Appendix 22A
Air Quality Analysis Methodology

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This appendix discusses the approach and methodology used to assess construction emissions associated with the proposed project. The analysis evaluates maximum daily and yearly emissions to comply with CEQA and NEPA guidelines in the Plan Area. Emissions analyzed include criteria pollutants and GHGs (CO_2, CH_4, N_2O, HFCs, and SF_6).

Construction activities associated with each proposed project component include demolition, excavation, paving, concrete batching, employee and vehicle travel, and offroad equipment operation. Several components also require the use of locomotives and marine vessels. Each of these activities was considered to evaluate the regional and localized air quality effects during construction of the project. Analysts also quantified emissions from geotechnical explorations, temporary and permeant utility construction, hauling of the precast tunnel segments, and material delivery. The following sections describe the quantification methodology.

22A.1 Construction Schedule

The analysis evaluates air quality and GHG effects from construction of the proposed project. Construction of the proposed project would occur between 2021 and 2031. Geotechnical explorations and temporary utilities would occur between 2018 and 2021 and 2019 and 2022, respectively. During peak construction periods, work would occur at several locations within the Plan Area, with overlapping construction of various project components. Working hours and workers present at any time would vary, depending on the activities being performed. Table 22B-1 in Appendix 22B, *Air Quality Assumptions* provides the construction schedule.

22A.2 Models and Methods for Emissions Quantification

Construction of the project would generate emissions of ROG, NO_X, CO, SO_X, PM10, PM2.5, CO_2, CH_4, N_2O, HFCs, and SF_6 that could result in short-term air quality and GHG effects. Emissions would originate from off-road equipment, employee and haul truck vehicles ("on-road vehicles"), marine vessels, helicopters, locomotives, earth moving activities, concrete batching, demolition, paving, and electricity consumption. These emissions would be temporary (i.e., limited to the construction period) and would cease when construction activities are complete.

The methods applied to the quantifying criteria pollutant and GHG emissions from construction of the proposed project are similar to the approaches used to analyze the approved project in the Final EIR/EIS. Combustion exhaust, fugitive dust (PM10 and PM2.5), and fugitive off-gassing (ROG) were estimated using a combination of emission factors and methodologies from CalEEMod, version 2016.3.2; CARB's EMFAC2017 model[1]; and the EPA's *AP-42 Compilation of Air Pollutant Emission*

[1] EPA approval of EMFAC2017 is forthcoming and expected prior to the record of decision for the proposed project (December 2018).

Factors (AP-42) based on project-specific construction data (e.g., schedule, equipment, truck volumes) provided by the project engineer (Gillespie pers. comm.). The following sections describe the quantification approach for each of the primary emission sources. Tables 22B-2 through 22B-12 in Appendix 22B, *Air Quality Assumptions* provide the modeling inputs for each emission source.

22A.2.1 Off-Road Equipment

Emission factors for off-road construction equipment (e.g., loaders, graders, bulldozers) were obtained from the CalEEMod (version 2016.3.2) User's Guide appendix, which provides values per unit of activity (in grams per horsepower-hour) (Trinity Consultants 2017).[2] Pollutants were estimated by multiplying the CalEEMod emission factors by the equipment inventory provided by the project engineer (Gillespie pers. comm.). The equipment inventory is comprised of model specific (e.g., CAT 963) equipment names, rather than generic operating types (e.g., bulldozer). To estimate emissions using CalEEMod emission factors, which are given for generic equipment, individual equipment provided by the project engineer was assigned a generic type based on the model description, industry resources, and professional experience.

The analysis of off-road equipment includes emissions from diesel equipment. Tunnel boring machines, tunnel fans, tunnel lights, certain air compressors, and pumps were assumed to be electric and were included in the electricity analysis (refer to Section 22A.1.2.10). Accessory equipment (e.g., trailers, clamshell bucket) with no engines or emissions-generating components were excluded from the analysis.

22A.2.2 On-Road Vehicles

On-road vehicles include vehicles used for material and equipment hauling, tunnel segment hauling, employee commuting, onsite crew and material movement, and as-needed supply and equipment pick-up. Exhaust emissions from on-road vehicles were estimated using the EMFAC2017 emissions model and activity data provided by the project engineers (Gillespie pers. comm.; Valles pers. comm.).[3]

Emission factors for haul trucks are based on aggregated-speed emission rates for EMFAC's T7 Single vehicle category. Equipment and materials delivered to the project site will likely originate in the Bay Area, Sacramento, or Stockton. As a reasonable, yet conservative assumption, it was assumed all equipment and material would be delivered from the Port of San Francisco (greatest distance from the project area). Tunnel segments were assumed to originate from three offsite casting yards, two of which would be located in the Bay Area and one would be located in Stockton. Trip distances (miles) from each casting yard were quantified using GoogleEarth.

Emission factors for on-site water, fuel, and concrete trucks were based on 5 miles per hour (mph) emission rates for the T6 Heavy vehicle category. Factors for on-site dump and utility/mechanic trucks were based on 5 mph emission rates for the T7 Single and T6 Utility vehicle categories, respectively. Emission factors for as-needed supply and equipment pick-up are based on weighted

[2] CalEEMod does not include emission factors for N_2O. Emissions of N_2O were determined by scaling CO_2 emissions by the ratio of N_2O/CO_2 (0.000025) emissions expected per gallon of diesel fuel according to the Climate Registry (2017).

[3] EMFAC does not include emission factors for HFC-134a from onboard air condition systems. Emissions of HFC-134a were determined by scaling CO_2 emissions by the ratio of HFC-134a/CO_2 (0.026) emissions, as reported in the United States national inventory (United States Environmental Protection Agency 2017).

average vehicle speeds for EMFAC's light-duty automobile (LDA)/light-duty truck (LDT)/T7 vehicle categories. All as-needed vehicle trips would be made to hardware or other local supply stores. An average one-way trip distance of 10 miles was assumed, consistent with the Final EIR/EIS.

Emission factors for employee commute vehicles are based on a weighted average for all vehicle speeds for EMFAC's LDA/LDT vehicle categories. One-way employee commute trip lengths were provided by DWR based on a geospatial analysis of labor densities in the Plan Area.

Fugitive re-entrained road dust emissions for all vehicle types were estimated using the EPA's AP-42, Sections 13.2.1 and 13.2.2 (U.S. Environmental Protection Agency 2006a, 2011).

22A.2.3 Marine Vessels

Marine vessels used during construction include workboats, passenger boats, and tugboats. Criteria pollutant emissions from marine vessels were quantified using CARB's (2012) *Emissions Estimation Methodology for Commercial Harbor Craft Operating in California* (Harbor Craft Methodology) and activity data provided by the project engineers (Gillespie pers. comm.; Valles pers. comm.). The Harbor Craft Methodology is based on a zero-hour emission rate for the engine model year in the absence of any malfunction or tampering of engine components that can change emissions, plus a deterioration rate.[4] The deterioration rate reflects the fact that base emissions of engines change as the equipment is used due to wear of various engine parts or reduced efficiency of emission control devices.[5]

22A.2.4 Helicopters

Helicopters would be used during line stringing activities for the permeant power reconductoring work. Helicopter emissions were estimated using emission factors from the Federal Aviation Administration's (FAA) Emissions and Dispersion Modeling System (EDMS), version 5.1.4, and supplemental information from the EPA (1985), FAA (2012), and MD Helicopters (2014).

22A.2.5 Locomotives

Small, mining-type locomotives would be used to convey excavated material and personnel in rail cars through the tunnel alignments. CARB's (2010) off-road diesel engine standards were used to quantify regulated criteria pollutant emissions (ROG, NO_X, CO, and PM). The emission standards are defined per unit of activity (in grams per horsepower-hour) by engine tier (e.g., Tier 4). SO_X emissions were calculated based on a diesel fuel density of 3,200 grams per gallon and a sulfur content of 15 parts per million sulfur, consistent with CARB and EPA requirements. Unlike criteria pollutants, there are no federal or state GHG standards for locomotives. Accordingly, CO_2, CH_4 and N_2O were calculated using emission factors from the Port of Long Beach (2016), which are based on fuel-specific combustion rates for each pollutant.

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[4] Emission deterioration is capped at 12,000 hours of operation per CARB methodology.

[5] CARB's deterioration factors, useful life, and zero-hour emission factors were used for all pollutants except SO_X. SO_X emissions were quantified based on brake-specific fuel consumption and a sulfur fuel content of 15 parts per million, which is the sulfur content limit for California harbor craft, in accordance with California Diesel Fuel Regulations.

22A.2.6 Earth Movement

Fugitive dust emissions from earth movement (i.e., site grading, bulldozing, excavation, dredging, and truck loading) were quantified using emission factors from the CalEEMod User's Guide (Trinity Consultants 2017). Striping acres and borrowed, excavated, and dredged quantities were provided by the project engineer (Gillespie pers. comm.). Bulldozing equipment hours were obtained from the off-road equipment inventory.

22A.2.7 Concrete Batching

Concrete required to construct the water conveyance facility will be manufactured at batch plants that store, convey, and discharge water, cement, fine aggregate, and coarse aggregate. Fugitive dust emissions[6] from concrete batching at the five new temporary batch plants[7] were quantified using the EPA's AP-42, Sections 11.12 and 13.2.4, and required concrete quantities provided by the project engineer (U.S. Environmental Protection Agency 2006b, 2006c; Gillespie pers. comm.). Emissions from wind erosion assumed an average stockpile size of 15 acres at each batch plant.

CO_2 emissions generated by cement manufacturing were calculated based on the anticipated volume of required concrete at various compression strengths. Based on data provided by DWR, structural components would require compression strength between 3,000 and 4,000 pounds per square inch (psi), whereas the tunnel segments would require strength between 6,000 and 8,000 psi. CO_2 emission factors for these strength ratios were obtained from Nisbet, Marceau, and VanGeem (2002) and the Slag Cement Association (2013).[8]

Emissions from operation of the batch plants were included in the electricity analysis (refer to Section 22A.1.2.10).

22A.2.8 Demolition

Fugitive dust emissions factors for demolition were obtained from the CalEEMod User's Guide appendix (Trinity Consultants 2017). GIS was used to identify the number of demolished structures. The majority of demolished structures are residential and storage/supporting facilities. An average size of 3,000 square feet per structure was therefore conservatively assumed to estimate the total demolished square footage for calculation purposes.

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[6] Metal emissions were also quantified to support the health risk assessment (see Appendix 22C, *Health Risk Assessment*) using emission factors from the EPA's (2006b) AP-42.

[7] A portion of concrete for the tunnel segments will be provided by three existing batch plants. These facilities are regulated and permitted to emit a maximum amount of criteria pollutants, including particulate matter. Therefore, fugitive dust emissions associated with concrete batching at existing facilities are not included in the analysis as these emissions have already been evaluated and accounted for in existing permit and environmental documents.

[8] Up to 57% of the CO_2 emitted during the cement manufacturing calcination may be re-absorbed by concrete over the 100 year life cycle (equivalent to about 7% of total batching emissions) (Haselbach 2009). While reabsorption may occur throughout the project lifetime, GHG impacts from concrete batching were conservatively evaluated assuming no reabsorption would occur.

22A.2.9 Paving

Fugitive ROG emissions associated with paving were calculated using activity data (e.g., square feet paved) provided by the project engineer and the CalEEMod default emission factor of 2.62 pounds of ROG per acre paved (Gillespie pers. comm.; Trinity Consultants 2017).

22A.2.10 Electricity Consumption

Construction of the water conveyance facility will require the use of electricity for lighting, tunnel ventilation, boring, and certain types of equipment. Operation of the batch plants would also consume electricity. Criteria pollutant and GHG emissions[9] from generation and transmission of electricity were quantified using emission factors from the CA-GREET model and electricity consumption data provided by the project engineers (Gillespie pers. comm.; Valles pers. comm.).

22A.3 Emissions by Air District and Air Basin

The project cross three air basins—SFBAAB, SVAB, and SJVAB—and falls under the jurisdiction of four air districts—YSAQMD, SMAQMD, BAAQMD, and SJVAPCD. GIS was used to identify the location of all construction activities. Emissions generated by construction of components that would occur exclusively within one air district were wholly assigned to that air district (e.g., intake construction in SMAQMD). Emissions estimates for components that span more than one air district were apportioned based on the location of construction activity. For example, 11 miles of tunnel will be constructed within Reach 4, of which 7 miles (64%) will be located within the SMAQMD and 4 miles (36%) will be located within the SJVAPCD. Sixty-four percent of Tunnel Reach 4 emissions were therefore appropriated to SMAQMD and the remaining 36% were apportioned to SJVAPCD. Table 22B-13 in Appendix 22B, *Air Quality Assumptions* summarizes the air district scaling factors.

22A.4 Environmental Commitments

DWR has identified several environmental commitments to reduce construction-related criteria pollutants and GHG emissions, as described in Appendix 3B, *Environmental Commitments.* Because environmental commitments are included as part of the project design, they are not treated as mitigation measures because they are incorporated into the project construction emissions estimate. Accordingly, the following emissions benefits achieved by implementation of the environmental commitments were assumed in the modeling:

1. **Off-Road Equipment**: All off-road diesel equipment would utilize EPA certified Tier 4 or newer engines. Tier 4 emission factors were obtained from the CalEEMod User's Guide appendix (Trinity Consultants 2017).
2. **On-Road Haul Trucks**: All heavy-duty haul trucks (T6 and T7) would use model year 2010 or newer engines. The analysis uses emission factors based on model year 2010 or newer engines,

[9] CA-GREET does not include emission factors for SF_6. Statewide SF_6 emissions in 2015 were therefore used to identify an emission factor per megawatt-hour by dividing total SF_6 emissions by the total electricity generation in California (California Air Resources Board 2017; California Energy Commission 2016).

and no less than the average fleet mix for the current calendar year as set forth in CARB's EMFAC2017 model.

3. **Marine Vessels**: All marine vessels would utilize EPA certified Tier 3 or newer engines. Tier 3 emission factors were obtained from CARB's (2012) Harbor Craft Methodology.

4. **Locomotives**: All tunneling locomotives would utilize EPA certified Tier 4 or newer engines. Tier 4 emission factors were obtained from CARB (2010).

5. **Earth Movement and Road Dust:** Implementation of basic and enhanced fugitive dust control measures would reduce emissions from onsite soil disturbance and re-entrained unpaved road dust were reduced by 61% and 55%, respectively, pursuant to the Western Governors' Association Fugitive Dust Handbook (Countess Environmental 2006).

6. **Concrete Batching**: All onsite concrete batch plants would implement typical control measures to reduce fugitive dust such as water sprays, enclosures, hoods, and other suitable technology, to reduce emissions to be equivalent to the EPA's controlled emissions levels, as outlined in AP-42 (2006b and 2006c) and SMAQMD's (2011) *Concrete Batching Operations Policy Manual*.

The emission modeling also accounts for implementation of Assembly Bill 1493 (Pavley) and the renewables portfolio standard (RPS). Emissions benefits achieved by these statewide regulations are incorporated into the outputs from EMFAC and CA-GREET, respectively.

22A.5 Impact Determination Comparison

The Final EIR/EIS (Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.4 Effects and Mitigation—Alternatives 4A, 2D, and 5A) evaluates 27 project-level air quality and GHG effects based on the analysis conducted at the time. The scope of the air quality analysis has been expanded based on new state and local guidance, as well as to reflect the current state-of-practice (e.g., SJVAPCD's AAQA trigger and requirement for localized dispersion modeling). The impact statements analyzed in this Supplemental EIR/EIS therefore differ slightly from those in Final EIR/EIS. The revised impact statements are required to fully address the additional air quality analyses. Modifications to the impact statements have also been made to consolidate analyses and improve readability and presentation. Table 22B-14 in Appendix 22B, *Air Quality Assumptions* compares the Supplemental EIR/EIS impact statements to those in the Final EIR/EIS.

22A.6 References Cited

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22A.6.2 Personal Communications

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