MONTE RIO AND VILLA GRANDE WASTEWATER SOLUTIONS PROJECT

ALTERNATIVES DEVELOPMENT AND ANALYSIS

SONOMA WATER

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1. INTRODUCTION

Sonoma Water has retained Brelje & Race Consulting Engineers (Brelje & Race) to provide engineering and design services related to the Monte Rio and Villa Grande Wastewater Treatment Project. The County of Sonoma (County) is collaborating with the Lower Russian River Interagency Team (Interagency Team) and the Lower Russian River Wastewater Citizens Advisory Group (CAG) to develop this feasibility report. The Interagency Team consists of representatives from the County of Sonoma, County of Sonoma Supervisorial District 5, the North Coast Regional Water Quality Control Board (Regional Board), and Sonoma Water. The CAG consists of volunteer members that live in lower Russian River communities. The CAG was created to communicate with and advise the Interagency Team with coordinating regulatory and implementation efforts, including the Monte Rio and Villa Grande Wastewater Solutions Project, and support citizens in understanding how the pilot project will identify wastewater solutions.

The County has initiated this pilot project to analyze alternatives for the communities of Monte Rio and Villa Grande for compliance with California State and Regional Board standards for wastewater disposal. The goal of this pilot project is to assist in the identification of a regulatory compliant wastewater solution for property owners within communities along the lower Russian River, such as Monte Rio and Villa Grande.

The Monte Rio and Villa Grande Wastewater Solutions Project consists of the following tasks:

- Study Area Analysis
- Alternatives Development and Analysis
- Outreach and Engagement
- Final Project Feasibility and Preliminary Design Report
- Conceptual Design of Selected Alternative

This report is the Alternatives Development and Analysis, in which alternatives introduced in the Study Area Analysis report will be evaluated through regulatory considerations, governance concerns, and lifecycle costs. Based on this evaluation a preferred project will be selected.

In the next task, the Final Project Feasibility and Preliminary Design Report will detail the findings of the first two tasks, detail the preferred project further, and identify potential funding sources.

2. BACKGROUND

The Study Area is comprised of Monte Rio and Villa Grande which are unincorporated communities located along the lower Russian River, south (and downstream) of Guerneville. Based on the Study Area Analysis, it was determined that the Study Area consists of 1,515 parcels, the majority of which are zoned for residential use. However, only 780 parcels or approximately 51 percent of the parcels are developed and generate wastewater. Some parcels that do not generate wastewater are developed, for example some parcels contain utility infrastructure such as tanks, or parking for other developments. There are 38 parcels that generate wastewater flow that are zoned for commercial use. See Figure 1 for a map of the parcels that generate wastewater in the Study Area.

The Study Area is currently served by aging individual onsite wastewater treatment systems (OWTS). The County has reliable documentation for OWTS built after 1970. Approximately 57 percent of the developed parcels have no septic system permits for a new system or repair to an existing system. Records documenting the location of existing systems for some of these parcels were developed to obtain clearance for a building permit. These records were not used to estimate the age of the septic system because they do not indicate an original installation date. The average age of the permitted systems is 23 years. Figure 2 depicts permit data for the Study Area. It is assumed that systems without permits were built prior to the establishment of septic regulations in Sonoma County. It is likely that many of these parcels without septic system permits are served by cesspools. Cesspools are prohibited by the California State OWTS Policy because of the lack of a treatment component.

New and replacement OWTS within the Study Area may not meet the requirements of the County of Sonoma Onsite Wastewater Treatment System Regulations and Technical Standards Manual (OWTS Manual) due to parcel size, topography, soil type, depth to groundwater, and proximity to the Russian River and/or Dutch Bill Creek.

The system area was evaluated based on OWTS design criteria such as topography, soil characteristics, and parcel size. It was found that some parcels may not be suitable for OWTS, primarily due to the encumbrance of the parcel by the Federal Emergency Management Agency (FEMA) floodway or parcel size.

2.1 EXISTING REGULATORY ENVIRONMENT

The California State Water Resources Control Board (State Board) establishes minimum requirements for the design and siting of OWTS in the Water Quality Control Policy for Siting, Design, Operation, and Maintenance of Onsite Wastewater Treatment Systems (OWTS Policy). The OWTS Policy categorizes OWTS into five tiers.

- Tier 0 are existing systems that are functioning and do not require corrective action.
- Tier 1 systems are low risk new or replacement systems in areas without a Local Agency Management Program (LAMP).
- Tier 2 systems are low risk new or replacement systems in areas with a LAMP.
- Tier 3 systems are existing, new, and replacement systems that are near an impaired water body.
- Tier 4 systems are OWTS that require corrective action or are failing.

The Regional Board establishes waste discharge requirements, publishes resolutions that relate to specific regional needs, and permits systems with flowrates greater than 10,000 gallons per day (gpd).

The County publishes the OWTS Manual and permits systems not governed by the Regional Board. The OWTS Manual is the policy that provides the framework and technical details that govern OWTS in Sonoma County. The current OWTS Manual is version 8.0, dated August 13, 2024. This version of the OWTS Manual is anticipated to go before the Regional Board for approval as a LAMP.

Each layer of more general policy acts as a minimum threshold for the more localized policy. Therefore, the localized policies supersede the more general policies.

The Tier 3 requirements in the OWTS Policy establish minimum requirements for OWTS located near impaired water bodies pursuant to Section 303(d) of the Clean Water Act. Certain sections of water bodies within the Russian River watershed are listed as impaired water bodies for pathogens, including the section of the mainstem Russian River between Fife Creek, located in Guerneville, and Dutch Bill Creek, located within the Study Area.

The Regional Board and the County can implement regulations or special provisions that supersede the Tier 3 requirements outlined within the OWTS Policy. The Regional Board can establish a TMDL action plan, or the County can establish special provisions as a part of an approved LAMP. As of August 2024, neither a TMDL action plan nor a LAMP have been adopted or accepted.

In August 2019, the Regional Board adopted Resolution No. R1-2019-0038, to amend the existing Basin Plan to include the Russian River Watershed Pathogen TMDL Action Plan (TMDL Action Plan). The TMDL Action Plan was amended in 2021, under Resolution No. R1-2021-0055. The TMDL Action Plan does not take effect under state or federal law until it is approved by the State Board, Office of Administrative Law, and the U.S. Environmental Protection Agency.

In the spring of 2024, the Regional Board rescinded the draft TMDL Action Plan due to feedback from the State Board. Regional Board staff has indicated that future drafts of the TMDL Action Plan will rely more on either the OWTS Policy or a LAMP, if established, to regulate OWTS near impaired water bodies and will focus efforts on identifying existing systems that are not authorized or code compliant, such as cesspools. The Regional Board staff anticipates beginning community outreach and engagement in the summer of 2024, and publication of a revised TMDL Action Plan in the fall or winter of 2024. Final state and federal approval for a revised TMDL Action Plan is anticipated in the fall or winter of 2025.

The Sonoma County Board of Supervisors voted to adopt Resolution 2024-0611 on August 13, 2024, approving the revised OWTS regulation and authorized the County to submit a revised Sonoma County LAMP for Regional Board approval. The new OWTS regulations, OWTS Manual version 8.0, includes special provisions for OWTS near the impaired water bodies. The special provisions within the OWTS Manual establishes an Advanced Protection Management Program (APMP) for OWTS within 600 feet of the impaired waterbodies and includes requirements for supplemental treatment and/or enhanced dispersal. Figure 3 displays a map of the study area with applicable locations of impaired water body and APMP area.

For the purposes of this study, it was assumed that the LAMP will be approved by the Regional Board including the special provisions for OWTS within the APMP area and that the Regional Board will implement inspections of systems that are suspected of being cesspools or non-code compliant. Therefore, systems that are identified for corrective action by the Regional Board or over time as systems need to be repaired, replaced, or upgraded, OWTS will need to meet the requirements within the LAMP and OWTS Manual.

3. ALTERNATIVES ANALYSIS

Two main alternatives for providing proper wastewater treatment within the Study Area were considered and evaluated.

1. Onsite Wastewater Treatment Systems Alternative
2. Centralized Sewage Collection System Alternative

The Onsite Wastewater Treatment Systems Alternative includes the continued use of OWTS throughout the Study Area. This would include the use of systems serving individual parcels and community systems serving multiple parcels.

The Centralized Sewage Collection System Alternative includes serving the community with a pressurized sewer collection system that would connect to an existing wastewater treatment plant. The construction of a new wastewater treatment plant was not considered as the capital, operation and maintenance costs associated with a new wastewater treatment plant for a small community are known to be cost prohibitive.

3.1 ONSITE WASTEWATER TREATMENT ALTERNATIVE

The Onsite Wastewater Treatment Alternative consists of the continued use of OWTS throughout the Study Area with ascribed costs of system replacement and required upgrades. In evaluating the feasibility of this alternative, parcels were analyzed based on OWTS design criteria including parcel size, slope, proximity to the Russian River, and septic suitable soil depth. Parcels for which it was determined that siting a compliant individual OWTS would be difficult, based on the design criteria described below, were grouped together into community systems.

The United States Environmental Protection Agency (EPA) estimates an average life span of a septic system to be 25 to 30 years. In practice, a well maintained OWTS could function significantly longer than 30 years. For this study, it was assumed that the average useful life of OWTS is 50 years and that after this period the OWTS would need to be replaced. The life cycle cost analysis performed is over a 50-year period. For comparison of alternatives, this assumes that OWTS for every developed parcel within the Study Area would need to be replaced within the duration of the analysis.

Publicly available data was utilized for this study including the Sonoma Vegetation Mapping and Light Detection and Ranging (LiDAR) Program, FEMA flood risk maps, and the United States Geological Survey (USGS) Web Soil Survey.

To develop the scope of the alternative, generalized assumptions were made to determine the scope of system replacements throughout the study area. It is important to note that system types delineated in this study for any particular parcel do not represent recommended septic solutions for any individual parcels. Ultimate particular recommendations can only be performed by a professional working on a specific permit and/or a system design for that property. The potential septic solutions noted in this report are simply identified to scope the alternative for analysis.

3.1.1 Onsite Wastewater Treatment System Types

There are a variety of available septic systems, both standard and non-standard types. A standard septic system type uses a septic tank for anaerobic treatment and solids settling and perforated pipes installed in gravel trenches for dispersal of septic tank effluent. These systems are sized based on the ability of effluent to travel through the sidewall which is the portion of trench with gravel below the perforated pipe. Standard system types include gravity and pressure distribution systems. Gravity systems utilize natural slope to convey septic tank effluent through the dispersal field. Pressure distribution systems utilize pumping equipment to convey septic tank effluent through the dispersal field. Pressurizing the dispersal system helps to allow equal distribution and reduce, if not eliminate, the possibility that a single trench gets used more frequently than the others. Frequently, pressure distribution systems are divided into separated zones that are rotated in operation.

Seepage pits are a system type, similar to a gravity standard system, except that it consists of a single, deep, dispersal bed of gravel with perforated pipe distributed evenly throughout instead of multiple trenches separated by native soil. They are sized based on the volume of gravel within the dispersal bed, which must be equal to or greater than the minimum required volume for the septic tank. These systems are limited to parcels that have no other options, typically due to the size of septic suitable area. Seepage pits are an improvement over cesspools because of the addition of the septic tank and rock within the pit but still are a concentrated point of dispersal. This increased concentration of dispersal necessitates a greater depth of suitable soil above groundwater to limit the possibility of contamination.

As septic regulations have expanded, the amount of soil testing required has increased. The testing methods have been refined to obtain more accurate data. Increased testing and long-term research have documented the impact poorly sited or failing standard systems can have on local water sources. This has led to the increased use of non-standard septic systems in Sonoma County. Non-standard systems provide increased effluent treatment over standard systems. All non-standard systems are pressurized and deliver effluent in a prescribed dose to the dispersal system. Non-standard systems include, but are not limited to, mound systems, at-grade mounds, and subsurface drip systems.

Mound systems use a raised dispersal bed of gravel and a sand bed above native soil. This raises the point of dispersal and incorporates a single-pass sand filter. An at-grade mound system is similar to a mound system but does not include the sand bed below the gravel dispersal bed. The extra sand reduces the depth of septic suitable soil that is needed in native grade. However, the sand increases the height of the system making the system more noticeable and having a larger footprint. Both systems are sized based on the linear loading rate (LLR), which is based on the type of the limiting layer, and slope of the site. The LLR dictates the width of the mound or at-grade mound. Both systems are designed with slope correction factors to ensure the partially treated effluent does not break through the side of the raised dispersal bed. Both mound and at-grade systems have the advantage of requiring a shallower lens of septic suitable soil without using a pretreatment unit, which removes the need to be in the Operational Permit and Monitoring program (OPR). The OPR program adds capital and operation costs to septic systems.

Subsurface drip systems apply small doses of septic tank effluent through controlled emitters on tubing that is installed 6 to 12 inches deep in soil. The emitters are small and require the use of pretreatment or supplemental treatment to reduce clogging. Drip systems are closed loop systems that recirculate through pretreatment or supplemental treatment. These systems have a small footprint due to the controlled small doses of pretreated effluent.

The other system type considered in this study was bottomless sand filters. It is classified as experimental in Sonoma County but there is a geographic waiver of experimental status for a portion of the Study Area close to the Russian River. The experimental status of bottomless sand filters is waived for systems that are located 100 feet from the summertime banks of the Russian River that serve structures located in the 100-year floodplain. Bottomless sand filters are a raised dispersal bed consisting of a gravel bed above a sand bed covered with six to 12 inches of soil. This dispersal bed is contained within a watertight frame that is shallowly imbedded (6 inches deep) within native soil. Bottomless sand filters are sized based on the soil application rate of the underlaying soils.

3.1.1.1 Community Systems

Community systems are a type of OWTS that accept wastewater from buildings or structures on two or more parcels. Typically, parcels connected to a community system would have individual septic and pump tanks. Septic tank effluent, from each connection, would be conveyed to a centralized dispersal system. Depending on the type and location of the dispersal systems, additional treatment in the form of a pretreatment unit may be required.

Community systems with design flow rates greater than 10,000 gallons per day (gpd) are regulated by the Regional Board. Requirements established by the Regional Board would likely include additional environmental studies to assess groundwater quality impacts and additional treatment for constituents, such as nitrogen compounds.

3.1.1.2 Supplemental Treatment

Supplemental treatment is defined in the OWTS Manual as "any OWTS or component of an OWTS, except a septic tank or dosing tank, that is National Sanitation Foundation (NSF) listed and certified which performs additional treatment of domestic wastewater to decrease the constituents of concern before they reach primary treatment components of the final effluent dispersal field." Supplemental treatment options are either pretreatment units, including but not limited to aerobic treatment units, textile filters, and recirculating sand filters, or waterless toilets, including composting or incinerating toilets.

In Sonoma County, pretreatment units must be approved by Permit Sonoma and are listed in Appendix A of the OWTS Manual. Pretreatment units are required for certain system types, to reduce the required depth of septic suitable soil, and to alleviate variance requests such as a reduction in setbacks. Any systems utilizing pretreatment units must be enrolled in the Operational Permit and Monitoring program (OPR). This requires the installation of monitoring wells and biannual reporting to the County. The OPR program also requires giving the County access to the property and paying annual fees.

Composting toilets were considered due to community interest. Composting toilets require regular additives to balance the nutrient availability and encourage the desired microbiota during the composting process. The product of composting toilets is considered a biosolid, not an inert compost. Therefore, the compost cannot be distributed across the property like garden compost. It must be off hauled by a certified hauler. As there are a limited number of composting toilets in use in Sonoma County, the available number of haulers of this type of material may be limited. Additionally, the hauled material must be disposed of at a facility that accepts biosolids. The closest facility is in Vallejo. Hauling compost such a distance significantly increases the price of hauling. Due to the significant costs of operation, composting toilets were considered cost prohibitive.

There are many similar pretreatment units made by various manufacturers; however, for the purposes of this study, the supplemental treatment unit was assumed to be an Orenco AdvanTex unit, which is a recirculating proprietary textile filter. Other approved pretreatment units in Sonoma County include peat filters, peat moss systems, recirculating and single pass sand filters, aerobic treatment units (Clearstream, Bio-Microbics FAST, Hoot Aerobic, Microseptic Enviroserve, Multiflo, Nyabdic, Southern Aerobic, and Whitewater Aerobic), and other filter system (Norweco Singulair and Norweco Biokinetic Singulair). The filters would require individual engineered design and the aerobic treatment units require more electricity and operation requirements. Orenco AdvanTex units were selected over Norweco because there are a variety of models that can accommodate a range of flows, addition of UV disinfection, and treatment of commercial waste streams. The addition of UV disinfection can be required to alleviate variance requests.

3.1.2 Design Criteria

The primary regulating body for OWTS in Sonoma County is Permit Sonoma, an agency of the County. The Regional Board becomes the regulating body under certain circumstances. These circumstances include when the design flow rate of OWTS exceed 10,000 gallons per day or if the requirements of the OWTS Manual cannot be met. For the purposes of this study, it was assumed that the County would be the regulating body for parcels within the Study Area.

The County only evaluates systems, reviews improvement plans, and issues OWTS permits under the following scenarios:

- If the homeowner reports system failure,
- If surfacing sewage is documented in a violation,
- If a property owner applies for a building permit, or
- If a system is in the OPR program.

Site conditions are evaluated and OWTS are designed based on the requirements outlined in the OWTS Manual. The design criteria, outlined in the following sections, were developed based on the OWTS Manual and in conjunction with the County and Regional Board staff.

3.1.2.1 General OWTS Requirements

New or replacement OWTS are designed based on wastewater flow rates, site conditions, and soil characteristics.

Residential flows are based on the number of bedrooms (150 gallons per day per bedroom). A flow reduction of up to 20 percent is allowed when low-flow devices are installed (120 gallons per day per bedroom). For the purposes of this study, all single-family residential parcels were assumed to be a two-bedroom residence with low-flow devices. Multifamily residential flows were estimated based on an assumed number of bedrooms per parcel and that low flow devices were installed. Commercial flows are estimated based on the type of commercial use per Section 11 of the Sonoma County OWTS Manual.

Reserve areas are required to ensure the future support of the parcel. Residential parcels created prior to October 1971 require a 100 percent reserve area. Residential parcels created after October 1971 require a 200 percent reserve area. For the purposes of this study, all residential parcels were assumed to require a 100 percent reserve area based on the time of subdivision for most of the parcels in the Study Area. All commercial parcels require a 200 percent reserve area. A reduction of reserve area may be applied for as a variance.

The setbacks for standard and non-standard systems differ and non-standard systems require larger setbacks. A summary of setbacks pertinent within the Study Area is presented in Table 1. These setbacks increase the parcel area required to site a compliant system on a property.

Table 1: Representative Setbacks

Minimum horizontal distance required from:	Dispersal Area (Standard)	Dispersal Area (Non-Standard)
Building or Structures - Upgradient/Laterally	8'	10'
Building or Structures - Downgradient	8'	25'
Property Line/Easements - Upgradient/Laterally	5'	10'
Property Line/Easements - Downgradient	5'	25'
Perennially flowing streams	100'	100'
Ephemeral springs	50'	50'
Drainage ways greater than 18 inches in depth	50'	50'
Drainage ways less than or equal to 18 inches in depth	25'	25'

For both gravity and pressure distribution systems, a minimum depth of 66 inches of soil is required. If a site is determined to have less than 66 inches of septic suitable soil, then a non-standard system such as subsurface drip or a mound system may be required.

3.1.2.2 Parcel Size

When most parcels within the Study Area were developed, the required area for septic systems was typically smaller than what is required in the current OWTS Manual. Reasons for this difference include parcels were developed for vacation homes (not full-time occupancy), replacement areas were not required, and the most common system type (cesspools) had a smaller footprint. Currently, OWTS may be difficult to site on smaller parcels within the Study Area because of the requirements within the OWTS Manual.

Figure 4 displays the parcels in the study area categorized by size range. The average and median parcel size is presented in Table 2.

Table 2: Average and Median Area of Developed Parcels by Land Use Type

Use Type	Average Parcel Area (acres)	Median Parcel Area (acres)
Developed Commercial	8.21	0.16
Developed Multifamily Residential	1.47	0.40
Developed Single Family Residential	0.23	0.14

The minimum land area required for various dispersal system types were estimated based on the wastewater flows for a two-bedroom home assuming the installation of low-flow fixtures. These areas include both the primary dispersal area and a 100 percent replacement area. A soil absorption rate (SAR) for sandy-clay-loam was assumed. The estimates are presented in Table 3 and supporting calculations are included in Appendix A.

Table 3: Size of Different OWTS Dispersal Area Types

Dispersal System Type	Minimum Dispersal Area for a Two-Bedroom System (square feet, sf)
Standard (Gravity)	4,800
Mound	8,420
At-grade Mound	2,470
Subsurface drip	960

For this study, it was assumed that parcels less than 0.15 acres in size would need to connect to a community septic system, as it would likely be difficult to site a compliant system. 0.15 acres was selected based on a rectangular lot with a 1,600 square foot house, using the non-standard setbacks and a drip dispersal area. It was assumed that the contour lines would be parallel to the narrower property line. Other sources of setbacks such as additional structures or drainage channels were not evaluated. Based on this threshold, 345 parcels were determined to be unlikely to support a code compliant septic system.

3.1.2.3 Topography

Topography is a major consideration for OWTS as it may limit the amount of available septic suitable area on a parcel. Minimum setbacks from features such as cutbanks and natural bluffs and additional site evaluation requirements for systems on steep slope are established in the OWTS Manual.

The construction of a dispersal system and the consistent introduction of effluent can destabilize slopes. Non-herbaceous vegetation such as trees and shrubs must be removed from OWTS dispersal areas, which can further destabilize slopes. The OWTS Manual requires a geotechnical evaluation to evaluate slope stability for systems constructed on slopes 30 percent or greater. This evaluation process increases costs and the time to construct. Additionally, steep slopes present difficulties in the construction of septic systems. These factors limit the available types of systems for a parcel based on topography.

Certain types of OWTS dispersal systems are more suited to steep slopes than others. In the *Wisconsin Mound Manual,* mound systems are not recommended in areas with slopes greater than 20 percent, due to construction safety and difficulty. Mound systems must also be constructed on contour and may not be curved inward because this could encourage effluent to concentrate at a central point. For these reasons, mound systems are not recommended on steep slopes. Other systems that add soil above grade such as filled land or at-grade mounds are assumed to have similar issues with constructability and stability. Subsurface drip systems are more suitable for steep slopes because they require limited trenching, do not require the addition of fill, and use a small dose of effluent.

Large portions of the Study Area have slopes of 30 percent or greater, based on available topographic data from the Sonoma County Vegetation Mapping and LiDAR Program. A map of average slopes in the Study Area is included in Figure 5. The accuracy of this data is unknown, as large portions of the Study Area are heavily forested which decreases the accuracy of LiDAR with respect to individual parcels. However, the overall slope of the study area is accurate and on-site evaluations generally confirm the LiDAR data.

For this study, it was assumed that any parcel with an average slope of 30 percent or greater would require a geotechnical evaluation during the replacement of an OWTS and would likely require the use of a subsurface drip dispersal system.

3.1.2.4 Soil Characteristics

Soil characteristics such as soil type, infiltration rate, and depth to groundwater, need to be considered when determining the dispersal system type and sizing of OWTS. Soil testing is performed prior to the installation of OWTS and can include a pre-percolation soil investigation, percolation test, and wet weather groundwater test.

A pre-percolation soil investigation involves the digging of a soil pit and assessment of the various layers of soil. Items analyzed include color, structure, soil type, rock content, root intrusion, water content, and the presence of redoximorphic (color patterns in soil) features. The presence of redoximorphic features such as mottling and the presence of seepage can be used as an approximation of groundwater levels. The soil type, texture, and presence of large items, such as roots or rock, can be used to estimate the suitability of soil for OWTS. Limiting features can include the presence of redoximorphic features, seepage, impermeable layers such as clay, and layers of greater than 50 percent rock. The depth of the suitable soil above the limiting layer can limit the appropriate types of dispersal systems. The type of soil can be used to approximate the soil application rate (SAR) and size of the system. Pre-percolation soil investigations are always required when designing OWTS.

Percolation tests can be used to approximate the ability of soil to accept and drain water. Percolation testing is required on undeveloped parcels and developed parcels with certain soils conditions, such as certain clays and soils with high rock content. Percolation testing is also mandatory in certain portions of the County. For example, percolation testing is required to remove the need for supplemental treatment in impaired areas. The County specifies the use of a falling-head percolation test. The percolation rate (minutes per inch or MPI) is correlated to a SAR based on Table 19.1B in the OWTS Manual version 8.0, which is then used for system sizing. For the purposes of capital cost estimating in this study, to be conservative, it was assumed that percolation testing would be performed for all replacement systems.

Wet-weather groundwater testing may be required on flat sites or sites where redoximorphic features were not identified in the pre-percolation soil investigation. Testing involves a direct measure of the groundwater level during the wet weather season. A minimum separation of two feet is required between the bottom of the dispersal area and the groundwater level. For this study, it was assumed that wet-weather groundwater testing will not be required due to the slopes of parcels within the Study Area.

For this study, USGS Web Soil Survey data was used when determining the probable solution for each parcel. However, when an existing OWTS is replaced, the required site testing will determine parcel-specific soil data. The available data is meant for large-scale planning purposes and site-specific testing may differ.

The Study Area has five major soil types: Yolo sandy loam (YiA), Hugo very gravelly loam (HkG), Hugo-Atwell complex (HiF), and Hugo-Josephine Complex (HnG). A map of the soil types within the Study Area is included in Figure 6. HkG, HiF, and HnG indicate characteristics of slopes greater than 30 percent. Parcels with this soil type are likely only eligible for subsurface drip with a geotechnical evaluation, per the discussion above regarding topography. YiA has no limiting layer, a depth to groundwater of more than 80 inches, and slopes of 0 to 2 percent. These soil characteristics do not eliminate any septic system types. However, the soil profile only goes down to 60 inches. This is not deep enough to determine if gravity systems, pressure distribution systems, and seepage pits would be an acceptable solution. Due to the lack of data and surrounding soil types encountering a limiting layer below 60 inches, it is assumed that these system types are not suitable for this soil type either. Although it was determined that gravity systems, pressure distribution systems, and seepage pits would not be the probable solution for any parcels within the Study Area, on a case-by-case basis these system types could be utilized.

3.1.2.5 Proximity to the Russian River or Dutch Bill Creek

The proximity of OWTS to the Russian River or Dutch Bill Creek was an important consideration for the feasibility of continued use of OWTS because of required setbacks and waivers for certain system types.

The OWTS Manual requires a minimum set back of 100 feet from the top of bank of blueline waterways to a septic dispersal area. Topographic mapping data detailed enough to determine the top of the bank of the Russian River was not available. For the purposes of this study, the FEMA floodway was used to approximate the top of bank of the Russian River. The FEMA floodway includes the channel of the waterbody and surrounding low lying land that must be reserved to release the base flood. This was confirmed to be a reasonable assumption for planning purposes during field visits to the area.

It was assumed that parcels that are 80 percent or more by area within the 100-foot setback are unlikely to have sufficient area for compliant OWTS and would likely need to connect to a community septic system. Parcels that are 60 to 80 percent within the 100-foot setback are likely to have limited area for compliant OWTS and would likely need to install a bottomless sand filter system. There is an existing geographic waiver of experimental status for bottomless sand filters that serve an existing structure located within the 100-year floodplain of the Russian River. It was assumed that bottomless sand filters are the only suitable system type for these parcels. Dutch Bill Creek also has a floodway but parcels in the Dutch Bill Creek floodway are outside the geographic waiver area. Experimental systems are subject to more extensive monitoring and testing. Additionally, a limited number of experimental systems are approved. Due to the uncertainty of approval and increased costs of experimental status, parcels outside of the geographic waiver are assumed to require a different solution. See Figure 7 for the delineation of the FEMA 100-Year Flood Hazard Zone which indicates the range of parcels affected by this design criterion.

3.1.2.6 Advanced Protection Management Program Area Requirements

The proposed OWTS Manual includes special provisions for new and replacement OWTS within the APMP or impaired area adjacent to the Russian River. The impaired area of note is defined as 600 feet from the top of bank of the mainstem Russian River from Fife Creek to Dutch Bill Creek. Approximately 232 parcels within the Study Area fall either fully or partially within the impaired area, 164 of which generate wastewater. See Figure 3 for a map of the APMP area.

Supplemental treatment and/or enhanced effluent dispersal systems will be required unless the exception requirements, established in the OWTS Manual, are met. For the purposes of this study, both supplemental treatment and enhanced effluent dispersal were assumed to be required within the APMP area.

Per the OWTS Manual, enhanced effluent dispersal system means “any system type that uses pressurized distribution system for dosing and/or even distribution of the effluent throughout the dispersal system.” Based on conversations with the County, bottomless sand filters were not considered enhanced dispersal and supplemental treatment will be required for these systems. For the purposes of this study, supplemental treatment is assumed to be in the form of a pretreatment unit.

3.1.2.7 Community Systems

Community OWTS systems were developed based on a maximum design flow rate and site conditions for communal dispersal fields. Community systems were assumed to have a maximum design flow rate of 10,000 gpd. Community systems larger than this would be regulated by the Regional Board, potentially resulting in stricter regulatory requirements and additional treatment requirements and would likely make a large (greater than 10,000 gpd) community system cost prohibitive.

Parcels were grouped into community systems based on the following design criteria:

- Capacity of available parcels to build community dispersal areas,
- Eliminating pumping across the Russian River,
- Limiting pumping across Dutch Bill Creek,
- Limiting the amount of piping required, and
- Limiting the number of dispersal areas within the APMP area.

There are a limited number of parcels both within, and adjacent to, the Study Area that would be suitable for the siting of a community system dispersal area. The parcels selected for the siting of a community system were either vacant or larger parcels that are partially vacant with limited existing development. All community systems were assumed to be subsurface drip systems because of topography and/or the smaller footprint. The same criteria for sizing the individual dispersal areas were used for community dispersal areas. Subsurface drip systems require the installation of a pretreatment unit upstream of the dispersal area. It was assumed that the pretreatment units would be centralized for each community system and located at the dispersal area site.

The location of the community systems on the selected parcels was based on the criteria in the OWTS Manual. Minimum setbacks were considered, including setbacks to drainage channels. Drainage channels were identified based on LiDAR. As much as possible, it was assumed that community systems would be sited on slopes of less than 30 percent. Further site testing would need to be performed and land rights would need to be negotiated prior to the implementation of any of the community systems identified in this study.

Community systems would require transmission mains to convey wastewater from the connections to the centralized dispersal area. The pipe material selected for the community system transmission mains was high-density polyethylene (HPDE). HPDE is flexible and can be deflected to accommodate curvilinear alignments within roads, limiting the number of required fittings. HPDE can be installed in long lengths with fused joints. The pipes are sized to accommodate the design flow rate of the community systems. Pipes were assumed to be 2 or 3 inches in diameter based on manufacturer recommendations of 2-inch diameter piping for less than 31 connections and 3-inch diameter for 31 to 180 connections.

3.1.3 Project Description

Based on these design criteria, the most probable OWTS solution was identified for each developed parcel within the Study Area. Of the developed parcels within the Study Area, 441 parcels, approximately 57 percent, were identified as not likely to be suitable for an individual OWTS solution and would connect to a community system. The need to connect to a community system for approximately 78 percent of these parcels was due to the size of the parcel; approximately 21 percent was due to the proximity to the top of bank of the Russian River or Dutch Bill Creek, and the remaining 1 percent was due to being suitable for bottomless sand filters but outside of the waiver area.

Of the parcels identified to be suitable for individual OWTS solutions, subsurface drip systems were determined to be the most probable solution for the parcels with steeper slopes and the mound/at-grade mound or bottomless sand filter systems were determined to be the most probable solution for parcels that are larger with flatter topography, typically closer to the Russian River. See Figure 8 for a map of the distribution of these solutions. A summary of the assumed OWTS solutions is presented in Table 4.

Table 4: Analysis Results

Result	Number	Percentage
Connection to a community septic system	441	56.5%
Subsurface drip with a geotechnical evaluation	188	24.1%
Mound	102	13.0%
Subsurface drip	30	3.8%
Bottomless sand filter	18	2.3%
Bottomless sand filter with pretreatment	1	0.1%

Based on the analysis and design criteria, the parcels assumed to be connecting to community systems were separated into 20 community systems. The community systems are located throughout the Study Area. A preliminary layout of transmission mains and dispersal areas for the proposed community systems are presented in Figure 9. It should be noted that some of the transmission main alignments depict multiple parallel transmission mains, which are required by the 10,000 gpd system limit. The community system size and number of connections is summarized in Table 5.

Other configurations and permutations of community systems are possible. Negotiations to purchase the parcels or establish easements on the parcels that are selected in the study may reveal other viable locations for community dispersal facilities.

Table 5: Summary of Community Systems

System No.	Number of Connections	Flow Rate (gpd)	Approximate Transmission Main Pipe Length (ft)	Required Dispersal Area (square ft)[1]
1	23	6,000	6,350	24,000
2	33	8,200	6,000	32,600
3	32	9,400	5,950	37,600
4	19	8,400	4,300	33,600
5	36	9,600	11,550	38,300
6	39	9,500	14,370	37,900
7	17	4,800	1,250	19,200
8	11	4,600	6,500	18,200
9	12	5,400	3,000	21,400
10	25	5,900	5,200	23,400
11	5	1,300	1,500	5,300
12	30	8,400	5,000	33,600
13	2	700	650	2,900
14	5	1,200	950	4,800
15	42	10,000	6,600	39,800
16	25	6,400	6,150	25,400
17	38	9,600	5,230	38,400
18	3	700	1,070	2,900
19	40	9,800	8,000	39,400
20	4	1,000	1,350	3,800

1 – The required area is based on a subsurface drip dispersal type, an SAR of 0.5, and a 100% reserve area.

3.1.4 Governance and Management

A governing or managing agency would likely need to be established to maintain and monitor the onsite wastewater treatment systems within the Study Area. This would ensure compliance with wastewater and water quality standards, allow for long range planning and implementation of community solutions, and could enable the community to seek funding solutions. Without the creation of some sort of governance, funding sources may be limited.

For the purposed of cost estimating, it is assumed that the governing or managing agency would assume responsibility for the following tasks:

- Establishing operational permits.
- Conducting routine inspections (every 5 years).
- Managing operation and maintenance contracts for community systems.
- Performing long-range planning activities, including applying for design and implementation funding.

Upon establishment of a governing body, an initial round of inspections would likely be performed to establish more detailed records of the systems within the zone and identify OWTS in need of repair or replacement, cesspools in particular. Cesspools and failing systems would be prioritized for replacement with a code-compliant system. The governing body would likely help plan, attract funding, and facilitate negotiations for community systems as the need arises.

3.1.4.1 Governance and Management Options

In 2021, the North Coast Regional Board commissioned an Alternatives Governance Structures Analysis for the area. This report recommended the following options:

- Expansion of latent powers and/or sphere of influence of a local agency such as, Sonoma Water, Community Service Area (CSA) 41, Russian River County Sanitation District (RRCSD), or Sweetwater Springs Water Districts (SSWD),
- Creation of an onsite wastewater disposal zone (OWTS Zone), or
- Creation of a community service area.

All these options would likely involve the approval of the Local Agency Formation commission (LAFCO). The expansion of the latent powers of a local agency would depend on the local agency selected. Options include Sonoma Water, CSA 41, RRCSD, and SSWD. All of these are governed by the County except for SSWD which is governed by an elected board.

The expansion of Sonoma Water would likely require the creation of a new district, which was not recommended, due to the cost and time required. Additionally, Sonoma Water manages the neighboring sanitation district of RRCSD, which provides sanitary sewer services for the neighboring community of Guerneville. Bringing the Study Area within RRCSD's purview would require an expansion of its service area. There is a possibility that this expansion of service area could be incorporated into the larger regionalization of county sanitation districts that is currently being studied by other consultants in the West Sonoma County Water Quality and Recycled Water Supply Feasibility Study.

CSA 41 currently oversees water services for neighboring communities of Fitch Mountain, Freestone, Jenner, and Salmon Creek. It would require an expansion of the service area and latent powers. SSWD provides water services to the Study Area and neighboring community of Guerneville. This alternative would only require an expansion of power.

An OWTS Zone is a type of governance structure defined in the California Health and Safety Code. This governance structure is limited to mechanisms used to collect, treat, recycle, or dispose of wastewater without the use of sanitary sewers or sewage systems. The process to create an OWTS Zone depends on how it is initiated. This process can be initiated by a resolution of a local agency or a petition of the local agency by the registered voters or landowners. The resolution by a local agency shall include:

- A description of the boundaries and map of the zone,
- A description of the public benefit derived from the creation of the zone,
- The number of commercial and residential users in the proposed zone,
- The proposed means of financing the operations of the zone, and
- A hearing date where any interested persons shall be heard.

The process varies based on the number of protests lodged. It is assumed that the creation of an OWTS Zone would be initiated by a local agency. This process is more streamlined and likely less costly.

Both the creation of an OWTS Zone and expansion of latent powers would require LAFCO approval. This process would include:

- Conferring with LAFCO.
- Updating the municipal service review (MSR) of the selected local agency to reflect current organization, operations, and fiscal state.
- Amending the sphere of influence, which would allow the selected local agency to apply to LAFCO for approval for an expansion of service area and or powers.
- Holding public meetings to petition for the inclusion or exclusion of areas.
- Preparing documentation to support the annexations. This will include maps, a legal description of the areas to be annexed, justification of proposed annexation, service plan, fiscal data and a first-year budget.
- Holding public hearings to take testimony for and against the proposal.
- Waiting for a reconsideration period and protest processes.

The creation of a new sanitation area would be the most expensive governance option. This district could be a dependent district, governed by the County or independent district with an elected board of directors. The formation of a new special district has a high bar for acceptance and approval by LAFCO. Due to the cost and the numerous other options available, the creation of a new community service area is unlikely to be feasible.

For this alternative, the most likely form of governance is the creation of an OWTS Zone initiated by Sonoma Water. There are multiple local successful OWTS Zones in the surrounding area that were created under similar circumstances.

3.1.5 Construction Cost Estimate

Construction cost estimates developed for this study are for planning and comparison purposes only. The site conditions for each system impact the construction costs and may vary from what is presented. The construction estimates presented in Table 6 include site evaluation costs, material costs, installation costs, and labor costs for each OWTS solution.

Table 6: OWTS Alternative Construction Cost Estimate

OWTS Type	Quantity	Units	Unit Cost	Total
Community System 1	1	LS	$2,445,000	$2,445,000
Community System 2	1	LS	$2,461,000	$2,461,000
Community System 3	1	LS	$2,465,000	$2,465,000
Community System 4	1	LS	$1,836,000	$1,836,000
Community System 5	1	LS	$4,249,000	$4,249,000
Community System 6	1	LS	$4,913,000	$4,913,000
Community System 7	1	LS	$916,000	$916,000
Community System 8	1	LS	$2,342,000	$2,342,000
Community System 9	1	LS	$1,334,000	$1,334,000
Community System 10	1	LS	$2,149,000	$2,149,00
Community System 11	1	LS	$635,000	$635,000
Community System 12	1	LS	$2,178,000	$2,178,000
Community System 13	1	LS	$312,000	$312,000
Community System 14	1	LS	$533,000	$533,000
Community System 15	1	LS	$2,934,000	$2,934,000
Community System 16	1	LS	$2,335,000	$2,335,000
Community System 17	1	LS	$2,402,000	$2,402,000
Community System 18	1	LS	$468,000	$468,000
Community System 19	1	LS	$3,108,000	$3,108,000
Community System 20	1	LS	$573,000	$573,000
OWTS with Bottomless Sand Filter	18	EA	$84,800	$1,526,000
OWTS with Supplemental Treatment and a Bottomless Sand Filter	1	EA	$119,300	$119,000
OWTS with Subsurface Drip System	30	EA	$85,900	$2,577,000
OWTS with Subsurface Drip System Requiring Geotechnical Variance	188	EA	$104,600	$19,665,000
OWTS with Mound System	101	EA	$84,500	$8,619,000
Total Capital Cost Estimate for OWTS Alternative				**$73,094,000**

It is assumed that new septic tanks and pump tanks would be installed, and a new dispersal field would be constructed. Installation and labor costs reflect that construction may be difficult in much of the Study Area due to the local topography and road network.

Equipment costs were estimated based on information from manufacturers and distributers. The manufacturers and distributers consulted included Orenco Systems, Jensen Precast, Environmental One (E-One) Corporation, Shape Incorporated, American Tank Company, Ferguson, GeoFlow, and Pace Supply.

There are a variety of available pretreatment units that are approved for use in the County. For the purposes of this study, the cost for Orenco AdvanTex units was utilized for the cost estimate of pretreatment units. Cost estimates include the price for a telemetry enabled control panel. For pretreatment units on individual OWTS, the AX-RT was used for the cost estimate. For community systems, AX-Max units were the basis of the cost estimates. Community systems with a flow rate of less than 2,400 gallons per day are anticipated to use chained AX-RT units.

The capital cost estimates for the OWTS Alternative does not include any cost associated with surveying. Community systems will likely need survey services for easements or property line adjustments for the dispersal fields. Additionally, some smaller parcels may require boundary surveys to confidently determine where property lines are and ensure that setbacks are maintained. Monuments are sparse in the Study Area, which increases the price. Many monuments previously installed in the Study Area were biodegradable (i.e. wood) and are no longer identifiable.

3.1.6 Operation and Maintenance Cost Estimate

Operation and maintenance (O&M) costs were estimated for each system type and each community system and are presented in Table 7. The O&M costs for individual systems were estimated for a two-bedroom system, similarly to the capital costs. The main causes for variations in O&M costs of each system type is the number of pumps and if a pretreatment unit is required.

Table 7: OWTS Alternative O&M Cost Estimate

OWTS Type	Unit[1]	Annual Cost/Unit	Annual Cost
Community System 1	23	$1,164	$27,000
Community System 2	33	$1,131	$37,000
Community System 3	32	$1,262	$40,000
Community System 4	19	$1,653	$31,000
Community System 5	36	$1,174	$42,000
Community System 6	39	$594	$23,000
Community System 7	17	$1,202	$20,000
Community System 8	11	$1,615	$18,000
Community System 9	12	$1,885	$23,000
Community System 10	25	$1,106	$28,000
Community System 11	5	$1,299	$6,000
Community System 12	30	$1,207	$36,000
Community System 13	2	$1,503	$3,000
Community System 14	5	$1,006	$5,000
Community System 15	42	$1,115	$47,000
Community System 16	25	$1,154	$29,000
Community System 17	38	$1,137	$43,000
Community System 18	3	$1,299	$4,000
Community System 19	40	$1,118	$45,000
Community System 20	4	$1,215	$5,000
OWTS with Bottomless Sand Filter	18	$814	$15,000
OWTS with Supplemental Treatment and a Bottomless Sand Filter	1	$1,123	$1,000
OWTS with Subsurface Drip System	218	$1,123	$245,000
OWTS with Mound System	102	$291	$30,000
Total Annual O&M Cost Estimate for OWTS Alternative			**$803,000**

1- Units are connections for the community systems and systems for the individual OWTS.

The frequency for replacement of parts and electricity use are based on manufacturer recommendations and specifications. The electricity use may be variable depending on occupancy, usage, and pump selection. The frequency of septage hauling for septic tanks is assumed to be 5 years.

It is assumed that regular inspections of septic systems will be required by the governing agency. To be conservative, the operational permit fee is based on the County's fee schedule and is assumed to remain constant year to year. The County does have a Reduced Annual Fee Program which reduces the cost based on the length of compliance with the program. If the homeowner submits the reporting forms and annual fees on time for two years, the fee is reduced by half and if they do so for three years the fee is reduced by two-thirds.

There is an economy of scale for the O&M costs for community systems' pretreatment electricity and monitoring costs. It was assumed that the operation, maintenance, repairs, inspections, and monitoring of community systems will be performed by the governing agency.

3.1.7 Life Cycle Cost Analysis

To compare the different alternatives, a 50-year present worth analysis was performed. An interest rate of 2.5 percent was used based on the December 2023 OMB Circular No. A-94 Appendix C for Real Interest Rates on Treasury Notes and Bonds of Specified Maturities for a 30-year period. Interest rates for longer periods of time were not available.

Permitted systems and repairs were used to estimate a replacement date for each parcel. Parcels with no septic permits were assumed to be installed pre-code (before 1971). A useful life of 50 years was assumed for each septic system. The OWTS improvements were phased by decade based on when the systems had reached the end of their useful life. For example, systems that would reach their useful life in the first 10 years after project implementation were included in the Phase 1 improvements. The community systems were assumed to need replacement at the time of the median replacement date of the parcels to be connected. The operation and maintenance costs for a typical year were used for both individual and community OWTS.

Over a 50-year period, it was estimated that the total present worth of the Onsite Wastewater Treatment Alternative was approximately $95,415,000. Table 8 lists the present worth for each system type.

Table 8: OWTS Alternative Present Worth Estimate

OWTS Type and Phase	Connections	Capital Cost Estimate	Annual O&M Cost Estimate	Operating Years	Present Worth Estimate
Bottomless Sand Filter Phase 1	10	$848,000	$8,100	50	$1,087,000
Bottomless Sand Filter Phase 2	2	$170,000	$2,100	40	$224,000
Bottomless Sand Filter Phase 3	2	$170,000	$2,700	30	$228,000
Bottomless Sand Filter Phase 4	2	$170,000	$3,400	20	$226,000
Bottomless Sand Filter Phase 5	2	$170,000	$4,400	10	$212,000
Supplemental Treatment and a Bottomless Sand Filter	1	$119,000	$1,100	50	$152,000
Subsurface Drip System Phase 1	20	$1,718,000	$22,500	50	$2,378,000
Subsurface Drip System Phase 2	2	$172,000	$2,900	40	$247,000
Subsurface Drip System Phase 3	4	$344,000	$7,400	30	$505,000
Subsurface Drip System Phase 4	4	$344,000	$9,400	20	$500,000
Subsurface Drip System with Geotechnical Variance Phase 1	139	$14,539,000	$156,000	50	$19,124,000
Subsurface Drip System with Geotechnical Variance Phase 2	3	$314,000	$3,400	40	$402,000
Subsurface Drip System with Geotechnical Variance Phase 3	13	$1,360,000	$14,600	30	$1,680,000
Subsurface Drip System with Geotechnical Variance Phase 4	17	$1,778,000	$19,100	20	$2,095,000
Subsurface Drip System with Geotechnical Variance Phase 5	16	$1,674,000	$18,000	10	$1,849,000
Mound System Phase 1	78	$6,507,000	$22,400	50	$7,164,000
Mound System Phase 2	5	$423,000	$1,500	40	$460,000
Mound System Phase 3	10	$930,000	$3,200	30	$1,000,000
Mound System Phase 4	7	$592,000	$2,000	20	$625,000
Mound System Phase 5	2	$169,000	$600	10	$175,000
Community System Phase 1 (Systems 1-9, 12, 14-16, and 19-20)	368	$34,622,000	$409,500	50	$46,648,000
Community System Phase 2 (System 17)	38	$2,402,000	$51,300	43	$3,797,000
Community System Phase 3 (System 13)	2	$312,000	$4,600	33	$419,000
Community System Phase 4 (System 10)	25	$2,149,000	$27,600	30	$2,755,000
Community System Phase 5 (System 18)	3	$468,000	$6,500	29	$608,000
Community System Phase 6 (System 11)	5	$635,000	$14,300	18	$855,000
Total Present Worth of the OWTS Alternative					**$95,415,000**

3.2 CENTRALIZED SEWAGE COLLECTION SYSTEM ALTERNATIVE

The Centralized Sewage Collection System Alternative consists of the construction of a centralized sewage collection system with conveyance of the wastewater to an existing wastewater treatment plant. The building of a new treatment plant for the Study Area was not considered as the construction, operation and maintenance of a small wastewater treatment plant is not typically financially feasible due to the regulatory requirements and the low economy of scale. This was experienced by the community as a new wastewater treatment plant to serve the study area was designed under a previous project, which ultimately failed due to difficulties securing sufficient funding.

For this study, it was assumed that the wastewater treatment plant that would receive, treat, and dispose of the wastewater from the Study Area would be the RRCSD wastewater treatment plant in Guerneville. There are other wastewater treatment plants within Sonoma County that could also provide wastewater treatment and disposal services to the Study Area such as the Windsor Water Reclamation Facility and the Laguna Wastewater Treatment Plant. However, these other options would likely require a much more regional solution to make it financially feasible. Sewer regionalization of the greater west Sonoma County area is currently being studied by others.

3.2.1 Design Criteria

In evaluating the feasibility of this alternative, wastewater generation rates were estimated for developed parcels, initial layouts and sizing of collection system facilities was performed, and cost estimates were developed for upfront construction and ongoing operation and maintenance costs.

3.2.1.1 Wastewater Generation Estimates

The area served by the proposed sewer collection system encompasses the entirety of the Study Area. Wastewater generation estimates for the Study Area were developed based on flow rates from the Fourth Edition Metcalf & Eddy Wastewater Engineering Treatment and Reuse (Metcalf & Eddy). It was assumed each single-family home is a household of 2 people and each unit within a multifamily connection is equivalent to an apartment. Wastewater generation for commercial and public connections were estimated by assuming number of employees, persons served, available restrooms, and various other factors. Similar to the analysis for the OWTS Alternative, it was determined that some of the parcels are developed but produce no flow. For example, parcels that house drinking water infrastructure, such as wells or storage tanks, do not have wastewater generating infrastructure.

The peaking factor for wastewater generation was estimated to account for the possibility of infiltration and inflow. This is especially important because a portion of the Study Area is within the 100-year flood plain which increases the risk for inflow and infiltration. However, considerations can be made to reduce the likelihood of inflow and infiltration. For example, a pressure sewer is less likely to experience infiltration than a gravity sewer, watertight structures can be specified, and particular pipe material can reduce the likelihood of infiltration. According to Metcalf & Eddy, a typical peaking factor for the population of the Study Area is 4. This peaking factor could potentially be reduced depending on the collection system type and design.

One of the potential funding sources, the State Revolving Fund, permits a 10 percent allowance to the preliminary design criteria to account for unknowns during planning and future growth. The average wastewater flow from the Study Area, with the 10 percent growth, was estimated to be approximately 164,000 gpd and the peak wastewater flow was estimated to be 608,000 gpd. An estimation of wastewater generation by connection type is presented in Table 9.

Table 9: Total Study Area Wastewater Generation Estimates per Connection Type

Connection Type	Number of Connections	Average Wastewater Generation Per Connection (gpd)	Total Estimated Average Daily Wastewater Generation (gpd)	Total Estimated Peak Daily Wastewater Generation (gpd)
Single Family Dwelling	704	158	111,000	444,000
Multi-Family Dwelling	39	390	15,000	61,000
Commercial	30	420	13,000	50,000
Public	8	1,356	11,000	43,000
Subtotal			149,000	553,000
Total with 10% Growth			**164,000**	**608,000**

3.2.1.2 Collection System Type

It was assumed for this study that the proposed centralized sewer would be designed to be a low-pressure collection system. A low-pressure system eliminates the need for pipelines to be installed with continuous positive slope to maintain gravity service and a minimum flow velocity, as is required for a traditional gravity sewer. Pipelines in a low-pressure system can be installed at minimum depths, following the topography of the public roads upon which they are aligned, therefore requiring significantly less excavation. This is especially true for areas with variable topography, like that of the Study Area. The diameter of the pressure pipelines can be much smaller than those for gravity systems.

Pressurized systems also reduce the risk for infiltration and inflow. Gravity systems require manholes that can allow water to inflow during rain events and unpressurized pipes are more susceptible to root intrusion and infiltration of groundwater. Pressure pipes have a reduced risk of infiltration because of the pressure in the pipe and the typical pipe materials utilized. There are two main types of low-pressure collection systems: grinder pump systems and septic tank effluent pumping (STEP) systems.

A STEP system uses on-site treatment in the form of a septic tank to remove solids. The solids are settled and only the liquid portion of the effluent is pumped into the collection system. Some of the parcels within the Study Area have existing septic tanks. These existing tanks would have to be evaluated for condition and watertightness prior to utilization for a STEP system. The parcels that do not have a septic tank, have a septic tank in poor condition, or have a septic tank that is insufficiently sized would have to install a new septic tank. Septic tanks must be pumped on a regular basis and therefore a STEP system has higher operation and maintenance costs than a grinder pump system.

Although there may be some construction cost savings associated with utilizing existing septic tanks for a STEP system, the cost associated with initially evaluating the septic tanks and then the regular septic tank pumping costs make it unlikely that a STEP system would be a financially feasible collection system alternative for the Study Area. In addition, utilizing existing septic tanks for a

STEP system does not allow for any reserve storage volume in the event of power failure. STEP systems were not considered further in this study.

Grinder pump systems collect sewage from the business or residence in a wet well, and simultaneously grind and pump sewage to a pressurized sewer main. A grinder pump system does not provide treatment of the wastewater at the connection. An individual grinder pump station would be required at each of the connections. For the purposes of this study, it was assumed that the collection system would be a grinder pump system.

The grinder pump wet well would likely be located near the existing sewage outlet, so replumbing of buildings would not be required. These grinder pumps would have to be located to allow gravity flow to the wet well and would likely need to maintain the setbacks for a septic tank outlined in the County OWTS Manual. If further piping is needed to meet these requirements it would be the responsibility of the connecting homeowner. Normally, for septic to sewer projects utilizing pressure sewers, the grinder pump station is located where the septic tank was installed previously – thus simplifying the connection to the household plumbing and excavation requirements. It is also assumed for this alternative that existing septic tanks will be properly decommissioned (i.e. taken out of service and backfilled with granular material) for all properties.

There are several different manufacturers of grinder pump systems, but the leading manufacturer is E-One Sewer Systems of Niskayuna, New York. E-One manufactures the modular wet well, grinder pump, pump control panel, and lateral kit which includes a ball and check valve assembly. Information supplied by E-One Sewer Systems was used as a basis for this preliminary design analysis. Image 1 is an image of an E-One wet well with the grinder pump equipment.

Image 1 – E-One Wet Well Cutaway with Pumping Equipment

The grinder pump system used for this analysis is the E-One W-Series. The W-Series contains an approximately 230-gallon wet well equipped with a one-horsepower progressing cavity-type pump with a grinder-equipped inlet. The 1-HP pump can discharge between 8 and 14 gallons per minute (gpm) of wastewater into a 1.25-inch diameter HDPE lateral that connects to either a gravity or pressurized sewer main. The sump can serve as emergency storage in case of a short-term power outage. The E-One unit chosen to be installed on each property will be able to store approximately 24 hours of wastewater flow in the case of an extended power outage.

The pump control panels would include radio or cellular telemetry for data communications to a central satellite-based control system, allowing the governing agency to remotely monitor the system and ensure each pump station is functioning. The wet well and grinder pump unit would be operated by the governing agency and the homeowner would not be responsible for maintenance or monitoring of the individual units. The homeowner would be responsible for the electricity needs of the grinder pump (estimated to be approximately $4 per month). Providing separate electrical service connections and meters for every grinder pump installation is not considered financially viable.

The E-One pumps have built in water level sensors, so the system does not need to rely on float switches for operation. The pump panel would include a generator receptacle which would allow for use of a portable generator to power the pump stations in the case of an extended power failure and a cellular transmitted telemetry that would transmit the system information to the governing agency.

Since there is no treatment inherent with a grinder pump system, all the sewage treatment would occur at the wastewater treatment plant. The grinder pump systems would not require onsite solids removal, eliminating the need for septage pumping by a septic hauler.

3.2.1.3 Pipe Material and Sizing Criteria

The pipe material selected for this alternative was high-density polyethylene (HPDE). HPDE is fairly flexible and can be deflected to accommodate curvilinear alignments within roads. This limits the number of required fittings. HPDE can be installed in long lengths with fused joints. This virtually eliminates ground water infiltration which is a major concern for the portions of the Study Area – particularly areas within the floodplain.

The system pipelines are sized conservatively so that the pipes can accommodate the flow from both developed parcels and the 10 percent assumed future growth. This allows for conservative pipe sizing to serve developed parcels during peak wastewater generation, in the case that more connections are flowing concurrently than estimated. The pipes were sized based on the probable number of concurrently active grinder pumps. This estimation of the probable number of flowing connections is based on the manufacturer (E-One) recommendations for design which is summarized in Table 10 below.

Table 10: Pipe Sizing Requirements

Pipe Size	Maximum Number of Connections	Number of Flowing Connections
2-inch	31	6
3-inch	180	11
4-inch	444	19
6-inch	>444	39

In parts of the Study Area, the roadways are narrow and may not be wide enough to accommodate the new sewer and existing water mains with the required minimum separation. The default minimum separation is ten feet horizontally and one foot vertically. Many of the roads, especially in the hillier portions of the study area are narrow, steep, and single lane roadways. However, HDPE can be installed in way such that the minimum required separation could potentially be reduced. The extent of the utility conflicts would be determined during the design phase after topographic mapping was done for the relevant roadways.

3.2.2 Project Description

The Centralize Sewage Collection System Alternative includes development of a centralized sewer system and conveyance of wastewater to the RRCSD wastewater treatment plant. Wet wells with grinder pumps would be installed on each developed property to be connected to the sewer. A common force main would convey the flow from each of the connection to centralized lift station(s). Likely two centralized main lift stations would be required to serve the Study Area, one on either side of the Russian River. The crossing of the Russian River and Dutch Bill Creek would occur in casings under the existing bridges. Similar casings would be used to cross bridges in local roads that cross smaller waterbodies. The proposed collection system layout including the proposed locations of the centralized lift stations are presented in Figure 10.

The effluent would be transported to a local WWTP, the closest is RRCSD. There is an existing force main in the southwest area of Guerneville. The trunk main could connect to the existing force main that serves this portion of Guerneville. The effluent would be transported to the existing WWTP located to the north of Northwood Golf Course through the existing Vacation Beach Lift Station. See Figure 11 for possible transmission main alignment options.

There are two optional force main alignments for conveying wastewater to the RRCSD wastewater treatment plant.

- The first option proposes connecting the force main to the existing RRCSD force main serving the District's Main Pump Station, just upstream of the existing force main crossing of the Russian River. This alternative utilizes a portion of the RRCSD collection system including one of the existing lift stations, prior to the wastewater treatment plant.
- The second option proposes connecting to the RRCSD wastewater treatment plant more directly utilizing an existing pipeline that crosses the Russian River near the Northwood Golf Club. This pipeline was constructed when a recycled water main was constructed to provided recycled water for irrigation of the golf course property. This alternative would not rely on the existing RRCSD collection system, however, the condition of this existing pipeline under the river is unknown.

The sizing of the force main sections throughout the collection system were determined based on the estimated flow rate contributing to that section. Based the preliminary collection system layout presented in Figure 10, the length of pipe per size are listed in Table 11.

Table 11: Required Collection System Pipe Lengths

Pipe Size	Length of Pipe (ft)
2-inch	32,610
3-inch	38,010
4-inch	6,660
6-inch	3,880

The length of pipe required for the transmission main depends on the route taken. Based on the connection to the pipeline in Guerneville and Vacation Beach Lift Station, 10,180 feet of 6-inch pipe would be required.

3.2.3 Governance and Management

A governing or managing agency would need to be established to plan, implement, operate, and maintain a centralized sewer system to serve the Study Area. The most likely existing agency that could assume this responsibility would be the RRCSD, as the owners and operators of the wastewater treatment plant that the Study Area is most likely to connect to. However, the governing agency could be different if a different wastewater treatment plant is selected to serve the Study Area. The governing district would be responsible for the following:

- Collection and treatment of wastewater,
- Maintenance of conveyance and treatment equipment,
- Inspection and repair of grinder pumps,
- Billing, and
- Applying for grants and funding.

The expansion of the RRCSD would require LAFCO approval. This process would include:

- Conferring with LAFCO.
- Updating the municipal service review (MSR) of RRCSD to reflect current organization, operations, and fiscal state.
- Amending the sphere of influence, which allows RRCSD to apply to LAFCO for approval for an expansion of service area.
- Public meetings to petition for the inclusion or exclusion of areas.
- Preparing documentation to support the annexations. This will include maps, a legal description of the areas to be annexed, justification of proposed annexation, service plan, fiscal data and a first-year budget.
- Documenting that existing capacity is sufficient. If the existing capacity is insufficient, documenting the necessary plan for expansion.
- Public hearings to take testimony for and against the proposal.

- A reconsideration period and protest processes.

Once the existing district has been expanded, the responsibility for the centralized sewer system within the Study Area would be assumed by Sonoma Water as part of their management of RRCSD. From discussions with Sonoma Water staff, several existing wastewater treatment system weaknesses have been identified. However, these issues exist, and require resolution, whether or not RRCSD accepts the wastewater from the Study Area. These weaknesses include headwork capacity, piping between the aeration basins and the secondary clarifiers, and the disposal facilities. Solutions to these issues are currently being addressed by RRCSD.

3.2.4 Construction Cost Estimate

The cost estimate includes the cost for construction of the collection system to serve currently developed parcels and 10 percent growth. Undeveloped parcels may connect to the collection system in the future. Additional infrastructure may be required to do so at the time of connection. If extra plumbing is required to install the grinder pumps, this will be the responsibility of the homeowner of the connecting parcel. The variable nature and lack of records for existing plumbing connections made estimating these costs impractical. However, since new grinder pump installations will normally be made in the location of the existing septic tanks, plumbing connections will be of minimal cost to the parcel owner.

The total construction cost estimate for the Centralized Sewage Collection System Alternative is approximately $51,520,000. The budgetary capital cost estimates are summarized in Table 12.

Table 12: Centralized Sewage Collection System Alternative Construction Cost Estimate

Item Description	Quantity	Unit	Unit Price	Estimated Capital Cost
Traffic Control	1	LS	$200,000	$200,000
Existing Septic Tank Decommission	780	EA	$3,200	$2,496,000
Grinder Pump Package	780	EA	$20,000	$15,600,000
Lateral Installations	780	EA	$5,400	$4,212,000
Building Electrical Connection	780	EA	$3,000	$2,340,000
6-inch HPDE Transmission Main to RRCSD WWTP	10,180	LF	$120	$1,221,000
6-inch HPDE Collection Force Main	3,880	LF	$120	$465,000
4-inch HPDE Collection Force Main	6,660	LF	$115	$767,000
3-inch HPDE Collection Force Main	38,000	LF	$112	$4,266,000
2-inch HPDE Collection Force Main	32,610	LF	$103	$3,368,000
Community Pump Stations	2	EA	$300,000	$600,000
Air Release Valve	87	EA	$18,000	$1,566,000
Cleanouts and Other Appurtenances	1	LS	$250,000	$250,000
Caltrans Bridge Crossings	2	EA	$111,100	$222,000
Local Road Bridge Crossings	9	EA	$25,000	$225,000
Potential Utility Conflict	361	EA	$3,500	$1,264,000
Caltrans Road Restoration (Transmission)	10,630	LF	$175	$1,860,000
Caltrans Road Restoration (Force Main)	10,180	LF	$175	$1,781,000
Local Road Restoration	70,540	LF	$125	$8,817,000
Total Construction Cost Estimate for Centralized Sewage Collection System Alternative				**$51,520,000**

Manufacturers and distributors consulted for cost estimates included E-One Corporation and Shape Incorporated, respectively. The estimation of number of air release valves, cleanouts and other appurtenances is based on the design recommendations from E-One.

3.2.5 Operation and Maintenance Cost Estimate

Operation and maintenance (O&M) costs include regular maintenance on low pressure collection mains, transmission force mains, individual grinder pump stations and main lift stations, equipment replacement costs, electricity and monitoring costs, and occasional emergency maintenance. The estimated annual O&M costs for the Centralized Sewage Collection System Alternative are summarized in Table 13.

Table 13: Centralized Sewage Collection System Alternative O&M Cost Estimate

Description	Annual Estimate
Scheduled Maintenance	$24,000
Line Cleaning	$13,000
Equipment Replacement	$157,000
Grinder Pump Electricity Cost	$36,000
Telemetry Monitoring	$78,000
Emergency maintenance	$43,000
Transmission Pump Station Maintenance and Operation	$73,000
Transmission Pump Station Electricity Cost	$6,800
Total Annual O&M Cost Estimate for Centralized Sewage Collection System Alternative	**$430,800**

The frequency for replacement of parts and electricity use are based on manufacturer recommendations and specifications. The electricity use may be variable depending on occupancy, usage, and pump selection. The regular inspections of grinder pumps, operation of the pump stations, scheduled maintenance, and emergency maintenance will be the responsibility of the governing agency.

All operation and maintenance costs (except for the cost of electricity to run the grinder pump) would be included in the monthly rate paid to the governing agency. The current RRCSD rate is $2,290 per year per equivalent single-family dwelling (ESD), or $190.83 per month per ESD. The rates charged for connections within the Study Area would be the same or potentially higher than this current rate. While the proposed connection system would utilize very little of the RRCSD collection system, the maintenance of the new collection system is expected to be similar. Therefore, for cost estimating purposes the existing RRCSD rate and the estimated electricity costs to operate the grinder pumps was utilized to calculate the annual O&M cost and perform the life cycle cost analysis. Based on these assumptions, the user cost per ESD is estimated to be $195 per month.

3.2.6 Life Cycle Cost Analysis

To compare the different alternatives, a 50-year present worth analysis was performed. The interest rate used is 2.5 percent according to the December 2023 OMB Circular No. A-94 Appendix C for Real Interest Rates on Treasury Notes and Bonds of Specified Maturities for a 30-year period. Interest rates for longer periods of time were not available.

For this life cycle analysis, it was assumed that the system would be built out as a single project. The annual operation and maintenance costs, based on the RRCSD rates, were utilized when estimating the present worth of the Centralized Sewage Collection System Alternative. Table 14 lists the present worth for the Centralized Sewage Collection System Alternative utilizing the design average year for the operation and maintenance costs.

Table 14: Centralized Sewage Collection System Alternative Present Worth Estimate

Cost Consideration	Centralized Sewage Collection System Alternative
Capital Cost Estimate	$51,520,000
Present Worth Estimate of Operation & Maintenance Cost	$53,683,000[1]
Total Project Present Worth Estimate for Centralized Sewage Collection System Alternative	**$105,203,000**

[1] Approximately $1,828,000 annually

4. ALTERNATIVES COMPARISON

The two alternatives were compared based on the following criteria:

- Estimated project costs (capital cost, operation and maintenance costs, and life cycle cost),
- Funding potential,
- Constructability,
- Resiliency, and
- Implementation.

The two alternatives were ranked in a decision matrix based on these criteria and preferred alternative was selected.

4.1 CONSIDERATIONS

The alternatives presented in this study, the OWTS Alternative and the Centralized Sewage Collection System Alternative, were developed with the purpose of bringing the community into compliance with California State and Regional Board standards for wastewater disposal. Ultimately, these alternatives aim to reduce and ultimately eliminate the possibility of discharging untreated wastewater into Dutch Bill Creek and the Russian River, thereby reducing pathogen pollution.

The OWTS Alternative achieves the project need by, over time, performing repairs and replacements of OWTS throughout the Study Area and implementing the use of community systems. Implementing community systems, for over half of the parcels in the Study Area, would allow for these parcels to connect to a fully compliant system when they may otherwise only be able to install a substantially conforming system. This protects the water quality more completely.

The Centralized Sewage Collection System Alternative achieves the project need by conveying wastewater out of the Study Area for treatment and disposal at an existing wastewater treatment facility. This would mean that the wastewater would be treated to meet the standards established by the Regional Board for that facility, typically a higher level of water quality than can be achieved by most OWTS. Also, it provides the opportunity for the treated wastewater to be utilized for beneficial reuse. This alternative has the ability to achieve the project objective for the entire Study Area in a significantly shorter time period.

Both alternatives provide benefits to the Study Area, while also presenting challenges. These benefits and challenges of each alternative are detailed and discussed in the following sections and will be utilized to select a preferred alternative.

4.1.1 Estimated Project Costs

A summary of the estimated capital costs, operation and maintenance costs, and life cycle costs are presented in Table 15.

Table 15: Cost Summary

Cost Consideration	OWTS Alternative	Centralized Sewage Collection System Alternative
Capital Cost Estimate	$73,095,000	$51,520,000
Present Worth Estimate of Operation and Maintenance Cost Estimate	$22,320,000[1]	$53,683,000[2]
Total Project Present Worth Estimate	**$95,415,000**	**$105,203,000**

[1] Varies from approximately $620,000 to $820,000 annually
[2] Approximately $1,828,300 annually

The capital cost of the Centralized Sewage Collection System Alternative is lower than the capital cost of the OWTS Alternative; however, the operation and maintenance costs are higher. This increased O&M cost of the Centralized Sewage Collection System Alternative is due to labor costs of the governing agency, whereas the repairs and maintenance of individual OWTS are assumed to be performed by homeowners with no labor cost. The monitoring and maintenance for the community systems is assumed to be conducted by staff of the governing agency.

The higher operation cost is sufficient to overcome the lower capital cost of the Centralized Sewage Collection System Alternative during the 50-year life cycle period. The life cycle cost of the OWTS Alternative is approximately $9.8 million dollars less over the 50-year time span.

4.1.2 Funding Potential

There are many potential funding sources for community level projects that aim to improve water quality and human health, including wastewater infrastructure. However, sources typically do not provide funding to offset operation and maintenance costs, only capital costs. Also, there are significantly more funding sources available for septic to sewer projects, such as the Centralized Sewage Collection System Alternative.

One possible source of funding is the Clean Water State Revolving Fund Program (State Revolving Fund). For the State Revolving Fund, there is a cap of $45,000 per household for decentralized project capital costs. This is a significant deficit of funding for all the OWTS, especially the systems that require pretreatment units. The average capital cost for the OWTS Alternative is $94,000 resulting in a deficit of $49,000 per household. The cap for septic to sewer projects is $125,000 per household which would cover the estimated capital cost estimate of $68,000 per household. The Centralized Sewage Collection System Alternative is also eligible for other funding sources such as the United States Department of Agriculture Rural Development programs.

To secure funding, typically a managing agency must apply for the grant money and provide some assurance of the ongoing benefits of the project. For the Centralized Sewage Collection System Alternative, a managing agency would need to be established to operate and maintain the collection system. Although a decentralized solution such as the OWTS Alternative may not require a governing agency for individual OWTS, to secure funding a managing agency would need to be established. Funding for individual homeowners is less readily available and individual OWTS would need to be a part of a community wide solution to potentially secure funding. A managing agency would be required for the community OWTS for planning, operation, and maintenance purposes, and therefore funding for these systems would likely be more readily available.

4.1.3 Constructability

The road network in upper portions of the Study Area is steep, narrow, and winding which will be a significant factor in the complexity and cost of construction of project components – particularly pipelines for either community OWTS systems or a centralized sewer system. In addition, it may be difficult to transport large items such as septic tanks and pump station wet wells for delivery to parcels that have restricted access due to the road network. Some parcels may not be readily accessible to heavy equipment for construction due to steep topography, which also will increase the construction cost.

The water distribution system served by the Sweetwater Springs Water District is located in most of the of the road network in the Study Area. Separation requirements between potable water and septic or sewer mains will be a factor with the design and construction of a OWTS community system or a sewer collection system. This complexity will be most accentuated in the upper portions of the Study Area where the public roadways are narrower and winding. In the lower areas of the Study Area, the public roadways are generally wider and straighter.

The primary vegetation types of the area also could make construction difficult and reduce the longevity of OWTS. Redwoods have a large network of shallow roots that make installation and maintenance of OWTS difficult. Redwood roots are also more likely to intrude into and damage the dispersal areas. Additionally, ivy can cause moisture to be retained in the soil which can limit the effectiveness of septic systems. Vegetation will have to be cleared for the installation and maintenance of a septic system. This can be expensive and potentially undesirable for property owners. It can also reduce the stability of steep slopes which would require some degree of intermediary erosion control measures. Herbaceous vegetation can be grown on top of septic systems, however, due to the amount of shade from surrounding trees it may be difficult to maintain, especially in smaller systems.

4.1.4 Resiliency

The Study Area is susceptible to flooding and power outages. Consideration will need to be made during the design of the selected alternative to ensure the smallest impact of these types of emergency events.

Power outages are a concern with any system that relies on electricity for conveying or treating wastewater. It is less of an issue for OWTS that have a gravity dispersal system. However, all the proposed OWTS types in this study do have some pumping component. Non-standard systems require electricity to pump effluent to the dispersal fields. Septic tanks can be designed to have extra capacity to provide emergency storage during power outages. The proposed collection system type for the Centralized Sewage Collection System Alternative, is a low-pressure collection system that relies on the grinder pump stations at each of the sewer connections. Each grinder pump station can be equipped with extra-large wet wells to provide emergency storage during outages. The grinder pump station control panels can also include connections for portable generators. The advantage the Centralized Sewage Collection System Alternative has is that there would likely be a community wide emergency action plan. This emergency plan would include procedures for the deployment of a generator(s) during extended power outages.

Flooding is a concern for both OWTS and centralized sewer collection systems as the inundation of the system components can affect the operation of the septic systems. OWTS can be less resilient and more susceptible to damage and malfunction during a flooding event than sewer systems. Septic tanks with cracks or that are otherwise not watertight, may leak raw sewage into the environment. Additionally, when the septic dispersal area is flooded, treatment is limited, and untreated wastewater may also leak into the environment from the dispersal area. Homeowner inspections after inundation are critical for maintenance and long-term functionality of systems. Any required improvements to the OWTS would be the responsibility of the homeowner.

Flooding can impact a sewer collection system through the increased potential of inflow and infiltration. However, with the proposed pressure-type collection system there would be limited infiltration and inflow compared to a gravity system type. The main component of concern for inflow or infiltration is the grinder pump wet well. The grinder pump wet well can be designed to have watertight lids for those connections serving parcels most likely to flood.

4.1.5 Implementation

The ease with which the alternatives could be implemented influences the feasibility of the alternatives. The more complex the project, the longer it may take to implement and therefore the less likely the project would be completed and achieve the project objectives.

The OWTS Alternative is a complex solution to the wastewater treatment issues the Study Area faces. The OWTS Alternative relies on homeowners for the design and construction of individual systems and the managing agency for the design and construction of community systems. The OWTS replacements have varying timelines for implementation, based on the needs of the systems being replaced and other circumstances. Extensive site evaluation is required for both individual parcels and parcels to be considered for community systems. Additionally, community systems require the establishment of easements and property rights, which could take a significant amount of time.

The Centralized Sewage Collection System Alternative has the ability to be implemented in a shorter timeframe than the OWTS Alternative. The Centralized Sewage Collection System Alternative would be implemented either all at once or potentially in a two-phase approach, making implementation less complex. There is a much clearer governmental agency choice, RRCSD, that would implement this project. Although design, construction, and sourcing project funding may take an extended period of time, this would only have to occur once (or twice depending on the phasing) for the project to benefit the entire Study Area.

4.2 Selection of Alternative

The two alternatives were evaluated and ranked for each of the five considerations: cost; funding sources; construction; resiliency; and implementation.

There are multiple elements of cost that inform the selection of a preferred alternative including capital costs, ongoing O&M costs, and the present worth of each alternative. The initial capital cost for the OWTS Alternative is higher than the capital cost for the Centralized Sewage Collection System Alternative. The annual O&M cost for the Centralized Sewage Collection System Alternative is higher than for the OWTS Alternative. However, the present worth of the OWTS Alternative is lower than the Centralized Sewage Collection System Alternative.

A possibility of being able to secure funding to offset capital costs exists for each of the alternatives. However, there are more funding opportunities available for community solutions. Funding sources would likely be available to offset the entire capital cost of the Centralized Sewage Collection System Alternative. Whereas funding sources would likely only be easily secured for the community systems portions of the OWTS Alternative as funding for improvements on individual parcels may be difficult to secure. For this reason, the Centralized Sewage Collection System Alternative has a general advantage over the OWTS Alternative in terms of being a fundable project.

Construction within the Study Area is likely to be difficult for both alternatives but may be easier for the Centralized Sewage Collection System Alternative. Both alternatives involve pipelines to be installed within the public road network which is steep, narrow, and winding and the drinking water distribution system is already installed in many of the roadways. However, the OWTS Alternative has the additional challenge that many of the properties (approximately 24 percent of the developed parcels within the Study Area) are located on steep terrain and have thick vegetation, making construction of OWTS on those parcels more expensive, if at all practical. The Centralized Sewage Collection System Alternative is deemed more constructable than the OWTS Alternative.

The Study Area is subject to seasonal flooding and potential power outages. This can cause issues with either alternative. Flooding can damage OWTS and inhibit their ability to properly treat and dispose of wastewater. The proposed sewer system type does rely on pumping to convey wastewater to the treatment plant. However, the collection system could be designed with emergency storage in the grinder pump wet wells and generator receptacles in the control panels that could allow for wet wells to be pumped out, as needed. Additionally, the collection system would be equipped with a monitoring system that would allow for community wide solutions in emergency situations. OWTS are less likely to have a community wide monitoring system, which could make emergency relief harder to manage and would burden the homeowner with this work. For these reasons, the Centralized Sewage Collection System Alternative is deemed more resilient than the OWTS Alternative.

The Centralized Sewage Collection System Alternative can be implemented in a much shorter time period than the OWTS Alternative and can be fully under the control of the implementing agency. Therefore, it would achieve project goals more rapidly.

A summary of the analysis for each consideration is presented in decision matrix in Table 16. A value of one indicates the preferred alternative for that consideration. Based on the compilation of the seven considerations the preferred alternative was determined to be the Centralized Sewage Collection System Alternative.

Table 16: Alternatives Analysis Decision Matrix

Criterion	OWTS Alternative	Centralized Sewage Collection System Alternative
Present Worth Cost	1	0
Capital Cost	0	1
Operation and Maintenance Cost	1	0
Funding Sources	0	1
Construction	0	1
Resiliency	0	1
Implementation	0	1
Total	**2**	**5**

5. RECOMMENDED PROJECT IMPLEMENTATION

The recommended project based on the alternatives analysis and comparison is the Centralized Sewage Collection System Alternative. The Centralized Sewage Collection System Alternative includes development of a centralized sewer system and conveyance of wastewater to the RRCSD wastewater treatment plant. Wet wells with grinder pumps would be installed on each developed property to be connected to a pressurized sewer system. A common force main would convey the flow from the centralized lift station(s) to the wastewater treatment plant. Likely two centralized lift stations would be required to serve the Study Area, one on either side of the Russian River. The capital cost was estimated to be approximately $52,700,000 to connect the entire Study Area to the RRCSD wastewater treatment plant.

5.1 RECOMMENDED PROJECT PHASING

Implementing a project of this magnitude could be difficult to plan, finance, and construct within the framework of one project. For practicality, the Centralized Sewage Collection System Alternative may need to be implemented in a phased approach. Construction and design could be phased based on prioritizing portions of the system that have the potential for the highest positive impacts of the planning criteria – protecting aquatic and human health. Therefore, the priority for the first phase would be to serve parcels closest to the Russian River and Dutch Bill Creek. These parcels are likely to have the most impact on fecal pathogen levels in the Russian River. These parcels are also located in the areas with the highest density of parcels that are likely to not be OWTS suitable. Also, the first phase would include parcels enveloped in the APMP. A map of the potential scope of the first phase of the Centralized Sewage Collection System Alternative is depicted in Figure 12.

This portion of the project scope could serve as the first phase for a duration of time while the project needs are reevaluated.

5.1.1 First Phase Project Description

The first phase, as presented, would serve approximately 550 parcels within the Study Area. It is anticipated that some parcels, not included in the first phase, may require an interim solution prior to implementation of subsequent phases. Potential interim solutions are outlined in Section 20 of the OWTS Manual and include OWTS repair, in-kind replacement, cesspool conversion, and substantially conforming new systems. A summary of the first phase is included in Table 17.

Table 17: Analysis Results for First Phase of Centralized Sewage Collection System

First Phase Status	Number of Parcels	Percentage of Study Area Parcels
Connection to centralized sewer	550	71%
Interim solutions may be prior to connection	230	29%
Total	780	100%

The first phase of the Centralized Sewage Collection System Alternative would require constructing approximately two-thirds of the total length of the pressure collection system as well as the transmission main to connect to the RRCSD wastewater treatment plant. The collection system pipe lengths per size are summarized in Table 18.

Table 18: Required Collection Pipe for First Phase

Pipe Size	1st Phase Pipe Length (ft)	Total Pipe Length (ft)
2-inch	16,160	32,610
3-inch	24,450	38,000
4-inch	6,290	6,660
6-inch	3,850	3,880
6-inch Transmission Main	10,180	10,180
Total Length of Pipe	60,920	91,350

The collection system shall connect to the trunk sewers located in Bohemian Highway and River Road. Two lift stations, as proposed for the full project, would be located on either side of the Russian River to convey the wastewater from the collection system to a transmission main. The approximately 10,180 feet of 6-inch transmission main would be required to connect to the existing pipeline in Guerneville.

At the time of the second phase of construction, the remaining grinder pumps and piping would be installed and connected to piping previously constructed in Phase 1.

5.1.2 First Phase Capital Cost Estimate

The capital cost of the first phase of the Centralized Sewage Collection System Alternatives was estimated to be approximately $35,179,000. A detailed estimate of the capital cost is presented in Table 19.

Based on this estimated capital cost for the first phase of the Sewer Collection System Alterative, the estimated cost per connection is approximately $65,000. This is slightly less than the cost per connection of the entire system, which is $68,000. This minor reduction in cost per connection is due to the density of developed parcels within this area and decreased quantity of potential utility conflicts.

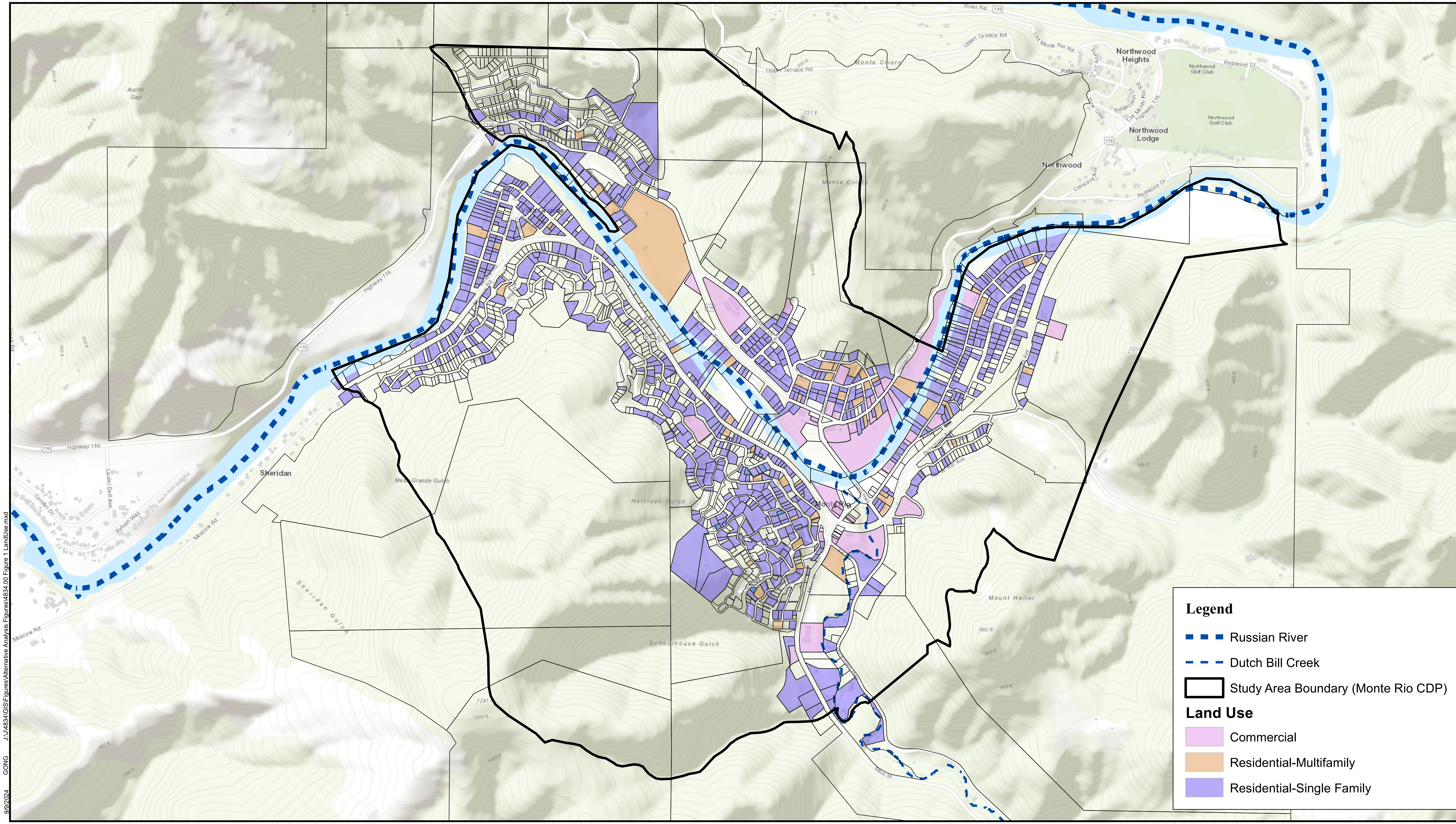
Table 19: First Phase of Centralized Sewage Collection System Capital Costs

Item Description	Quantity	Unit	Unit Price	Estimated Capital Cost
Traffic Control	1	LS	$90,000	$132,000
Existing Septic Tank Decommission	550	EA	$3,200	$1,760,000
Grinder Pump Package	550	EA	$20,000	$11,000,000
Lateral Installations	550	EA	$5,400	$2,970,000
Building Electrical Connection	550	EA	$3,000	$1,650,000
6-inch HPDE Transmission Main	10,180	LF	$120	$1,221,000
6-inch HPDE Force Main	3,850	LF	$120	$461,000
4-inch HPDE Force Main	6,290	LF	$115	$724,000
3-inch HPDE Force Main	24,450	LF	$112	$2,744,000
2-inch HPDE Force Main	16,160	LF	$103	$1,668,000
Community Pump Stations	2	EA	$300,000	$600,000
Air Release Valve	35	EA	$18,000	$630,000
Cleanouts and Other Appurtenances	1	LS	$165,000	$165,000
Caltrans Bridge Crossings	2	EA	$111,100	$222,000
Local Road Bridge Crossings	4	EA	$25,000	$100,000
Potential Utility Conflicts	107	EA	$3,500	$375,000
Caltrans Road Restoration (Transmission)	10,180	LF	$175	$1,781,000
Caltrans Road Restoration (Force Main)	12,650	LF	$175	$2,214,000
Local Road Restoration	38,100	LF	$125	$4,762,000
Total				**$35,179,000**

5.1.3 First Phase Operation and Maintenance Cost Estimate

All operation and maintenance costs, except for the cost of electricity to run the grinder pump, would be included in the monthly rate paid to the governing agency. The current RRCSD rate is $2,290 per year per equivalent single-family dwelling (ESD), or $190.83 per month per ESD. The rates charged for connections within the Study Area, including for just the first phase, would be the same or potentially higher than this current rate.

LIST OF FIGURES



NORTH

0 275 550 1,100 Feet

1 inch = 1,100 feet

DRAFT

FIGURE 1

PARCELS THAT GENERATE WASTEWATER

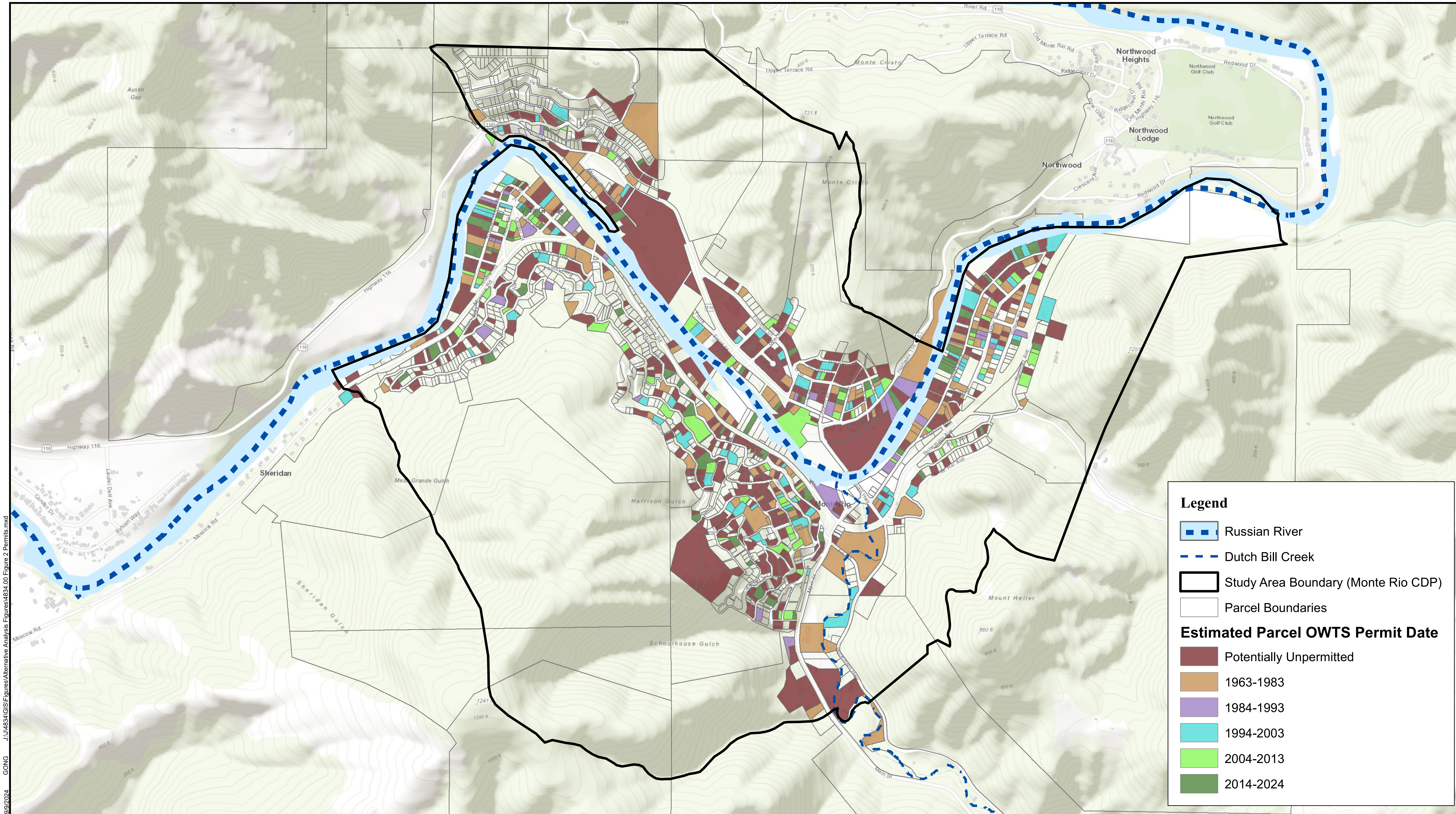
MONTE RIO AND VILLA GRANDE ALTERNATIVES ANALYSIS

SEPTEMBER 2024

Brelje & Race CONSULTING ENGINEERS

475 Aviation Blvd. Suite 120, Santa Rosa, CA 95403

9/9/2024 GONG J:\4834\GIS\Figures\Alternative Analysis Figures\4834.00 Figure 1 LandUse.mxd



NORTH

0 275 550 1,100 Feet

1 inch = 1,100 feet

DRAFT

FIGURE 2
OWTS PERMIT STATUS

MONTE RIO AND VILLA GRANDE
ALTERNATIVES ANALYSIS
SEPTEMBER 2024

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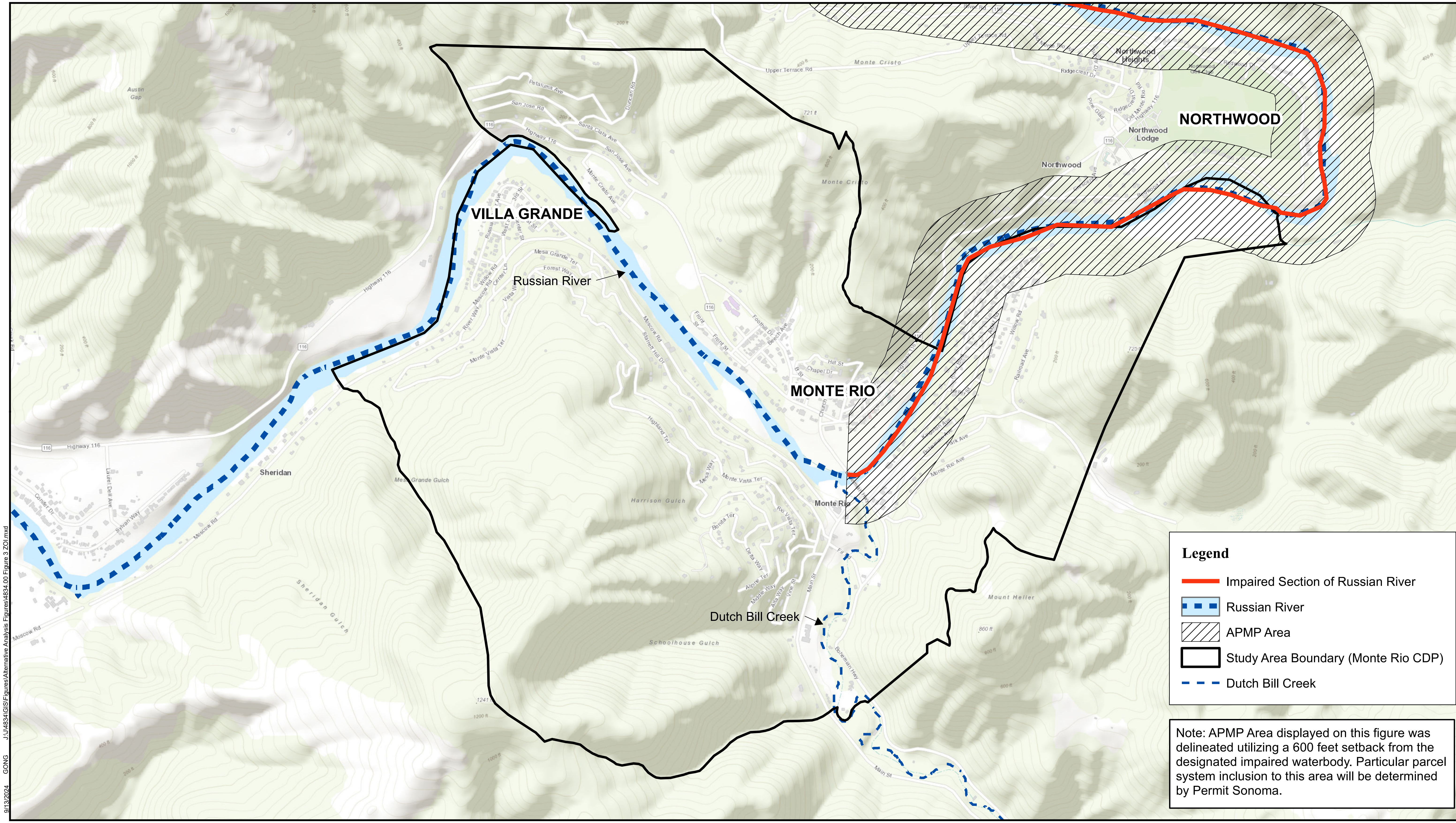
9/9/2024 GONG J:\J4834\GIS\Figures\Alternative Analysis Figures\4834.00 Figure 2 Permits.mxd



NORTH

0 275 550 1,100 Feet

1 inch = 1,100 feet

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FIGURE 3
Advanced Protection Managament Program (APMP) Boundary

MONTE RIO AND VILLA GRANDE ALTERNATIVES ANALYSIS
SEPTEMBER 2024

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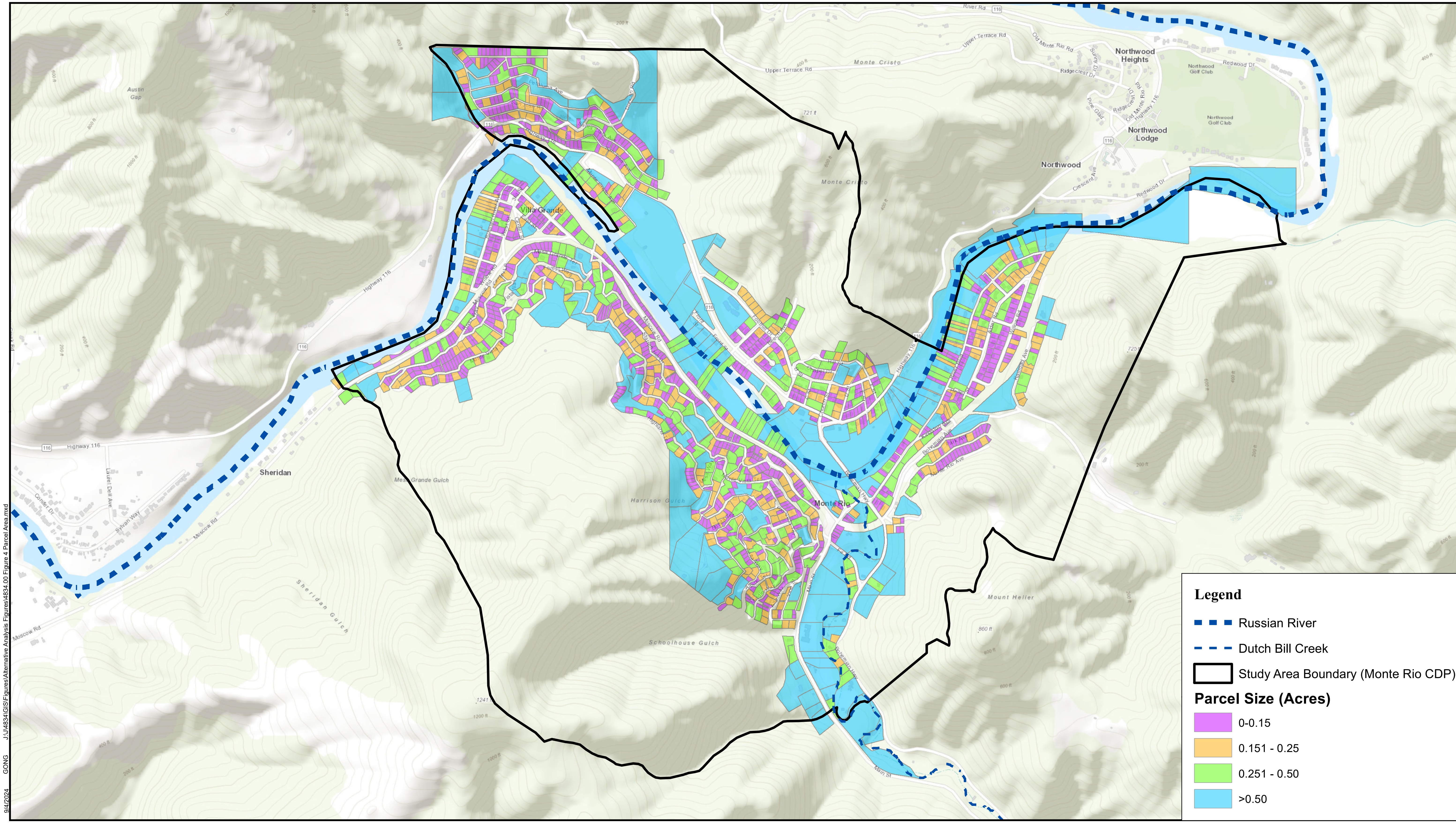

9/4/2024 GONG J:\4834\GIS\Figures\Alternative Analysis Figures\4834.00 Figure 4 Parcel Area.mxd

NORTH

0 275 550 1,100 Feet

1 inch = 1,100 feet

DRAFT

FIGURE 4
PARCEL SIZE

MONTE RIO AND VILLA GRANDE ALTERNATIVES ANALYSIS
SEPTEMBER 2024

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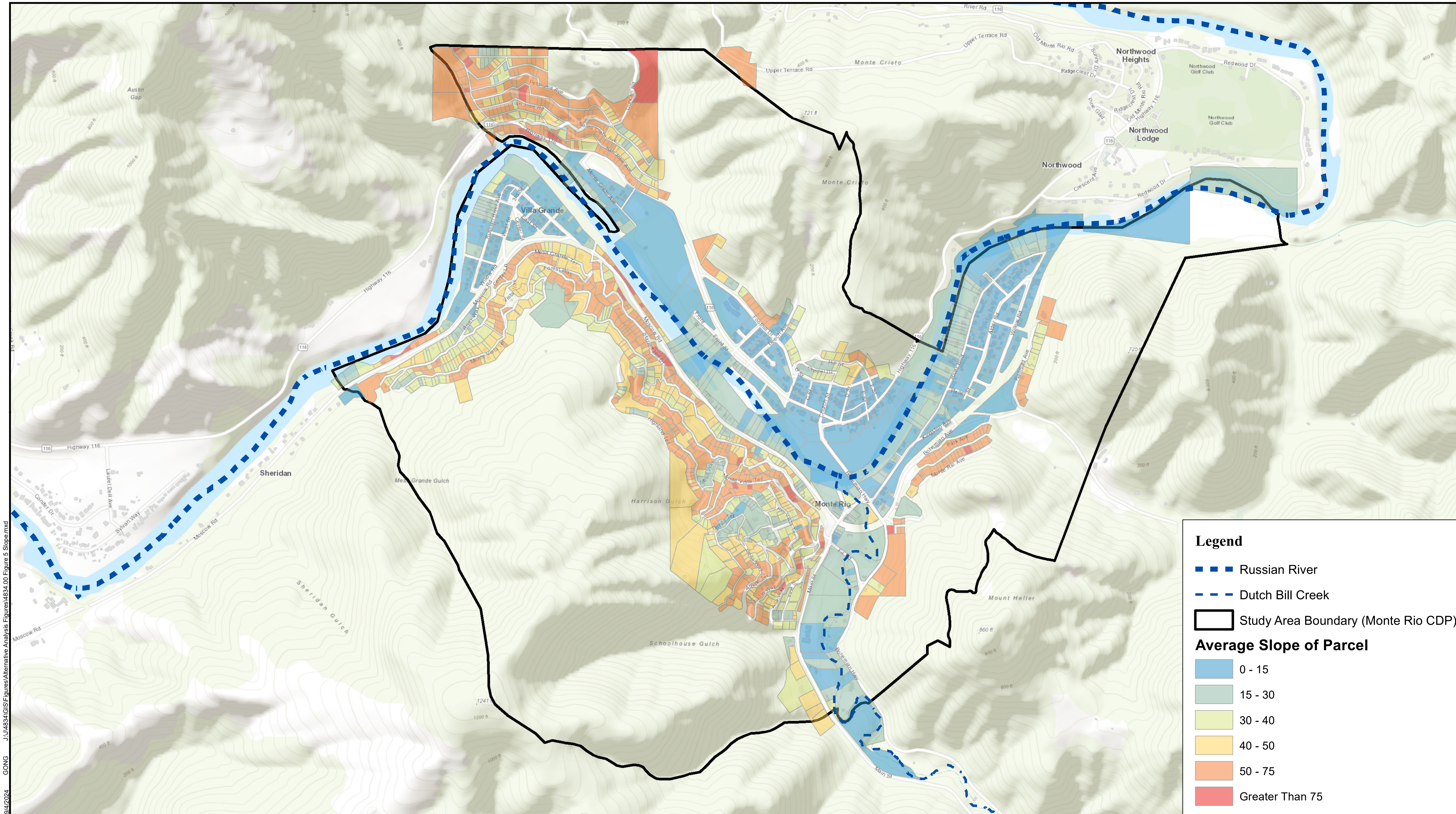
475 Aviation Blvd. Suite 120, Santa Rosa, CA 95403



J:\J4834\GIS\Figures\Alternative Analysis Figures\4834.00 Figure 5 Slope.mxd GONG 9/4/2024

NORTH

0 275 550 1,100 Feet

1 inch = 1,100 feet

DRAFT

FIGURE 5

PARCEL AVERAGE SLOPE

MONTE RIO AND VILLA GRANDE ALTERNATIVES ANALYSIS

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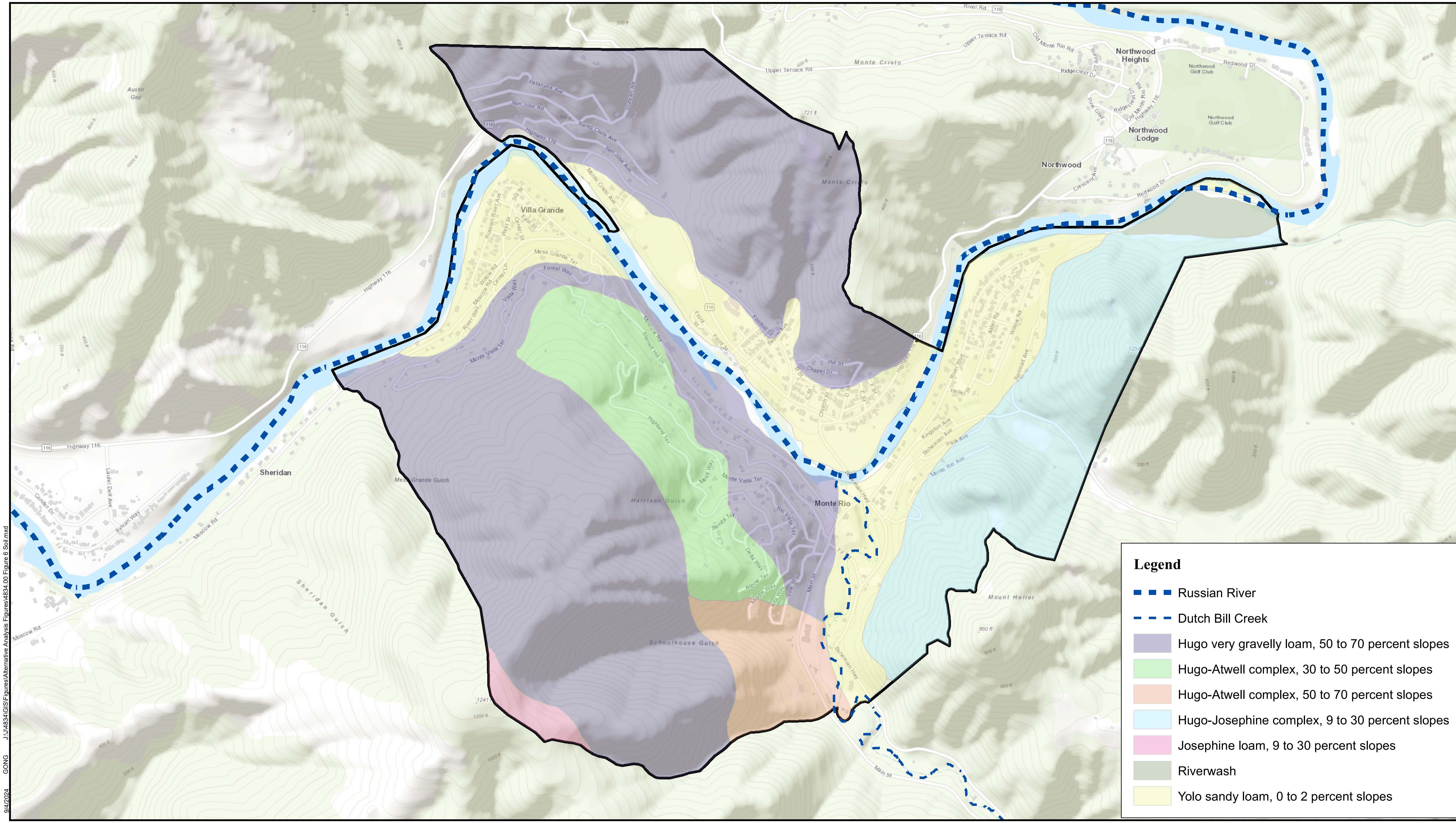

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GONG
9/4/2024

NORTH

0 275 550 1,100 Feet

1 inch = 1,100 feet

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FIGURE 6
SOIL TYPE

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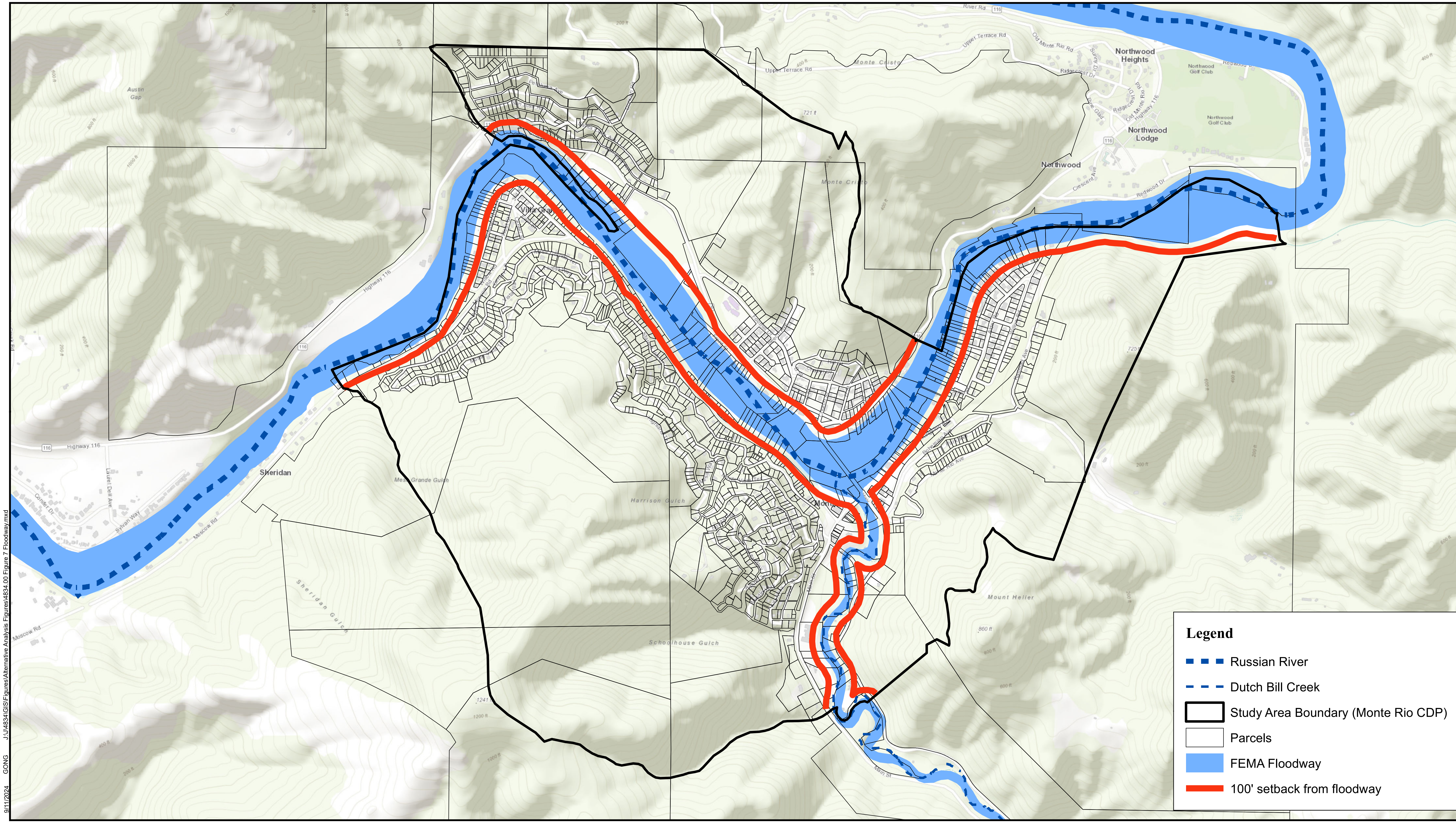

NORTH

0 275 550 1,100 Feet

1 inch = 1,100 feet

DRAFT

FIGURE 7
FEMA FLOODWAY

MONTE RIO AND VILLA GRANDE ALTERNATIVES ANALYSIS
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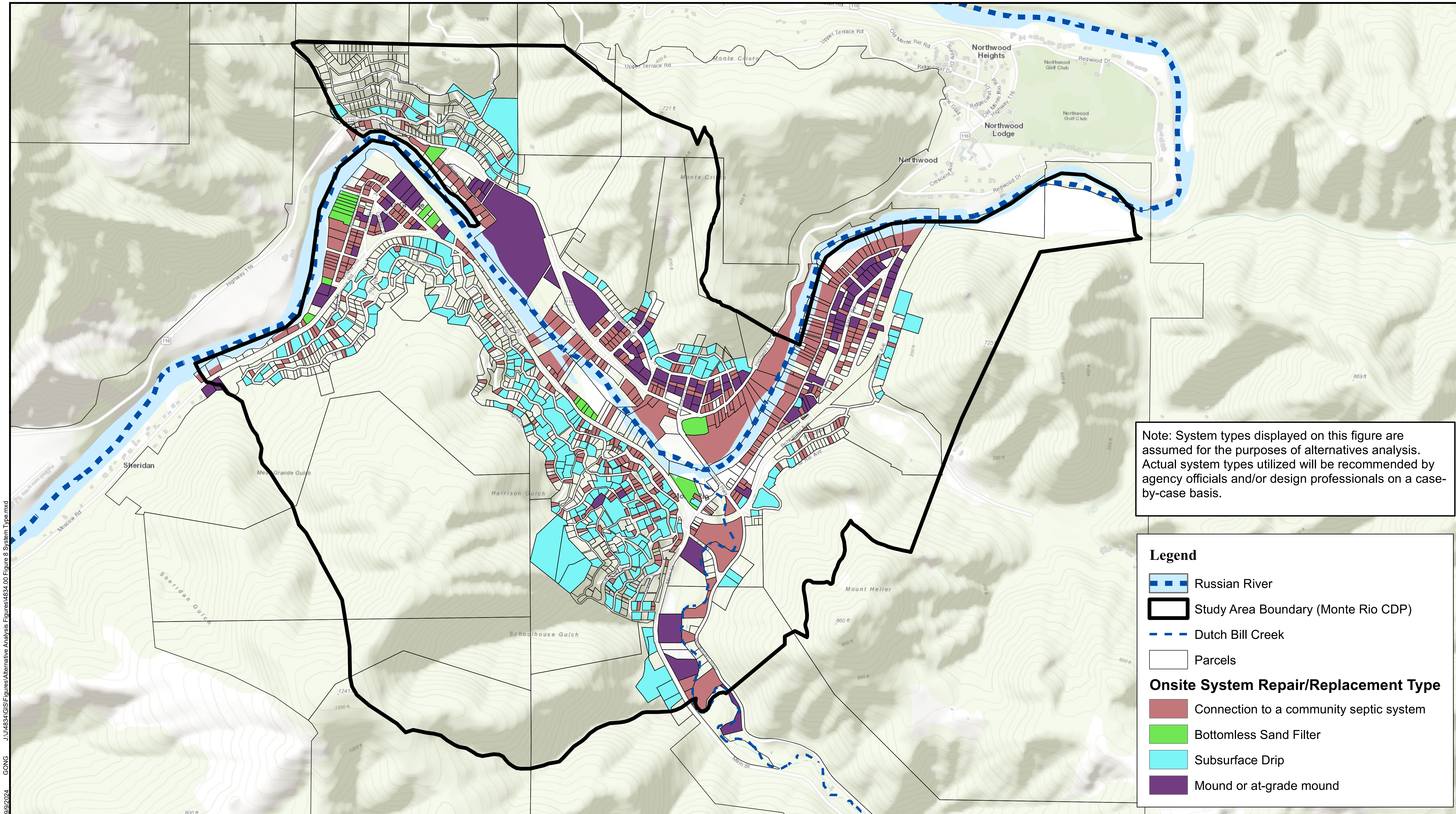

9/9/2024 GONG J:\J4834\GIS\Figures\Alternative Analysis Figures\4834.00 Figure 8 System Type.mxd

NORTH

0 275 550 1,100 Feet

1 inch = 1,110 feet

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FIGURE 8
ASSUMED OWTS TYPE
OWTS ALTERNATIVE

MONTE RIO AND VILLA GRANDE
ALTERNATIVES ANALYSIS
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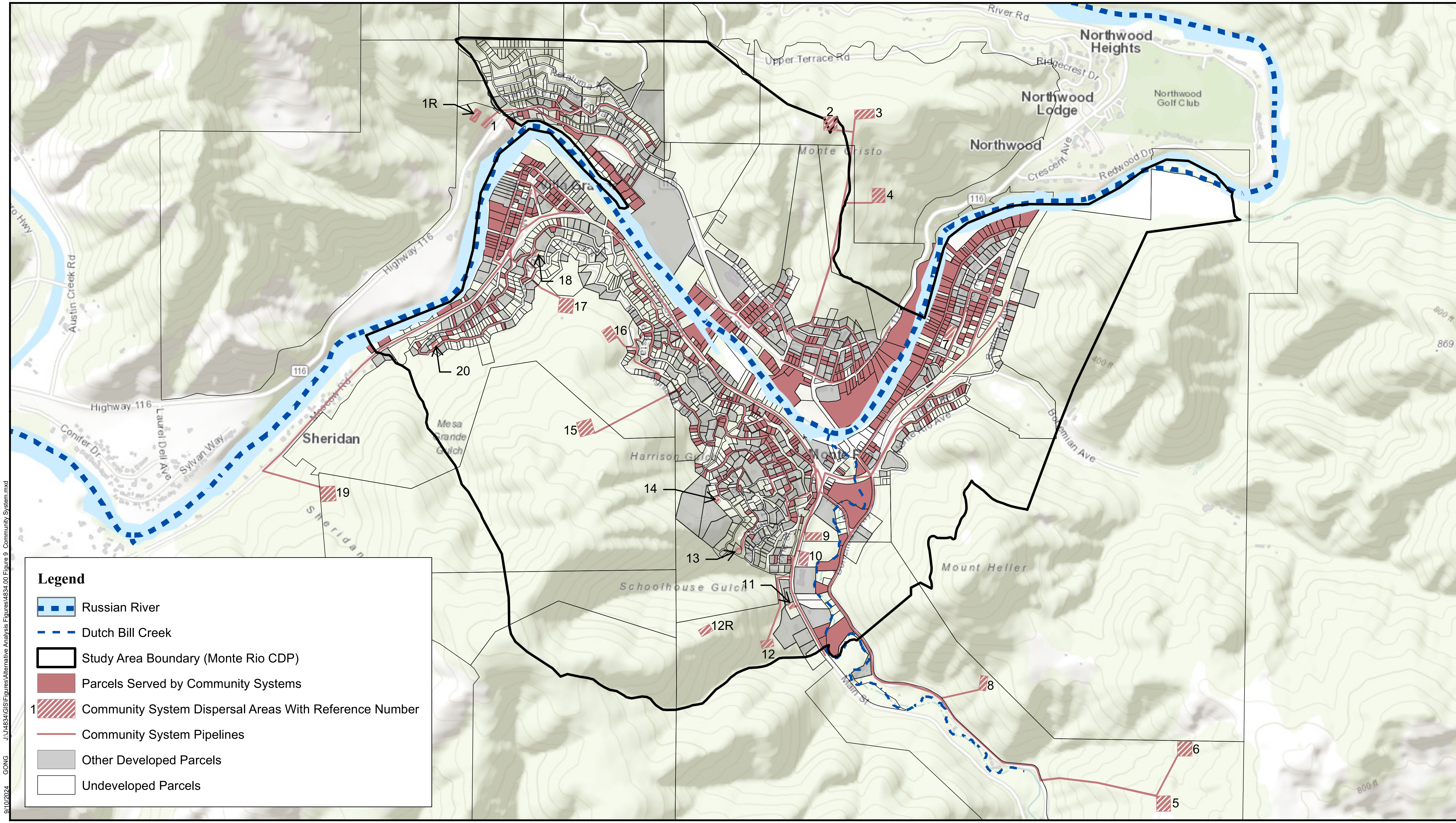

J:\J4834\GIS\Figures\Alternative Analysis Figures\4834.00 Figure 9 Community System.mxd
9/10/2024 GONG

NORTH

0 300 600 1,200 Feet

1 inch = 1,200 feet

DRAFT

FIGURE 9
COMMUNITY SEPTIC SYSTEMS
OWTS ALTERNATIVE

MONTE RIO AND VILLA GRANDE
ALTERNATIVES ANALYSIS
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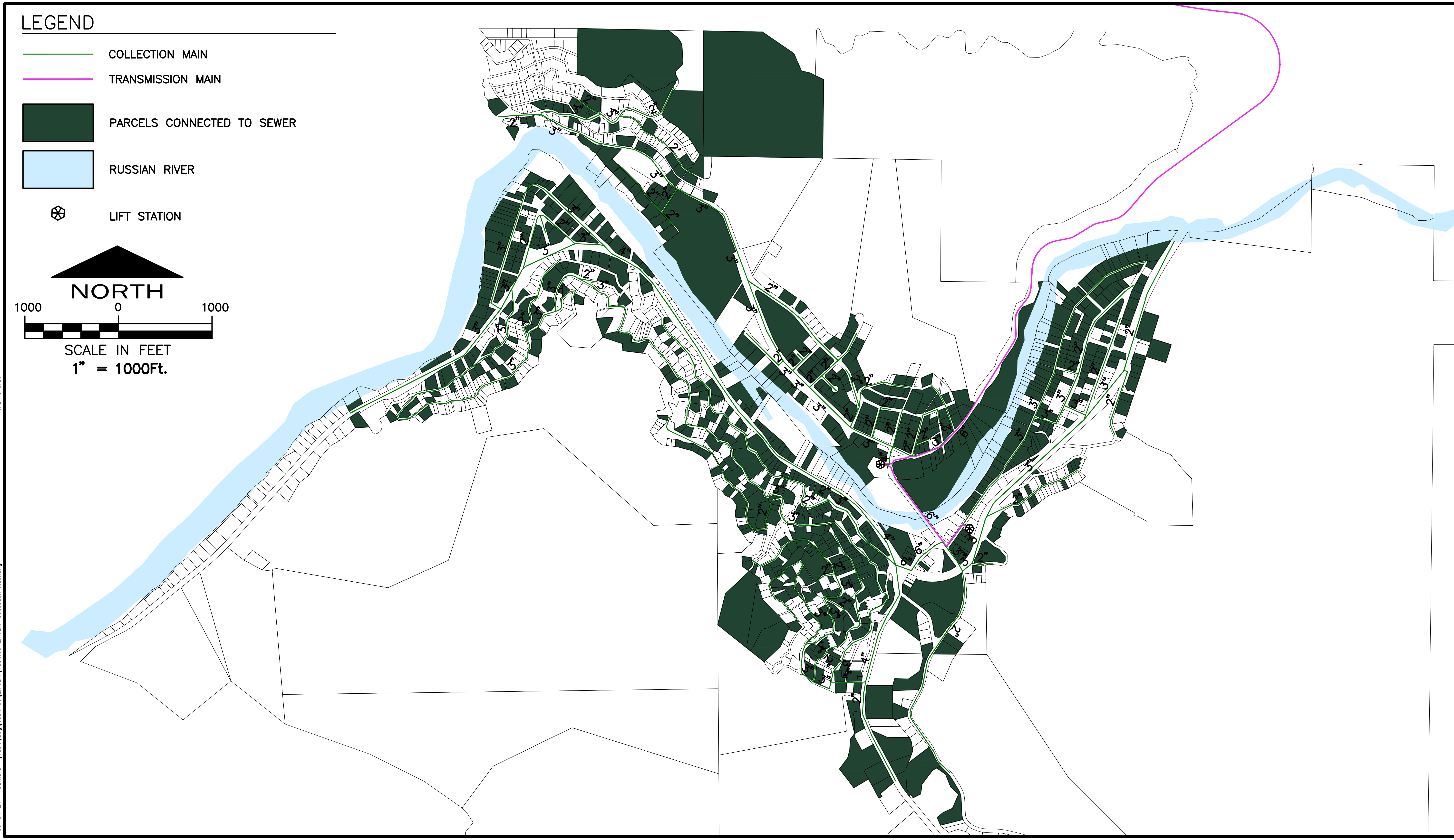

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FIGURE 10
ASSUMED SEWER COLLECTION SYSTEM
SEWER COLLECTION SYSTEM ALTERNATIVE

MONTE RIO AND VILLA GRANDE
ALTERNATIVES ANALYSIS
SEPTEMBER 2024

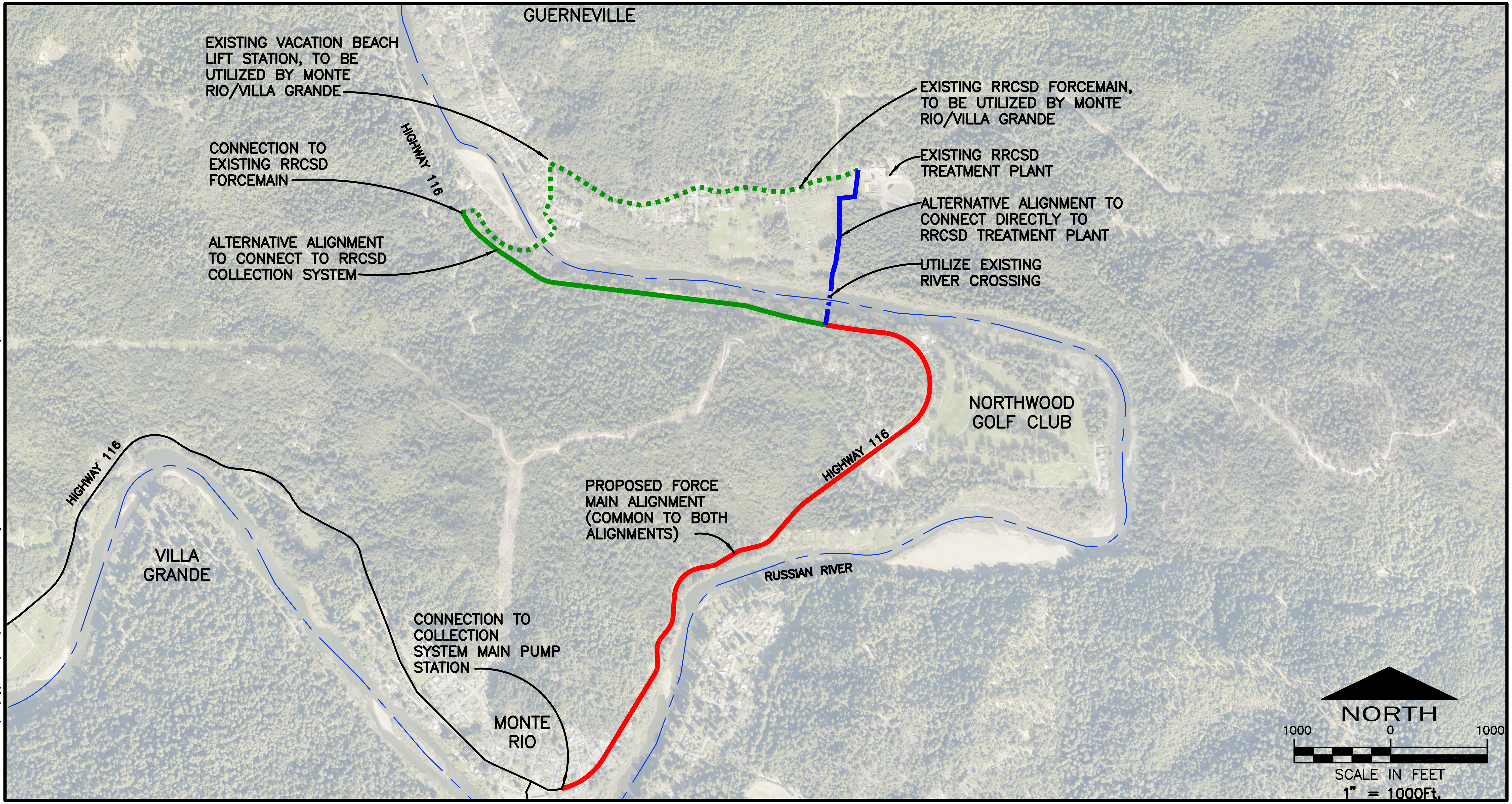

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FIGURE 11
RRCSD WWTP CONNECTION ALIGNMENT OPTIONS
SEWER COLLECTION SYSTEM ALTERNATIVE

MONTE RIO AND VILLA GRANDE
ALTERNATIVES ANALYSIS
SEPTEMBER 2024

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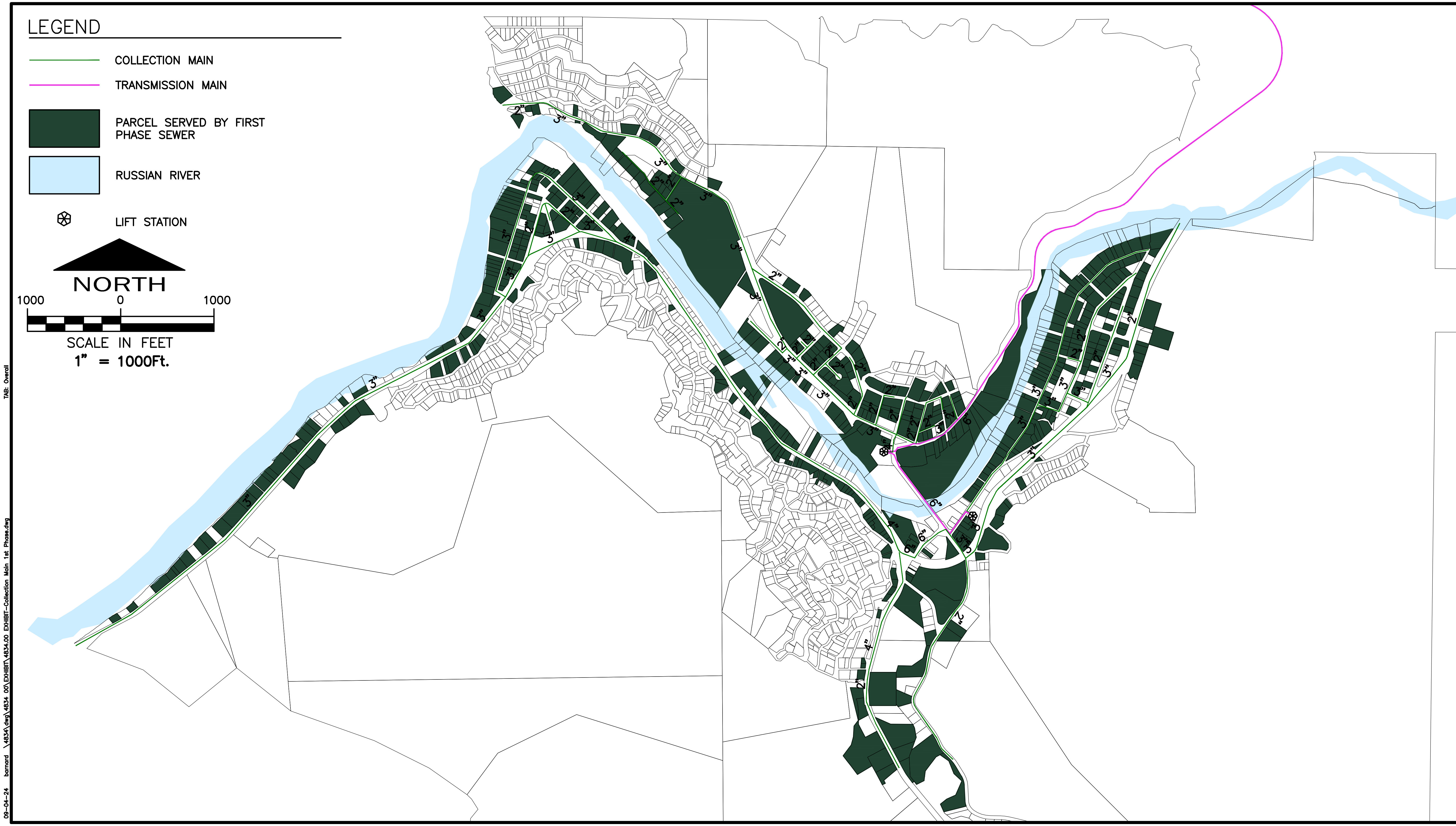

09-04-24 barnard \4834\dwg\4834 00\EXHIBIT\4834.00 EXHIBIT—Collection Main 1st Phase.dwg TAB: Overall

DRAFT

FIGURE 12
FIRST PHASE OF SEWER COLLECTION SYSTEM
SEWER COLLECTION SYSTEM ALTERNATIVE

MONTE RIO AND VILLA GRANDE
ALTERNATIVES ANALYSIS
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Appendix A - OWTS Dispersal Area Supporting Calculations

ASSUMPTIONS

For all the calculations it is assumed that the flow rate is 240 gallons per day, the soil application rate (SAR) of the soil is 0.5 gallons per square foot per day, and the slope is assumed to be 20%. The SAR is based on the rate for sandy-clay-loam recommended by the Sonoma County OWTS manual v8.0 Table 7.2B, as this is the most common soil type in the area. The slope was assumed to be 20% because it is the maximum slope for systems with slope corrections, and therefore this would be the worst-case scenario. Also, a majority of the Study Area has steep slopes. It is assumed that all of the parcels would require a 100% reserve area.

CESSPOOL

Assumed depth = 6 feet. Cesspools are designed based on the volume held.

$$Required\quad u\quad e = Mini\quad u\quad Septic\ Tank\ Size\ = 750\ ga\quad ns$$
$$= 750\ ga\quad ns \times \frac{1\ cf}{7.48\ ga\quad n} = 100.26\ \text{cf}$$

$$Square\ Feet = \frac{Required\quad u\quad e}{Depth} = \frac{100.26}{6} = 16.71\ sf\ \approx 17\ sf$$

With a 100% reserve area the required area is 34 square feet.

STANDARD SYSTEM

Standard septic systems are sized based on the sidewall per linear foot. It is assumed that the gravel depth is the minimum depth of one foot, depending on the tested soil conditions the gravel depth could be increased which would increase the sidewall per linear foot and decrease the required area. At the assumed depth of gravel the perforated pipes are separated eight feet on center. It is assumed that each line is 60 feet long

$$Sidewa\quad per\ \ inear\ f\quad t = \frac{grave\ \ depth\ \times 2}{f\quad t} = \frac{1\ \times 2}{1} = 2\frac{ft}{ft}$$

$$LF\ Required = \frac{gallons\ per\ day}{SAR\ \times Sidewall\ per\ lf} = \frac{240}{0.5\ \times 2} = 240\ \ f$$

$$Lines = \frac{linear\ feet\ required}{line\ length} = \frac{240}{60} = 4\ \text{lines}$$

$$Square\ feet\ required = (\ ines + 1) \times\ \ ffset \times\ \ ine\ \ ength = (4+1)\times 8 \times 60$$
$$= 2{,}400\ sf$$

With a 100% reserve area the required area is 4,800 square feet.

MOUND

Corrections factors used were based on slope. The linear loading rate (LLR) of 6 was based on a semipermeable soil layer based on the average soil characteristics of the area. The SAR rate for sand is 1 gallon per square foot per day for residential use.

Table 1: Correction Factors

Type	Correction Factor
Sand	
Downslope Width (I)	2.5’
Upslope Width (J)	0.62’
Upslope Depth (D)	1’
Downslope Depth (E)	2.2’

Soil Cover	
End/upslope	4’
Downslope	10’
Constants	
Height of soil at peak (H)	1
Depth of gravel bed (F)	0.83’

Gravel Bed

$$Required\ Area = \frac{Ga\quad ns\ per\ day}{SAR\quad f\ sand} = \frac{240}{1} = 240\ sf$$

$$Grave\ \ Bed\ Width = \frac{LLR}{SAR\quad f\ sand} = \frac{6}{1} = 6\ ft$$

$$Grave\ \ Bed\ Width = \frac{Required\ Area}{Grave\ \ Bed\ Width} + (2 \times Edge\ Space) = \frac{240}{6} + (2 \times 2) = 44\ ft$$

Sand Bed

$$Sand\ Bed\ D\ \ wns\quad pe\ Width = (E + \ F + 1) \times 3 \times I = (2.2 + 0.83 + 1) \times 3 \times 2.5 = 30.225'$$

$$Sand\ Bed\ Ups\quad pe\ Width = (D + \ F + 1) \times 3 \times I = (1 + 0.83 + 1) \times 3 \times 0.62 = 5.2638'$$

$$Sand\ Bed\ End\ Length = \left(\frac{D+E}{2} + F + H\right) \times 3 = \left(\frac{1+2.2}{2} + 0.83 + 1\right) \times 3 = 10.29'$$

Basal Area

$$Avai\ ab\ e = Grave\ \ Bed\ Length \times (Grave\ \ Bed\ Width + Sand\ Bed\ D\ \ wns\quad pe\ Width) = 40\ \times (6 + 30.225) = 1449\ sf$$

$$Required\ Basa\ \ = \frac{Ga\quad ns\ per\ day}{SAR\ s\ \ i} = \frac{240}{0.5} = 480\ sf$$

$$Avai\ ab\ e > Required; G\quad d.$$

Mound Area

$$M\ \ und\ Length = (2 \times Sand\ End\ Length) + (2 \times End\ s\ \ i\ \ c\ \ ver) + Grave\ \ \ Bed\ Length = (2 \times 10.29) + (2 \times 4) + 60 = 88.58\ ft$$

$$M\ \ und\ Width = Ups\quad pe\ Sand\ Width + D\ \ wns\quad pe\ Sand\ Width + Ups\quad pe\ S\ \ i\ \ C\ \ ver + D\ \ wns\quad pe\ S\ \ i\ \ C\ \ ver + Grave\ \ \ Bed\ Width = 5.2638 + 30.225 + 4 + 10 + 6 = 52.4888\ ft$$

$$M\ \ und\ Area = M\ \ und\ Length\ \times W\ \ und\ Width = 88.58\ \times 52.4888 = \ 4{,}649.45\ sf \approx 4{,}650\ sf$$

With Reserve Area

It is assumed that the soil cover of the reserve area will be allowed to overlap along the downslope end to conserve space. The OWTS Manual has a separation requirement of zero feet between the downslope reserve and primary system.

$$Space\ Saved = (D\ \ wns\quad pe\ S\ \ i\ \ C\ \ ver) \times M\ \ und\ Length = 10 \times 88.58 = 885.8\ sf$$

$$T\ \ ta\ \ Area = (2 \times M\ \ und\ Area) - Space\ Saved = (2 \times 4649.45) - 885.5 = \ 8{,}413.4\ sf \approx 8{,}414\ sf$$

AT-GRADE MOUND

The linear loading rate (LLR) of 6 was based on a semipermeable soil layer based on the average soil characteristics of the area.

Dispersal Area

$$Required\ Area = \frac{Ga\quad ns\ per\ day}{SAR} = \frac{240}{0.5} = 480\ sf$$

$$Required\ Length = \frac{Required\ Area}{LLR} = \frac{480}{6} = 40\ ft$$

$$Grave\ \ Bed\ Length = Required\ Length + (\ 2 \times endcap) = 40 + (2 \times 2) = 44\ ft$$

$$Required\ Width = \frac{Required\ Area}{Required\ Length} = \frac{480}{40} = 12\ ft$$

$$Required\ Width < 15\ ft; G\quad d$$

$$Grave\ \ Bed\ Width = Required\ Width + (\ Width\ Ab\ \ ve\ Pipe) = 12 + (2) = 12 = 14\ ft$$

At-Grade Mound Area

$$At - Grade\ M\ \ und\ Width = Ups\quad pe\ S\ \ i\ \ C\ \ ver + D\ \ wns\quad pe\ S\ \ i\ \ C\ \ ver + Grave\ \ \ Bed\ Width = 4 + 10 + 14 = 28\ ft$$

$$At - Grade\ M\ \ und\ Length = (2 \times End\ s\ \ i\ \ c\ \ ver) + Grave\ \ \ Bed\ Length = (2 \times 4) + 44 = 52\ ft$$

$$At - Grade\ M\ \ und\ Area = At - Grade\ M\ \ und\ Length \times At - Grade\ W\ \ und\ Width = 28 \times 52 = 1{,}456$$

With Reserve Area

It is assumed that the soil cover of the reserve area will be allowed to overlap along the downslope end to conserve space. The OWTS Manual has a separation requirement of zero feet between the downslope reserve and primary system.

$$Space\ Saved = (D\ \ wns\quad pe\ S\ \ i\ \ C\ \ ver) \times M\ \ und\ Length = 10 \times 44 = 444\ sf$$

$$T\ \ ta\ \ \ Area = (2 \times At - Grade\ M\ \ und\ Area) - Space\ Saved = (2 \times 1{,}456) - 444 = 2{,}468\ sf$$

BOTTOMLESS SAND FILTER

$$Required\ Area = \frac{Ga\quad ns\ per\ day}{0.5} = \frac{240}{0.5} = 480\ sf$$

With a 100% reserve area the required area is 960 square feet.

SUBSURFACE DRIP

The subsurface drip calculations are per manufacturer recommendations. With a 100% reserve area the required area is 960 square feet.

Small Systems Design Sheet

Directions: Fill-in applicable cells in BLACK. Answers appear in PURPLE.

Definitions: 1. Day = 24 hours
2. Lateral = supply to return connection total length
3. Run = number and length within each lateral

240	gpd, **maximum flow**
0.500	gpd/ft^2, soil loading rate
100%	usuable acres for dispersal
480	ft^2, total
0.011	acres, minimum
G-WFPC-16-2-24-PRO	drip tubing p/n
2.0	ft, dripline spacing
240	ft, dripline required
2	ft, dripper (emitter) spacing
4	ft^2 per dripper
2.00	gpd dispersed, per dripper
0.6	gph, per dripper rate
3.33	**hrs/d**, theoretical per dripper max run time
200	**min/d**, theoretical per dripper max run time
12	max hrs/d, pump run time *(12 hrs default)*
4	max theoretical zones, no.
1	select number of zones
480	ft^2, each zone
240	ft, theoretical dripline run length per zone
No	drip lateral length >10% (shortest to longest)
202.0	ft, lateral length
13	select laterals per zone
0.50	fps, flush velocity
2,626.0	ft, calculated dripline run length per zone
1,313	drippers, calculated per zone
13.1	gpm, dispersal flow rate
17.9	gpm, flushing flow rate
4.8	gpm, return flow rate
12	input cycles per day per zone, no. *(all zones dosed invidually each cycle)*
1.52	min, run time (fully pressurized) per zone per dose
1.52	min, "on" time per dose cycle
118.48	min, "off" time per dose cycle
18	min/d, "on" time, *or* 0.30 hrs/d
1422	min/d, "off" time, *or* 23.70 hrs/d

→dosing tank capacity must accommodate peak hourly, daily, and weekly flows, and intermittent flow storage←

240 gpd, maximum dispersed