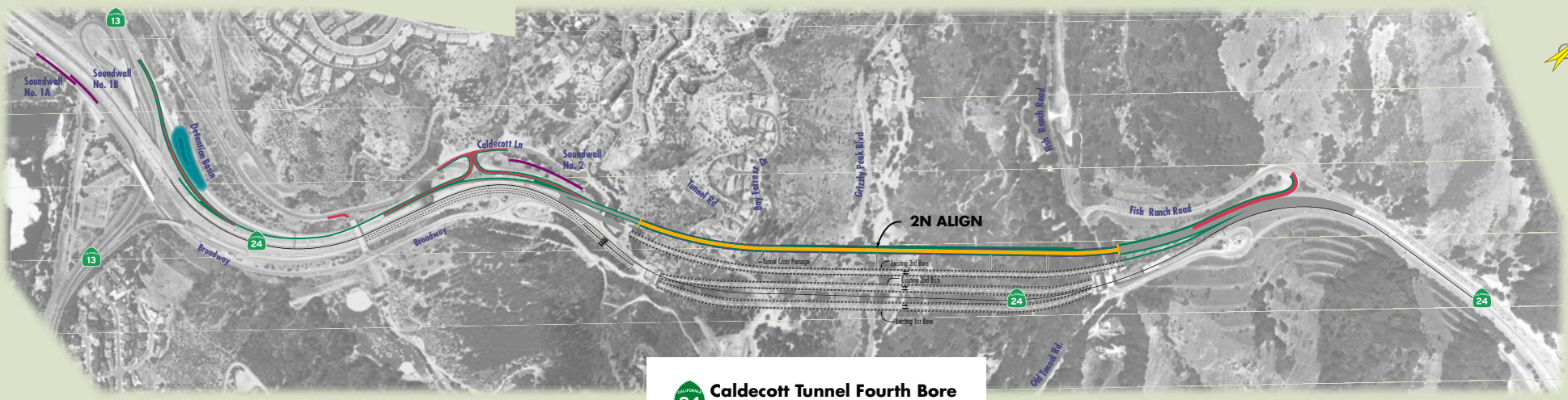
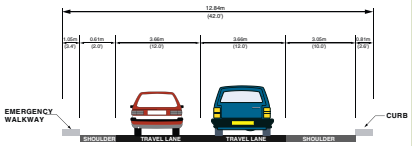
Station Four

2-Lane North Alternative



Caldecott Tunnel Fourth Bore

Proposed Tunnel Cross Section

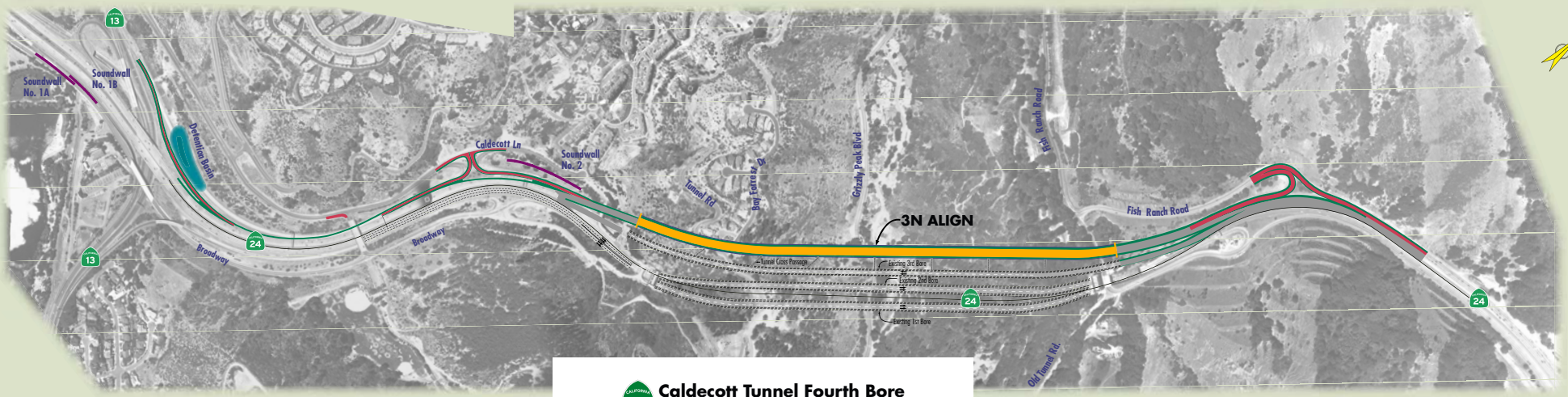


2-LANE BORE

LEGEND

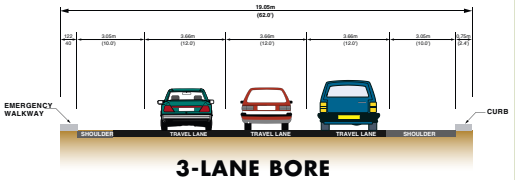
- Emergency Walkway
- Ramp
- Tunnel
- Shoulder
- Highway
- Soundwall

3-Lane North Alternative



Caldecott Tunnel Fourth Bore

Proposed Tunnel Cross Section



3-LANE BORE

LEGEND

- Emergency Walkway
- Ramp
- Tunnel
- Shoulder
- Highway
- Soundwall

TUNNEL DESIGN

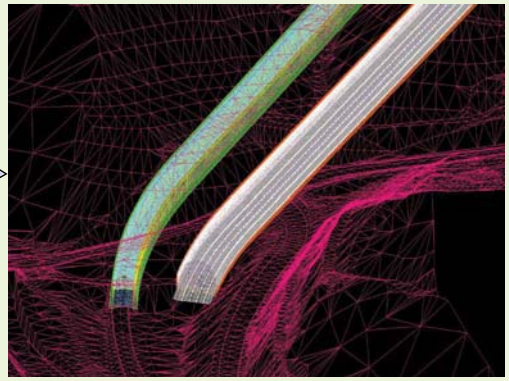
CALDECOTT Improvement Project

Horizontal boreholes being drilled in March 2005 near the proposed Oakland Portal

Rock core samples are removed from the drill rigs, reviewed, photographed, and logged. Lab testing yields rock strength and other data needed to design the tunnel support and linings

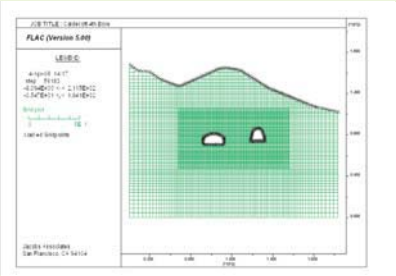
Historic construction photos and documents of the first 3 Caldecott tunnel bores yields valuable information about the ground conditions that can be expected in the new tunnel

Step 1 – Historical Review and Geotechnical Investigation: Rock and soil samples are taken from proposed alignment – Surface geological formations, faults, and groundwater conditions are reviewed and analyzed

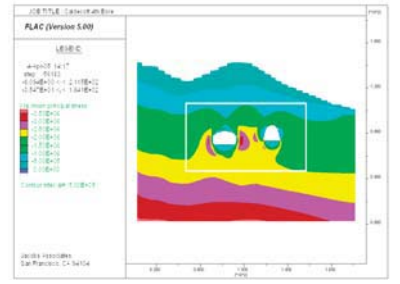


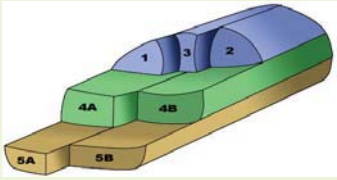
3D CAD model above shows view at Orinda and of tunnel with existing third bore on left and proposed 4th bore on the right

Step 2 – Tunnel Alignment and Interaction: Proposed alignment is refined while potential impact on existing 3rd bore must be considered

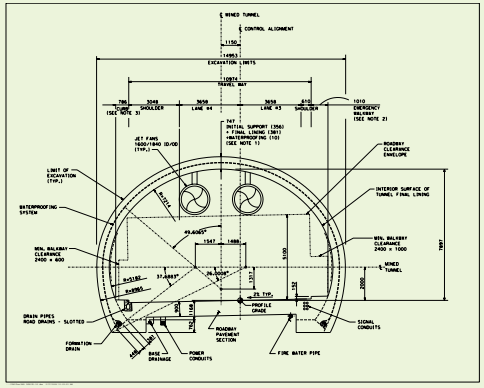


Finite element computer modeling is used to determine allowable clearance between the new tunnel and the existing tunnel on ground conditions determined from geologic and historic investigation





Step 3 – Initial Tunnel Lining and Excavation Design: Full tunnel will be mined in stages (drifts) from top to bottom so smaller areas can be more easily supported with sprayed-on concrete (Shotcrete)



Step 4 – Final Tunnel Lining and Finishes: Waterproofing, final concrete lining, lighting, architectural finishes and safety systems are designed to meet long-term design life of new tunnel

Final Step – Engineers are geologists map and interpret actual ground conditions encountered during tunnel construction to ensure appropriate ground support types are placed to meet design requirements

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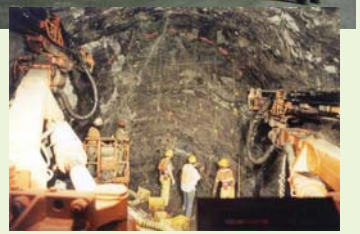
TUNNEL CONSTRUCTION EQUIPMENT

CALDECOTT Improvement Project

ROADHEADER: This equipment will be the primary excavating equipment used in the tunnel to excavate softer rock. It uses a rotating cutter head that grinds the rock away in a controlled manner and conveys the muck to dump trucks behind it for hauling

DRILL JUMBO: Large drill jumbos may be used to drill in holes in precise patterns at the face of the excavation. These holes are used for setting small blasting rounds to loosen and excavate very hard rock encountered in the tunnel



DUMP/HAUL TRUCKS: 10-20 Cubic Yard rubber tire dump trucks are used for tunnel muck transport

ROLLING STEEL FORMS: Prefabricated steel forms made to the exact final dimensions of the tunnel allow efficient placement of the final concrete lining along the excavated tunnel

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TUNNEL CONSTRUCTION SEQUENCE

CALDECOTT Improvement Project

Step 1 – Staging Area Preparation: Construction Equipment, trailers, and materials are gathered at each portal and softer earth and rock materials are removed to allow beginning of mined tunneling

BELOW: A mechanical "Roadheader" will be used to cut through most of the rock

Step 2 – Tunnel Excavation: Tunnel is excavated in stages from both the Oakland and Orinda Portals and muck is removed off-site via rubber tire haul trucks

ABOVE: Sprayed-on concrete (Shotcrete) is applied over steel supports to the top of the tunnel to provide temporary support during construction

Step 3 – Tunnel Concrete Lining: Final Concrete Lining is cast-in-place with steel reinforcement to form the final structural surface of the tunnel

ABOVE: Emergency cross-passengers will be installed every 400 feet to allow safe exit to the 3rd bore in case of emergency

Step 4 – Tunnel Utilities: Lighting, ventilation and other tunnel utilities are installed in tunnel and cross-passages. Final roadway surface is placed

Final Step – Tunnel Opens! Final system, quality, and safety checks are performed prior to opening tunnel to traffic

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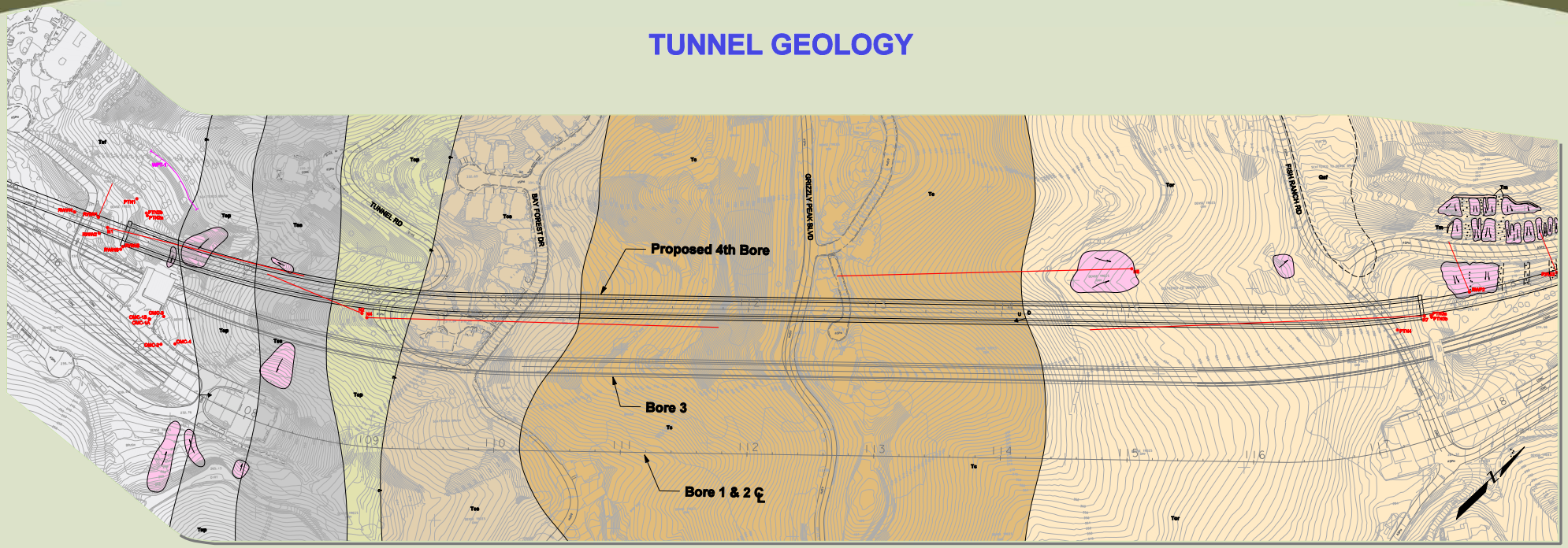
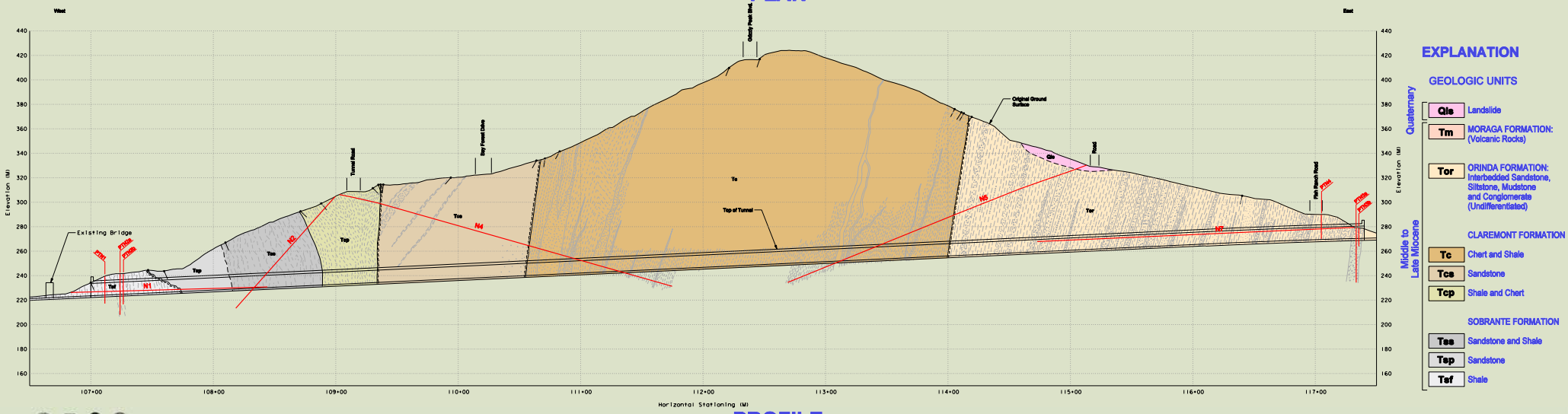
GEOLOGIC/GEOTECHNICAL STUDIES

TUNNEL GEOLOGY



PLAN



PROFILE

EXPLANATION

GEOLOGIC UNITS

Quaternary

- Qls — Landslide
- Tm — MORAGA FORMATION: (Volcanic Rocks)
- Tor — ORINDA FORMATION: Interbedded Sandstone, Siltstone, Mudstone and Conglomerate (Undifferentiated)

Middle to Late Miocene

CLAREMONT FORMATION
- Tc — Chert and Shale
- Tcs — Sandstone
- Tcp — Shale and Chert

SOBRANTE FORMATION
- Tsb — Sandstone and Shale
- Tsp — Sandstone
- Tsf — Shale

CONSTRUCTION STAGING

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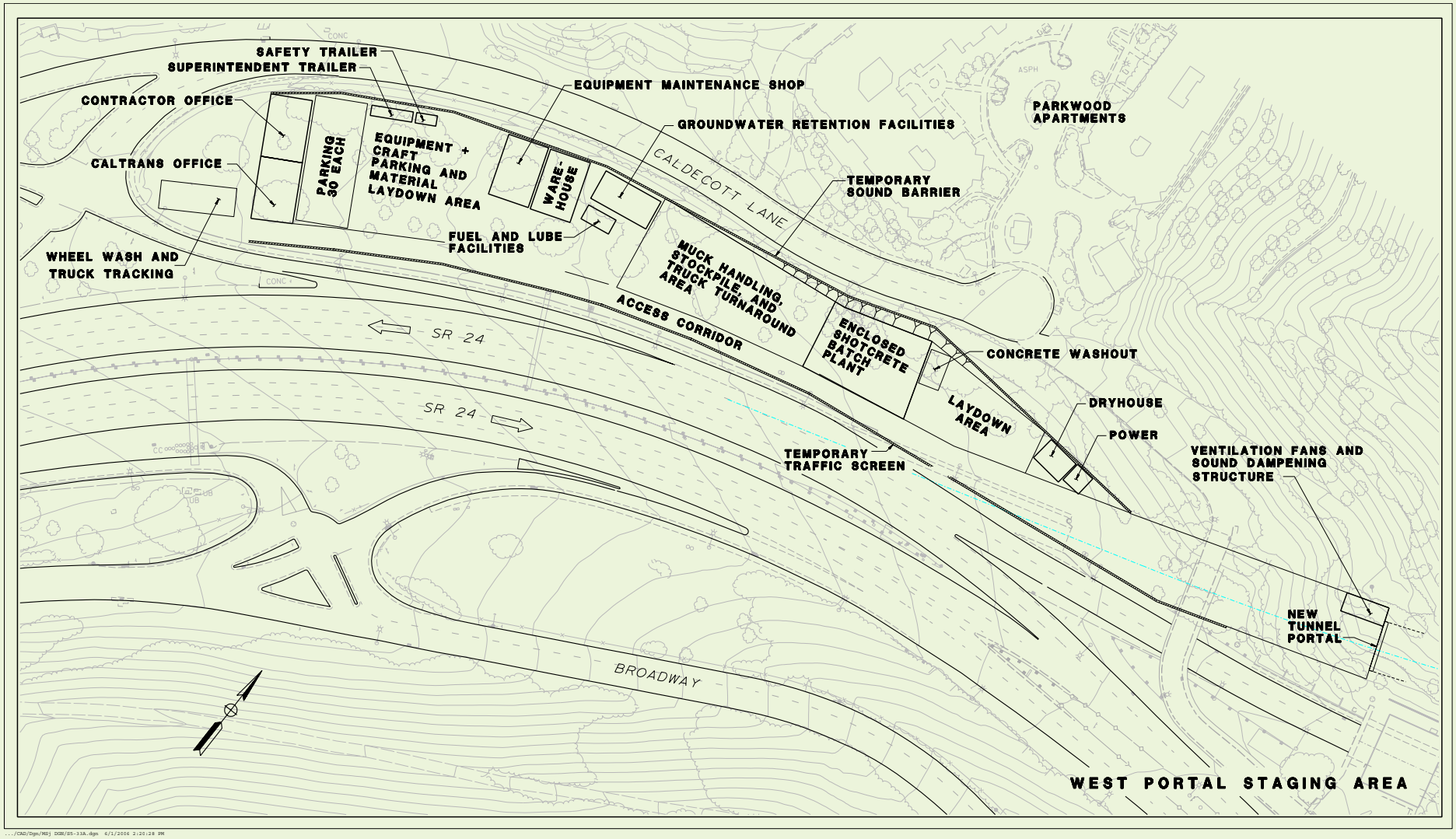

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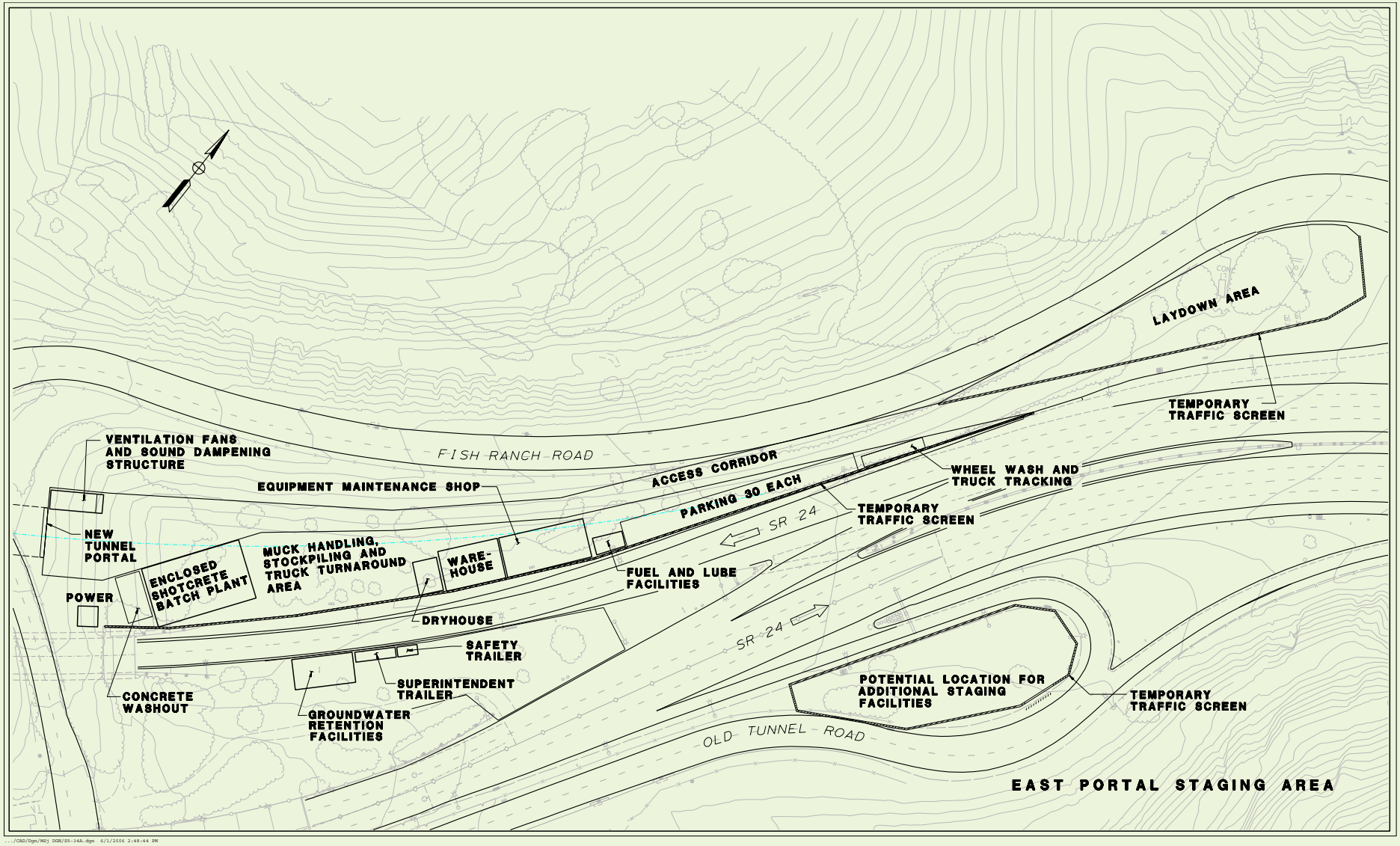
CONSTRUCTION STAGING

CALDECOTT Improvement Project



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JACOBS ASSOCIATES

CONSTRUCTION MITIGATION

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- **Noise:** provide enclosures for compressors; construct a temporary soundwall; construct noise barriers as first items of work; keep community informed in advance of noisy activities; specify limits on equipment noise; schedule the majority of material deliveries and transport of excavated material to daytime hours, when possible

- **Monitoring:** perform preconstruction surveys of select residences, and if blasting is required, monitor select homes for vibration

- **Dust and Dirt:** apply water or dust palliatives; wet down stockpiles, provide wheel washes and street-sweeping services; seal aggregate and cement silos; follow "Best Management Practices"

- **Community Relations:** provide on-going community coordination and implement construction inquiry response protocol

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