SONOMA-MARIN AREA RAIL TRANSIT DISTRICT

PASSENGER RAIL SERVICE
NOVATO TO SUISUN CITY

MAY 2019

COVER LETTER

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April 29, 2019

Brian Annis, Secretary
California State Transportation Agency
915 Capitol Mall, Suite 350B
Sacramento, CA 95814

Chad Edison, Deputy Secretary
California State Transportation Agency
915 Capitol Mall, Suite 350B
Sacramento, CA 95814

Re: SMART Passenger Rail Study – Novato to Suisun City

Dear Secretary Annis and Deputy Secretary Edison:

I am pleased to submit our report on the feasibility of providing passenger rail connectivity between the SMART passenger rail system in Novato and the Capitol Corridor passenger rail system in Suisun City. This Study is in response to your request and funding to explore an east-west connection to expand transit connectivity in Northern California. In brief, we found that not only is such a connection generally feasible, it is quite implementable and could be completed relatively quickly.

The Feasibility Study inventoried the physical elements of the railroad, performed a high-level review of the natural environment to get a sense of habitat and conditions, and prepared a high-level order-of-magnitude cost estimate. The Study established two implementation options for service: 1) a minimal, rapid deployment basic level of service; and 2) a more robust reconstruction of the railroad with higher level of service. There is of course the ability to scale service in both options as demand warrants which will ensure that this infrastructure investment delivers connectivity for years to come. All options include fundamental elements of a modern passenger rail system such as Positive Train Control (PTC) to provide high degree of safety and providing interoperability with freight operations. While it is too early to identify vehicles for the operation, there are several real-world applications of "green trains" that utilize low-emissions propulsion technologies such as hydrogen and battery that could make this a state-of-the-art twenty-first century low-emissions transit system. The cost of the two options range from approximately $780M to $1.3B and could be implemented in four to six years once funding is identified.

The California State Rail Plan that you published last year identified the possibility of creating an east-west connection that would greatly improve the travel options in one of the highest growth travel markets in the State, connecting between rail systems and providing an alternative transportation choice in a corridor currently experiencing tremendous congestion. A rail connection between Novato and Suisun could provide much needed relief to commuters that currently rely on State Route 37, a no-exit two-lane highway experiencing more annual vehicle hours of delay in Sonoma County than Highway 101. The highly volatile nature of SR 37, sees PM peak period travel east for the 19-miles between Highway 101 and SR 29 routinely taking 80-100 minutes on weekdays and 40+ minutes on weekends. These conditions penalize the region's economic engine, with workers traveling between Sacramento/Solano/Napa counties and Sonoma/Marin/San Francisco facing punishing transportation conditions on a regular basis.

SMART's initial review of the rail infrastructure and environmental conditions between Novato and Suisun uncovered opportunities to leverage the public ownership by SMART of approximately two-thirds of the 41-mile rail corridor. The SMART ownership of the alignment could help to implement a rail connection in a fast and cost-effective manner, with options including interim rail stations and the implementation of the latest technology of hybrid or electric trains supporting the State's goals of becoming carbon neutral by 2045. As we see it, this passenger rail connection could provide tremendous benefits to Californians in the form of transportation options, reduction of greenhouse gases and congestion relief.

Beginning in May, we will brief the Federal, State and local executives and policy makers, the Metropolitan Transportation Commission staff, and the Congestion Management Agencies for the involved counties on the study. We look forward to working with you in the coming months to develop an operational model of the system to develop run times, evaluate connections on both ends and refine the scope of the project. The next steps would be to prepare an environmental evaluation document and initiate preliminary engineering when funding is made available.

While SMART is committed to completing the SMART north-south passenger rail system between Larkspur and Cloverdale, we look forward to working with the State to realize a rail connection between Novato and Suisun City. Thank you for funding this study and providing SMART with the opportunity to explore the possibilities for maximizing the utility of our publicly-owned transportation facility and for creating a greater passenger rail network in Northern California.

If you have any questions, please don't hesitate to contact me.

Very truly yours,

Farhad Mansourian
General Manager

Enclosure

C: SMART Board of Directors
Bill Gamlen, Chief Engineer
Joanne Parker, Programming and Grants Manager

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EXECUTIVE SUMMARY

1 | EXECUTIVE **SUMMARY**

This report examines the technical feasibility of implementing passenger rail service in the corridor between Marin, Sonoma, Napa, and Solano counties, linking the existing Novato-Hamilton station near Novato on the Sonoma-Marin Area Rail Transit (SMART) corridor with the existing Suisun-Fairfield station on the Capitol Corridor rail system. This new service would provide connectivity between existing SMART and Capitol Corridor passenger rail services, while also providing new transportation options between Novato, Sonoma, American Canyon, Cordelia, and Fairfield-Suisun.

Implementing passenger service along this corridor is feasible.

Implementing passenger service would require improvements to the existing trackway and bridges, new stations, and installation of a new signal system with Positive Train Control (PTC). Passenger service could be established in 4 to 6 years once funding becomes available.

This report studies two capital improvement options:

- Option 1 would allow rapid implementation of passenger service connecting the existing SMART passenger rail system and the existing Capitol Corridor passenger rail system. This Option assumes the minimum level of capital investment required to initiate service.
- Option 2 would allow an improved level of passenger service over Option 1, with higher speeds, reduced travel times, and lower ongoing maintenance costs. This option requires more capital investment and a somewhat longer implementation schedule but offers an improved operating scenario, improved connectivity, and reduced maintenance costs.

Although two distinct options are considered in this report, Option 1 serves as a baseline approach, and outlines the minimum investment needed to establish passenger rail service. Because a scalable approach is possible, incremental, additional investments could return significant improvements in service levels and connectivity.

Option 1 Summary:

Option 1 assumes limited improvements to the existing railroad embankment, including:

- Replacement of most of the existing rail and timber cross ties with new rail and new timber ties
- Construction of two new passing sidings.
- Construction of additional platforms and passenger connectivity features at the SMART Novato-Hamilton and Capitol Corridor Suisun-Fairfield stations.
- Construction of up to three intermediate stations.
- Rehabilitation of the existing Black Point bridge or replacement with a lift bridge acquired from another location.
- Replacement of all existing timber bridges with concrete bridges.
- Construction of a new signal system.
- Implementation of a Positive Train Control (PTC) system.

The service characteristics of Option 1 include:

- Second-hand locomotives pulling conventional passenger cars.
- Initial capacity would be approximately 2100 passengers per day.
- Maximum operating speed would be 60 miles per hour, with estimated travel time between Novato-Hamilton Station and Suisun-Fairfield station of approximately 70 to 80 minutes.

Option 2 Summary:

Option 2 assumes more significant improvements to the rail line, including:

- Re-grading, stabilizing, and widening the existing railroad embankment, including a new subballast layer.
- New ballast and new concrete tie track.
- Construction of four new passing sidings to allow additional operational flexibility.
- Construction of additional platforms and passenger connectivity features at the SMART Novato-Hamilton and Capitol Corridor Suisun-Fairfield stations.
- Construction of up to four intermediate stations.
- Replacement of the existing Black Point bridge with a new bridge.
- Replacement of all existing timber bridges with concrete bridges.
- Construction of a new signal system.
- Implementation of a Positive Train Control system that is inter-operable with Union Pacific's existing PTC technology.

The service characteristics of Option 2 would be:

- Train options could range from new passenger cars and locomotives to Diesel Multiple Units (DMUs), with the possibility of alternative energy vehicles, such as hydrogen fuel cell or battery powered "green" DMUs.
- Initial capacity would be approximately 5400 passengers per day.
- Maximum operating speed would be 79 miles per hour, with estimated travel time between Novato-Hamilton Station and Suisun-Fairfield station of approximately 60 to 75 minutes.

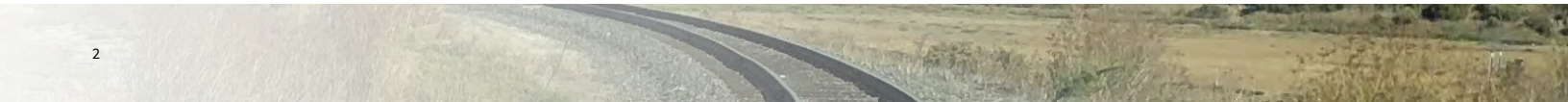
Schedule and Costs:

Option 1 could be completed in four to five years from availability of sufficient funds to start the preliminary engineering and environmental documentation processes. The conceptual cost range, including contingencies, for Option 1 is $780MM to $898MM. Because the railroad would not be completely reconstructed in Option 1, ongoing maintenance costs would be higher than those in Option 2.

Option 2 could be completed in six years from availability of funds to start the preliminary engineering and environmental documentation processes. The conceptual cost range for Option 2, including contingencies, is $1.1B to $1.3B. Because the railroad would be completely reconstructed in Option 2, ongoing maintenance costs would be lower than those in Option 1.

As noted, a spectrum of improvements and service levels are possible, ranging from the minimum level outlined in Option 1, to the full suite of improvements outlined in Option 2.

Because the corridor traverses sensitive wetlands and flora/fauna habitat, the level of environmental documentation and mitigation is highly dependent on the extent of the impacts from the constructed project. Although these impacts have not yet been defined, the lower level of infrastructure rehabilitation contemplated in Option 1 would result in lower levels of environmental impacts. By comparison, Option 2, which assumes a higher level of infrastructure rehabilitation, would create more environmental impacts and require more detailed environmental studies.



INTRODUCTION

2 | INTRODUCTION

SMART currently provides passenger service in a corridor linking Santa Rosa Airport to San Rafael. Between these termini, SMART serves communities including Santa Rosa, Rohnert Park, Petaluma, and Novato. The existing SMART service generally parallels the existing Highway 101 corridor. After one year of service, current ridership is approximately 2500 passengers per weekday. A new extension, currently under construction, will soon extend passenger service to the Larkspur ferry terminal. Preliminary engineering has commenced on an extension north to Windsor.

The California State Rail Plan identifies planning for the Novato to Suisun corridor as a short term goal.

Section 4.6 of the 2018 California State Rail Plan (see Reference 1) recommends evaluating expansion of passenger service connecting the SMART system to the Capitol Corridor system:

Evaluate expansion of rail service from San Rafael, Sonoma, and Napa Counties to Solano County, considering rail service primarily on existing rail alignments with potential connections to the statewide network at Fairfield-Suisun or near Vallejo.

This rail expansion would provide rail connectivity for travelers in the Highway 37 and Highway 12 corridors between Marin County, Black Point, Sonoma, Napa/American Canyon/Vallejo, and the Suisun/Fairfield areas, as well as provide connections, via existing SMART service, to northern Sonoma County, Marin, and, via ferry, to San Francisco.

Figure 1 illustrates the project study area and potential rail corridor.

FIGURE 1— PROJECT STUDY AREA

2.1 PURPOSE OF THIS REPORT

- Examine the technical feasibility of implementing passenger rail service between Novato and Suisun City;
- Document the existing physical condition of the corridor;
- Propose limited infrastructure options, and their corresponding operating characteristics;
- Identify potential infrastructure and environmental challenges;
- Prepare order of magnitude schedule and cost estimates; and
- Recommend next-steps.

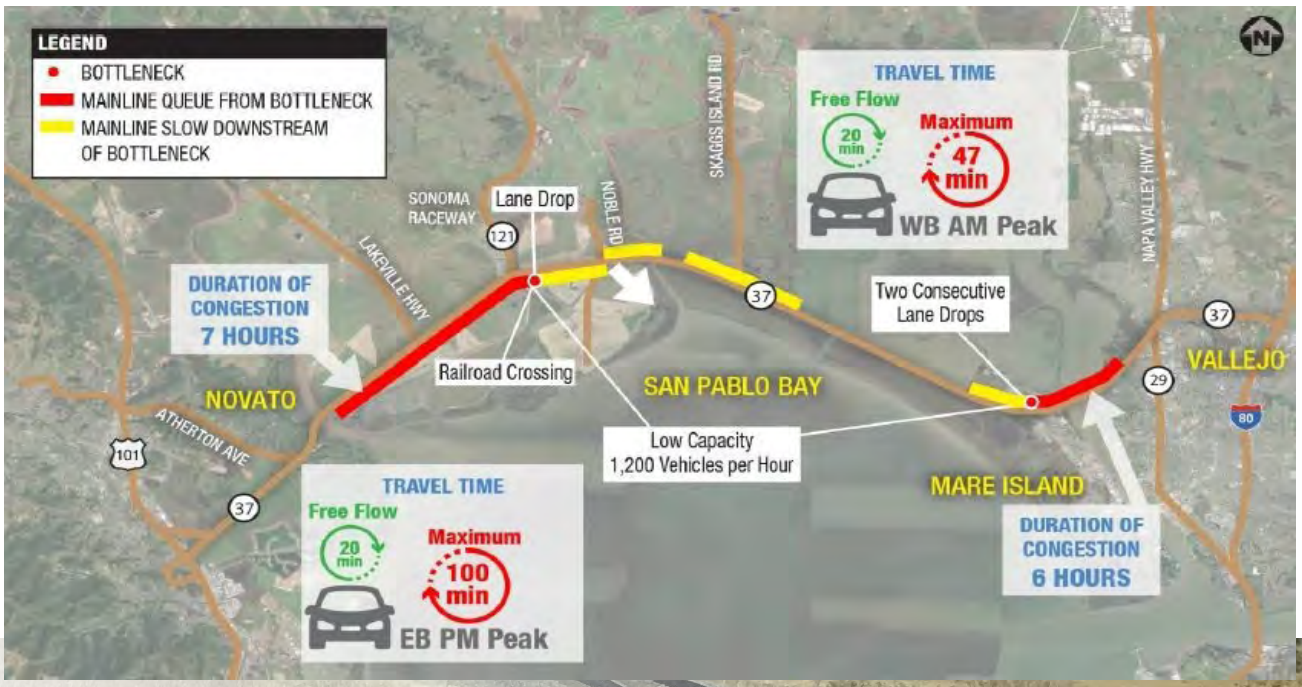
2.2 REGIONAL CONTEXT: EXISTING STATE ROUTE 37 ROADWAY CORRIDOR

State Route 37 (SR 37) Is the primary roadway corridor connecting Marin County with Sonoma, Napa, and Solano Counties, and roughly parallels the rail line owned by SMART. The number of vehicles on SR 37 exceeds the roadway capacity during most peak hours, resulting in long delays of motorists, and is the subject of ongoing studies to determine the feasibility of improving mobility in this corridor.

The current SR 37 corridor study is being conducted in collaboration with multiple transit operators in the Highway 37 corridor, including Napa Valley Transportation Authority, Solano Transportation Authority, Sonoma County Transportation Authority, and Transportation Authority of Marin. The February 2018 report titled "SR 37 Transportation and Sea Level Rise Corridor Improvement Plan" (See Reference 2) summarizes the corridor congestion as follows:

- The primary cause of corridor congestion is vehicular demand exceeding the capacity of the 2-lane highway segment.
- The capacity of this segment is unusually low, about 1200 vehicles per hour per lane, which is less than other, similar facilities, which typically provide about 1600 vehicles per hour per lane. This low vehicle capacity is primarily due to the short merge distances approaching the lane drops east of Sears Point (SR 121 junction) and Mare Island. Between Sears Point and Mare Island (approximately 9 miles), SR 37 is mostly a single lane in each direction. In addition, SR 37 has high volumes of heavy vehicles, and significant grades at the Sonoma Creek Bridge and Sears Point.
- The high traffic demand combined with the low capacity results in severe congestion for both weekday peak period and weekend traffic.
- Westbound SR 37 traffic typically experiences congestion approaching the lane drop west of the Mare Island interchange for about 6 hours during the weekday AM peak period and throughout much of the day on weekends.

FIGURE 2.1- ROADWAY CONGESTION ON SR 37 (FROM SR 37 TRANSPORTATION AND SEA LEVEL RISE CORRIDOR IMPROVEMENT PLAN, REFERENCE 2)



- Eastbound SR 37 congestion occurs approaching the lane drop east of SR 121 intersection for about 7 hours during the weekday PM peak period as well as much of the day on weekends. On typical weekdays, the maximum westbound delay in the morning peak period is about 27 minutes and the maximum eastbound delay in the afternoon peak period is about 80 minutes.

A graphic illustration of roadway current congestion in the SR-37 corridor is shown in Figure 2.1, excerpted from the 2018 report. The report proposed several potential highway improvement strategies.

Although the SR 37 study is preliminary in nature, it outlines both initial, incremental improvements that could be made in the next few years, as well as a larger, multi-billion dollar program which could require over 20 years to complete. The Novato to Suisun City study examines the potential for passenger rail service to play a role in alleviating congestion and providing transportation options in the SR 37 corridor.

The proposed schedule for SR 37 improvements, from the February 2018 report, is shown in Figure 2.2.

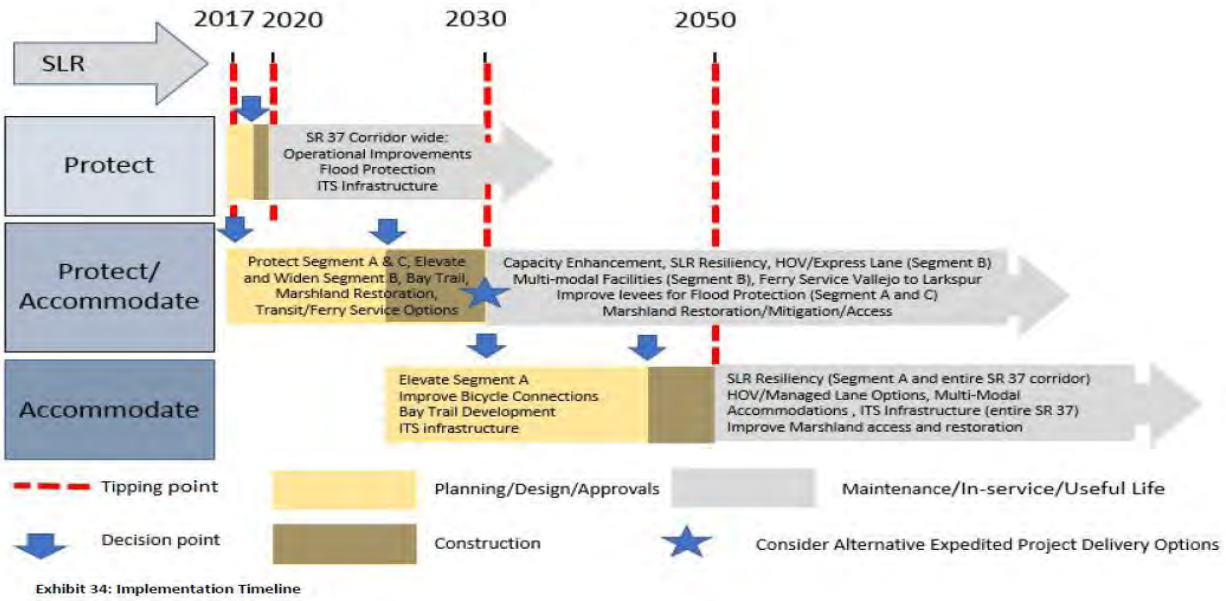


FIGURE 2.2— HIGHWAY 37 IMPROVEMENTS PROPOSED SCHEDULE
(FROM SR 37 TRANSPORTATION AND SEA LEVEL RISE CORRIDOR IMPROVEMENT PLAN, REFERENCE 2)

2.3 TRANSIT CONNECTIVITY

At the statewide level, the 2018 California State Rail Plan emphasizes "connectivity" between transportation services as a key goal. Underlying the concept of connectivity is a seamless travel experience for riders, with smooth integration between transit modes and service providers. This concept applies not only to connectivity between individual rail services, but also connectivity between rail and express bus, local bus, and bicycle networks (Chapter 4, California State Rail Plan; Reference 1). The Novato to Suisun rail corridor, which would connect the existing SMART service to Solano County (including Capitol Corridor rail service and regional bus services, among others), is one of the key elements of the State Rail Plan.

The Novato to Suisun City rail corridor provides new opportunities for transit connectivity.

To enhance connectivity between services, the State Rail Plan also identifies a "pulsed" service scenario goal, where service providers offer arrival and departure frequencies on consistent 30-minute or 60-minute headways. The existing SMART service has already achieved this pulsed service concept; today, SMART provides 30-minute headways between San Rafael and Santa Rosa during most service hours.

Establishing a rail connection between Novato and Suisun would help achieve the connectivity goals outlined in the State Rail Plan and could form the basis of an east-west transit spine, linking services provided by multiple local transit providers in Solano, Napa, Sonoma, and Marin counties.

2.4 ENVIRONMENTAL CONSIDERATIONS

By providing an integrated transportation alternative between Novato and Suisun City, the project offers the opportunity to reduce the number of single-occupancy vehicles traveling in the Highway 37 corridor. This will help achieve the State's goals of congestion mitigation, reduction in fossil fuel use, and greenhouse gas reduction.

There are also location-specific environmental considerations associated with the project. Land cover within the project area and a 500-foot buffer surrounding the project area was classified based on a preliminary aerial imagery desktop review. The land cover within the potential project area consists of six general coverage types: agricultural, developed, grassland, waterway, wetland, and woodland.

A significant wetland and wildlife refuge surround portions of the project corridor. The San Pablo Bay National Wildlife Refuge lies along the north shore of San Pablo Bay in Sonoma, Solano, and Napa Counties. The refuge includes open bay, tidal marsh, mud flats, and seasonal and managed wetland habitats.

An example of the environmental sensitivity of the area is the potential for animal and plant species that are protected at the state or federal levels. Figure 3 below is an overview of the potentially sensitive habitat and various species that may occur in the corridor.

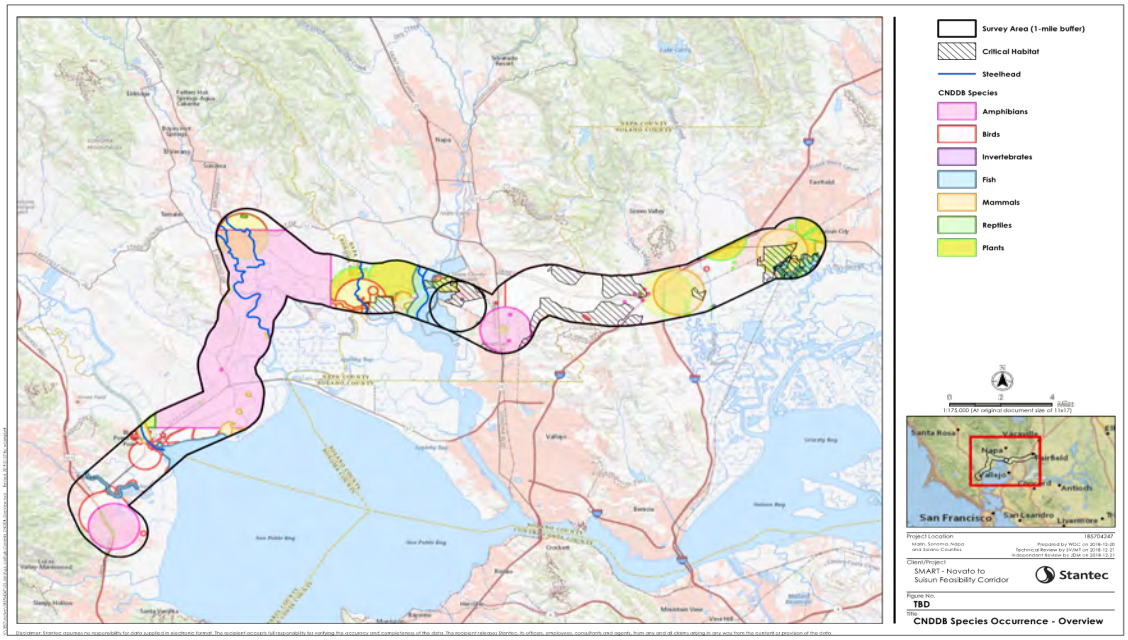


FIGURE 3— SPECIES OCCURRENCE OVERVIEW

Because most of the improvements contemplated in Option 1 are "rehabilitation" (i.e., replacement of existing ties and rail in-kind, on the existing alignment) and are similar to typical railroad maintenance activities, much of the work could be conducted from the existing railroad track, with only modest encroachments outside the existing embankment footprint. As a result, the potential environmental impacts would be comparatively minimal, and mostly confined to an area within a few feet of the existing embankment.

Option 2 assumes that the railroad trackbed would be completely reconstructed, widened slightly, improved with a layer of subballast (a granular rock similar to the subbase material used for roadways), and several new sidings added to what is presently a single-track railroad. The scope of Option 2 implies a higher level of ground disturbance, and thus a higher potential for environmental impacts in sensitive areas of the corridor. However, the benefit of completely reconstructing the trackbed is that long-term maintenance costs would be reduced, while the additional sidings would provide improved operational reliability and flexibility.

EXISTING CONDITIONS

EXISTING CONDITIONS

3 | EXISTING **CONDITIONS**

3.1. EXISTING RAIL CORRIDOR OWNERSHIP AND FREIGHT OPERATIONS

The railroad corridor connecting the existing SMART Novato-Hamilton station, near Novato, and the existing Capitol Corridor station at Suisun-Fairfield is approximately 41 miles long. Ownership of the corridor is split between SMART and Union Pacific Railroad (UPRR). The existing freight rail service is provided by two separate freight operators, the Northwestern Pacific Railroad and the California Northern Railroad.

SMART owns the right-of-way from Novato-Hamilton station eastward to approximately American Canyon. SMART calls this east-west corridor the "Brazos Subdivision." Although SMART owns the track, the Northwestern Pacific Railroad provides freight service on this segment, typically consisting of two round trips per week.

The right-of-way from American Canyon eastward to the Suisun-Fairfield Capitol Corridor station is owned by Union Pacific Railroad (UPRR). UPRR has contracted with California Northern Railroad to provide freight service on this segment, typically consisting of 1 round trip per day, 5 days per week.

For a more detailed history of the line, see Information from the Northwestern Pacific Historical Society. See Reference 3.

3.1.1. SMART RIGHT-OF-WAY (NOVATO-HAMILTON STATION TO AMERICAN CANYON)

The SMART right-of-way for the proposed project consists of two distinct portions.

The first, shorter section of SMART-owned right-of-way is comprised of a 1.6-mile-long portion overlapping with the current SMART north-south operating route. This short section would provide the proposed passenger service with a connection from the rail junction at Novato to the existing SMART Novato-Hamilton station.

The second, longer section of SMART-owned right-of-way extends from Novato eastward to American Canyon. At Novato, the existing SMART north-south operating corridor connects to the east-west Brazos Subdivision, also owned by SMART and which is currently used only for freight service. This east-west corridor roughly parallels State Route 37, and extends eastward from the rail junction at Novato to American Canyon, a distance of approximately 24 miles. Due to the relatively deteriorated condition of the track, the line has a maximum allowable speed of 25 miles per hour for freight trains.

Aerial mapping is included in this report showing existing trackway with mileposts, key structures, drainage features, bridges/structures, public and private grade crossings. See Appendix 2.

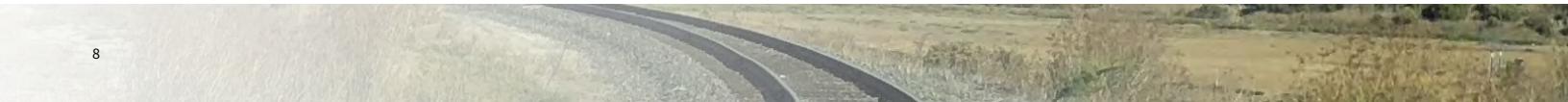
3.1.2. UNION PACIFIC RAILROAD CORRIDOR (AMERICAN CANYON TO SUISUN CITY)

Union Pacific Railroad (UPRR) owns and controls the right-of-way and track between American Canyon and Suisun City, approximately 15 miles. The UPRR route roughly parallels Highway 12 (State Route 12) between these locations. In order to provide passenger connectivity to the existing Capitol Corridor passenger service at the Suisun-Fairfield station, the proposed passenger service would operate on the UPRR corridor between American Canyon and Suisun City.

There are several rail-served industries located in the American Canyon and Suisun City areas. UPRR has contracted with California Northern Railroad to provide freight services along the line between American Canyon and Suisun City. Current freight service typically consists of 1 round trip per day, 5 days per week.

In order to operate passenger service on this segment of track, an agreement with the track owner, UPRR, would be necessary, as would improvements to the rail infrastructure.

Aerial mapping is included in this report showing existing trackway with mileposts, key structures, drainage features, bridges/structures, public and private grade crossings. See Appendix 2.



INFRASTRUCTURE AND SERVICE OPTIONS

INFRASTRUCTURE AND SERVICE OPTIONS

4 | INFRASTRUCTURE AND **SERVICE OPTIONS**

4.1. PASSENGER RAIL FEASIBILITY

The project study team has evaluated the existing rail corridor by making field visits to review actual corridor conditions and developing preliminary mapping of the corridor. Because of the relatively deteriorated condition of the infrastructure (e.g., rails, ties, bridges), lack of a signal system, and lack of a positive train control system, passenger rail service cannot be implemented using the current infrastructure. However, with suitable capital improvements, passenger rail service could be implemented.

RAIL REPAIRS AND IMPROVEMENTS NEEDED FOR PASSENGER SERVICE

The existing track (rail, wood ties, and rock ballast) can carry freight traffic at today's relatively low speeds. However, the track is largely comprised of well-worn, short (39' long) sections of rail with bolted connections (joints) between the rails. Where the existing joints became loose, over time the rail has become permanently "bent" in the vertical direction.

The existing ties are made of wood, which have an effective lifespan of approximately 35 years before requiring replacement. The newest ties along the line are approximately 10 years old, with the remaining ties even older and thus even closer to being considered "unserviceable."

The existing rock ballast supporting the ties (and rail) is largely comprised of rounded river rock — though it has been mixed with dirt in many areas. Individual pieces of river rock, with rounded edges, have poor ability to interlock with each other; thus, the layer of round river rock under the ties would be unable to distribute loads created by higher speed train operation. In addition, the dirt that has become mixed-in with the ballast acts as a "lubricant" between the ballast particles, further reducing their ability to interlock and support loads from the track. Although some angular rock was added approximately ten years ago, this was mostly a surface layer, and much of the round river rock remains under the ties.

To provide passenger train operation at speeds over 25 MPH, it would be necessary to replace much or all the rail with continuously welded rail (CWR), wherein the joints are eliminated by welding the rails together into long strings (often several miles long). Replacing the rail with CWR would eliminate the worn, bent rails, eliminate the possibility of rail joints becoming loose, and provide a much smoother ride for passengers. CWR also eliminates the possibility of rail joint failures and improves the reliability of the railroad signal system.

Thus, the majority of the existing rail, ties, and ballast would need to be replaced in order to provide reliable passenger service at speeds over 60 MPH.

GRADE CROSSINGS

There are comparatively few grade crossings on the corridor. Between Novato and American Canyon, the only major crossings are the SR 37 crossing at Sears Point and the two crossings of SR 121 at Schellville. On the UPRR-owned section between American Canyon and Suisun, there are several heavily used crossings in Cordelia and Suisun.

BRIDGES

There are two major bridges (the Black Point and Brazos bridges), as well as many smaller, minor bridges. Both options assume that the minor bridges would be replaced, and that the Black Point bridge would be upgraded or replaced.

STATIONS

While there are existing stations at Novato-Hamilton and Suisun-Fairfield, these facilities would need to be significantly expanded to accommodate the new service. Between these end points, there are no stations, and thus new stations would need to be constructed.

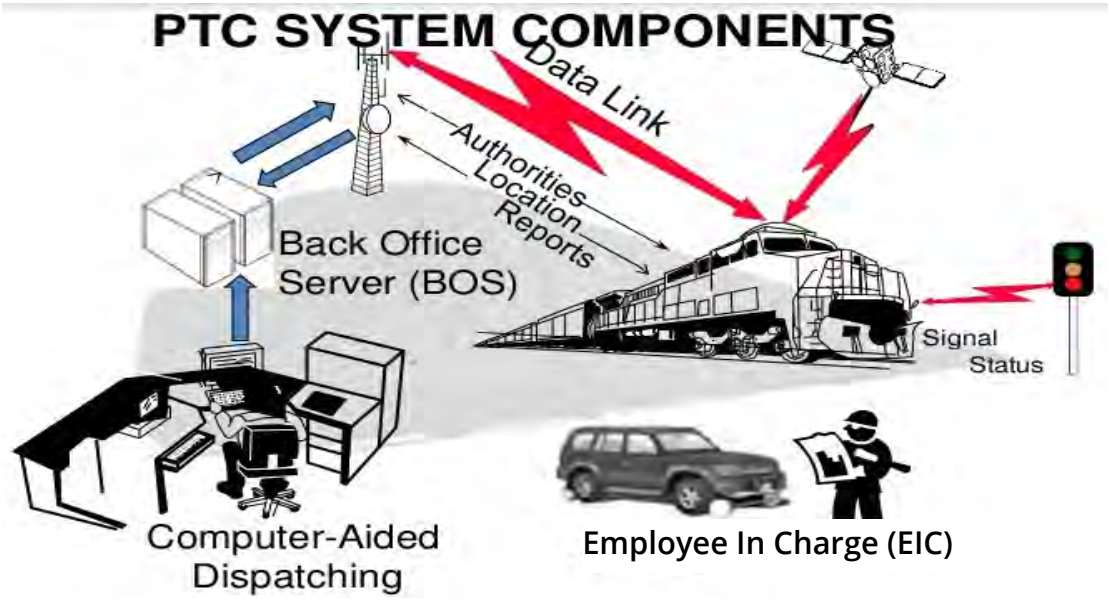
BASIC SIGNAL SYSTEM INCLUDING POSITIVE TRAIN CONTROL

Positive Train Control (PTC) is a federally mandated requirement for all rail passenger services connected to the national railway network (see Reference 4). PTC uses communication-based and microprocessor-based train control technology to prevent train-to-train collisions, overspeed derailments, incursions into established work zone limits, and the movement of a train through a switch in the wrong position.

There is no PTC system on the majority of the corridor connecting Novato-Hamilton station with Suisun City. Although the proposed passenger service would overlap with a short (approximately 1.6 mile long) section of the existing SMART operating system which is currently equipped with PTC, the SMART PTC system could not be leveraged for the proposed service. Instead, in order to comply with the federal mandate, an entirely new PTC system would be needed for the proposed service in the east-west corridor between Novato-Hamilton Station and Suisun-Fairfield Station.

The requirement for an entirely new PTC system stems from the UPRR ownership of the eastern 1/3rd of the corridor for the proposed service. UPRR's PTC system employs an entirely different technology than the existing SMART PTC system. Since UPRR controls part of the corridor, it is assumed that the proposed PTC system must be compatible with the UPRR PTC system. Thus, while the existing SMART PTC system could remain in service for trains operating in the north-south SMART corridor (between San Rafael and Santa Rosa), new PTC and supporting signal infrastructure would be needed between the Novato-Hamilton station and Suisun-Fairfield.

Once these improvements are completed, passenger service would be feasible. Depending upon the level of infrastructure improvements, the operating speed could range between 60 MPH and 80 MPH. More improvements would be needed to allow higher speeds. However, by making



POSITIVE TRAIN CONTROL COMPONENTS

more improvements prior to the initiation of passenger service, the reliability of the service would improve, and the ongoing maintenance costs would be reduced.

4.2. Rail Corridor Improvements for Two Options

This report studies two corridor improvement options for implementing passenger service. Both options include descriptions of improvement assumptions, environmental considerations, concept cost, schedule, and an operating scenario.

Improvements are scalable: while Option 1 is a baseline approach, additional modest investments could provide improved service levels without the full cost of Option 2.

Option 1 represents the minimum infrastructure improvements that would allow passenger trains to run safely and connect the SMART rail system to the Capitol Corridor rail system. This option would provide a "base" level of service.

Option 2 considers an improved level of passenger service over Option 1. Option 2 would provide additional service frequencies and reduced travel times when compared to the base level of service provided by Option 1. While Option 2 requires more capital investment than Option 1, Option 2 offers reduced maintenance costs, an improved operating scenario with better connectivity to the existing SMART and Capitol Corridor services, and improved connectivity to local transit services at intermediate stations.

Note that both Options could be scaled to provide a level of service appropriate for passenger demand.

4.2.1. OPTION 1: PASSENGER RAIL USING EXISTING INFRASTRUCTURE

4.2.1.1. INFRASTRUCTURE IMPROVEMENTS

This option describes the minimum infrastructure improvements necessary to operate passenger service. In general, the improvements contemplated under Option 1 would stay within the existing railroad embankment prism. Option 1 assumes that the track would be shared with existing freight operations, and that UPRR would grant access to the UPRR-owned track between American Canyon and Suisun-Fairfield. Option 1 assumes the following improvements:

- Replacement of the majority (over 85%) of the existing jointed rail with new continuously welded rail.
- Replacement of the majority (over 85%) of the existing wood ties with new wood ties.
- Addition of new crushed rock ballast.
- Perform either major rehabilitation to the Black Point bridge over the Petaluma River, or replace it with a with a second-hand bridge moved from another location.
- Minor repairs to the Napa River (Brazos) bridge.
- Replace all timber bridges with concrete bridges.
- Maintain existing drainage.
- Install a new train control signal system and new grade crossing signal system.
- Install Positive Train Control field apparatus, back-office technology, and on-board equipment compatible with Union Pacific's Positive Train Control standards
- Add track along a short (under 2-mile) section of the existing SMART system between Novato-Hamilton station and the junction at Novato. This would provide sufficient operational capacity for the proposed service to join the existing SMART north-south passenger rail system near Novato and traverse the short distance south to the Novato-Hamilton station.
- Station improvements (additional passenger platforms and tracks) at the SMART Novato-Hamilton station to provide a connection to the existing SMART passenger rail system.
- Connect to the Capitol Corridor passenger rail system at the existing Suisun-Fairfield Station. Construct new passenger platforms and track for the new service, and provide improvements to the existing station area to allow transfer to Capitol Corridor.
- Three new intermediate stations along the corridor.
- Addition of two new sidings between Novato and the Suisun-Fairfield Station.

Major Bridges

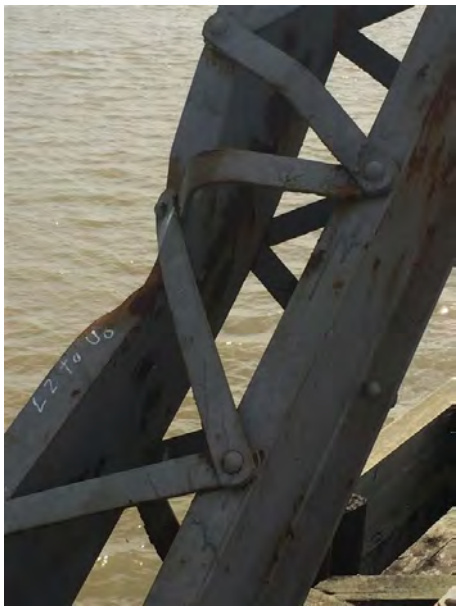
There are two major bridges on the proposed extension, the Black Point Bridge over the Petaluma River and the Brazos Bridge over the Napa River. SMART owns both bridges. They are "movable" bridges, meaning their main spans move in order to clear the navigable channel for maritime traffic. These structures have the potential to be major cost drivers for any new service scenario. The conditions and proposed upgrades to both bridges are discussed below.

Black Point Bridge

The Black Point movable bridge was constructed in 1911 as a "swing bridge." The center portion of the bridge rotates 90-degrees in order to provide a clear channel for ship traffic to navigate the Petaluma River. The bridge is comprised of the center steel swing span, and on each side, two long timber trestles. The Black Point bridge is at the end of its useful life. It is adequately maintained to accommodate low-speed and low-volume freight traffic, but must be replaced in order to implement reliable passenger rail service. The following pictures depict the bridge and provide a sample of recent damage it has sustained.

Upgrades to the Black Point bridge would benefit both rail and waterway users.

BLACK POINT SWING BRIDGE OVER PETALUMA RIVER – "OPENED" POSITION FOR MARINE TRAFFIC



BLACK POINT BRIDGE—DAMAGED STRUCTURE FROM SHIP COLLISION

For Option 1, SMART has assumed that either that major repairs would be made to the Black Point bridge, or that a second-hand movable bridge will become available as a replacement for the Black Point swing bridge. In addition, the timber approach trestles would be upgraded with concrete

spans. While re-use of a second hand bridge may seem like an unusual concept, as part of the initial build-out of the SMART system, SMART already successfully and cost-effectively replaced the swing bridge over the Petaluma River with a refurbished drawbridge that was relocated from Galveston, Texas.

The Alameda-Fruitvale railroad lift bridge, shown below, is an example of a bridge that may be available for re-use to replace the Black Point bridge. The Fruitvale lift bridge was constructed 1951 but has been out of service since 2000.

ALAMEDA-FRUITVALE RAILROAD BRIDGE

Brazos Bridge

The second major bridge is the Brazos vertical lift bridge over the Napa River. The center section of this bridge moves vertically to clear the channel for ship traffic. The lift bridge was constructed in 1979, replacing an earlier swing bridge and is in good condition. Only minor repairs and preventative maintenance are required for the lift section of this bridge. Although the lift section of the bridge is relatively new, the approach spans were never upgraded and are still comprised of timber trestles. Option 1 (as well as Option 2, described in the following section), assumes the timber approaches would be replaced with new concrete bridges.

BRAZOS VERTICAL LIFT BRIDGE OVER THE NAPA RIVER

4.2.1.2. PASSENGER EQUIPMENT

The existing SMART system passenger vehicles are Diesel Multiple Units (DMUs); each passenger car has its own diesel engine and control cab. These high-floor vehicles require a high station platform (nominally 48-inches above top of rail) to provide level boarding, in compliance with the Americans with Disabilities Act.

Option 1 is intended to represent the minimum level of investment necessary to initiate service, therefore this Option assumes the vehicles will be second-hand, level boarding commuter rail passenger trains rehabilitated for the service rather than new DMUs. While second-hand DMUs are

not available, there is a much higher probability of second-hand conventional passenger equipment being available.

CONVENTIONAL PASSENGER CARS IN SERVICE IN SOUTHERN CALIFORNIA

Photo courtesy of Stephen Hager

Option 1 assumes purchasing second-hand locomotives and second-hand, conventional coaches. Both the locomotives and coaches would be rehabilitated. To initiate a limited service, the minimum required fleet would be:

- Three second-hand locomotives — including one as a spare
- Six second-hand coaches — including two spares
- Three second-hand cab control coaches — including one spare

Second-hand locomotives offer a lower initial cost compared to new locomotives. Option 1 assumes that the second-hand locomotives would require some refurbishing to provide adequate reliability.

Similarly, second-hand coaches, some equipped with a control cab to provide for "push-pull" operation would be acquired and refurbished. Push-pull operation allows train crews to reverse direction at the end of a trip simply by walking to the opposite end of the train. The coaches purchased must also comply with the Americans with Disabilities Act (ADA), or be retrofitted to be ADA-compliant. The Caltrans Division of Rail and Mass Transit recently acquired and refurbished second-hand "Comet" cars for the San Joaquin passenger service; Option 1 assumes that a similar approach would be taken for the Novato to Suisun service.

Option 1 assumes that basic equipment maintenance could be provided by a local railroad or railroad service entity with a suitable facility. This avoids the cost of constructing a brand-new maintenance facility.

Although Option 1 assumes conventional passenger equipment in order to minimize capital costs, other vehicle types are available. These alternative vehicle types are described in Option 2.

4.2.1.3. CONCEPTUAL SERVICE LEVEL

Option 1 assumes:

- Two morning round trips per day
- Two evening round trips per day

This is a total of 8 trips per day.

Coaches typically seat 90 passengers. A three car consist can therefore carry approximately 270 passengers on each trip. Daily capacity for the 8 trips is thus approximately 2100 passengers.

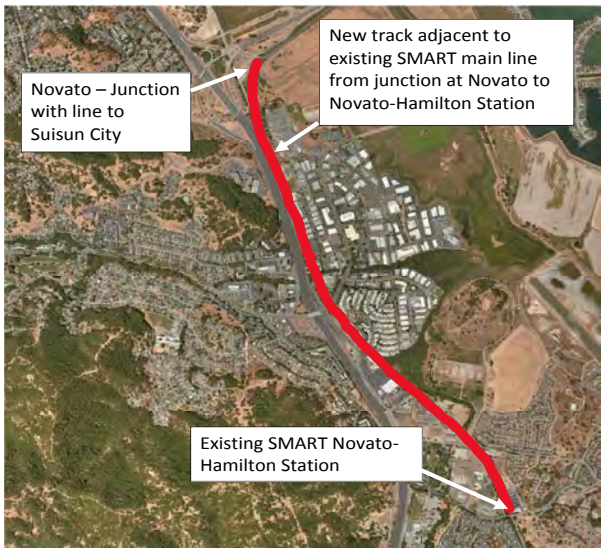
The conceptual service level identified for Option 1 could be expanded with relatively modest capital investments.

The number of trips is, in part, dependent upon train speed and the locations of sidings. It is possible that an optimized version of Option 1 could provide additional round trips; further study would be required to refine vehicle and track capacity requirements. Preliminary travel time estimates between Novato-Hamilton Station and Suisun-Fairfield station are approximately 70 to 80 minutes. This assumes 60 MPH maximum operating speed and up to three intermediate station stops.

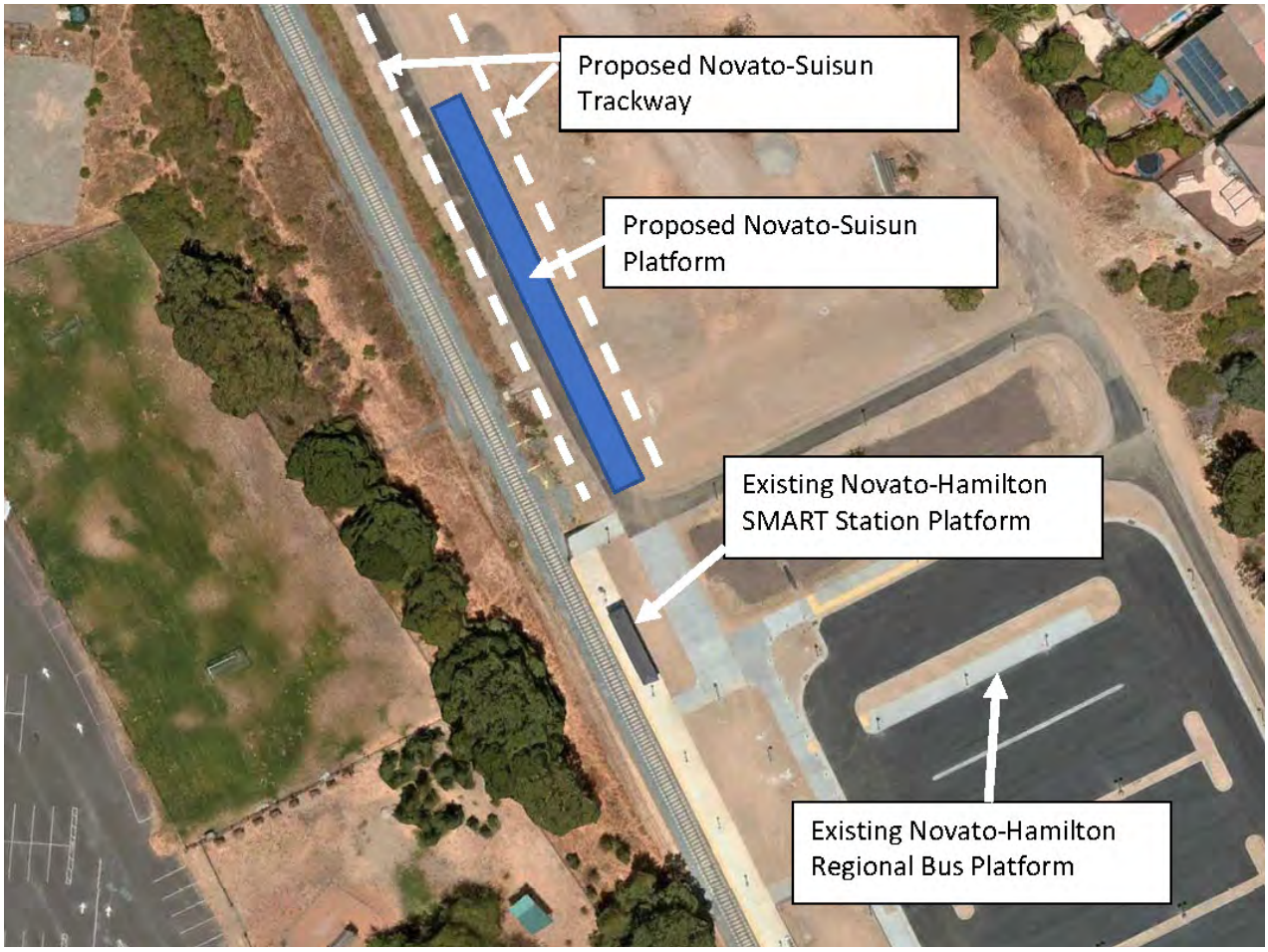
4.2.1.4. CONNECTION TO THE SMART RAIL SYSTEM

Option 1 would establish a connection to the SMART system in Novato by constructing additional tracks and platforms at the existing SMART Novato-Hamilton Station. The new tracks and platforms are necessary because the trains for the new service are assumed to "end" their runs at Novato-Hamilton, allowing passengers a timed, coordinated cross-platform transfer to the north-south SMART system for travel to their destinations in Marin or Sonoma counties.

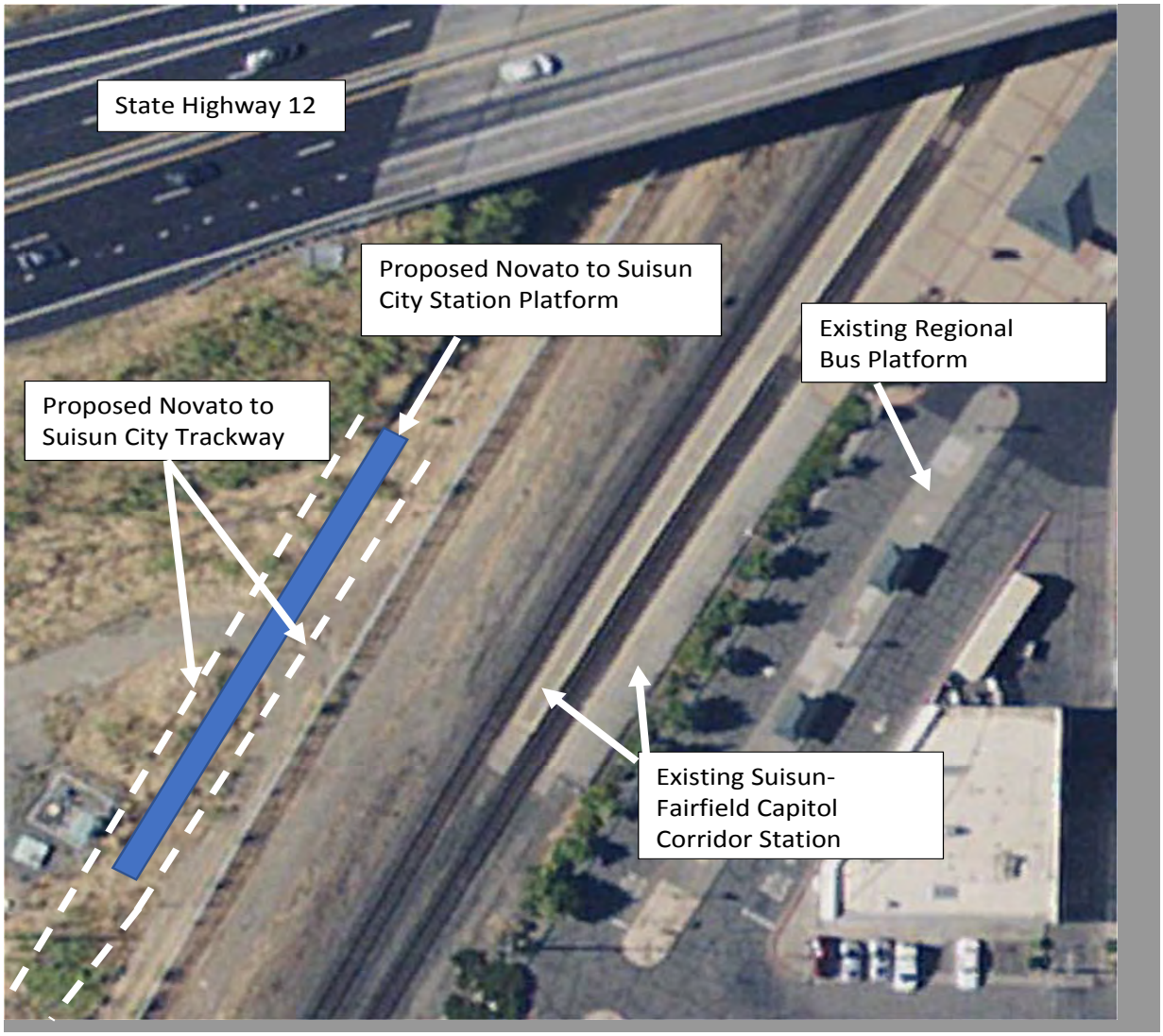
Thus, the Novato-Hamilton station would serve the western terminus station for the Novato to Suisun trains; once trains arrive at Novato-Hamilton station, they would need time to "change direction" to be prepared to proceed eastward toward Suisun. Because of the need for operating crews to change control cabs and to re-initiate the Positive Train Control system, it would take several minutes for a train to be ready to operate eastward toward Suisun. It would not be feasible to accomplish this with a train stopped on the SMART main line; thus, separate tracks and platforms have been provided to accommodate these activities. Note that Option 2 assumes a similar configuration at the Novato-Hamilton station.



NEW TRACK FROM NOVATO TO NOVATO-HAMILTON STATION



EXISTING NOVATO-HAMILTON STATION SHOWING PROPOSED NOVATO TO SUISUN PLATFORM AND TRACK



EXISTING CAPITOL CORRIDOR SUISUN-FAIRFIELD STATION SHOWING PROPOSED NOVATO TO SUISUN CITY PLATFORM AND TRACK

4.2.1.5. CONNECTION TO CAPITOL CORRIDOR

Option 1 establishes a connection to the Capitol Corridor rail system at the Suisun-Fairfield station. The existing Union Pacific Railroad (UPRR) main line, where the present Capitol Corridor station is located, is operating at full capacity. The proposed Novato to Suisun City trains would need separate tracks and high-level platforms. Passengers would be able to connect to the Capitol Corridor station via a grade-separated crossing of the UPRR main line.

4.2.1.6. STATION AREAS

Option 1 assumes two end-of-line stations, and three intermediate station areas:

- SMART Novato-Hamilton Station—this is an existing station that would be expanded to accommodate the Novato to Suisun trains
- An intermediate station in the Highway 121/37 area
- An intermediate station in the Schellville area
- An intermediate station in the American Canyon area
- Capitol Corridor Suisun-Fairfield station—this is an existing station that would be expanded to accommodate the Novato-Suisun trains

4.2.1.7. INTERACTION WITH FREIGHT TRAFFIC

UPRR owns 15 miles of the right-of-way from approximately American Canyon to Suisun City. UPRR has contracted daily freight operations on that portion of the line to the California Northern Railroad (owned by Genesee and Wyoming, a holding company), though Union Pacific retains full ownership and control of the line. Passenger rail service would need to be integrated into the existing freight service. There are several active freight customers in the Suisun area and the American Canyon area.

Northwestern Pacific Railroad (NWP) provides freight service on the SMART-owned corridor between American Canyon and Novato.

Agreements for track access would be required between SMART and the freight owners/operators. SMART is in regular discussions with Northwestern Pacific Railroad and, while NWP has operating rights over the SMART tracks, SMART retains full ownership and control of the tracks.

However, no discussions have yet been held with Union Pacific Railroad. UPRR's agreement would be necessary in order for passenger service to reach Suisun.

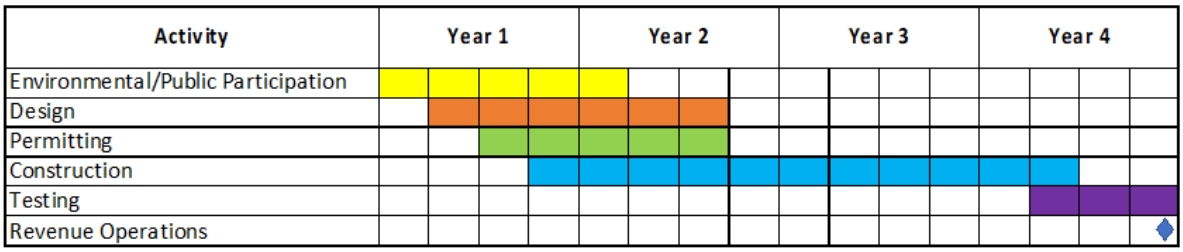
4.2.1.8. IMPLEMENTATION SCHEDULE

Option 1 could be implemented in approximately four years once project funding is secured and agreements reached with Union Pacific. The final schedule would be dependent on the required environmental documentation and permitting requirements and securing agreements with the freight railroad operators.

This schedule assumes some form of "Alternative Delivery" would be employed for design and construction. These methods allow the design phase to overlap the construction phase, thereby shortening the overall project schedule. SMART has already successfully used Alternative Delivery methods to build its north-south corridor. Several Alternative Delivery methods exist, including:

The relative simplicity of Option 1, combined with Alternative Delivery methods, offers a rapid implementation schedule.

- "Design/Build," wherein the owner (in this case, SMART) prepares preliminary designs and then solicits bids from construction contractors who would both complete the design and build the improvements.
- "Construction Manager/General Contractor," wherein the owner retains control of the design process and obtains input from the construction contractor during the design phase on ways to achieve both cost and schedule efficiencies, ultimately resulting in a negotiated, guaranteed maximum price for construction (this method may require authorization from the state legislature).



OPTION 1 CONCEPTUAL IMPLEMENTATION SCHEDULE

4.2.1.9. CONCEPTUAL CAPITAL COST ESTIMATE

The following conceptual capital cost estimate is based on historic costs from similar projects, a site visit, and conceptual designs based on aerial imagery. All costs are in 2019 dollars.
Key cost drivers of Option 1:

- Black Point Bridge must undergo significant rehabilitation or be replaced with a second-hand structure, moved to Black Point from some other location and refurbished.
- Since service must share track with UPRR, new wayside signal, data, and Positive Train Control systems, compatible with UPRR systems, would be required. Although the new wayside

signal system could leverage SMART's existing dispatching infrastructure, a PTC system inter-operable with UPRR's PTC system would be a stand-alone system, requiring entirely new field infrastructure, data transmission networks, new back-office technology, new vehicle on-board systems, and new Information Technology infrastructure (both hardware and software) to coordinate with UPRR's systems. Though these technology systems are proven in service, they represent significant expenses.

COST CATEGORY	Cost ($K's)
Track & Signal Construction	$332,000
Sitework, Structures, & Maintenance Facility	$171,000
Environmental Mitigation, Site Restoration, & Station ROW	$25,000
Mobilization, Bonds, & Insurance	$36,000
Rail Vehicles	$30,000
Project Development, Support, and Start-up	$52,000
Contingency	$194,000
Conceptual Cost Total	**$839,000,000**

Low Range of Conceptual Costs (-7% of Total)	**$780,000**
High Range of Conceptual Costs (+7% of Total)	**$898,000**

(Totals may vary slightly due to rounding)

OPTION 1 CONCEPTUAL CAPITAL COST SUMMARY

4.2.2. OPTION 2: IMPROVED LEVEL OF SERVICE

4.2.2.1. INFRASTRUCTURE IMPROVEMENTS

In order to achieve faster and more frequent passenger service and improved connectivity with the existing SMART and Capitol Corridor services, Option 2 includes additional infrastructure improvements, above and beyond those contemplated in Option 1. The infrastructure in Option 2 would provide a more robust rail line and facilitate faster, more frequent passenger service with reduced travel times, compared to Option 1. The increased infrastructure investment would also result in reduced ongoing maintenance costs. Like Option 1, Option 2 assumes that the track would be shared with existing freight operations, and that Union Pacific would grant access to the track between American Canyon and Suisun-Fairfield station.

Option 2 assumes the following improvements:

- Widen the track existing embankment, consolidate "soft" areas of embankment, remove existing rounded, river rock ballast, and provide layer of new base rock ("subballast") to best support the track.
- Remove all existing wood tie track and replace with new concrete tie track.
- Provide new crushed rock ballast.
- Replace the existing Black Point bridge over the Petaluma River with a new bridge.
- Replace all existing timber bridges with concrete bridges.
- Improve the drainage systems.
- Install train signal system.
- Install Positive Train Control field apparatus, back-office technology, and on-board equipment compatible with Union Pacific's Positive Train Control standards.

- Add track along a short (1.6 mile) section of the existing SMART system between Novato-Hamilton station and the junction near Novato with the east-west line to Suisun-Fairfield. This would provide sufficient operational capacity for the proposed service to join the existing SMART north-south passenger rail system at Ignacio and traverse the short distance south to the Novato-Hamilton station.
- Connect to the Capitol Corridor passenger rail system at the existing Suisun-Fairfield station. Construct new passenger platforms and track for the new service, and provide improvements to the existing station area to allow transfer to the Capitol Corridor (similar to Option 1).
- Up to four new intermediate stations along the corridor.
- A new equipment maintenance facility.

Replacing the rails, ties, and ballast with new materials necessitates widening the trackway in some areas. This widening will most likely result in wetland impacts requiring a more robust environmental document, additional mitigation, and therefore more time allotted for environmental clearance and permits.

EXAMPLE OF NEW TRACK WITH CONCRETE TIES AND CRUSHED ROCK BALLAST

4.2.2.2. PASSENGER EQUIPMENT

Option 2 assumes purchasing new equipment. The fleet size is larger, compared to Option 1, in order to provide more frequent service headways and longer trains. Together, these mean more passenger capacity would be available, and there would be more options for and better connectivity to the existing SMART and Capitol Corridor services at each end of the line. There would also be better connectivity to local transit services at intermediate stations. The assumed equipment for Option 2 includes either a fleet of conventional passenger equipment or a fleet of Diesel Multiple Units; the two fleet options are assumed to have roughly equal capital costs:

- Six new Tier 4 compliant locomotives — including one spare
- Twelve new high platform coaches
- Six new Cab coaches — including one spare

Or:

- Fourteen new DMUs — including spares

An example of conventional diesel-powered passenger equipment (locomotives pulling coaches) was illustrated in Option 1, which assumed second-hand, reconditioned equipment. An alternate diesel-powered technology, Diesel Multiple Units (DMUs), has recently been adopted by several commuter rail systems around the United States and Canada. DMUs are similar to “standard” passenger cars, except each DMU is also equipped with control equipment and a small diesel engine to provide propulsion; they do not require a separate locomotive for propulsion. The

Low-emission and zero-emission vehicle technology is available.

existing SMART system, linking San Rafael to Santa Rosa, uses DMUs. As additional types of DMUs are offered in the United States market, there is the potential for both fuel efficiency and carbon emission profiles to improve, and also the potential for capital costs to be reduced as domestic DMU manufacturing capabilities are expanded. Alternate vehicle technologies are described further in Section 6.

SMART DMU

4.2.2.3. CONCEPTUAL SERVICE LEVEL

Option 2 assumes the following baseline service:

- Five morning round trips per day
- Five evening round trips per day

This is a total of 20 one-way trips per day.

Coaches typically seat 90 passengers. A three car consist can therefore carry approximately 270 passengers on each trip. Daily capacity for the 20 trips would be approximately 5400 passenger trips.

It is possible that an optimized version of Option 2 could provide additional round trips; further study would be required to refine vehicle and track capacity requirements.

For Option 2, preliminary travel time estimates between Novato-Hamilton station and Suisun-Fairfield station are approximately 60 to 75 minutes. This assumes 79 MPH maximum operating speed and up to four intermediate station stops. See Appendix 3 for a preliminary Time-Distance diagram.

4.2.2.4. CONNECTION TO THE SMART RAIL SYSTEM

Option 2 would establish a connection to the SMART system in Novato by constructing additional tracks and platforms at the existing SMART Novato-Hamilton station. The new tracks and platforms would be necessary because the trains for the new service would “end” their runs at Novato-Hamilton station, allowing passengers a timed, coordinated cross-platform transfer to the north-south SMART system for travel to their destinations in Marin or Sonoma counties.

Thus, the Novato-Hamilton station would serve the western terminus station for the Novato to Suisun trains; once trains arrive at Novato-Hamilton station, they would need time to “change direction” to be prepared to proceed eastward toward Suisun. Because of the need for operating crews to change control cabs and to re-initiate the Positive Train Control system, it would take several minutes for a train to be ready to operate eastward toward Suisun. It would not be feasible to accomplish this with a train stopped on the SMART main line; thus, separate tracks and

platforms have been provided to accommodate these activities.

Note that this is the same configuration assumed in Option 1; conceptual drawings of this configuration can be seen in the previous section of this report.

4.2.2.5. CONNECTION TO CAPITOL CORRIDOR

Option 2 establishes a connection to the Capitol Corridor rail system at the Suisun-Fairfield station. The existing Union Pacific Railroad (UPRR) main line, where the present Capitol Corridor station is located, is operating at full capacity. The proposed Novato to Suisun trains would need separate tracks and high-level platforms. Passengers would be able to connect to the Capitol Corridor station via a grade-separated crossing of the UPRR main line.

Note that this is the same configuration assumed in Option 1; conceptual drawings of this configuration can be seen in the previous section of this report.

4.2.2.6. STATION AREAS

Option 2 assumes two end-of-line stations, and four intermediate station areas:

- SMART Novato-Hamilton Station—this is an existing station that would be expanded to accommodate the Novato-Suisun trains.
- An intermediate station in the Highway 121/37 area.
- An intermediate station in the Schellville area.
- An intermediate station in the American Canyon area.
- An intermediate station in either the Black Point or Cordelia areas.
- Capitol Corridor Suisun-Fairfield station—this is an existing station that would be expanded to accommodate the Novato to Suisun trains.

4.2.2.7. INTERACTION WITH FREIGHT TRAFFIC

An identical situation to Option 1 exists: Union Pacific Railroad (UPRR) owns 15 miles of the right-of-way from approximately American Canyon to Suisun City. UPRR has contracted daily freight operations on that portion of the line to the California Northern Railroad (CFNR), though Union Pacific retains full ownership and control of the line. Freight service would need to be maintained If passenger service is added to the corridor.

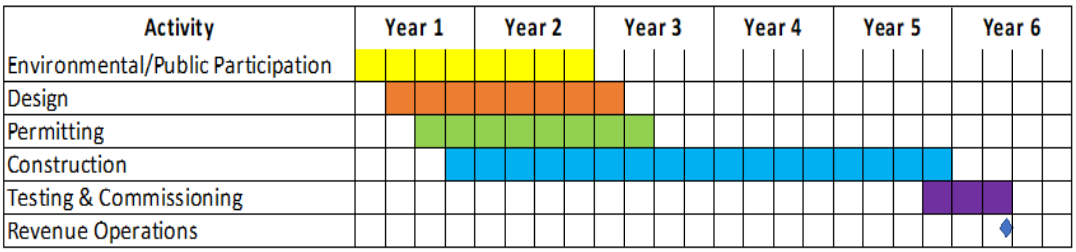
Northwestern Pacific Railroad (NWP) provides freight service on the SMART-owned corridor between American Canyon and Ignacio.

As with Option 1, agreements would be required between the freight owners/operators and the passenger service provider. SMART is in regular discussions with Northwestern Pacific Railroad and, while NWP has operating rights over SMART tracks, SMART retains full ownership and control of the tracks. However, no discussions have yet been held with Union Pacific Railroad. UPRR's agreement would be necessary in order for passenger service to reach Suisun.

4.2.2.8. IMPLEMENTATION SCHEDULE

Option 2 could be implemented in approximately six years once project funding is available. As with Option 1, the schedule for Option 2 is highly dependent on the required environmental documentation and permitting requirements. And, like Option 1, the schedule for Option 2 assumes some form of "Alternative delivery" would be employed for construction. The implementation timeline for Option 2 is longer due to:

- Additional environmental impacts (compared to Option 1), and therefore longer environmental document preparation and permitting times.
- More thorough track reconstruction and bridge designs will take longer.
- Longer construction duration due to increased scope of track and bridge replacement.



OPTION 2 CONCEPTUAL IMPLEMENTATION SCHEDULE

4.2.2.9. CONCEPTUAL CAPITAL COST ESTIMATE

The following concept cost estimate is based on historic costs from similar projects, a site visit, and conceptual designs based on aerial imagery. All costs are in 2019 dollars.

Key cost drivers of Option 2:

- Black Point Bridge would be replaced in its entirety. Option 2 assumes designing and constructing a completely new lift bridge.
- Since service must share track with UPRR, new wayside signal, data, and Positive Train Control systems, compatible with UPRR systems, would be required. Although the new wayside signal system could leverage SMART's existing dispatching infrastructure, a PTC system inter-operable with UPRR's PTC system would be a stand-along system, requiring entirely new field infrastructure, data transmission networks, new back-office technology, new on-board systems on vehicles, and new Information Technology infrastructure (both hardware and software) to coordinate with UPRR's systems. These technology systems represent significant expenses.
- A new, dedicated maintenance facility would be constructed
- All vehicles in Option 2 are assumed to be new, rather than the rehabilitated second-hand vehicles assumed in Option 1.
- All trackwork would be removed and replaced with new subgrade, ballast, concrete ties, and rails.

COST CATEGORY	Cost ($K's)
Track & Signal Construction	$364,000
Sitework, Structures, & Maintenance Facility	$310,000
Environmental Mitigation, Site Restoration, & Station ROW	$49,000
Mobilization, Bonds, & Insurance	$50,000
Rail Vehicles	$96,000
Project Development, Support, and Start-up	$69,000
Contingency	$281,000
Conceptual Cost Total	**$1,219,000,000**

Low Range of Conceptual Costs (-7% of Total)	**$1,134,000**
High Range of Conceptual Costs (+7% of Total)	**$1,304,000**

(Totals may vary slightly due to rounding)

OPTION 2 CONCEPTUAL CAPITAL COST SUMMARY

ALTERNATE VEHICLE TECHNOLOGY

5 | ALTERNATE VEHICLE **TECHNOLOGY**

5.1. ALTERNATE VEHICLE TYPES AND PROPULSION OPTIONS

Although Options 1 and 2 are assumed to employ on currently available diesel-powered equipment, there are alternative equipment options which could be employed for either Option 1 or Option 2. Propulsion systems that are either zero, or very low emissions, continue to improve and may be viable options for this corridor and thus offer the opportunity to provide a regional transit system that meets California's zero emissions goal.

The following technologies offer low-emission or zero emissions and should be studied further:

ELECTRIC MULTIPLE UNIT: Electric Multiple Units (EMUs) are a proven technology used throughout the United States and the world. EMUs are similar to "standard" passenger cars, except EMUs are also equipped with control equipment and electric motors to provide propulsion; they rely on an overhead wire (known as an overhead contact system) to provide electricity for the motors. However, EMUs do not require a separate locomotive for propulsion. Currently, the Caltrain system is installing such an overhead contact system and purchasing EMU vehicles to replace their existing, conventional diesel-powered passenger trains. Electrifying the Novato to Suisun City route would add significant cost to the project and, for the purposes of this conceptual study, has not been considered. Although an overhead contact system is the conventional power source an EMU, other sources of electricity for an EMU have recently become practical, such as batteries or hydrogen fuel cells; these are described, below.

EMU POWERED BY OVERHEAD WIRES

CNG/HYBRID: DMU-style vehicles powered by compressed natural gas and hybrid DMUs, powered by a combination of internal combustion engines and storage batteries (the same principal as a hybrid automobile) are being developed. Stadler is pursuing CNG technology, while MTU is pursuing hybrid diesel/electric technology. See Reference 5 for an article on CNG/hybrid technology and the environmental/fuel cost benefits of this technology.

BATTERY: Similar to the technology enabling battery-powered automobiles, the technology for battery-powered passenger trains has been rapidly evolving. In 2018, Bombardier introduced a prototype vehicle with a 25-mile range and plans to introduce a second prototype with a 62-mile range. The vehicles are being placed in service on the Austrian Federal Railways. The longer-range version may prove to be suitable for the Novato-Suisun City corridor. The batteries are charged via short sections of overhead wire or at end-of-line charging stations. However, they operate on battery power for the majority of each trip. These trains are a variant of the "conventional" EMU trains, using the batteries to supply electric power. See Reference 6 for the Bombardier battery powered train.

Opportunity for zero-emission vehicle technology

BATTERY EMU

HYDROGEN FUEL CELLS: The Alstom Coradia iLint, the first commercially available hydrogen fuel cell passenger railcar, recently went into service in the German state of Lower Saxony. As with other alternate fuel rail vehicles, this is similar to an EMU but with fuel cells, rather than overhead wires, providing the source of electricity. The manufacturer estimates it will be capable of speeds in excess of 80 miles per hour and a range of over 600 miles. See Reference 7.

HYDROGEN FUEL CELL EMU

ENVIRONMENTAL

6 | ENVIRONMENTAL

6.1. ENVIRONMENTAL REVIEW SCENARIOS

Based on review of preliminary information related to the two options considered in this feasibility report, the proposed project would need to comply with the California Environmental Quality Act (CEQA) and, if federal funds or federal lands were to be used, the National Environmental Policy Act (NEPA). SMART would serve as the lead CEQA agency and a Federal agency, such as the Federal Railroad Administration (FRA) or the Federal Transit Administration (FTA), would serve as the lead NEPA agency.

For both Options, it is assumed that an Environmental Impact Report (EIR) would satisfy the CEQA documentation requirements:

- Section 15121 of the CEQA Guidelines states that the purpose of an EIR "is to provide public agencies and the public in general with detailed information about the effect which a proposed project is likely to have on the environment; to list ways in which the significant effects of such a project might be minimized; and to indicate alternatives to such a project."

It is possible that the reduced scope associated with Option 1 may qualify for an Initial Study/ Mitigated Negative Declaration , rather than a full EIR.

If federal funding or federal lands are to be used, the following guidelines would be evaluated to determine the NEPA class of action in consultation with the Federal Lead Agency:

- **Categorical Exclusions**: Categorical Exclusions (CEs) are granted for actions that do not individually or cumulatively involve significant social, economic, or environmental impacts.
- **Environmental Assessments**: the Federal Lead Agency may require an Environmental Assessment (EA) for any of several reasons: (a) the significance of the environmental impact is not clearly established; (b) a CE is not appropriate because alternatives must be considered (e.g., under Section 4(f)); or (c) a CE is not appropriate because public involvement is needed. An EA can result in either a Finding of No Significant Impact (23 CFR Part 771.121) requiring no further environmental evaluation, or identification of significant impacts requiring the lead agency and the grant applicant to conduct an Environmental Impact Statement (EIS).
- **Environmental Impact Statements**: For a major project with significant impact, the Federal Lead Agency would require the grant applicant to develop an Environmental Impact Statement (EIS). An EIS requires that a substantial technical analysis and public review process be conducted to evaluate project alternatives, identify potential social, economic, and environmental impacts of the project, and designate methods to avoid or mitigate these impacts. Successful completion of an EIS results in the Federal Lead Agency signing an environmental Record of Decision (ROD).

Minimizing the project footprint offers the possibility of a faster environmental review process.

With respect to federal environmental documentation, for Option 1, it is assumed that either a CE or EA would be the appropriate level of documentation, and for Option 2 it would be either an EA or EIS.

If federal funds and/or federal lands are to be used, a joint CEQA/NEPA document could be prepared with SMART as the lead CEQA agency and the appropriate federal agency to act as the lead NEPA agency.

For both Options, the main resource areas of concern that are anticipated in the CEQA and NEPA evaluation include:

- Aesthetics/Visual Resources
- Biological Resources
- Cultural Resources
- Hazards and Hazardous Materials
- Hydrology and Water Quality
- Public Services
- Recreation
- Transportation/Traffic
- Utilities, Energy and Service Systems
- Growth-Inducing Impacts

6.2. AQUATIC RESOURCES OVERVIEW

Aquatic resources are one of the critical elements to environmental review and subsequent permitting efforts. The current railroad alignment would have been constructed on the flattest available high ground, on what was most likely the historic North Bay shoreline before levees and roads muted tidal influence from the Bay and rivers in the area. Today, the railroad berm and bridges pass through or cross extensive areas of wetlands and numerous waterways.

The overall landscape surrounding the SMART corridor (Novato to American Canyon) is substantially influenced by wetlands and waterways. This corridor crosses four major tidal waters that drain to San Pablo Bay - Novato Creek, the Petaluma River, Sonoma Creek, and the Napa River - in addition to crossing several smaller creeks and sloughs and many acres of diked wetlands.

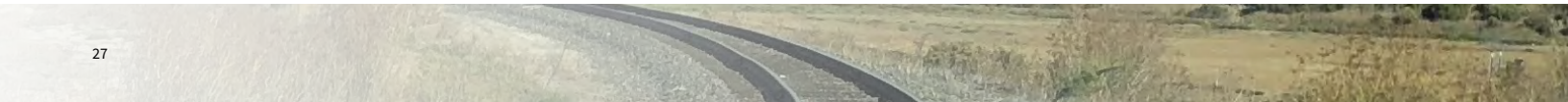
The landscape surrounding the UPRR corridor (American Canyon to Suisun City) is characterized more by grassland, agriculture, and development, and crosses only smaller (i.e., narrower) waterways, including North Slough and Fagan Creek tributaries, which drain to San Pablo Bay, as well as Cordelia Slough and Suisun Creek, which drain to Suisun Bay. A portion of this corridor, located in Jameson Canyon in Napa County, parallels the south branch of Sheehy Creek and is situated in close proximity to the creek channel and its associated canopy of riparian woodland.

As wetlands, waterways, and riparian communities are protected by various environmental regulations and jurisdictions, railroad improvements that could affect these aquatic habitats may be constrained or may require permits or other authorizations before they could be implemented.

Under Option 1, environmental permit requirements could be minimized by ensuring that bridge repairs are limited and minimize impacts on wetlands, waterways, or riparian vegetation. The three proposed stations are not likely to require aquatic resources permits to authorize construction. Under Option 2, most of the proposed activities (excluding construction of the four proposed stations) would result in impacts to wetlands, waterways, and riparian vegetation. Preliminary and advanced designs of each Option would need to be evaluated to determine applicable or avoidable environmental permit requirements. If either Option would result in permanent impacts to wetlands and waterways, compensatory mitigation would be required.

6.3. PERMITS

The following table summarizes many of the environmental permits potentially triggered by infrastructure improvements along the corridor. Note that this table does not address federal agency consultations regarding biological (fish, wildlife, plants) and cultural (archaeological and historic) resources.



Agency	Permit
U.S. Army Corps of Engineers	Clean Water Act Section 404 & Rivers and Harbors Act Section 10 permits for work in waters of the United States
San Francisco Bay Regional Water Quality Control Board	Clean Water Act Section 401 Water Quality Certification
San Francisco Bay Conservation and Development Commission	Coastal Development Permit
California State Lands Commission	Surface and Submerged Lands Lease or letter of non-objection
California Department of Fish and Wildlife	Streambed Alteration Agreement
US Coast Guard	Bridge Permit
U.S. Fish and Wildlife Service	Special Status Species
National Marine Fisheries Service	Special Status Species

TABLE 5.3-1 SUMMARY OF POTENTIAL PERMITTING AGENCIES RELATED TO AQUATIC RESOURCES

The environmental documentation effort would identify a comprehensive list of stakeholder agencies and permits. For example, additional agency consultations may include involvement from State Historic Preservation Office, and the California Public Utilities Commission.

6.4. SPECIAL STATUS SPECIES

A preliminary desktop review of natural resource agency databases, literature, aerial imagery, and other relevant sources was performed to identify special-status plant and animal species that may occur within the project area. The review sources included: (1) U.S. Fish and Wildlife Service (USFWS) list of endangered and threatened species (USFWS 2018); (2) California Department of Fish and Wildlife (CDFW) California Natural Diversity Database (CNDDB; CDFW 2018); and (3) California Native Plant Society (CNPS) Inventory of Rare and Endangered Plants (CNPS 2018). The presence of these species affect environmental documentation and permitting efforts. Based on the preliminary desktop and field review, 64 special-status plant and animal species, such as California Alkali Grass and the California Red-Legged Frog, were determined to have potential to occur in the vicinity of the project area.

6.5. CULTURAL AND HISTORICAL OVERVIEW

Cultural resources constraints along the Novato-Hamilton to American Canyon and American Canyon to Suisun sections were evaluated using desktop resources, including aerial images, historic maps and aerials, available archaeological literature, and contextual data resources. Additionally, an environmental sensitivity predictive model accounting for potential surface and buried archaeological deposits was applied to these sections. The results of this review indicate:

- There is the possibility of pre-historic occupation, particularly along waterways crossing the rail corridor.
- There are multiple historic-era resources along the corridor, including structures such as the Schellville station and the Cordelia Historic District.

Additional information is included in Appendix 4.

NEXT STEPS

NEXT STEPS

7 | NEXT **STEPS**

The next steps would be to prepare operational evaluations, preliminary engineering, and environmental research which would better define the project, its challenges, costs, and timelines. The next steps would include:

- Developing operating plans and ridership estimates.
- Refining the project scope.
- Refining capital and operational costs.
- Identifying funding options.
- Resolving institutional challenges such as operating rights on Union Pacific's right-of-way between American Canyon and Suisun-Fairfield.
- Developing preliminary engineering and environmental documentation.
- Identifying required right-of-way and if necessary, acquiring right-of-way.
- Refining station locations in cooperation with communities and local agencies such as the Transportation Agency of Marin, Sonoma County Transportation Authority, Napa County Transportation and Planning Agency, and the Solano Transportation Authority.

APPENDICES

8 | APPENDICES

Appendix 1: Conceptual Cost Estimates

Appendix 2: Conceptual track plans

Appendix 3: Novato to Suisun Time-Distance Diagram

Appendix 4: Archaeological and Cultural Resources

Appendix 5: Concept Environmental plans

REFERENCES

1. California State Rail Plan:

   http://www.dot.ca.gov/californiarail/docs/CSRP_Final_rev121818.pdf

2. SR 37 Transportation and Sea Level Rise Corridor Improvement Plan

   http://www.nvta.ca.gov/sites/default/files/SR-37-Corridor-Plan-with-appendix.pdf

3. Information from Northwestern Pacific Historical Society http://www.nwprrhs.org/history.html

4. 49 U.S. Code § 20157 - Implementation of positive train control systems

   https://www.federalregister.gov/documents/2016/02/29/2016-04293/positive-train-control-systems

5. Railway Gazette, Hybrid DMUs

   https://www.railwaygazette.com/news/single-view/view/hybrid-dmu-projects-announced.html

Stadler is also developing a CNG DMU

6. Bombardier Introduces Talent 3 Battery-Operated Train

   https://insideevs.com/bombardier-battery-operated-train/

7. Hydrogen-powered Multiple Unit train, as described on the Alstom Website:

   https://www.alstom.com/our-solutions/rolling-stock/coradia-ilint-worlds-1st-hydrogen-powered-train

8. Moratto, Michael, J.

1984 California Archaeology. Academic Press: (Reproduction, 2004; Coyote Press, Salinas, CA).

APPENDIX 1: CONCEPTUAL COST ESTIMATES

CONCEPTUAL CONSTRUCTION ESTIMATE - NOVATO TO SUISUN CITY - OPTION 1 (Rehabilitation)

Location: **SMART Brazos Subdivision**
Project: **Novato to Suisun Passenger Rail Study**
Conceptual Construction Cost

By: RailPros
Date orig: February 13, 2019
Revision#: 5
Date: April 23, 2019

Scope: Option 1 Summary: Rehabilitate existing track, new sidings, new stations, new signal system, new PTC system, second-hand vehicles

CONSTRUCTION

ITEM DESCRIPTION	EST. QUANT.	UNITS	UNIT PRICE	EXTENDED COST
Mobilization	1	Pct	5%	$ 25,800,000
Bonds and Insurance	1	Pct	2%	$ 10,300,000
Track				
Trackwork - Hamilton - Ignacio (New track for station & capacity)	2	Mi	$ 2,000,000	$ 4,000,000
Trackwork - Ignacio - American Canyon (Rehabilitate-85% ties, rail, partial undercut)	25	Mi	$ 1,800,000	$ 45,000,000
Trackwork - American Canyon - Suisun (Rehabilitate - 85% ties, rail, partial undercut)	14	Mi	$ 1,800,000	$ 25,200,000
Trackwork - Suisun 2nd Track+Station Track	4	Mi	$ 2,000,000	$ 8,000,000
Trackwork - New Sidings	2	Mi	$ 2,000,000	$ 4,000,000
Trackwork - Adjacent Track Upgrades	6	Mi	$ 1,100,000	$ 6,600,000
Grade Crossing Track+Panels	2,010	TF	$ 1,700	$ 3,400,000
New Power Turnouts	24	EA	$ 350,000	$ 8,400,000
New Hand Throw Turnouts	22	EA	$ 180,000	$ 4,000,000
Signal				
Wayside Signals (Long block lengths)	41	Rt. Mile	$ 2,000,000	$ 82,000,000
Wayside Signal Power to Remote Locations	25	Mile	$ 500,000	$ 12,500,000
Grade Crossing (Public)	25	EA	$ 700,000	$ 17,500,000
Grade Crossing (Private)	28	EA	$ 300,000	$ 8,400,000
PTC (I-ETMS Hamilton - Suisun)	41	Rt. Mile	$ 2,500,000	$ 102,500,000
			Track + Signal subtotal	*$ 331,500,000*
Sitework and Structures				
Clearing and Grubbing	72	AC	$ 10,000	$ 700,000
Earthwork for Track (Ignacio-Lombard)	20	Mile	$ 630,000	$ 12,600,000
Earthwork for New Track (Hamilton-Ignacio)	2	Mile	$ 1,100,000	$ 2,200,000
Earthwork for Sidings+New Track at Suisun	6	Mile	$ 1,100,000	$ 6,600,000
Subballast (for sidings+new track)	40,000	CY	$ 50	$ 2,000,000
Earthwork for Wayside CILs and Antennae	25	EA	$ 50,000	$ 1,300,000
Tunnel Rehabilitation or Removal (Daylight)	1	LS	$ 5,000,000	$ 5,000,000
Geotechnical Improvements	1	AL	$ 2,000,000	$ 2,000,000
HazMat Remediation	1	AL	$ 2,000,000	$ 2,000,000
Misc. Retaining Walls	24,000	SF	$ 150	$ 3,600,000
Railroad Bridge PCB (Replace timber trestles)	5,100	TF	$ 10,000	$ 51,000,000
Railroad Bridge Steel Through Girder	100	TF	$ 20,000	$ 2,000,000
Railroad Bridge Black Point (Rehab or replace with relocated lift bridge)	1	LS	$ 40,000,000	$ 40,000,000
Railroad Bridge Brazos (Through truss upgrades & remote operation)	1	LS	$ 1,500,000	$ 1,500,000
Culvert Replacement with RCP	100	EA	$ 35,000	$ 3,500,000
Roadway Modifications at Public Crossings	25	EA	$ 300,000	$ 7,500,000
Roadway Modifications at Private Crossings	28	EA	$ 70,000	$ 2,000,000
Utility Modifications / Connections	1	LS	$ 3,000,000	$ 3,000,000
Stormwater Management	1	LS	$ 3,000,000	$ 3,000,000
Stations (Novato-Hamilton)	1	EA	$ 1,500,000	$ 1,500,000
Station at Suisun-Fairfield (Assumes pre-fabricated overhead pedestrian crossing)	1	EA	$ 10,000,000	$ 10,000,000
Stations (Intermediate)	3	EA	$ 2,000,000	$ 6,000,000
			Sitework + Structures subtotal	*$ 169,000,000*
Maintenance Facility				
Improvements to Existing CFNR Facility to accommodate addt'l locomotives	1	LS	$ 1,500,000	$ 1,500,000
			Maintenance Facility subtotal	*$ 1,500,000*
Environmental (assumes required mitigation is minimal)				
Mitigation (Track earthwork)	13	AC	$ 750,000	$ 9,800,000
Mitigation (Bridges)	1	AC	$ 1,000,000	$ 1,000,000
			Environmental Mitigation subtotal	*$ 10,800,000*
Restoration				
Site Cleanup and Restoration at End of Construction	1	LS	$ 2,500,000	$ 2,500,000
			Restoration subtotal	*$ 2,500,000*
			Construction Subtotal (rounded)	*$ 551,000,000*
Property / ROW Acquisition for Stations	12.0	AC	$ 1,000,000	$12,000,000
Construction + ROW Subtotal (Construction + Property Acquisition)				**$ 563,000,000**

RAIL EQUIPMENT

Locomotives (Pre-owned Tier 3, reconditioned)	3	EA	$ 5,000,000	$ 15,000,000.00
Cab Cars (Pre-owned, reconditioned)	3	EA	$ 1,500,000	$ 4,500,000.00
Coach Cars (Pre-owned, reconditioned)	6	EA	$ 1,750,000	$ 10,500,000.00
			subtotal	*$ 30,000,000.00*
Rail Equipment Subtotal				**$30,000,000**

Capital Cost Subtotal (Const.+ROW+Equip.): $593,000,000

PROJECT DEVELOPMENT & SUPPORT

Commissioning, Testing, and Start-Up	AL	$ 4,000,000
Project Management (% of Capital Cost subtotal)	1.0%	$ 5,900,000
Environmental Documentation (NEPA/CEQA) (% of Const.+ROW Subtot.)	1.0%	$ 5,600,000
PS&E (Preliminary Engineering & Bridging Documents) (% of Const.+ROW Subtot.)	1.0%	$ 5,600,000
PS&E (Civil Final Design by D/B) (% of Const.+ROW Subtot.)	4.5%	$ 25,300,000
Construction Management (% of Capital Cost Subtot.)	1.0%	$ 5,900,000
	subtotal	*$ 52,300,000*

Project Development Subtotal: $ 52,300,000

Contingency (*Applied to All Cost Items, Incl. Const. + R/W + Equipment + Project Development*): 30% **$ 194,000,000**

PROJECT TOTAL: $839,000,000

ESTIMATE RANGE (+/- of "Project Total" Including Contingency): 7%

LOW RANGE OF ESTIMATED COSTS: $780,000,000 **HIGH RANGE OF ESTIMATED COSTS: $898,000,000**

Note: there are 47 track miles in Option 1 Average Cost per Track Mile (Incl. Contingency): $17,900,000 Note: totals may vary slightly due to rounding

CONCEPTUAL CONSTRUCTION ESTIMATE - NOVATO TO SUISUN CITY- OPTION 2 (Reconstruction)

Location: **SMART Brazos Subdivision**
Project: **Novato to Suisun Passenger Rail Study**
Conceptual Construction Cost

By: RailPros
Date orig: February 13, 2019
Revision#: 5
Date: April 23, 2019

Scope: Option 2 Summary: New/reconstructed track, new sidings, new stations, new signal system, new PTC system, new vehicles

CONSTRUCTION

ITEM DESCRIPTION	EST. QUANT.	UNITS	UNIT PRICE	EXTENDED COST
Mobilization	1	Pct	5%	$ 35,400,000
Bonds and Insurance	1	Pct	2%	$ 14,200,000
Track				
Trackwork - Hamilton - Ignacio (New track for station & capacity)	2	Mi	$ 2,000,000	$ 4,000,000
Trackwork - Ignacio - American Canyon (New track construction - rail, ties, ballast)	25	Mi	$ 2,000,000	$ 50,000,000
Trackwork - American Canyon - Suisun (New track construction - rail, ties, ballast)	14	Mi	$ 2,000,000	$ 28,000,000
Trackwork - Suisun 2nd Track+Station Track	4	Mi	$ 2,000,000	$ 8,000,000
Trackwork - New Sidings	4	Mi	$ 2,000,000	$ 8,000,000
Trackwork - Adjacent Track Upgrades	6	Mi	$ 1,100,000	$ 6,600,000
Grade Crossing Track+Panels	2,010	TF	$ 1,700	$ 3,400,000
New Power Turnouts	26	EA	$ 250,000	$ 6,500,000
New Hand Throw Turnouts	22	EA	$ 180,000	$ 4,000,000
Signal				
Wayside Signals (Medium block lengths)	41	Rt. Mile	$ 2,500,000	$ 102,500,000
Wayside Signal Power to Remote Locations	25	Mile	$ 600,000	$ 15,000,000
Grade Crossing (Public)	25	EA	$ 700,000	$ 17,500,000
Grade Crossing (Private)	28	EA	$ 300,000	$ 8,400,000
PTC (I-ETMS Hamilton - Suisun)	41	Rt. Mile	$ 2,500,000	$ 102,500,000
			Track + Signal subtotal	*$ 364,400,000*
Sitework and Structures				
Clearing and Grubbing	215	AC	$ 10,000	$ 2,200,000
Earthwork for Track (Ignacio-Suisun)	25	Mile	$ 840,000	$ 21,000,000
Earthwork for New Track (Hamilton-Ignacio)	2	Mile	$ 1,060,000	$ 2,100,000
Earthwork for Sidings+New Track at Suisun	8	Mile	$ 1,060,000	$ 8,500,000
Subballast (for sidings+new track)	260,000	CY	$ 50	$ 13,000,000
Earthwork for Wayside CILs and Antennae	27	EA	$ 50,000	$ 1,400,000
Tunnel Rehabilitation or Removal (Daylight)	1	LS	$ 5,000,000	$ 5,000,000
Geotechnical Improvements	1	AL	$ 4,000,000	$ 4,000,000
HazMat Remediation	1	AL	$ 2,000,000	$ 2,000,000
Misc. Retaining Walls	24,000	SF	$ 150	$ 3,600,000
Railroad Bridge PCB (Replace timber trestles)	5,100	TF	$ 10,000	$ 51,000,000
Railroad Bridge Steel Through Girder	100	TF	$ 20,000	$ 2,000,000
Railroad Bridge Black Point (Replace with new span)	1	LS	$ 120,000,000	$ 120,000,000
Railroad Bridge Brazos (Through truss upgrades & remote operation)	1	LS	$ 1,500,000	$ 1,500,000
Culvert Replacement with RCP	100	EA	$ 35,000	$ 3,500,000
Roadway Modifications at Public Crossings	25	EA	$ 300,000	$ 7,500,000
Roadway Modifications at Private Crossings	28	EA	$ 70,000	$ 2,000,000
Utility Modifications / Connections	1	LS	$ 4,000,000	$ 4,000,000
Stormwater Management	1	LS	$ 4,000,000	$ 4,000,000
Stations (Novato-Hamilton)	1	EA	$ 1,500,000	$ 1,500,000
Station at Suisun-Fairfield (Includes ped. tunnel connection to CCJPA station)	1	EA	$ 18,000,000	$ 18,000,000
Stations (Intermediate)	4	EA	$ 3,000,000	$ 12,000,000
			Sitework + Structures subtotal	*$ 289,800,000*
Maintenance Facility				
Dedicated Maintenance Facility	1	LS	$ 20,000,000	$ 20,000,000
			Maintenance Facility subtotal	*$ 20,000,000*
Environmental (assumes required mitigation is minimal)				
Mitigation (Track earthwork)	32	AC	$ 750,000	$ 24,000,000
Mitigation (Bridges)	3	AC	$ 2,000,000	$ 6,000,000
			Environmental Mitigation subtotal	*$ 30,000,000*
Restoration				
Site Cleanup and Restoration at End of Construction	1	LS	$ 4,000,000	$ 4,000,000
			Restoration subtotal	*$ 4,000,000*
			Construction Subtotal (rounded)	*$ 758,000,000*
Property / ROW Acquisition for Stations	15.0	AC	$ 1,000,000	$15,000,000
Construction + ROW Subtotal (Construction + Property Acquisition)				**$ 773,000,000**

RAIL EQUIPMENT

Locomotives (New Tier 4)	6	EA	$ 7,000,000	$ 42,000,000.00
Cab Cars (New)	6	EA	$ 3,500,000	$ 21,000,000.00
Coach Cars (New)	12	EA	$ 2,750,000	$ 33,000,000.00
			subtotal	*$ 96,000,000.00*
Rail Equipment Subtotal				**$96,000,000**

Capital Cost Subtotal (Const.+ROW+Equip.): $869,000,000

PROJECT DEVELOPMENT & SUPPORT

Commissioning, Testing, and Start-Up	AL	$ 4,000,000
Project Management (% of Capital Cost Subtotal)	0.8%	$ 7,000,000
Environmental Documentation (NEPA/CEQA) (% of Const.+ROW Subtot.)	0.9%	$ 7,000,000
PS&E (Preliminary Engineering & Bridging Documents) (% of Const.+ROW Subtot.)	0.9%	$ 7,000,000
PS&E (Civil Final Design by D/B) (% of Const.+ROW Subtot.)	4.5%	$ 34,800,000
Construction Management (% of Capital Cost Subtot.)	1.0%	$ 8,700,000
	subtotal	*$ 69,000,000*

Project Development Subtotal: $ 69,000,000

Contingency (*Applied to All Cost Items, Incl. Const. + R/W + Equipment + Project Development*): 30% **$ 281,000,000**

PROJECT TOTAL: $1,219,000,000

ESTIMATE RANGE (+/- of "Project Total" Including Contingency): 7%

LOW RANGE OF ESTIMATED COSTS: $1,134,000,000 **HIGH RANGE OF ESTIMATED COSTS: $1,304,000,000**

Note: there are 49 track miles in Option 2 Average Cost per Track Mile (Incl. Contingency): $24,900,000 Note: totals may vary slightly due to rounding

APPENDIX 2: CONCEPTUAL TRACK PLANS

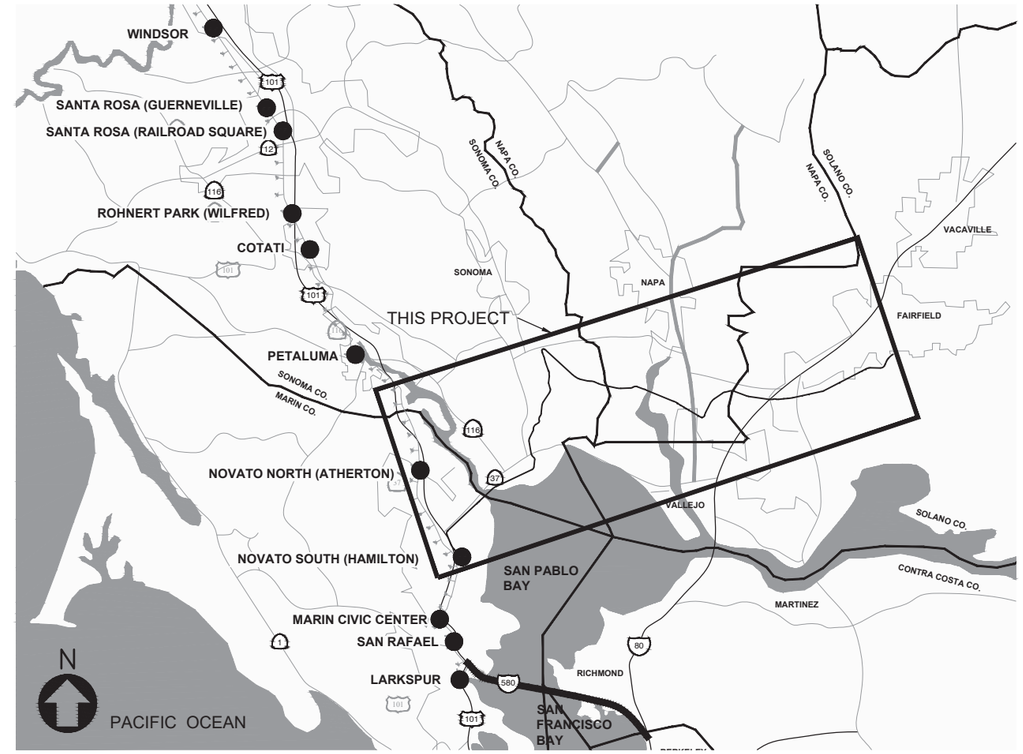
CIVIL/TRACK DRAWINGS FOR CONCEPTUAL DESIGN

CV-DB-XX-XXX

SUISUN EXTENSION

MILEPOST 0.00 TO MILEPOST 41.63

MARIN COUNTY, CALIFORNIA
SONOMA COUNTY, CALIFORNIA
NAPA COUNTY, CALIFORNIA
SOLANO COUNTY, CALIFORNIA
MARCH 2019



LOCATION MAP

NOT TO SCALE

DESIGN PACKAGE SUMMARY		
PKG	LIMITS	NOTES
1	MP 0.00 TO MP 41.63	CONCEPTUAL DESIGN
2		

REV	DATE	BY	SUB	APR	DESCRIPTION

NOT FOR CONSTRUCTION

PREPARED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE MAR 14, 2019

DRAFT

MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION
GENERAL
COVER SHEET
SHEET 1 OF 2

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SCALE
CONTRACT NO. CV-DB-XX-XXX
DWG. NO. G001
MILEPOST

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EXISTING TRACK

PROPOSED TRACK

EXISTING STATION

POTENTIAL STATION

PLAN
SCALE: 1"=5000'

REV	DATE	BY	SUB	APR	DESCRIPTION

NOT FOR CONSTRUCTION

PREPARED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE MAR 14, 2019

DRAFT

MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION
GENERAL
KEY MAP
SHEET 2 OF 2

CADD FILENAME G002.dwg
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CONTRACT NO. CV-DB-XX-XXX
DWG. NO. G002
MILEPOST –

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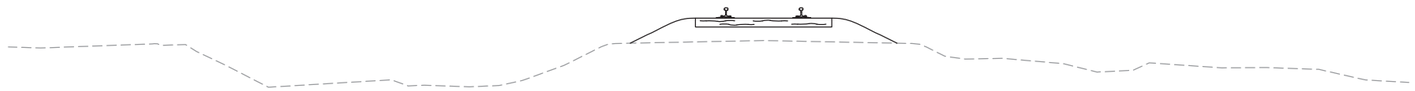
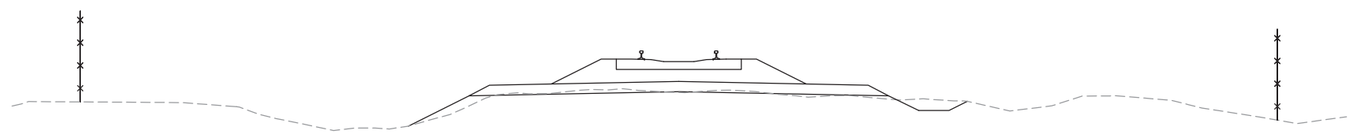
ABBREVIATIONS

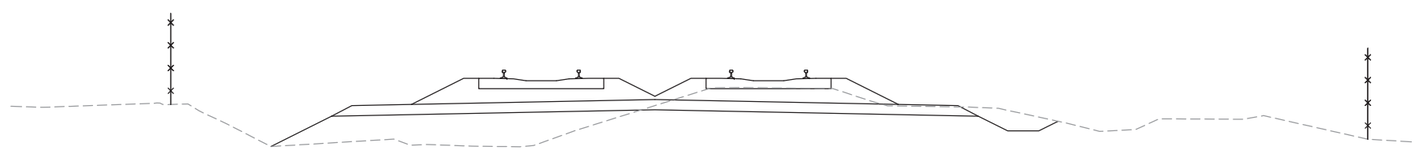
CORR	CORRUGATED
CONC	CONCRETE
Dc	DEGREE OF CURVATURE
EX	EXISTING
HT	MANUAL TURNOUT
HWY	HIGHWAY
Lc	LENGTH OF CHORD
LH	LEFT HAND
MP	MILE POST
PI	POINT OF INTERSECTION
PO	POWER TURNOUT
POC	POINT OF CURVE
POT	POINT OF TANGENT
R	RADIUS
RH	RIGHT HAND
RCP	REINFORCED CONCRETE PIPE
ROW	RIGHT OF WAY
RWB	REINFORCED WOODEN BOX
TO	TURNOUT
Δ	DELTA ANGLE



A – TYPICAL SECTION
EXISTING SINGLE TRACK SECTION



B – TYPICAL SECTION
NEW SINGLE TRACK SECTION



C – TYPICAL SECTION
NEW MAIN TRACK W/SIDING SECTION

5' 0' 5' 10'
SCALE

REV	DATE	BY	SUB	APR	DESCRIPTION

NOT FOR CONSTRUCTION

PREPARED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE MAR 14, 2019

DRAFT

MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TYPICAL SECTIONS

SHEET 0 OF 38

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DWG. NO. TR001
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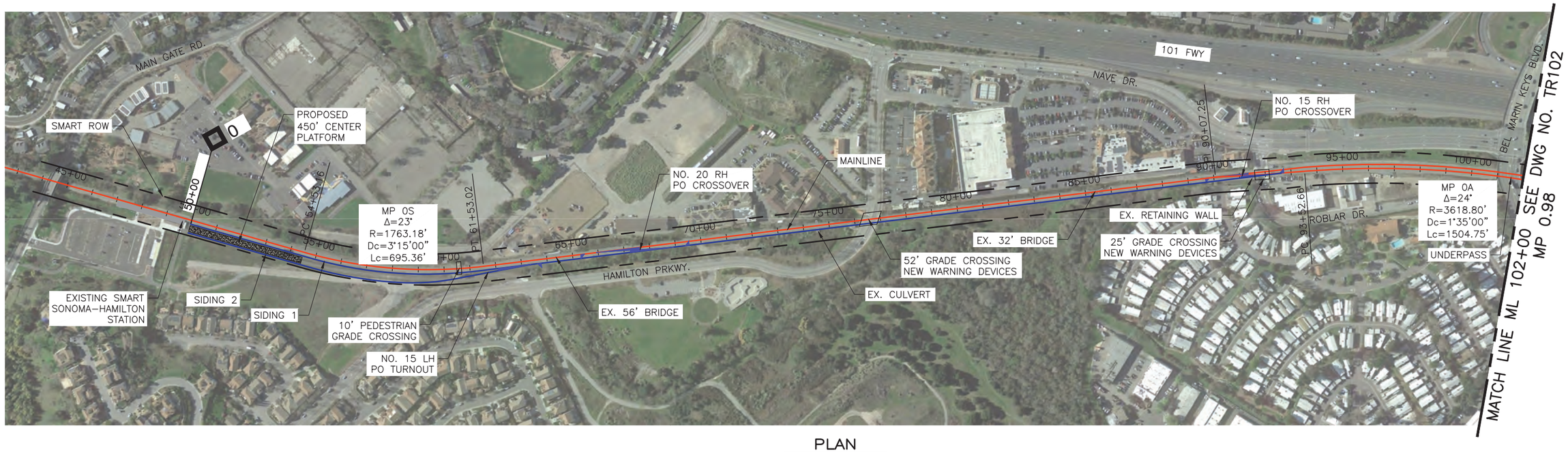

PLAN
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SCALE

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PREPARED BY
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DATE MAR 14, 2019

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 44+35 TO STA 102+00

SHEET 1 OF 38

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DWG. NO. TR101
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DATE MAR 14, 2019

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 102+00 TO STA 160+00

SHEET 2 OF 38

CADD FILENAME TR101–TR110.dwg
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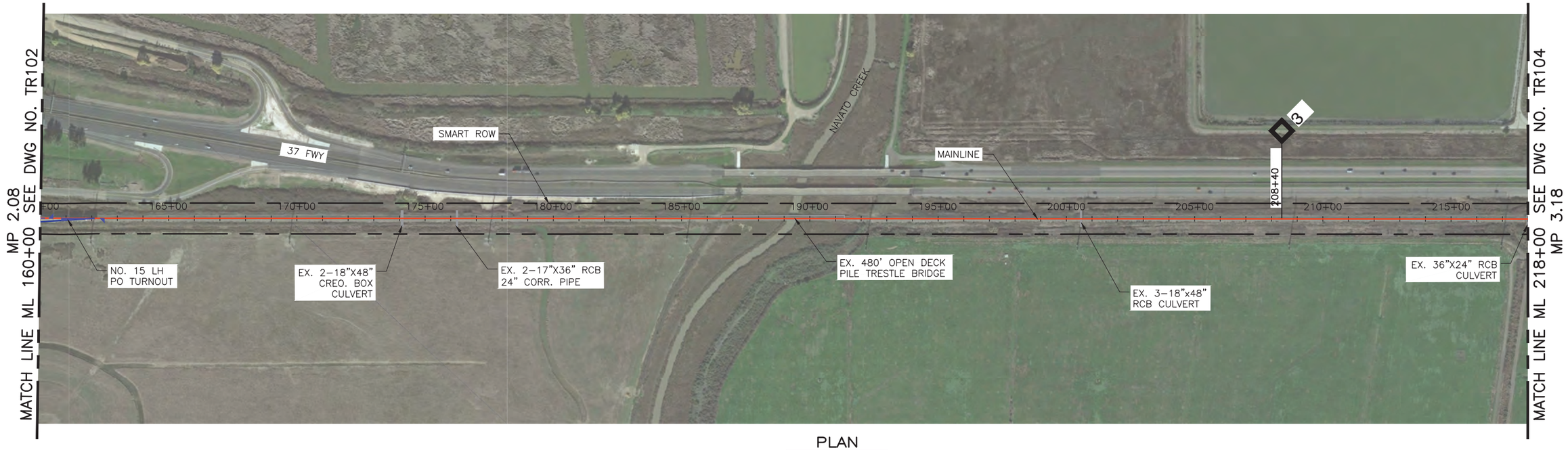

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PREPARED BY
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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 160+00 TO STA 218+00

SHEET 3 OF 38

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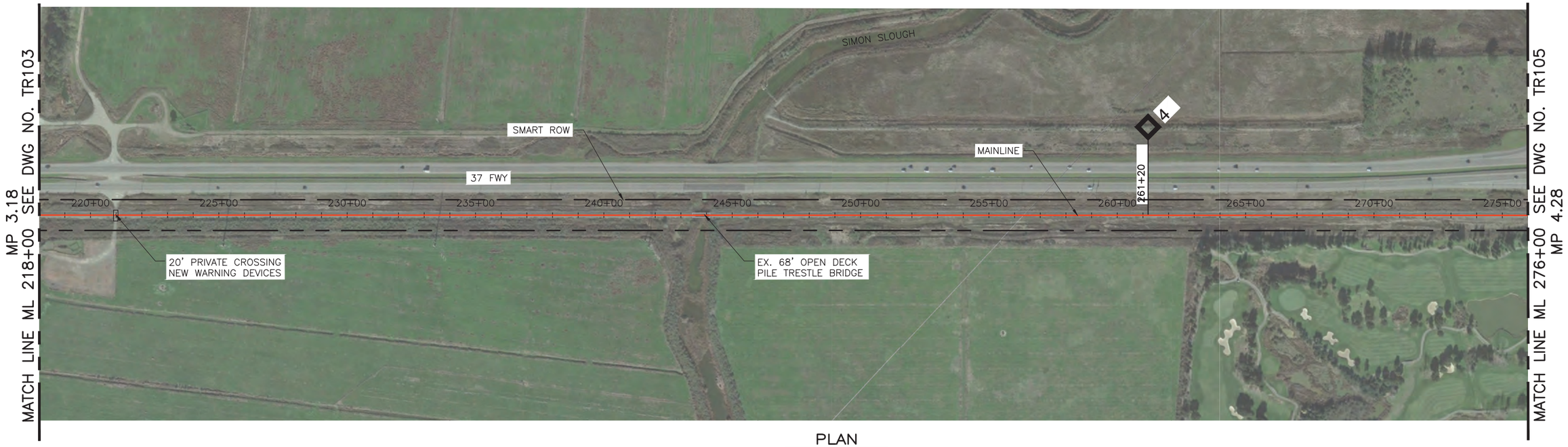

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 218+00 TO STA 276+00

SHEET 4 OF 38

CADD FILENAME TR101–TR110.dwg
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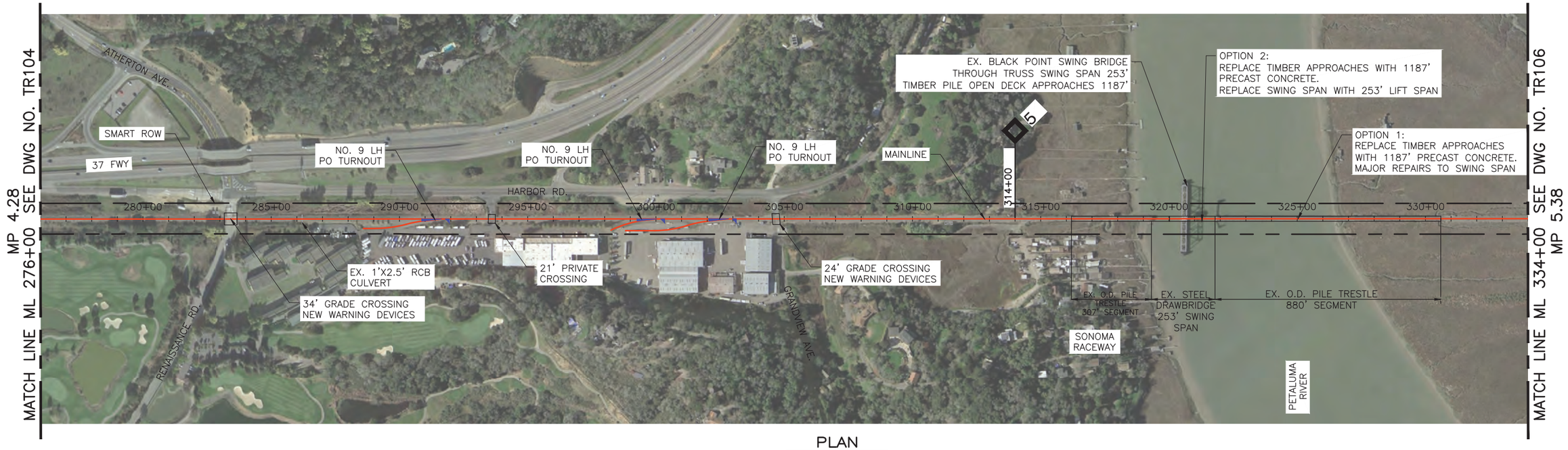

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DATE MAR 14, 2019

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 276+00 TO STA 334+00

SHEET 5 OF 38

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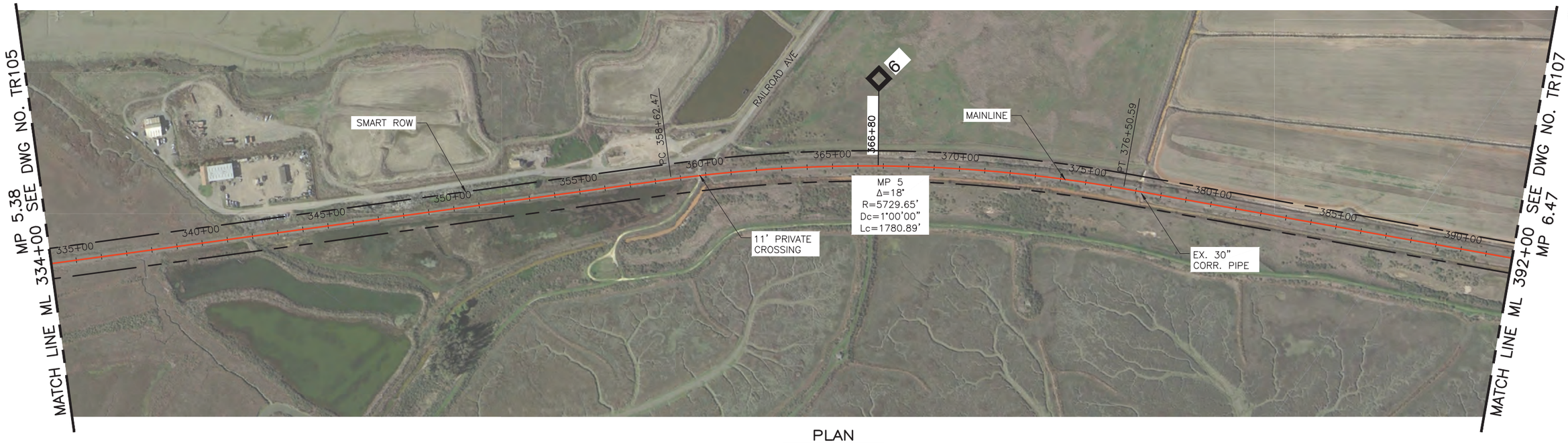

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 334+00 TO STA 392+00

SHEET 6 OF 38

CADD FILENAME TR101–TR110.dwg
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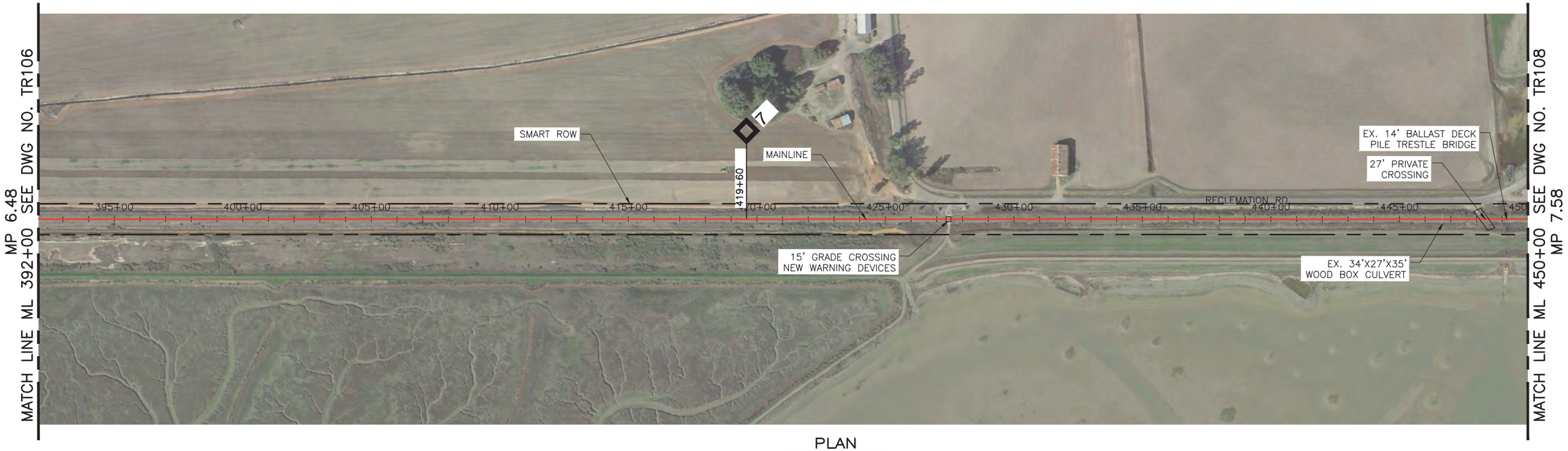

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 392+00 TO STA 450+00

SHEET 7 OF 38

CADD FILENAME TR101–TR110.dwg
SCALE AS NOTED
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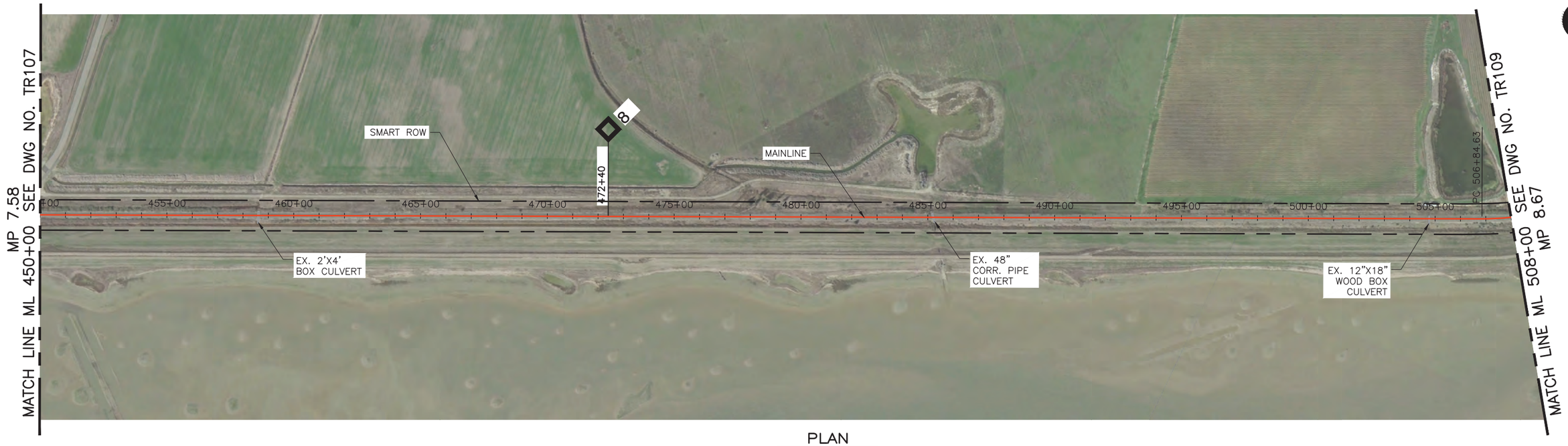

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 450+00 TO STA 508+00

SHEET 8 OF 38

CADD FILENAME TR101–TR110.dwg
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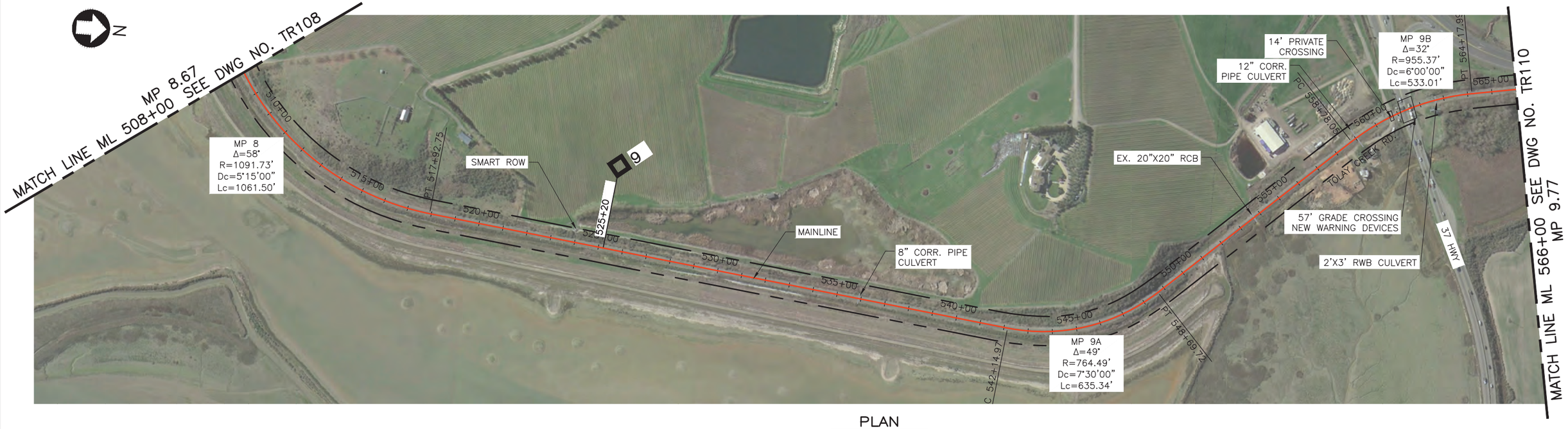

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 508+00 TO STA 566+00

SHEET 9 OF 38

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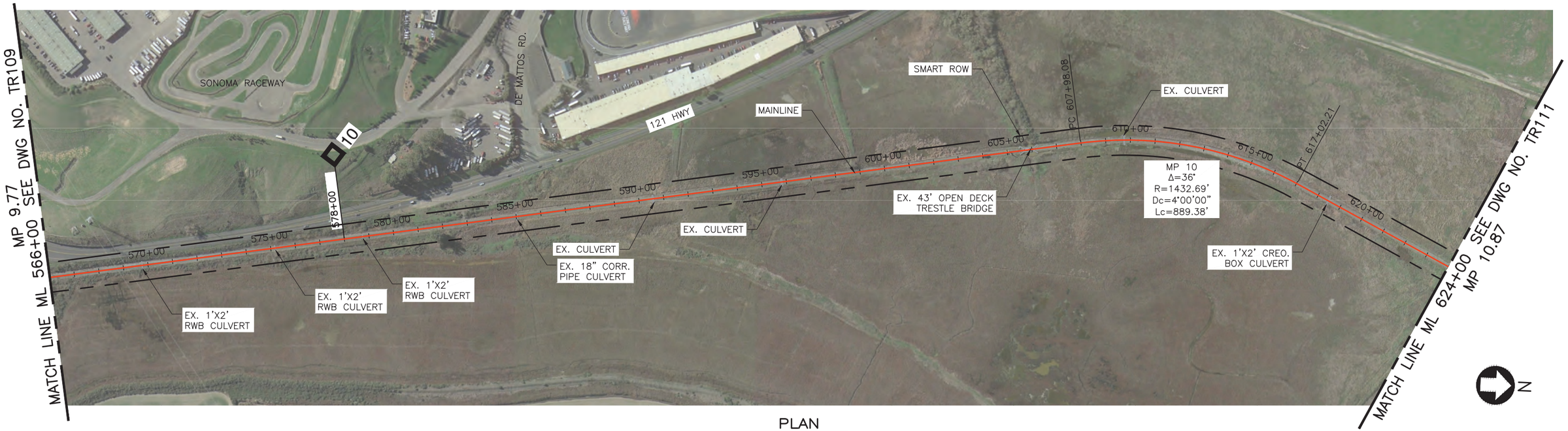

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 566+00 TO STA 624+00

SHEET 10 OF 38

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CONTRACT NO. CV–DB–XX–XXX
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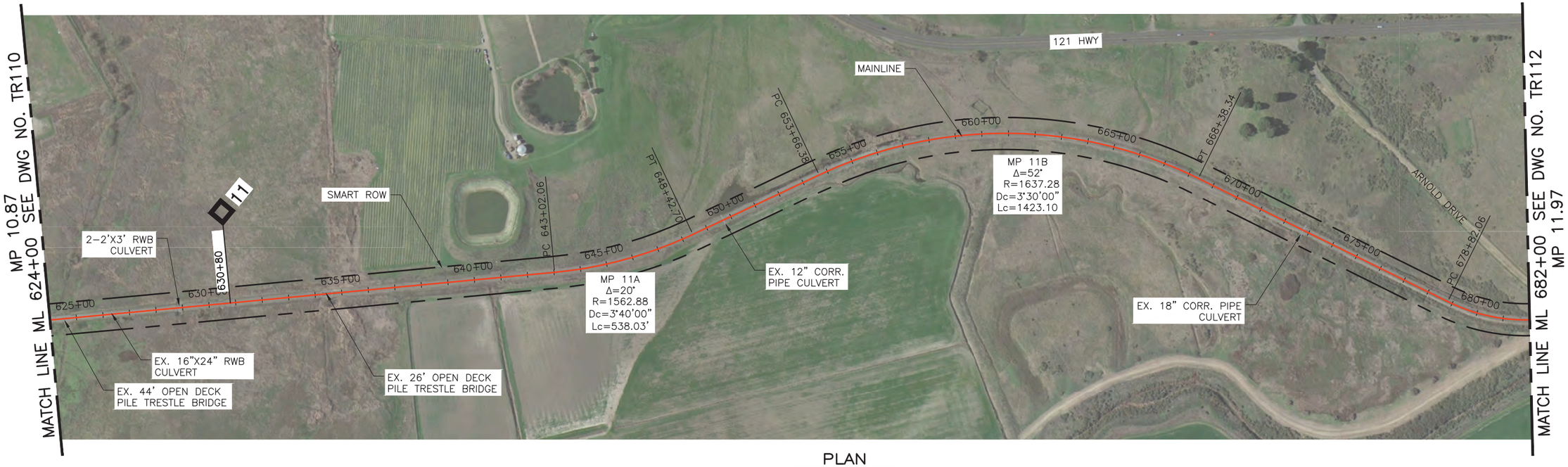

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 624+00 TO STA 682+00

SHEET 11 OF 38

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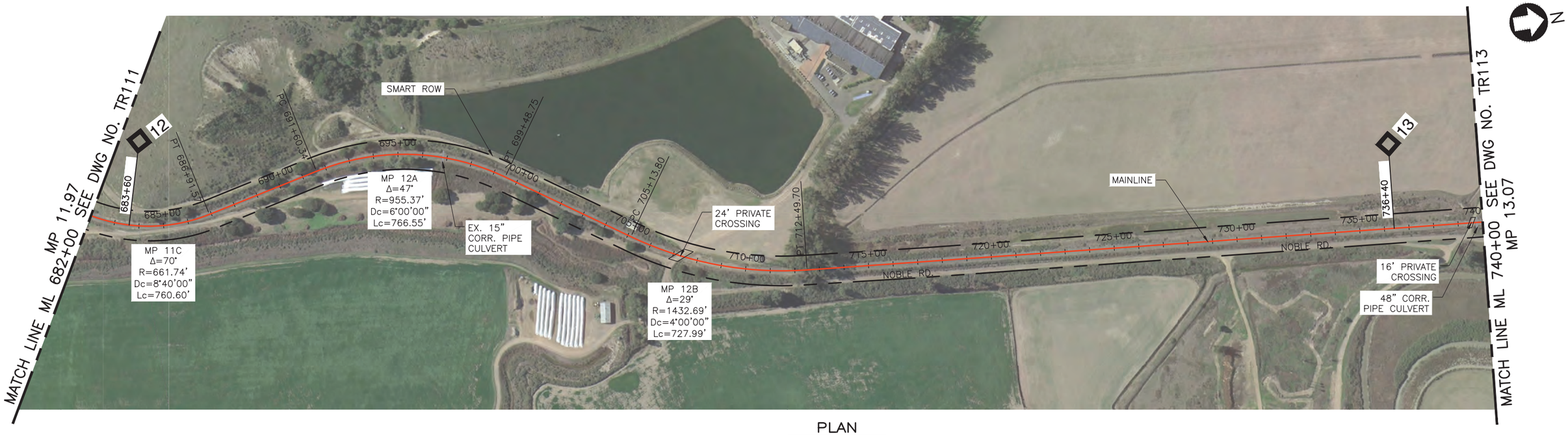

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 682+00 TO STA 740+00

SHEET 12 OF 38

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MILEPOST 11.97

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SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 740+00 TO STA 798+00

SHEET 13 OF 38

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CONTRACT NO. CV–DB–XX–XXX
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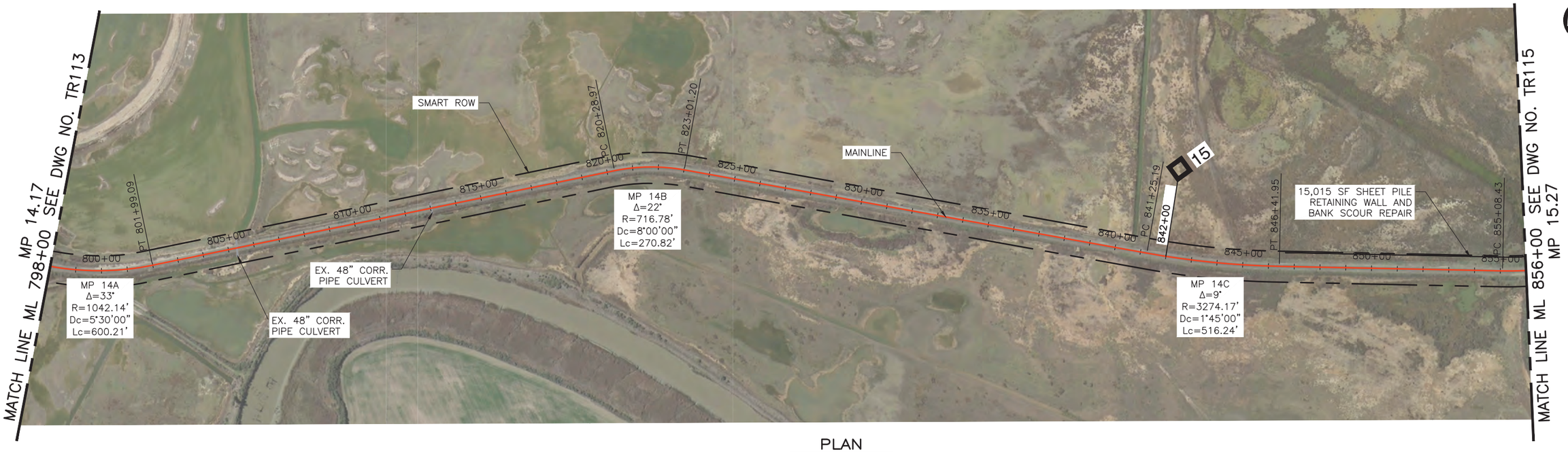

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DATE MAR 14, 2019

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 798+00 TO STA 856+00

SHEET 14 OF 38

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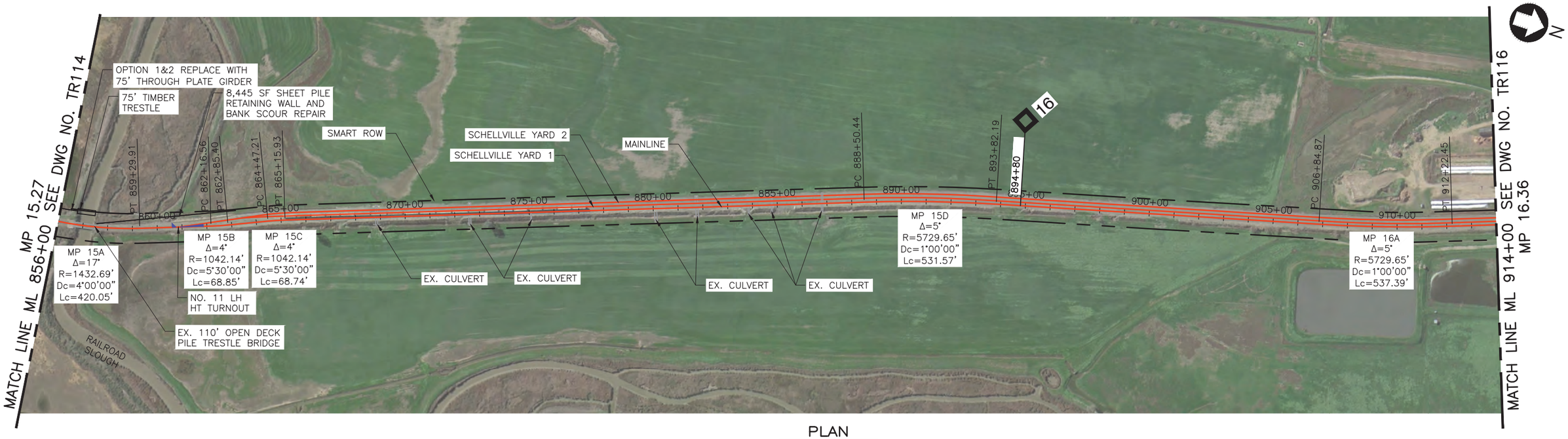

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SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 856+00 TO STA 914+00

SHEET 15 OF 38

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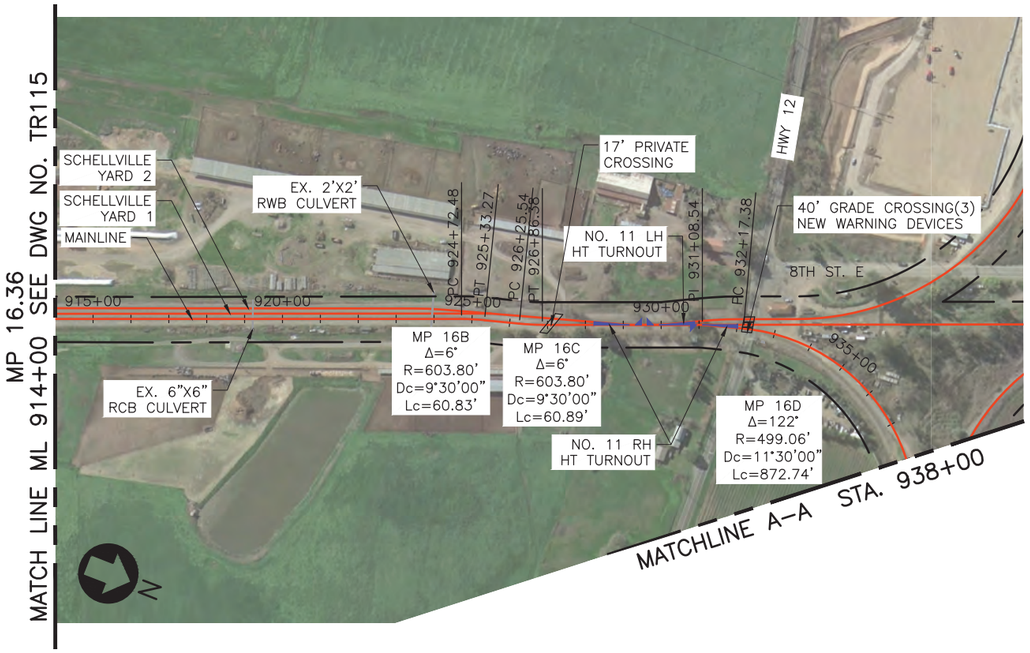

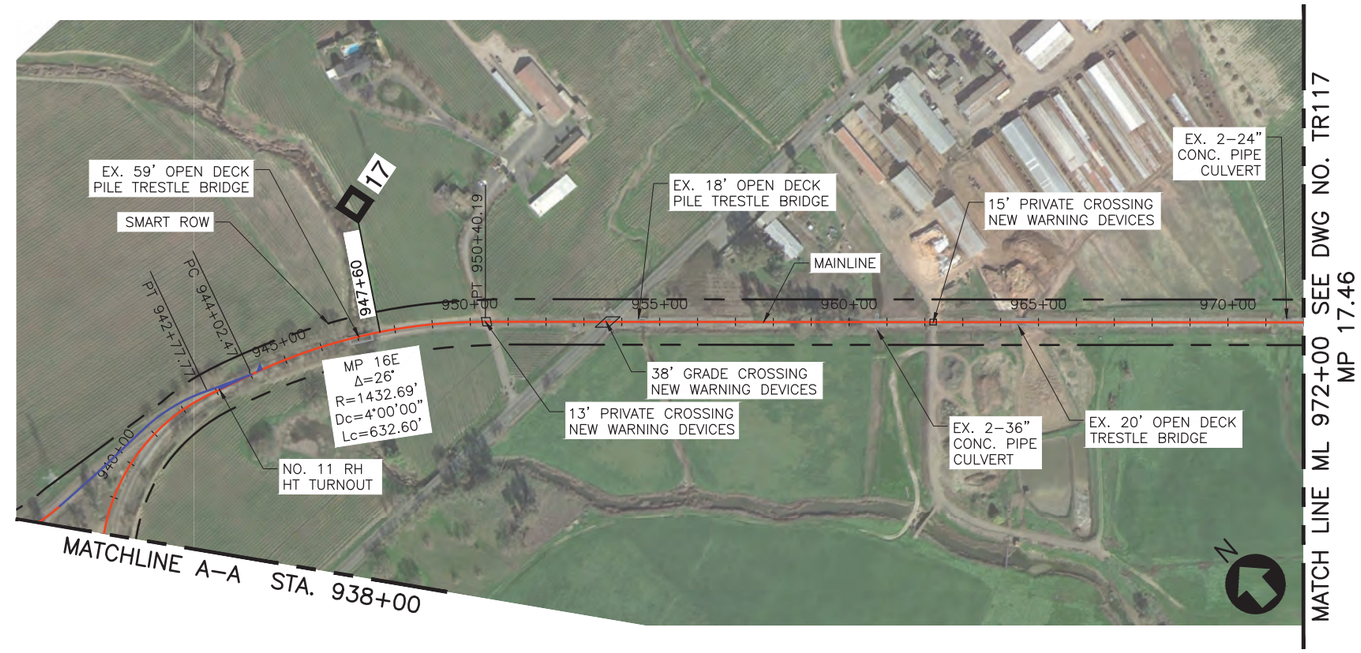

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DATE MAR 14, 2019

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 914+00 TO STA 972+00

SHEET 16 OF 38

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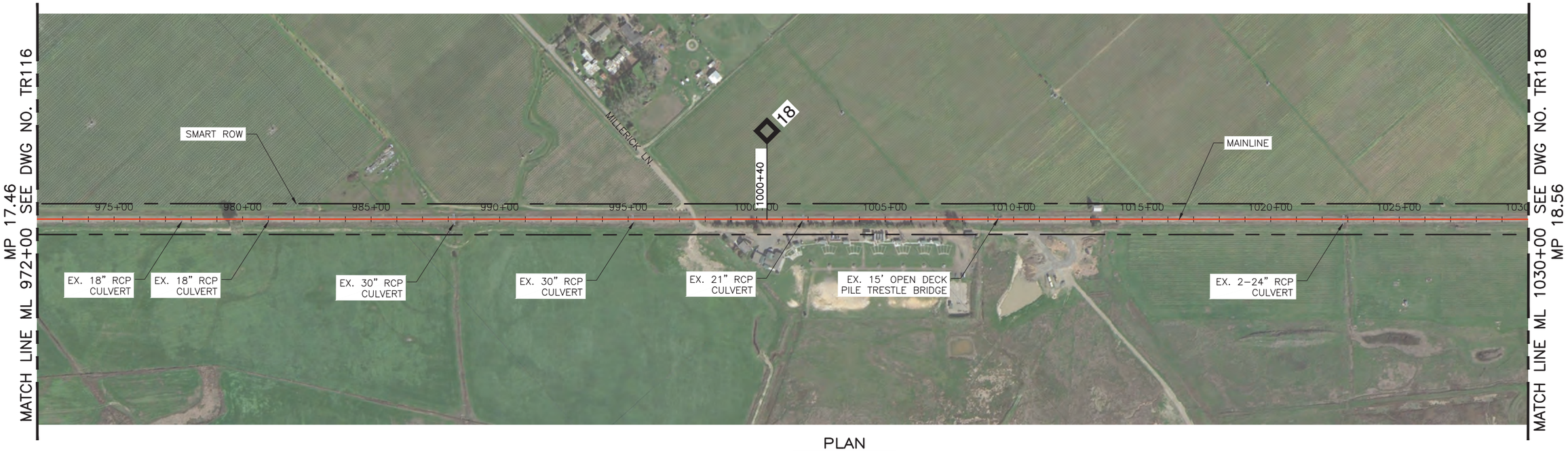

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IN CHARGE
DATE MAR 14, 2019

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 972+00 TO STA 1030+00

SHEET 17 OF 38

CADD FILENAME TR111-TR120.dwg
SCALE AS NOTED
CONTRACT NO. CV-DB-XX-XXX
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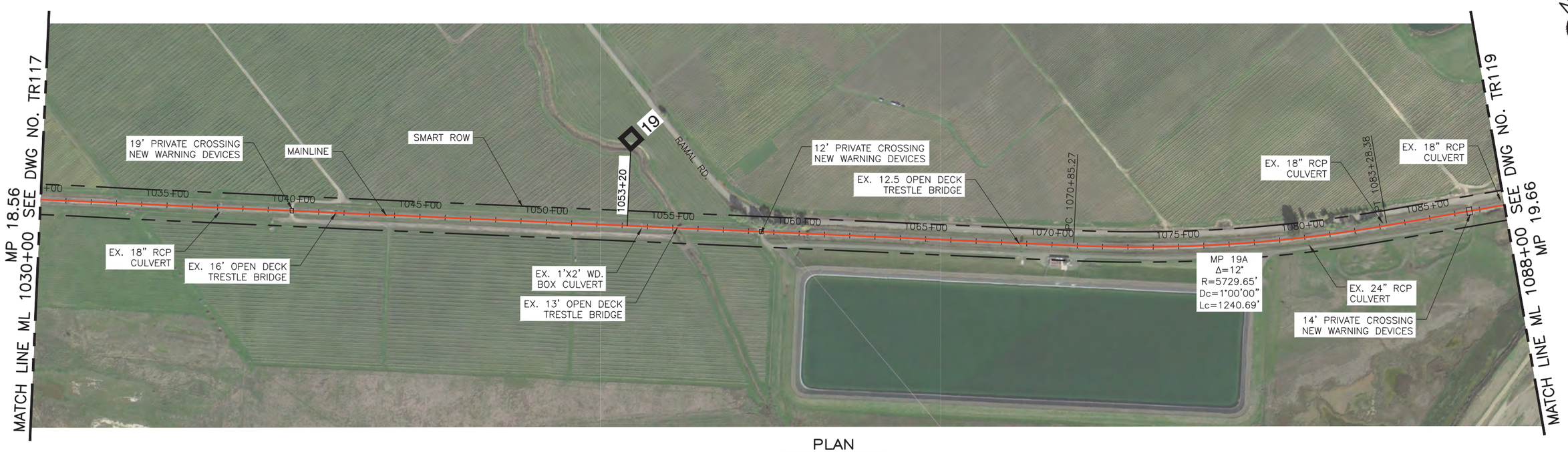

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DATE MAR 14, 2019

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 1030+00 TO STA 1088+00

SHEET 18 OF 38

CADD FILENAME TR111–TR120.dwg
SCALE AS NOTED
CONTRACT NO. CV–DB–XX–XXX
DWG. NO. TR118
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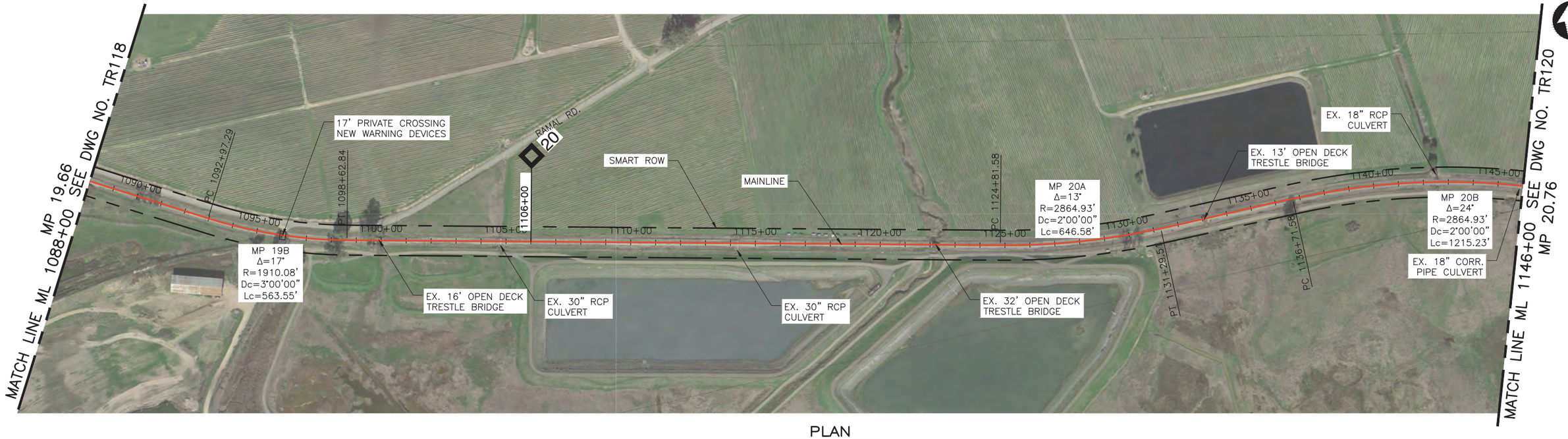

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 1088+00 TO STA 1146+00

SHEET 19 OF 38

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SCALE AS NOTED
CONTRACT NO. CV–DB–XX–XXX
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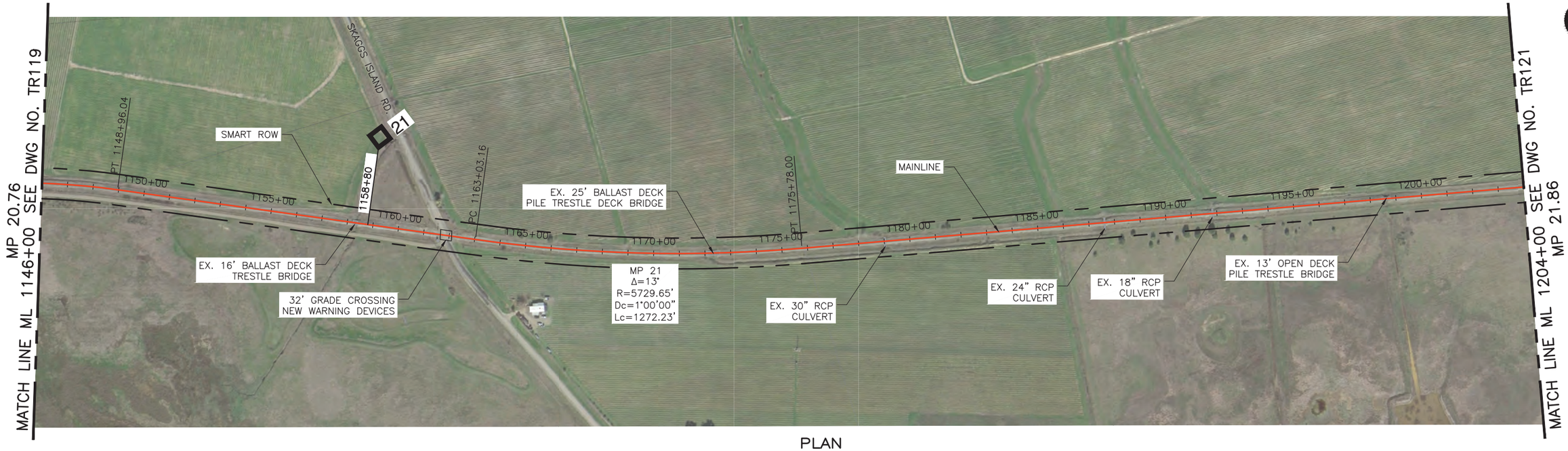

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 1146+00 TO STA 1204+00

SHEET 20 OF 38

CADD FILENAME TR111–TR120.dwg
SCALE AS NOTED
CONTRACT NO. CV–DB–XX–XXX
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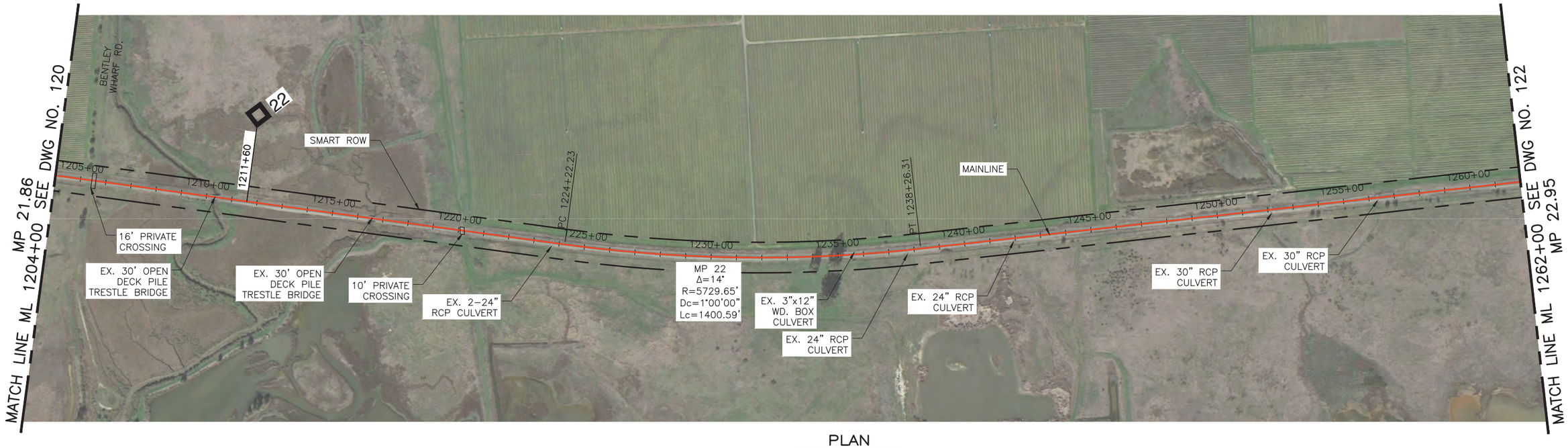

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 1204+00 TO STA 1262+00

SHEET 21 OF 38

CADD FILENAME TR121-TR130.dwg
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CONTRACT NO. CV-DB-XX-XXX
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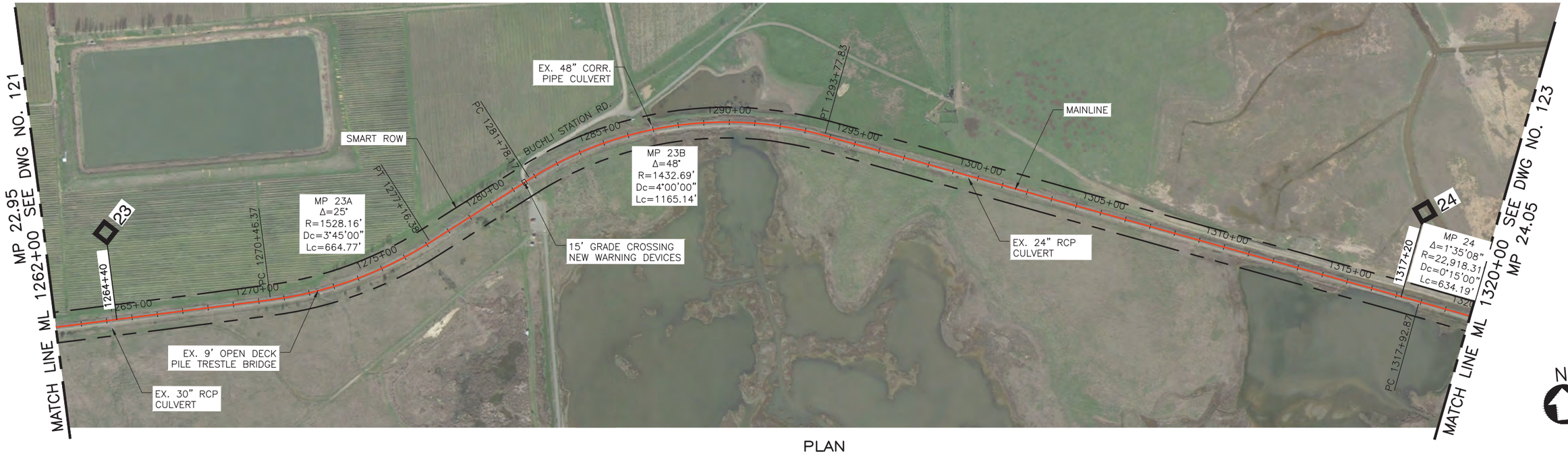

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PREPARED BY
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DATE MAR 14, 2019

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

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SHEET 22 OF 38

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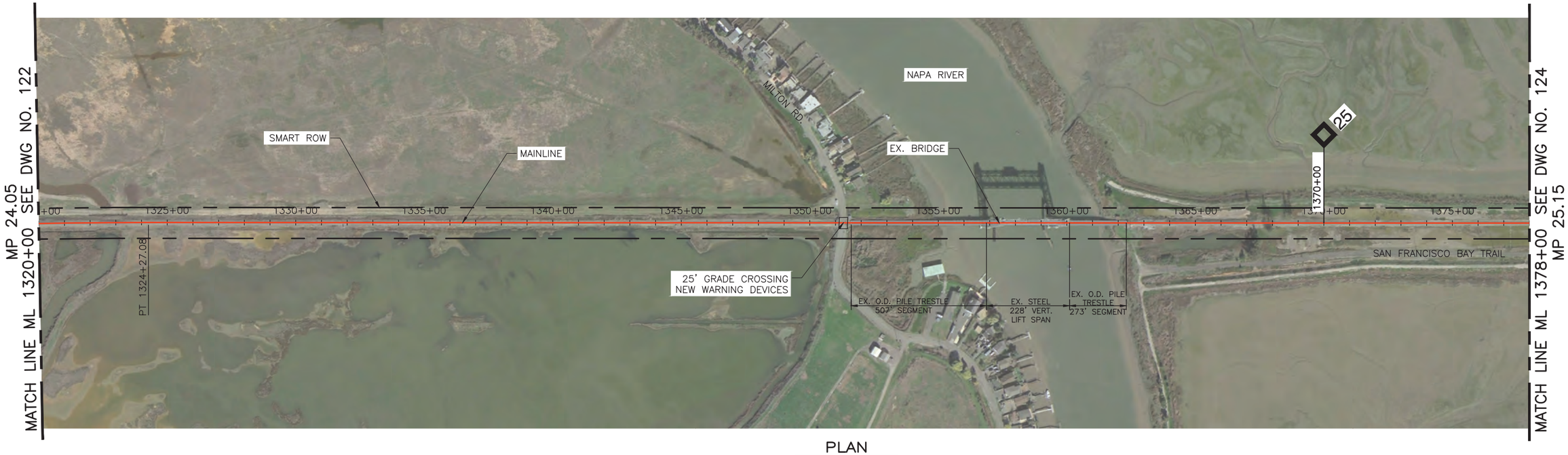

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 1320+00 TO STA 1378+00

SHEET 23 OF 38

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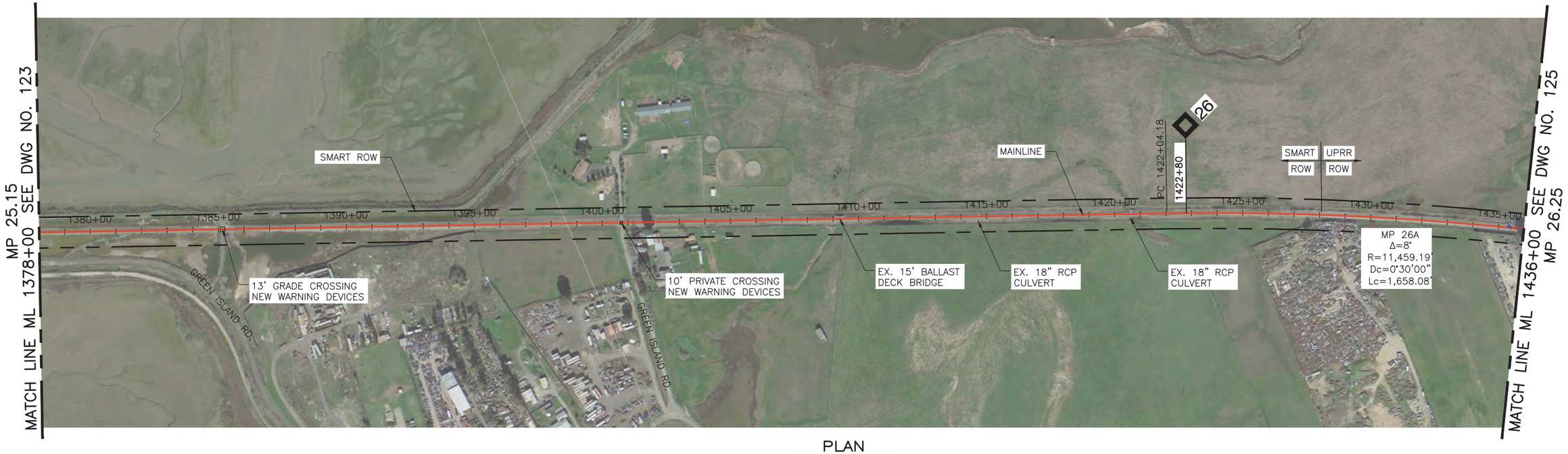

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SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
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ML STA 1378+00 TO STA 1436+00

SHEET 24 OF 38

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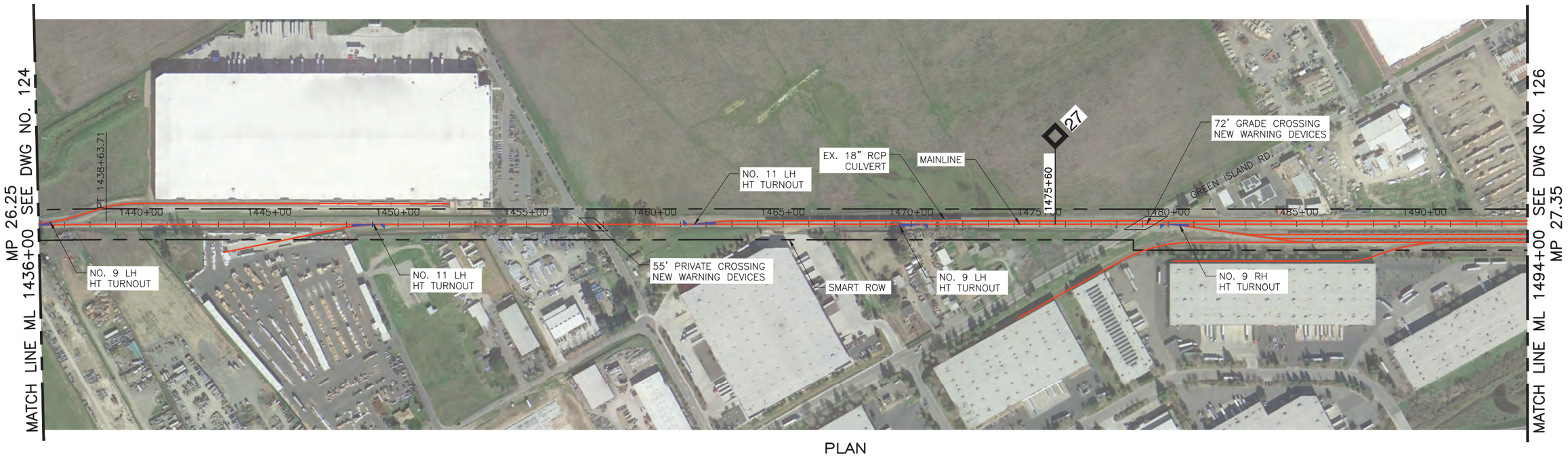

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SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 1436+00 TO STA 1494+00

SHEET 25 OF 38

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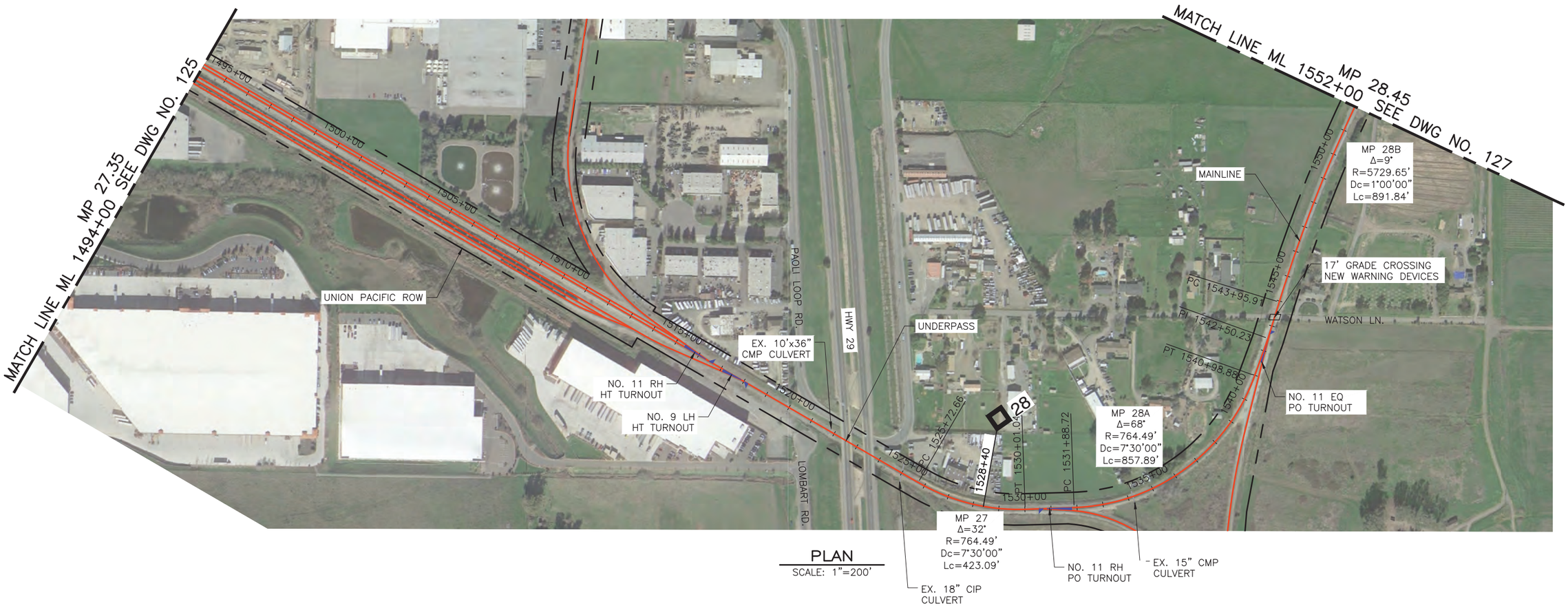

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SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

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ML STA 1494+00 TO STA 1552+00

SHEET 26 OF 38

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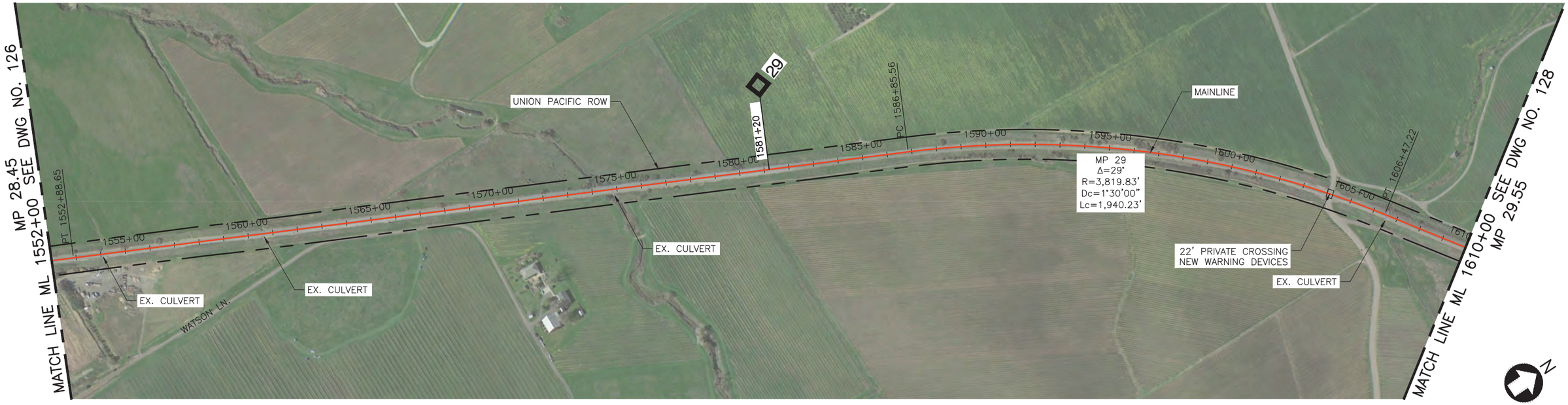

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

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ML STA 1552+00 TO STA 1610+00

SHEET 27 OF 38

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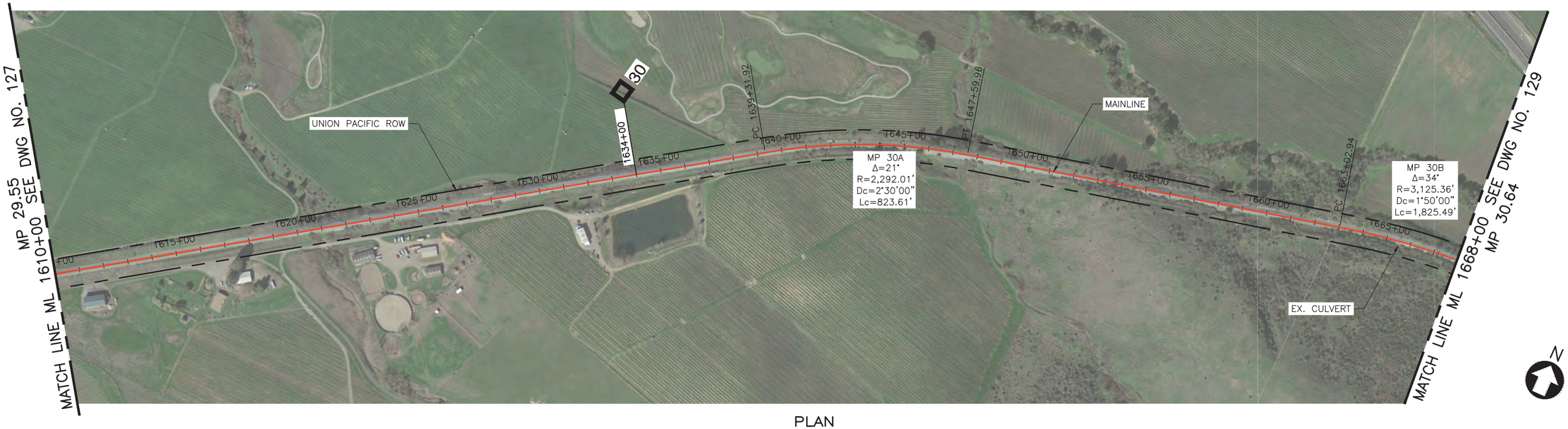

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 1610+00 TO STA 1668+00

SHEET 28 OF 38

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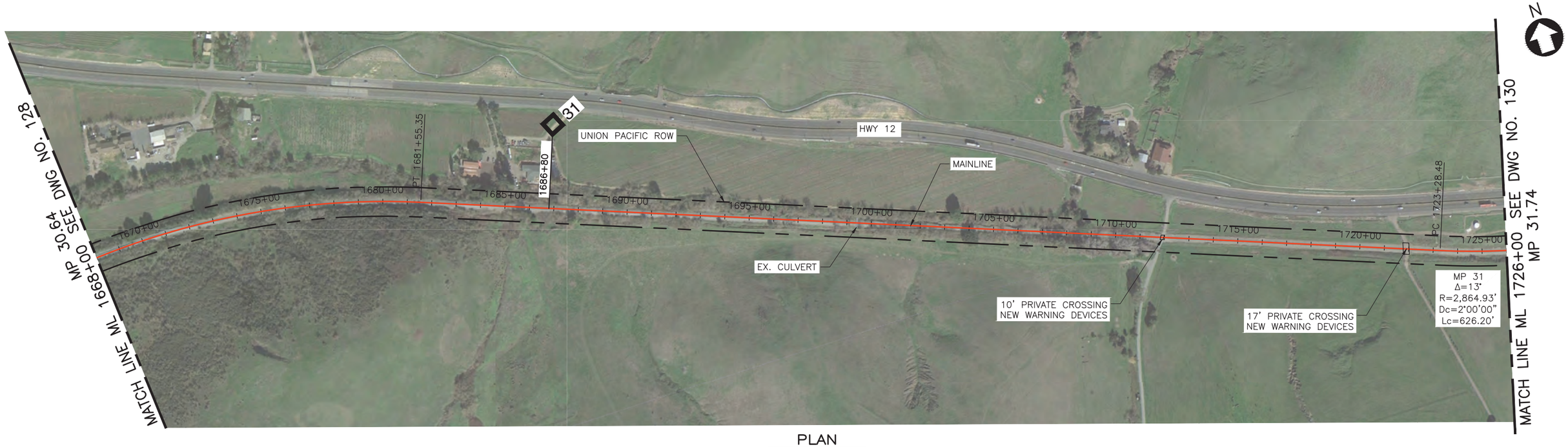

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SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 1668+00 TO STA 1726+00

SHEET 29 OF 38

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SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 1726+00 TO STA 1784+00

SHEET 30 OF 38

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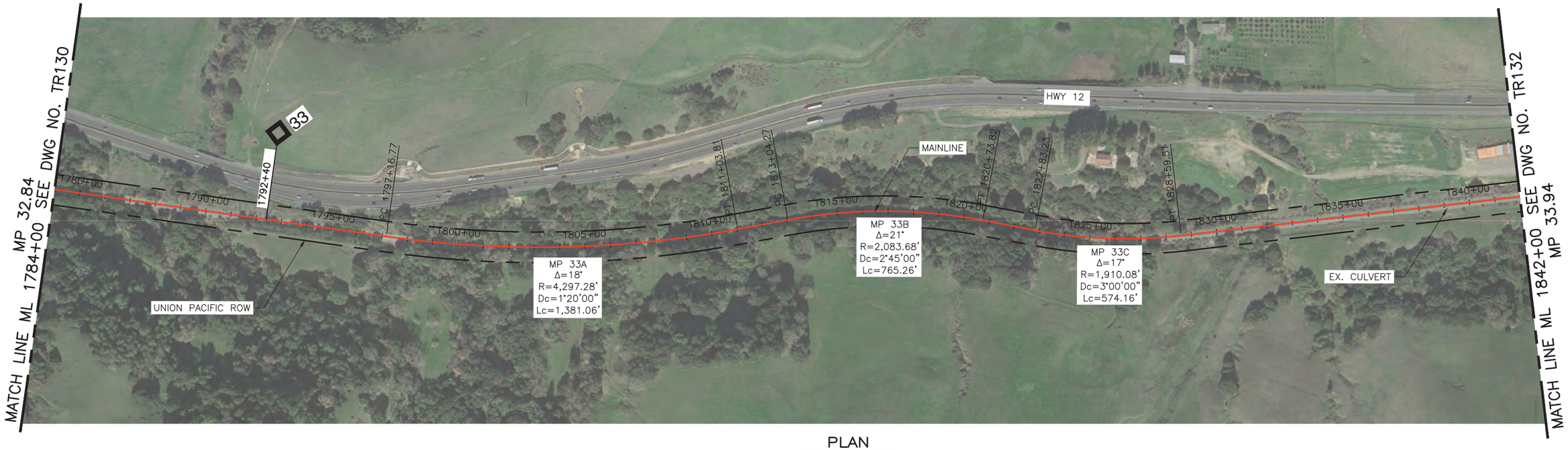

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MARCH, 2019

SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
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ML STA 1784+00 TO STA 1842+00

SHEET 31 OF 38

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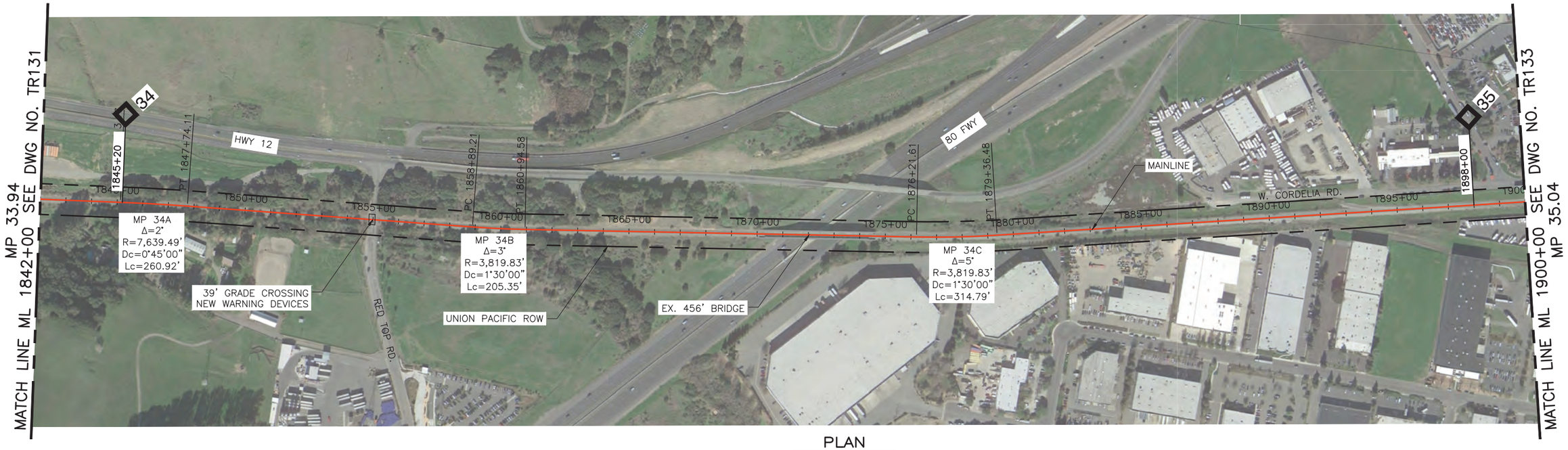

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SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 1842+00 TO STA 1900+00

SHEET 32 OF 38

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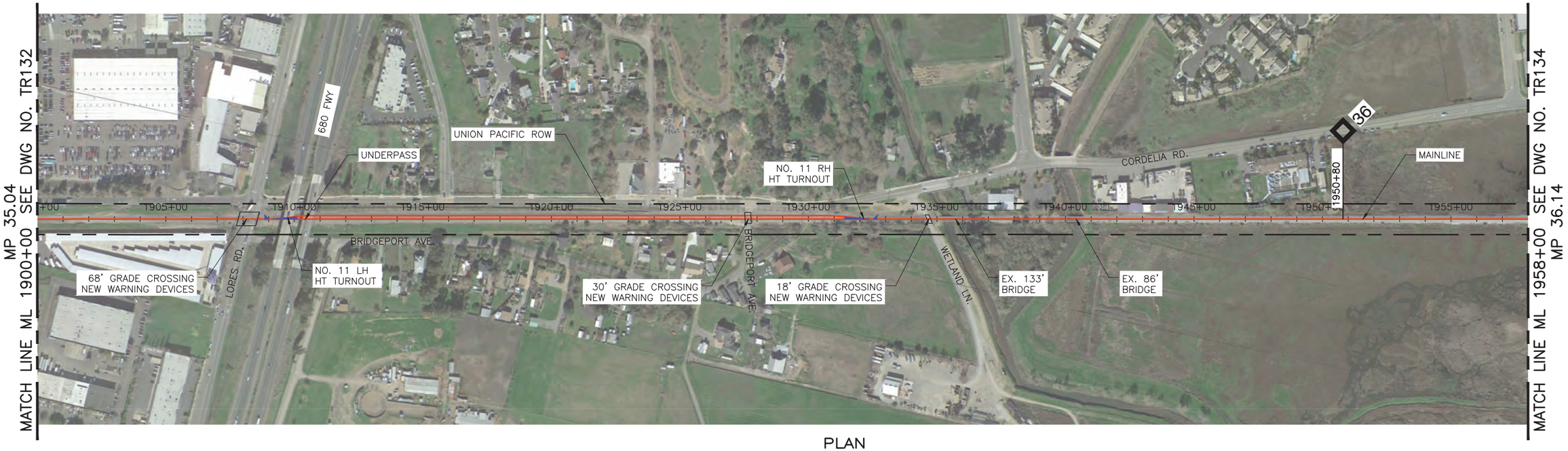

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SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 1900+00 TO STA 1958+00

SHEET 33 OF 38

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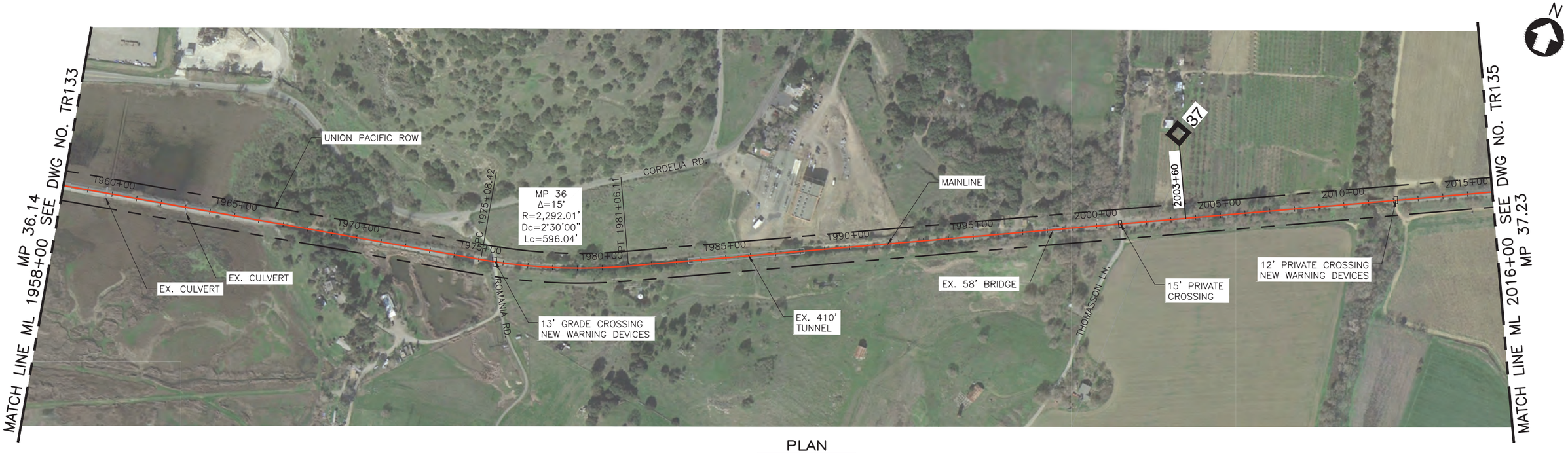

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SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
TRACK PLAN & PROFILE
ML STA 1958+00 TO STA 2016+00

SHEET 34 OF 38

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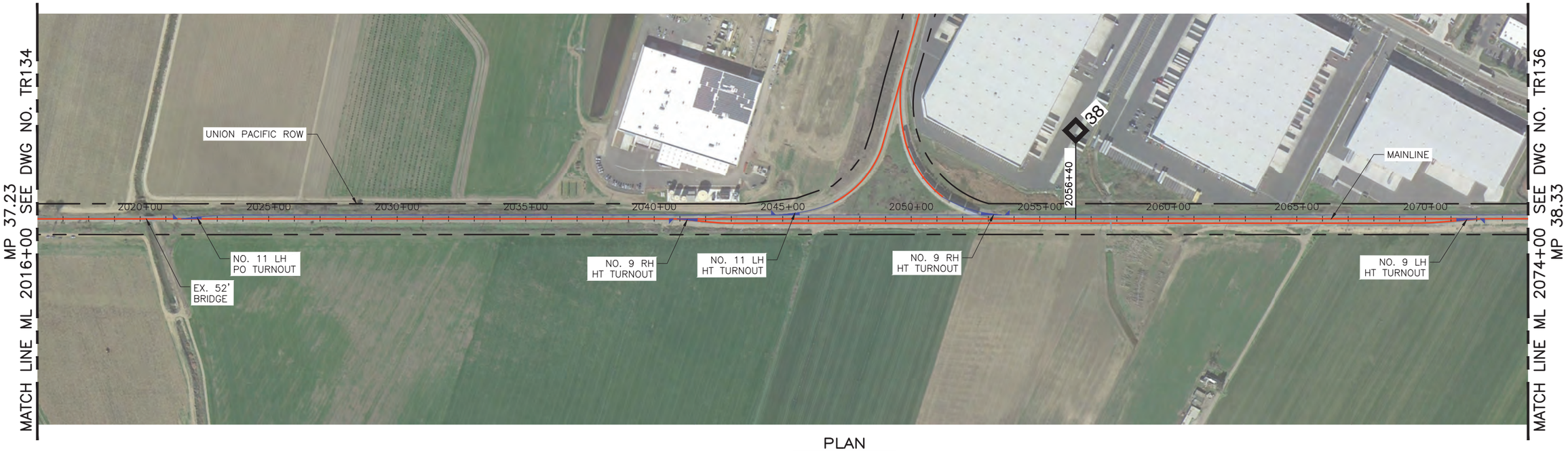

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SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
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ML STA 2016+00 TO STA 2074+00

SHEET 35 OF 38

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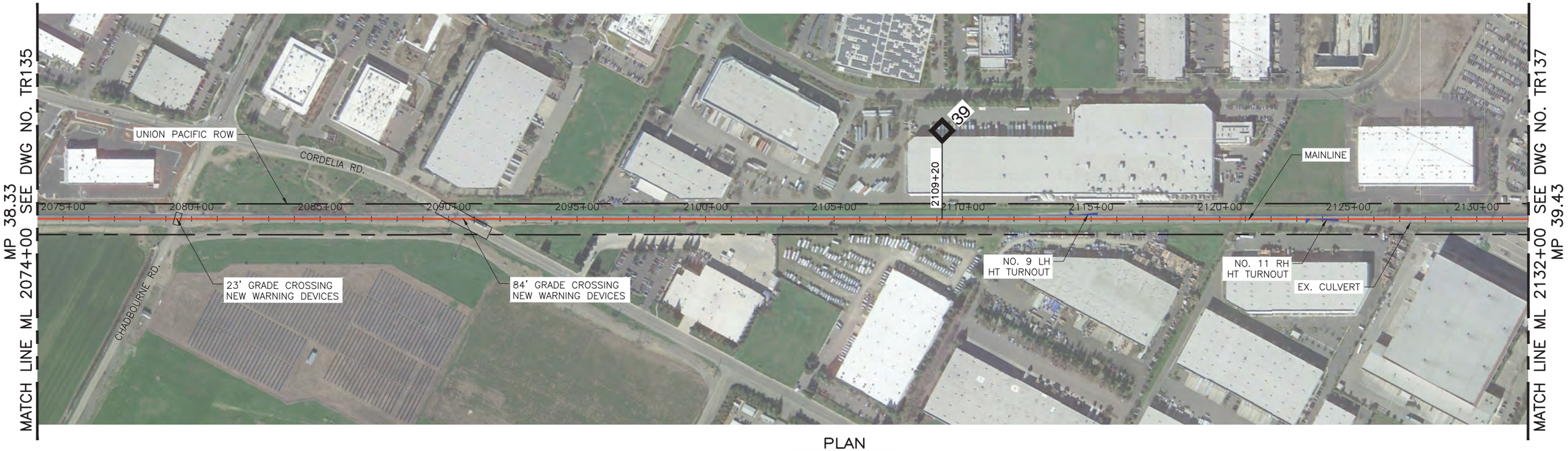

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SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

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ML STA 2074+00 TO STA 2132+00

SHEET 36 OF 38

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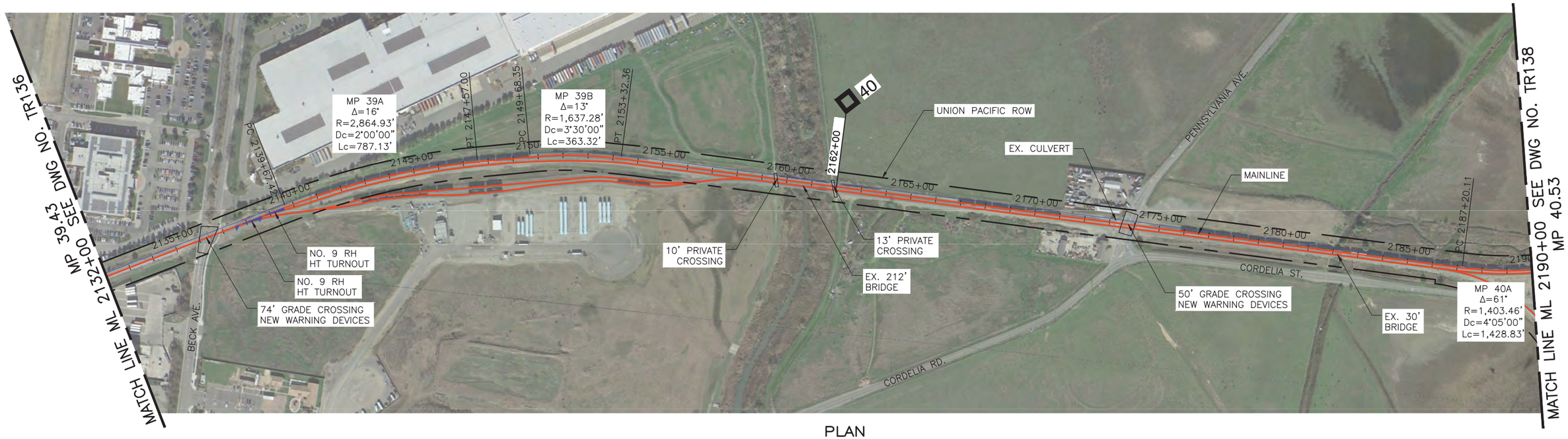

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SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
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ML STA 2132+00 TO STA 2190+00

SHEET 37 OF 38

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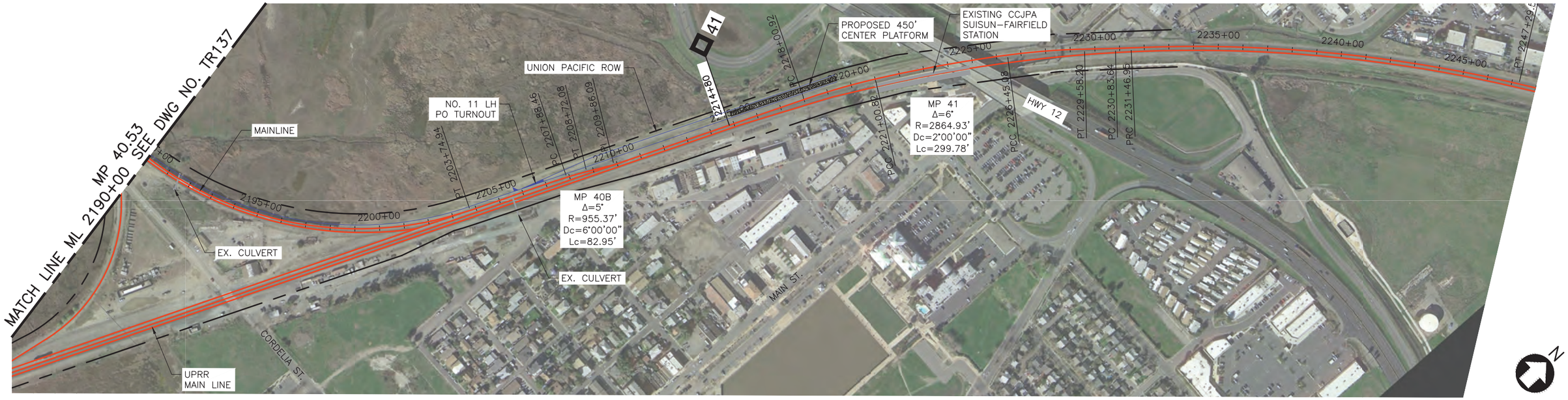

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SONOMA-MARIN SMART AREA RAIL TRANSIT

SUISUN EXTENSION

TRACK PLAN AND PROFILE
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ML STA 2190+00 TO STA 2248+00

SHEET 38 OF 38

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DWG. NO. TR138
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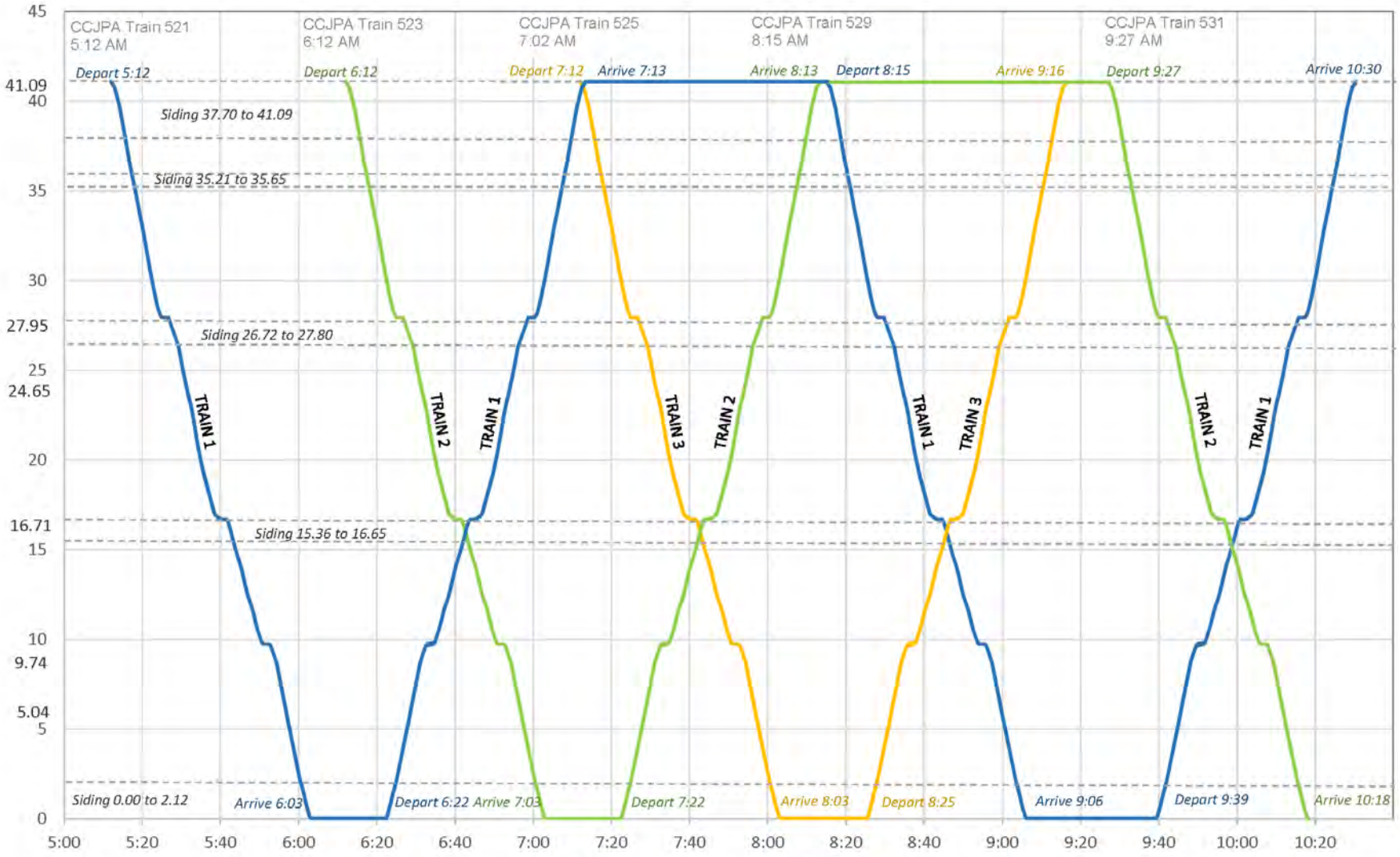
APPENDIX 3: NOVATO TO SUISUN TIME-DISTANCE DIAGRAM

Conceptual Time-Distance Diagram - Novato to Suisun City

79 MPH Maximum Speed



Conceptual Weekday Morning Schedule

Conceptual Timed Connection to CCJPA Westbound Trains at Suisun-Fairfield Station

APPENDIX 4: ARCHAEOLOGICAL AND CULTURAL RESOURCES

PREHISTORIC ARCHAEOLOGICAL SENSITIVITY

Evidence of prehistoric occupation of the two corridor sections under analysis dates back at least as far as 7,500 years before present. Ethnographically, the area was occupied in the west by the Coast Miwok (North of San Pablo Bay to roughly the Sonoma River drainage) and to the east by the Patwin. Large village settlements of both tribes were generally situated in north-to-south linear corridors along the region's major waterways (i.e. San Antonio Creek, Petaluma River, Sonoma River and Napa River). However, surface expression of archaeological deposits varies greatly due primarily to significant areas of recent alluvial deposit across the much of the area and owing to a retreating coastline that changed significantly in the last 8,000 years. Typical sites of the region include villages and resource extraction areas. Moratto (See Reference 8) points out that deposits dating to older than 8,000 years ago likely exist but are deeply buried on Pleistocene landforms (pp. 224-225). Areas of greatest sensitivity for prehistoric archaeological resources in the region are within 250 feet of annual drainages.

HISTORIC ERA ARCHAEOLOGY AND BUILT ENVIRONMENT RESOURCES

Historic era archaeology dates to the earliest historic settlement of California by Spanish missionaries and explorers. Significant development of the area during the historic period however occurs after the Gold Rush of 1849 and consists primarily farming/ranching sites and industrial development including brickworks, and quarries. Built environment resources consist of canal systems, ports, transportation areas (roads and rails), and settlement and historic era land use. Below is a list of built environment resources located within the 500-foot corridor along both the Novato-Hamilton station to American Canyon and American Canyon to Suisun-Fairfield station sections. These represent potentially significant historical resources that could require evaluation and, if determined significant, mitigation. The list is a sample survey population and may vary depending on agency and permitting specifics.

Hamilton to American Canyon

- Canals along Highway 37.
- Effects analysis for previously studied highways.
- Residential development at Black Point.
- Port Sonoma Marina.
- Levees and dykes on shore of San Pablo bay.
- Farm and ranch properties along San Pablo Bay.
- Reclamation Islands in the delta.
- Several dairy farms (1890s-1940s) in Schellville.
- Schellville train station.
- Clover Dairy on Highway 12.
- Residential properties on Steamboat Slough and lift span rail bridge.
- Industrial properties on Green Island.

American Canyon to Suisun

- Industrial and commercial properties at Napa Junction.
- Residential properties at Napa Junction (1920a-1970s).
- Ranch and dairy properties along Highway 12.
- 20-30 residences in outskirts of Cordelia 1920s to 1960s.
- Cordelia Substation (1919).
- Historic orchard properties outside Cordelia.
- Cordelia Historic District.
- Suisun City Historic District.

CULTURAL RESOURCES CONSTRAINTS SUMMARY

Because the proposed route is along an existing rail corridor most constraints that may be located along the route are unlikely to be impacted by continued use in kind. With the exception of any proposed excavation in known archaeological resources, or the demolition of standing structures over 50-years of age, the extension of SMART rail along these two sections is unlikely to impact cultural resources that exhibit historical significance.

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