For implementation, Phases IV and V may be constructed together if funding is available.



9/28/16 S:_PROJECTS\TBG18-001 - RAW WATER PIPELINE REPLACEMENT DESIGN\CADD\EXHIBITS\PHASE 3.1 - PARCEL INFORMATION.DWG

COLEMAN ENGINEERING

COLEMAN ENGINEERING
1358 BLUE OAKS BOULEVARD
SUITE 200
ROSEVILLE, CA 95678
(916) 791-1188

BAR IS ONE INCH AT FULL SCALE
0 1"
IF NOT ONE INCH ON THIS SHEET SCALE ACCORDINGLY

NO.	REVISIONS	BY	APP	DATE
6				
5				
4				
3				
2				
1				

FORT BRAGG — **RAW WATER PIPELINE REPLACEMENT DESIGN**

FIGURE 12: PREFERRED PHASE III ALIGNMENT – NORTH

CITY OF FORT BRAGG — **CALIFORNIA**

DESIGNED UNDER THE DIRECTION OF:

SIMON N GRAY — DATE
R.C.E. No. 60311 - REGISTRATION EXPIRES 06-30-20

DESIGN: MS	DATE: 12-6-19
DRAWN: MS	DATE: 12-6-19
CHECKED: SNG	DATE: 12-6-19

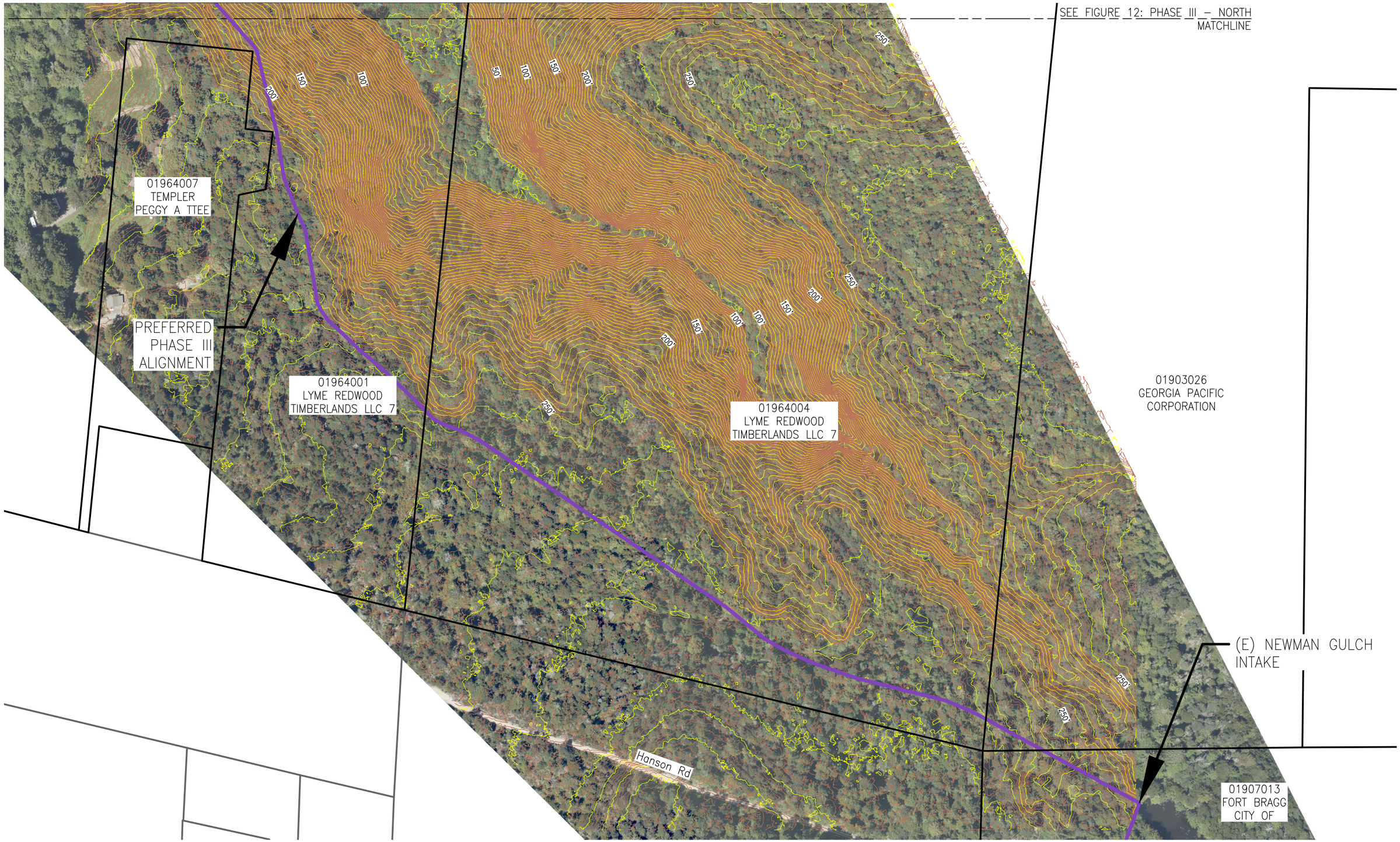
REGISTERED PROFESSIONAL ENGINEER — SIMON N. GRAY — No. C60311 Exp. 06-30-20 — CIVIL — STATE OF CALIFORNIA

SCALE 1"=100'

DRAWING NUMBER

SHEET NUMBER

OF SHEETS



9/28/16 S:_PROJECTS\TBC18-001 - RAW WATER PIPELINE REPLACEMENT DESIGN\CADD\EXHIBITS\PHASE 3.2 - PARCEL INFO.DWG

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(916) 791-1188

BAR IS ONE INCH AT FULL SCALE

0 1"

IF NOT ONE INCH ON THIS SHEET SCALE ACCORDINGLY

NO.	REVISIONS	BY	APP	DATE
6				
5				
4				
3				
2				
1				

FORT BRAGG — **RAW WATER PIPELINE REPLACEMENT DESIGN**

FIGURE 13: PREFERRED PHASE III ALIGNMENT – SOUTH

CITY OF FORT BRAGG — **CALIFORNIA**

DESIGNED UNDER THE DIRECTION OF:

SIMON N GRAY, R.C.E. No. 60311 - REGISTRATION EXPIRES 06-30-20 — DATE

DESIGN: MS	DATE: 09-17-19
DRAWN: MS	DATE: 09-17-19
CHECKED: SNG	DATE: 09-17-19

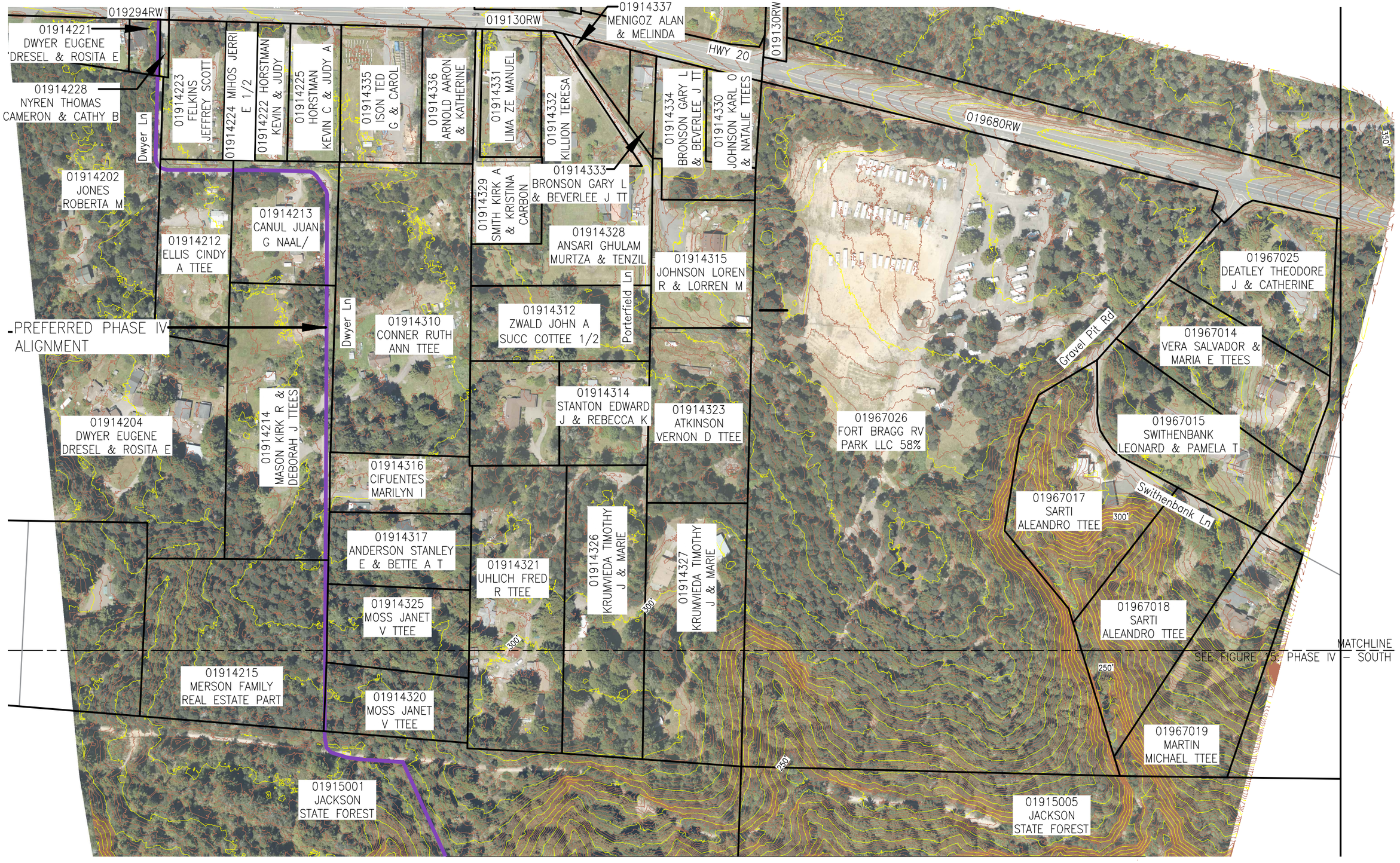
REGISTERED PROFESSIONAL ENGINEER — SIMON N. GRAY — No. C60311 Exp. 06-30-20 — CIVIL — STATE OF CALIFORNIA

SCALE 1"=100'

DRAWING NUMBER

SHEET NUMBER

OF SHEETS



9/28/16 S:_PROJECTS\TB618-001 - RAW WATER PIPELINE REPLACEMENT DESIGN\CADD\EXHIBITS\PHASE 4.1 - PARCEL INFORMATION.DWG

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COLEMAN ENGINEERING
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SUITE 200
ROSEVILLE, CA 95678
(916) 791-1188

BAR IS ONE INCH AT FULL SCALE
0 — 1"
IF NOT ONE INCH ON THIS SHEET SCALE ACCORDINGLY

NO.	REVISIONS	BY	APP	DATE
6				
5				
4				
3				
2				
1				

FORT BRAGG — **RAW WATER PIPELINE REPLACEMENT DESIGN**

FIGURE 14: PREFERRED PHASE IV ALIGNMENT – NORTH

CITY OF FORT BRAGG — **CALIFORNIA**

DESIGNED UNDER THE DIRECTION OF:

SIMON N GRAY — DATE
R.C.E. No. 60311 - REGISTRATION EXPIRES 06-30-20

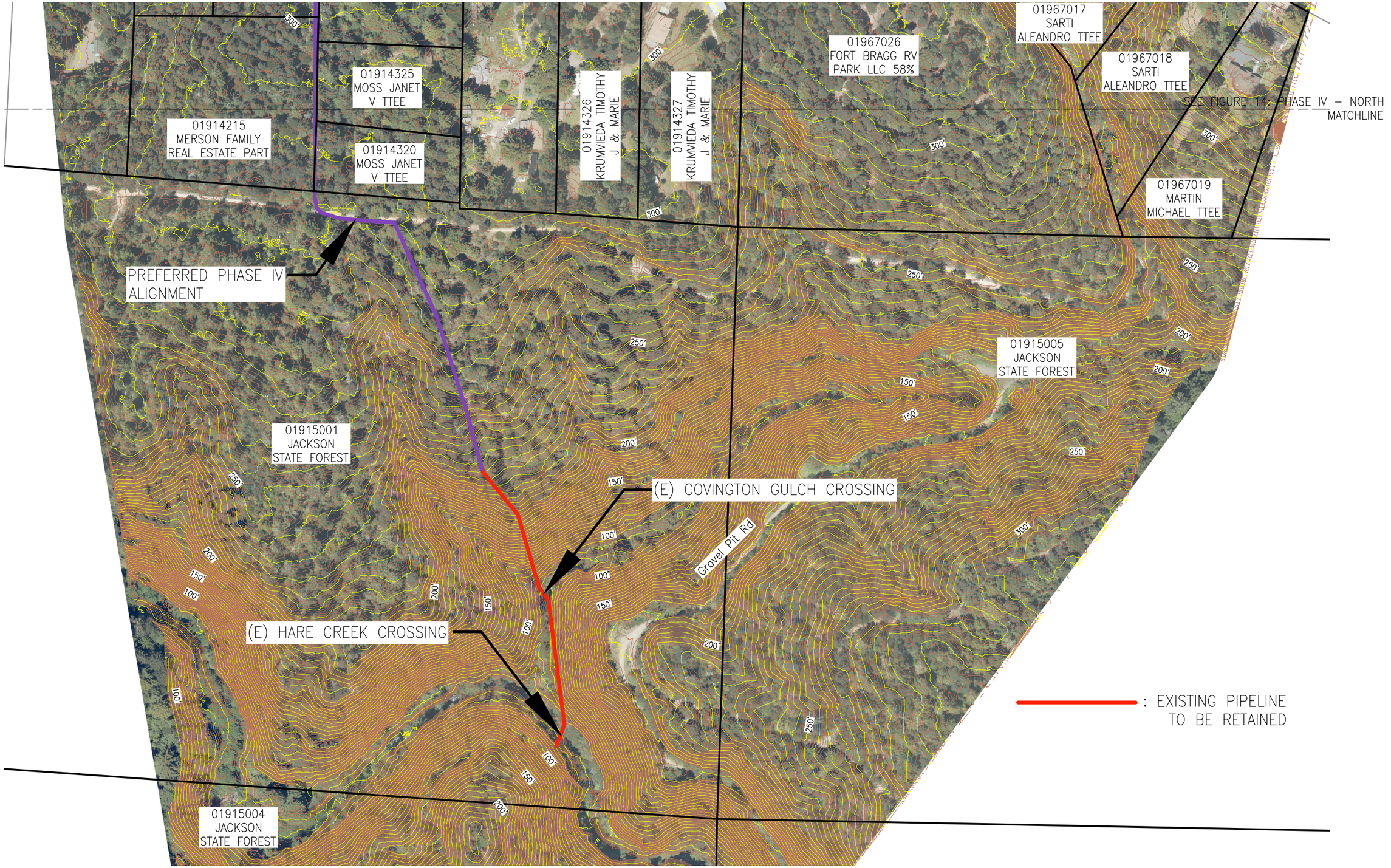
DESIGN: MS	DATE: 09-17-19
DRAWN: MS	DATE: 09-17-19
CHECKED: SNG	DATE: 09-17-19

REGISTERED PROFESSIONAL ENGINEER
SIMON N. GRAY
No. 60311
Exp. 06-30-20
CIVIL
STATE OF CALIFORNIA

SCALE
1"=100'

DRAWING NUMBER

SHEET NUMBER
OF SHEETS



9/28/16 S:_PROJECTS\TBD18-001 - RAW WATER PIPELINE REPLACEMENT DESIGN\CADD\EXHIBITS\PHASE 4.2 - PARCEL INFORMATION.DWG

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(916) 791-1188

BAR IS ONE INCH AT FULL SCALE

0 1"

IF NOT ONE INCH ON THIS SHEET SCALE ACCORDINGLY

NO.	REVISIONS	BY	APP	DATE
6				
5				
4				
3				
2				
1				

FORT BRAGG — **RAW WATER PIPELINE REPLACEMENT DESIGN**

FIGURE 15: PREFERRED PHASE IV ALIGNMENT – SOUTH

CITY OF FORT BRAGG — **CALIFORNIA**

DESIGNED UNDER THE DIRECTION OF:

SIMON N GRAY — DATE
R.C.E. No. 60311 - REGISTRATION EXPIRES 06-30-20

DESIGN: MS	DATE: 09-17-19
DRAWN: MS	DATE: 09-17-19
CHECKED: SNG	DATE: 09-17-19

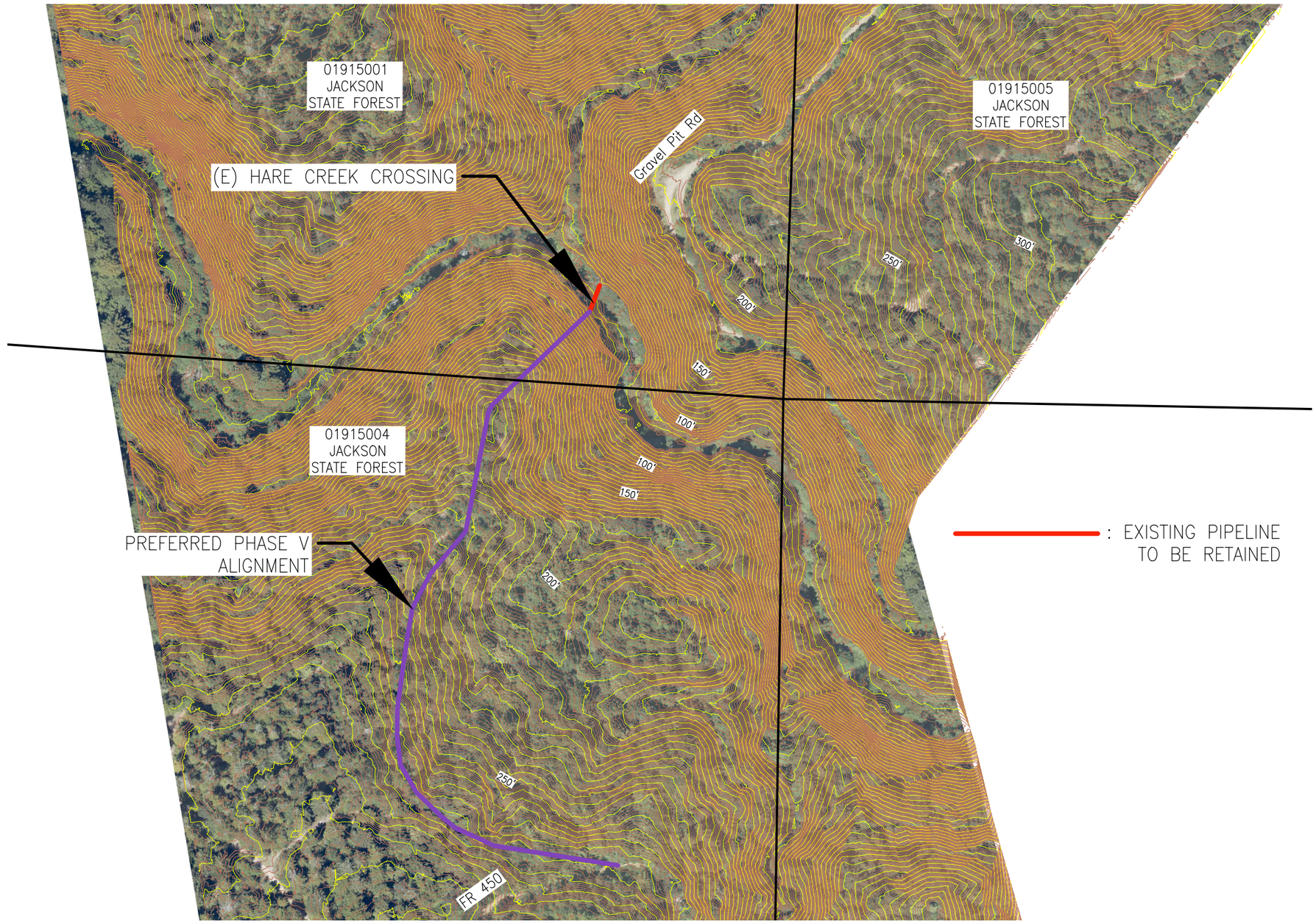
REGISTERED PROFESSIONAL ENGINEER — SIMON N. GRAY — No. C60311 Exp. 06-30-20 — CIVIL — STATE OF CALIFORNIA

SCALE 1"=100'

DRAWING NUMBER

SHEET NUMBER

OF SHEETS



9/28/16 S:_PROJECTS\TBD18-001 - RAW WATER PIPELINE REPLACEMENT DESIGN\CADD\EXHIBITS\PHASE 5 - PARCEL INFORMATION.DWG

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SUITE 200
ROSEVILLE, CA 95678
(916) 791-1188

BAR IS ONE INCH AT FULL SCALE
0 1"
IF NOT ONE INCH ON THIS SHEET SCALE ACCORDINGLY

NO.	REVISIONS	BY	APP	DATE
6				
5				
4				
3				
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FORT BRAGG — **RAW WATER PIPELINE REPLACEMENT DESIGN**

FIGURE 16: PREFERRED PHASE V ALIGNMENT

CITY OF FORT BRAGG — **CALIFORNIA**

DESIGNED UNDER THE DIRECTION OF:

SIMON N.GRAY — DATE
R.C.E. No. 60311 - REGISTRATION EXPIRES 06-30-20

DESIGN: MS	DATE: 09-17-19
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CHECKED: SNG	DATE: 09-17-19

REGISTERED PROFESSIONAL ENGINEER
SIMON N. GRAY
No. C60311
Exp. 06-30-20
CIVIL
STATE OF CALIFORNIA

SCALE
1"=100'

DRAWING NUMBER

SHEET NUMBER
OF SHEETS

8.2 Next Steps

During the next stage of project implementation, consultation is needed with critical public agencies (including the Coastal Commission, CalFire, and Caltrans) to review the project and the preferred alignments, and to identify any further constraints or permitting restrictions / requirements. This process is to allow the preferred alignments to be adjusted or changed prior to the start of preliminary design. In addition, meetings need to take place immediately with potentially impacted landowners about easement acquisition to determine if they are "willing sellers". It is important that any potential difficulty or delay in obtaining easements from any parcel owner be identified by the start of preliminary design, so designs can be modified to suit, or to avoid, a particular parcel.

APPENDICES

A. Summaries of Easements along the Pipeline Routes.

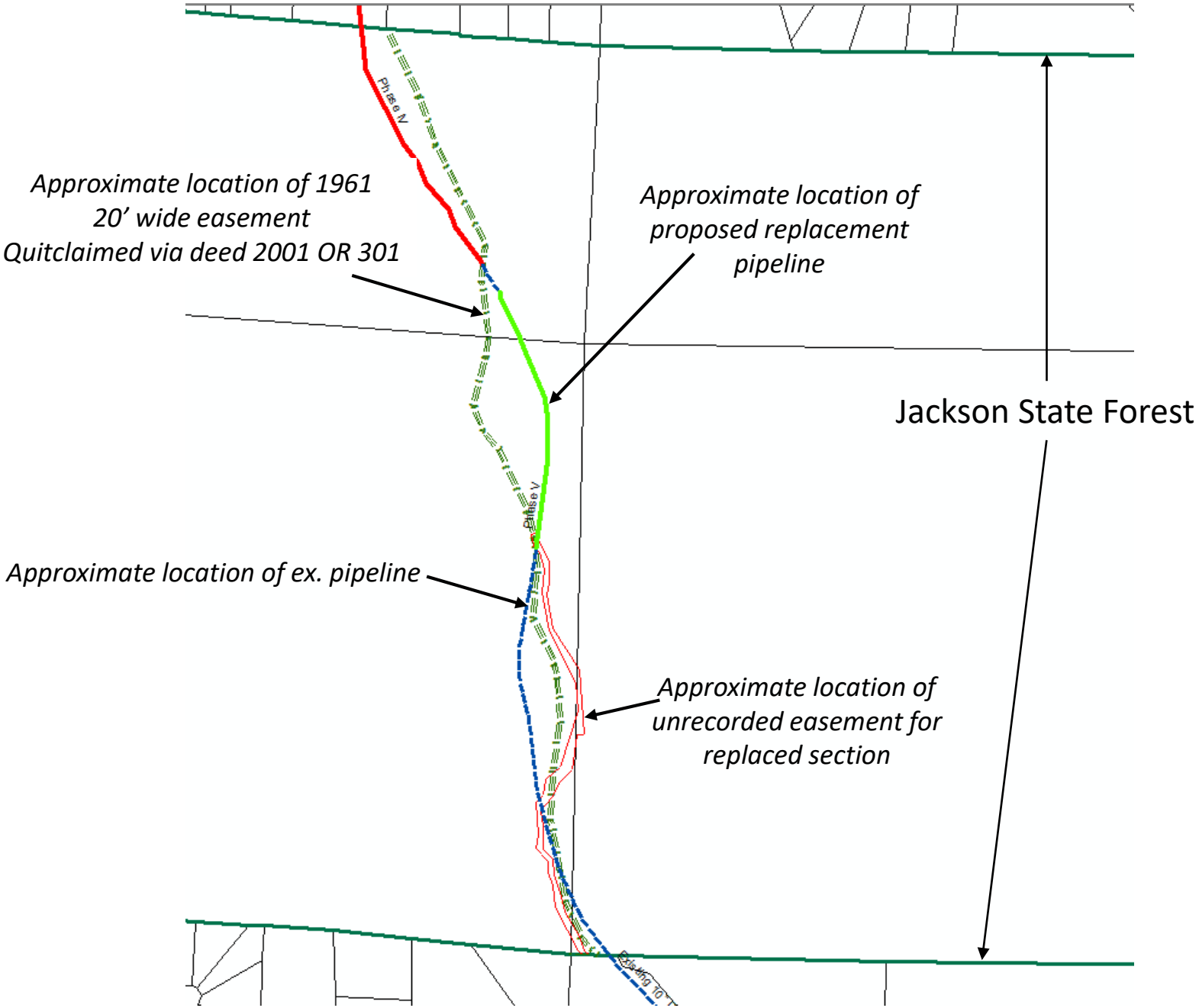
B. Unpriced Example of Bid Items Used in Construction Cost Estimating

APPENDIX A: SUMMARIES OF EASEMENTS ALONG THE PIPELINE ROUTES

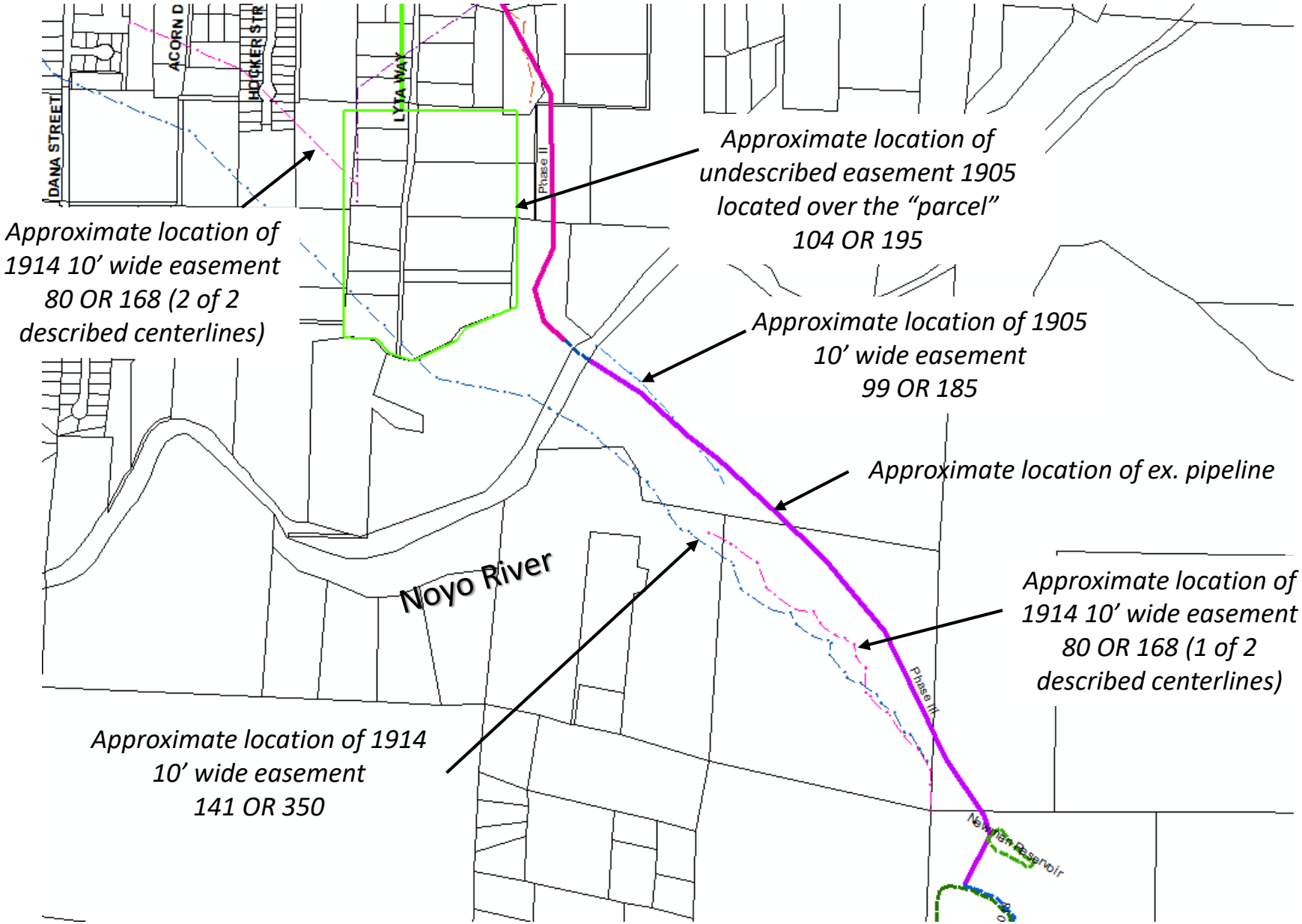
NOTE

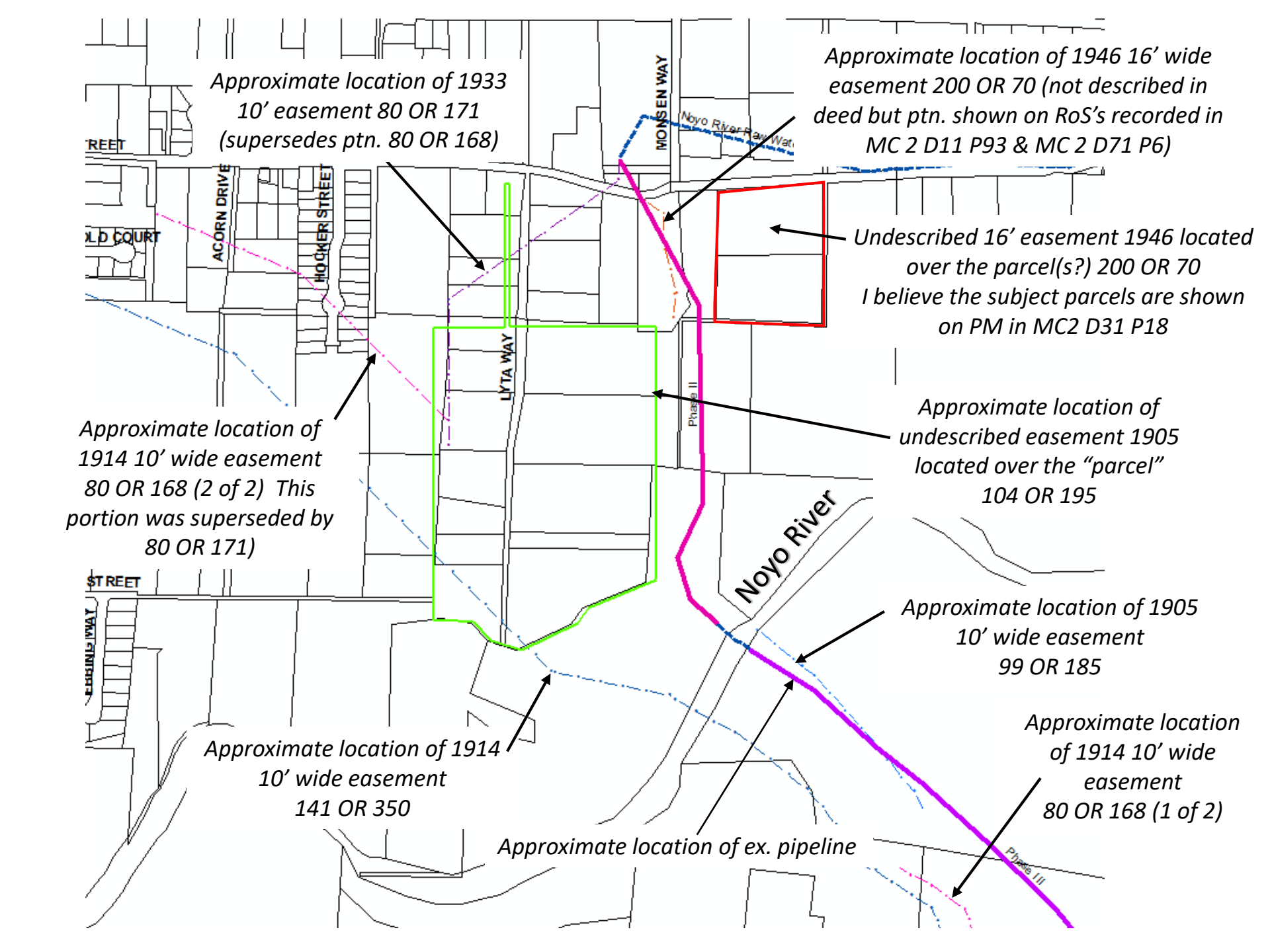
Easements were located using graphically determined section corners per USGS topo maps

Easement from 104 OR 195 was shifted to partially match existing parcel configurations.


Approximate location of 1961
20' wide easement
Quitclaimed via deed 2001 OR 301
Approximate location of
proposed replacement
pipeline
Jackson State Forest
Approximate location of ex. pipeline
Approximate location of
unrecorded easement for
replaced section


Approximate location of pipeline
Approximate location of 1934 10' wide easement 95 OR 330
Phase IV


DANA STREET
ACORN D
HOOKER STR
LYTA WAY
Phase II
Phase III
Noyo River
Approximate location of undescribed easement 1905 located over the "parcel" 104 OR 195
Approximate location of 1914 10' wide easement 80 OR 168 (2 of 2 described centerlines)
Approximate location of 1905 10' wide easement 99 OR 185
Approximate location of ex. pipeline
Approximate location of 1914 10' wide easement 80 OR 168 (1 of 2 described centerlines)
Approximate location of 1914 10' wide easement 141 OR 350


Approximate location of 1933 10' easement 80 OR 171 (supersedes ptn. 80 OR 168)
Approximate location of 1946 16' wide easement 200 OR 70 (not described in deed but ptn. shown on RoS's recorded in MC 2 D11 P93 & MC 2 D71 P6)
Undescribed 16' easement 1946 located over the parcel(s?) 200 OR 70
I believe the subject parcels are shown on PM in MC2 D31 P18
Approximate location of 1914 10' wide easement 80 OR 168 (2 of 2) This portion was superseded by 80 OR 171)
Approximate location of undescribed easement 1905 located over the "parcel" 104 OR 195
Approximate location of 1905 10' wide easement 99 OR 185
Approximate location of 1914 10' wide easement 141 OR 350
Approximate location of ex. pipeline
Approximate location of 1914 10' wide easement 80 OR 168 (1 of 2)
MONSEN WAY
ACORN DRIVE
HOOKER STREET
LYTA WAY
Phase II
Phase III
Noyo River
Noyo River Raw Wat
REET
LD COURT
ST REET

APPENDIX B: UNPRICED EXAMPLE OF BID ITEMS USED IN CONSTRUCTION COST ESTIMATING

08/30/2019 10:11
2019006G Fort Bragg Raw Waterline - Phase IV.2
***

BID TOTALS

Biditem	Description	Quantity	Units	Unit Price	Bid Total
	BASE BID				
1	Mobilization	1.000	LS		
2	Demobilization	1.000	LS		
3	Site Specific Safety Plan	1.000	LS		
4	SWPP Plan	1.000	LS		
5	SWPPP and Erosion Control	1.000	LS		
6	Site Security	1.000	LS		
7	Clear and Grubing ROW	1.000	LS		
8	Traffic Control	1.000	LS		
9	Construction Staking	1.000	LS		
10	Dewatering	1.000	LS		
11	8" PVC Water Line - Forest ROW	200.000	LF		
12	8" PVC Waterline - Unpaved Access Road	5,150.000	LF		
13	8" PVC Waterline - Paved Road	500.000	LF		
14	8" DIP Waterline - Creek Crossing	1.000	EA		
15	Rock Excavation	300.000	CY		
16	Trench Foundation Excavation	200.000	CY		
17	Trench Foundation Materials	200.000	CY		
18	1" Air Release Valves	5.000	EA		
19	2" Blowoff Valves	2.000	EA		
20	8" Flex Coupling	2.000	EA		
21	Trench Cutoff Wall	10.000	EA		
22	8" Gate Valve	6.000	EA		
23	1" Sample Station	1.000	EA		
24	Corrosion Protection	1.000	LS		
25	Locate Stations	4.000	EA		
26	Pipeline Cleaning, Testing and Disinfection	1.000	LS		
27	Connect to Existing Waterline	1.000	LS		
28	Place and Maintain Final Erosion Control	1.000	LS		
29	Final Restoration	1.000	LS		
	BASE BID TOTAL				
	Bid Total ========>				$0.00

**Notes:

COLEMAN ENGINEERING, INC.

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Roseville, CA 95678

T: 916-791-1188

W: www.coleman-eng.com